ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA)

BAHRIA FOUNDATION LNG TERMINAL

FINAL REPORT
FEBRUARY 2017

EMC Pakistan
Private Limited

Environmental & Social Impact Assessment (ESIA)

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Executive Summary

The Bahria Foundation (hereinafter referred as *Project Proponent*) intends to establish an Offshore Floating LNG Terminal (The *Project*) at Sonmiani Bay, Balochistan (Figure EX-1). The prospective location is positioned next to Churna Island, a small uninhabited island located in Sonmiani Bay in Balochistan Province. The island lies about 9 km west of the mouth of Hub River. Churna Island is approximately 1.5 km long and 0.5 km wide. In recent history, it was mostly used as a firing target by Pakistan Navy. The area around Churna Island is known for fishing and scuba diving. The site is therefore significant with regard to environmental and social considerations, if the terminal shall be placed in close proximity to Churna Island.

The objective of the LNG terminal is to provide all the required facilities such as jetty, subsea & onshore, interconnection pipeline and all other related facilities to fulfill the function of LNG unloading, storage, regasification, metering and transport the RLNG to the injection point in SSGC pipeline system at SMS Kathore. The Floating Storage & Regasification Unit (FSRU) will be moored along conventional marine facility (Jetty/Berth) in shallow water. Gas will be sent to an onshore receiving point (point of delivery) via a pipeline (subsea/on raised structure) (approximately 5-7 km). The main components of the project include:

- A Floating Storage and Regasification Unit (FSRU) rated for up to 750 MMSCFD of send out and 170,000 m^3 of LNG storage;
- Offshore breakwater designed to maintain a sea state that is conducive to FSRU operations and maneuvering of LNG carriers alongside the FSRU for ship-to-ship transfer operations;
- Jetty with mooring and berthing facilities;
- Pipeline connecting the FSRU to the local transmission network of SSGCL;
- Support Systems such as tug boats and other ancillary systems.

The project will be structured as an unbundled project structure. Under this project structure, LNG will be imported from another country like Qatar by a GOP-designated buyer (“LNG Buyer”), under the LNG SPA (Sale and Purchase Agreement) which could be on a delivered ex-ship basis (CIF) by or collected on a FOB basis from the LNG Seller. The LNG Buyer will enter into an agreement with the REGAS SPV (Special Purpose Vehicle) for the provision of LNG receiving, storage and regasification services at the terminal under tolling-type agreement (“LNG Terminalling Services”).

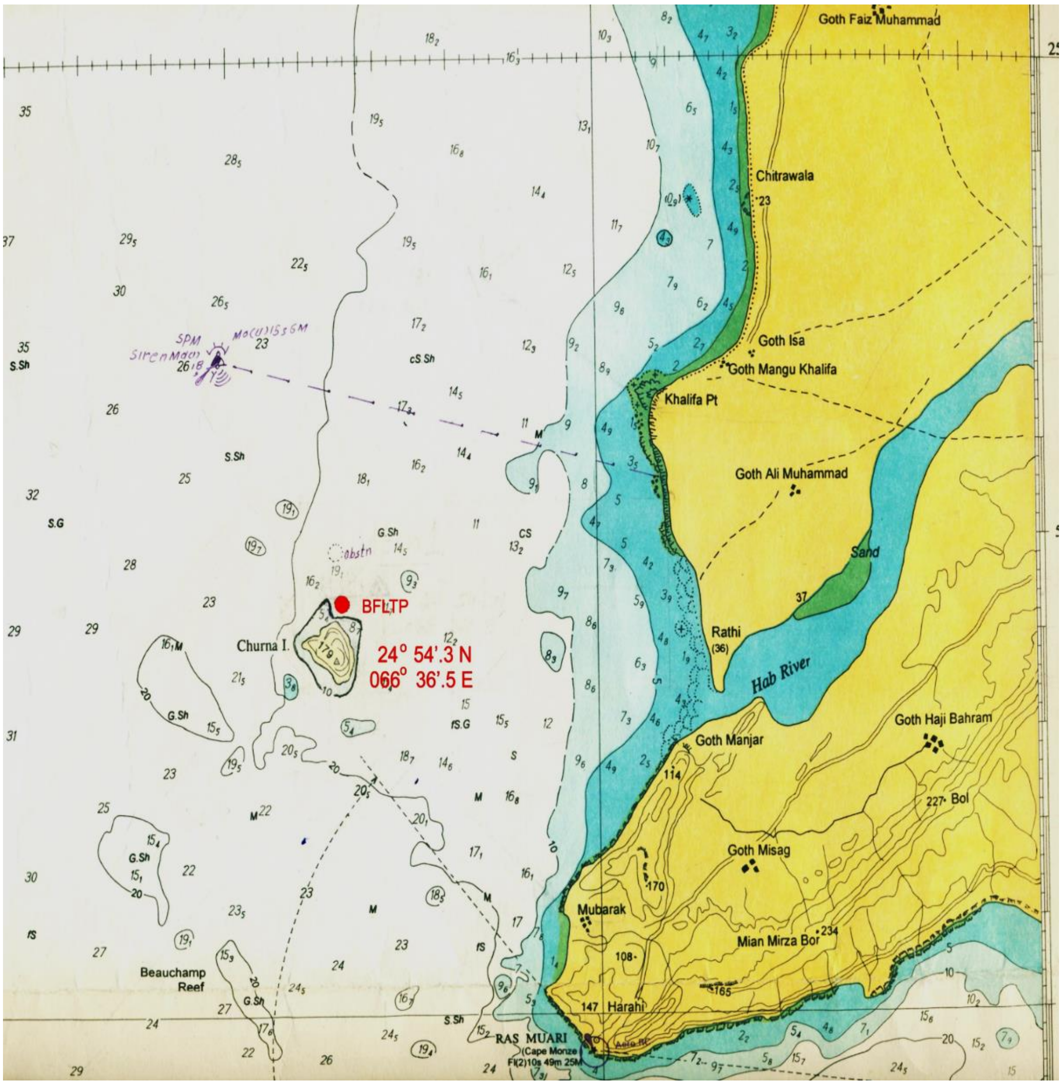


Figure EX-1: Prospective Locations for LNG Terminal in Sonmiani Bay

The Pakistan Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 have clearly defined the categories of projects that require an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) in Schedules I & II respectively.

- Schedule II of the regulations includes: "all projects located in environmentally sensitive areas" and "any project likely to cause an adverse environmental effect."

- Ports and harbors having gross ship displacement of less than 500 tons are covered by Schedule-I, while Schedule-II covers ports and harbors having ship gross displacement exceeding 500 tons.

The proposed LNG terminal project involves shipping activity having gross displacement above 500 tons. The Project therefore falls under Schedule-II. Accordingly an ESIA study has been conducted and the report will be submitted to Balochistan EPA for review and approval.

This ESIA report has been prepared by EMC Pakistan Pvt. Ltd. EMC organized the following team for conducting the environmental assessment and preparing the Report:

Table EX-1: ESIA Study Team	
Team Member	*Position*
Syed Nadeem Arif	Project Director
Mr. Saquib Ejaz Hussain	Project Manager / ESIA Specialist
Mr. Shams Ul Haq Memon	Advisor on Coastal Ecosystem
Dr. M. Mansha	Water Quality Expert
Dr. Shahid Amjad	Oceanography & Marine Biology Expert
Dr. Badar Ghauri	Air Quality Expert
Dr. Syed Ali Ghalib	Ecologist
Mr. S. M. Zaman	Geologist
Mr. Khurram S. Khan	Sociologist

The proposed site for the LNG Terminal is located in Sonmiani Bay, positioned in the Arabian Sea. The selection of preferred location considered the following aspect :

- Local development plan
- Safest possible location.
- Least social and environmental impact.
- No interference on navigation of marine and air traffic.
- Shortest construction duration.
- Least cost of construction (utilities, natural terrain, earth work, foundation treatment, breakwater, dredging work and submarine pipeline length).
- Lowest operating cost.
- Continuous gas supply

Two project locations were investigated in terms of navigational issues, technical, environmental and economic feasibility (Figure EX-2). For both locations, optimizations of the definite sites were considered. The optimization of the locations should ensure that a water depth of at least 15 m (LAT) (which includes 12.5 m summer draft + minimum 2 m under keel clearance) has to be considered as well as navigational approach ways and sea state, especially wave height/wave protection. Due to the sea bed conditions, the preferred location shall require no or minor dredging works. However, it might be possible that dredging is the more economical solution in some circumstances than a bigger breakwater due to water depth when dumping ground is nearby and cutter dredger is useable.

Location 1 (24°54.3''N, 66°36.5''E) is positioned next to Churna Island, a small uninhabited island located in Sonmiani Bay. The island lies about 9 km west of the mouth of Hub River. Churna Island is approximately 1.5 km long and 0.5 km wide. In recent history, it was mostly used as a firing target by Pakistan Navy. Actual the location around Churna Island is used for fishing and scuba diving. For further design phases, environmental and social impact has to be considered, if the terminal shall be placed in close proximity to Churna Island. Location 2 (24°58'N, 66°38.5''E) is positioned in a near shore area northeast of location 1. There is one recently constructed single point mooring (SPM) facility in the bay. The SPM, featuring a draft of 25 meters. The buoy of the SPM moves freely within defined limits. The first vessel was moored to the SPM on December 26, 2012.

Navigational charts show that the water depth at both locations is larger than 15 m. Location 1 is in close proximity to Churna Island. Both locations are favorable in terms of sufficient water depth and from a navigational perspective but do not provide protection against the main wave direction. Due to this, both sites require efficient wave protection by a breakwater, which is for near shore terminals a cost intensive part of the terminal. The breakwater with the length of approx. 1,500 m has to be constructed. The breakwater is designed to reach a wave reduction to less than 2 m for wave events with a recurrence interval of 1 in 10 years. The stability, however, is calculated for the recurrence interval of 1 in 100 year wave events. Consequently, the breakwater freeboard is about 1.8 m. The evaluation draws the conclusion that location 1, which is closer to Churna Island, is the most convenient location.

The jetty itself shall be a reinforced concrete platform founded on sand filled piles. Further equipment covers mooring and breasting dolphins, catwalks, foam filled (floating) fenders as well as an additional pier for crew boats. The nautical approach was proven by a navigational study. The approach is proven even for severe weather conditions with vessel approach from north-westerly direction. Tugboats have to support the vessel in an early stage in order to ensure safe navigation though the approach channel. Minor area with major dredging might be needed due to shallower areas in the preferred approach channel.

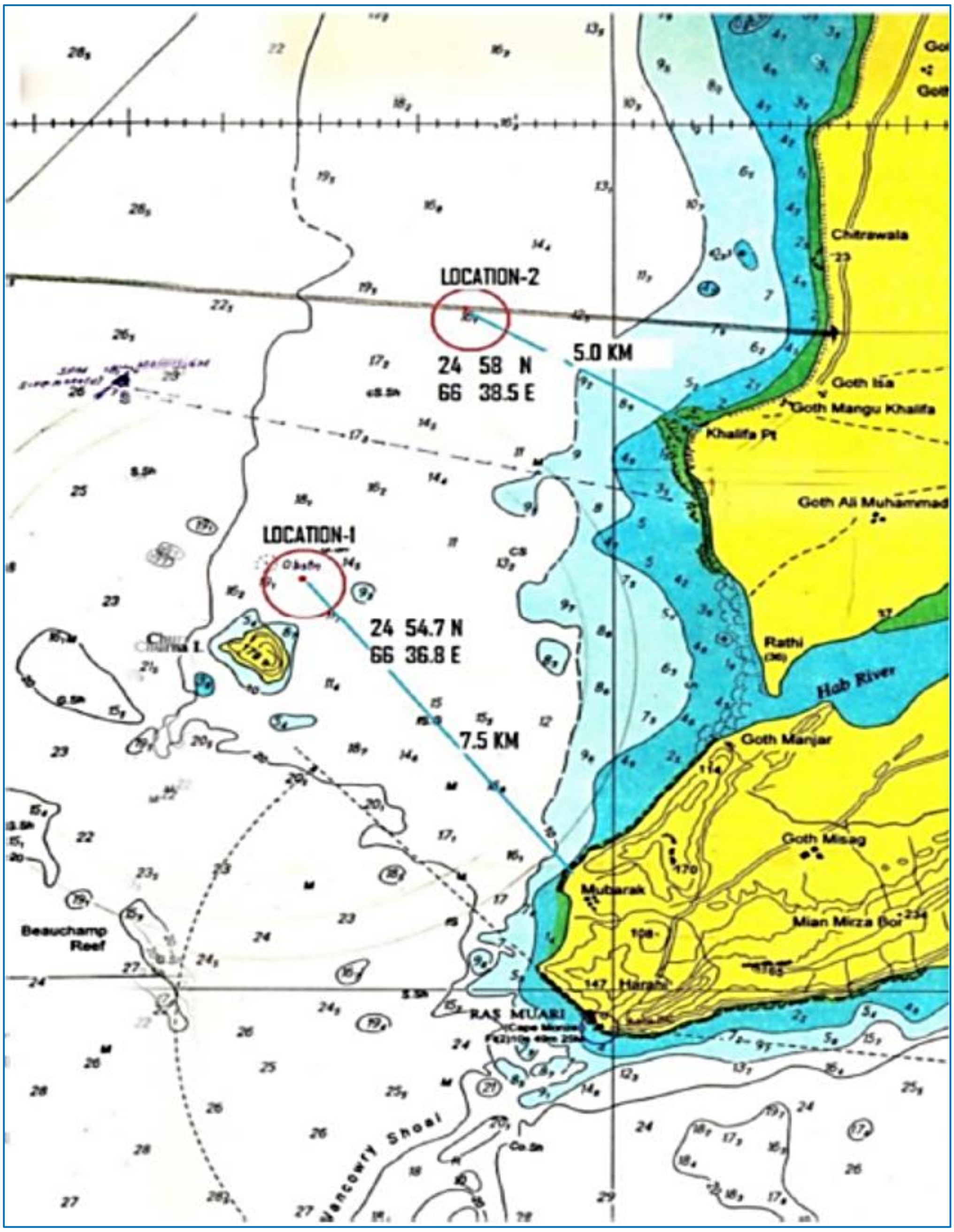


Figure EX-2: Terminal Location

The proposed LNG Terminal project is component of:

i. **Offshore Facilities comprising FSRU, jetty, & submarine pipeline,**

ii. **Onshore Facilities comprising metering station and connection pipeline.**

The LNG from LNG carriers will be received by the FSRU offloading system, stored in tanks, pumped out and regasified into natural gas, delivered to metering station through high-pressure loading arms fixed on the jetty and submarine pipeline. After metering at the Metering station, natural gas will be injected to the gas network at delivery point through connection pipeline.

FSRU is Floating Storage and Regasification Unit with similar shape to LNG Carrier, and with the function of storage & regasification is the core part of Floating LNG Receiving Terminal.

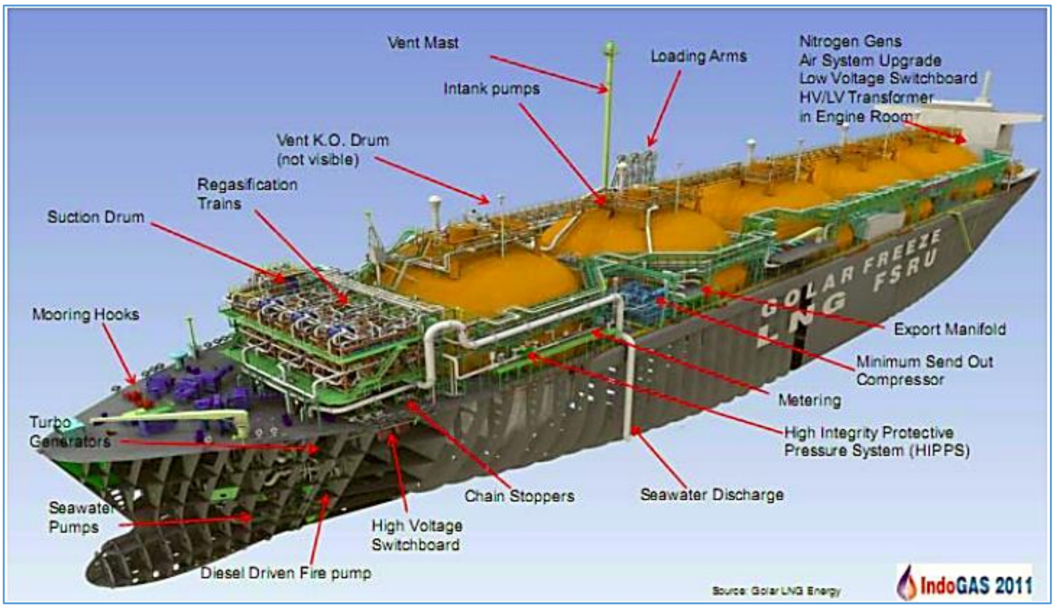


Figure EX-3: Typical Layout of FSRU

The proposed design of the jetty is an open structure like a concrete deck supported by a pile foundation with cross beams. The piles will be covered with corrosion protection paint and filled with sand. The jetty is not connected to the shore by a trestle bridge because this would be uneconomic.

The alignment of the jetty will be straight in southwest-northeast direction based on the assumption, that the ships shall be moored along the major wind and wave direction. The length will be designed in order to moor a Qmax LNG Carrier on the one side and an FSRU with the 294 m length and 46 m breadth on the other side. The berthing is required to have a depth of at least 15 m LAT for Qmax vessels as well as the FSRU with a maximum summer draught of 12.5 m providing under keel clearance of at least 3 m. The jetty construction includes the firewater pumps with diesel tank, bikeway, and pipe rack for supporting piping (gas pipeline, Firewater, Nitrogen etc.) and cables.

The conceptual jetty layout is shown in Figure EX-4.

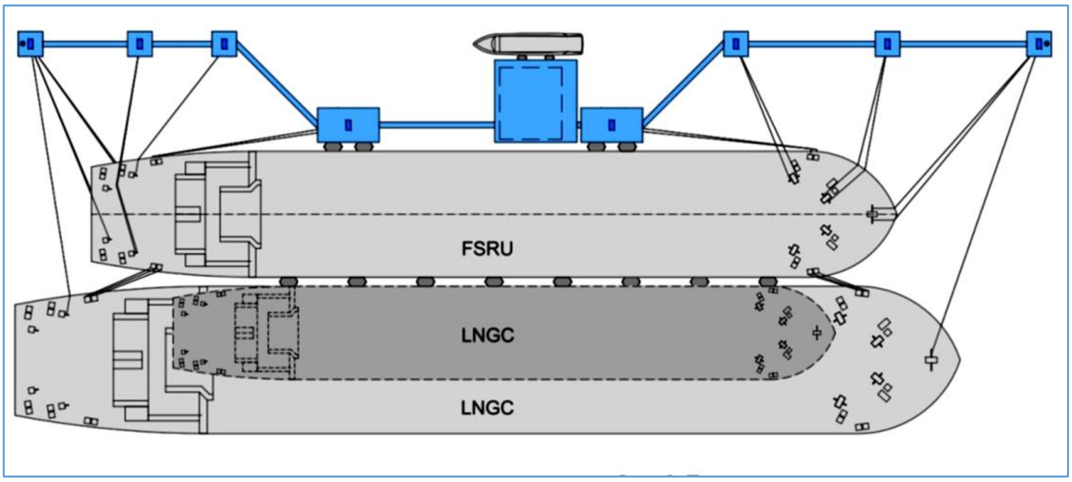


Figure EX-4: Jetty Layout

Geographically, the macroenvironment can be divided into the alluvial plain surrounding Lasbela extending southwards up-to the Bay of Sonmiani and the hilly regions situated in the East and West of this plain. The plain itself consists of alluvium deposits of Porali and other rivers.At the edge of the plain are adjoining hilly regions and near the coast, lie raised sea-beaches, situated some 15 to 25 meters above the sea level. The East of alluvial plain exhibits the greatest variety of rocks forming the Anticline Ranges separated by various valleys. The hilly region is situated to the West of the alluvial plain of the Porali and extends along the Makran coast. The whole of the eastern part of the district is mountainous. The plain in the center, comprising of a greater portion of the district is in a triangular shape. The principal hill ranges are on the western slopes of Kirthar Mountains, and Lak Phusi in the North. The other side includes main ridge of the Pub Range with parts of Khude or Khudo and part of Pub Range. The third side comprises of lower slopes of the Makran coast. Consisting of plains, mountains and terrain elevation range, the Lasbela District is situated at 0-1494 meters above Mean Sea Level (MSL). The Mor range and Khude are surrounded by Saman branch of Kolachi River on the South; Hub River on the East and Gidar Dhor River on the West. Valleys of the Kharari or Kanrach and the Mithri, Mohbar and Chebechi torrents are situated in the South. From its entrance into Lasbela District, the Porali River runs over a stony course and has low banks as far as Mangia, where it passes through clay soil. At Shah Lakhra, a dam has been constructed at about 89 km to North of Shah Lakhra, a branch of the Porali River, known as the Titian River, takes off and eventually flows into the Siranda Lake.

The wave conditions at the proposed site area are relatively severe during the monsoon month of May to September and especially during cyclones.

A computational wave modeling study by HR Wallingford (2008) was given as a design basis. The study was initially carried out in order to understand the wave climate at the site of a nearby Single Point Mooring (SPM) facility which was installed at 24.950°N, 66.572°E. The study by HR Wallingford used the TELURAY model in order to transform offshore wave conditions to near shore locations of interest by representing the effects of refraction and shoaling. HR Wallingford (2008) introduces to numerous wave height measurements. The results of the different systems show high discrepancies in the range of 5.3 m and 9.3 m for the 1 in 100 year conditions.

The offshore wave conditions used for calculations in the HR Wallingford study have a significant wave height HS of 4 – 4.5 m and a mean wave period of 6 -8 s with a mean wave direction from the sectors centered on 210° N and 240°N.

The effects of shoaling and refraction were calculated by the use of the Shore Protection Manual. The results show that the wave height reduction from deep water conditions (h ≈ 40 m) to a water depth of 16 m estimate to 7.5 % due to refraction and approximately 11.3 % due to shoaling. By applying these reduction coefficient to the offshore wave height the reduced significant height is estimated to approximately 3.7 m. Since the mathematical theory of wave propagation is far from complete, it is necessary to make simplifying assumptions and use approximate methods which are sufficient for a feasibility study. Assumptions which were made: (1) waves follow broadly the linear wave theory (2) wave period is constant over the entire depth of the shore.

The annual wave rose gives information on the wave direction. Figure EX-5 represents the wave rose at the FSRU location, which is understood to be in the area for the proposed site.

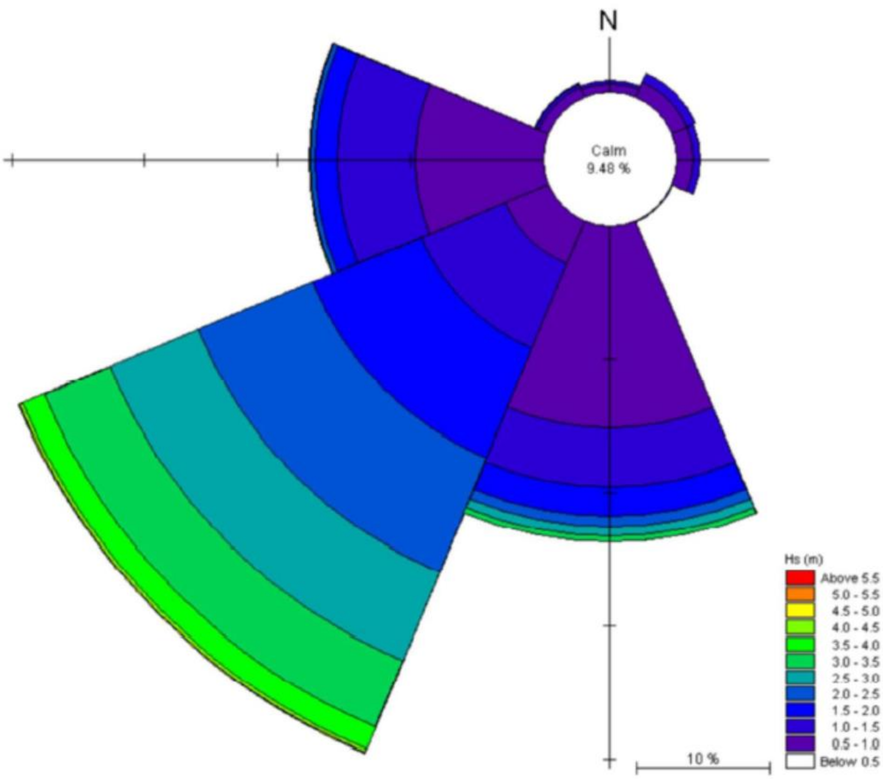


Figure EX-5: Wave rose at FSRU location

It is required that the FSRU and mooring system as well as all stability calculations for terminal equipment and breakwater shall be designed for the 100 year return conditions.

The maximum recorded wave heights are in the range of 3m to 4m from June to August (HS = 3.0 m) and 1m to 2m in September and October in 1979. Wave direction in deep water is estimated to follow the direction of wind, however waves caused by southwest monsoon are expected to slightly change direction to the right when meeting the shallow water area. The main wave directions are in the range of 210°N to 270°N.The mean wave direction however is observed between 237°N and 235°N.

The tides at Sonmiani Bay are semi-diurnal which means that there are two high waters and two low waters each day. Diurnal inequality exists whereby the two high tides and low tides vary considerably from each other in tidal range. Reliable data about the tidal range exists at a datum near Karachi Port. Mean high water is 2.4 m above datum and mean low water is 0.4 m above datum, which results to mean tidal range of 2.0 m. It is expected that the tidal range in the bay will be significantly lower. Tidal currents can be substantially. Since there is no contraction or channel present tidal currents are considered to be low.

The current pattern over the whole of the Arabian Sea varies continually. From January to March, these currents have a common tendency to set towards the west and northwest. Near the coast of Pakistan, a current setting to southeast becomes evident in late January or February and gains in constancy and strength during the next few months. From February through mid-April, the transition period of the northwest and southwest monsoon, the currents are extremely variable. By the end of April, south and southwest winds prevail and give rise to an east and southeast drift that builds up to a maximum in July and August and decreases during September. During November a generally clockwise circulation is set up in the Arabian Sea as a result of the northeast monsoon. In December, the northeast winds prevail over the sea and the period of west drift begins.

Mean velocity of accumulated wind drift and tidal current for the top 10 m in Sonmiani Bay for 100 years return period is 1.6 kt. Recently recorded current data show low current speeds of maximum 0.27 m/s with directions mainly coming from straight north to south. The data was recorded by the use of a current meter on October 6th and 7th 2015 at the South Easterly end of Churna Island. Remark that the current data was not taken during the monsoon season though, it expected that higher currents occur from May till September.

The recommended water depth for LNGCs and the FSRU are at minimum 2 m below the deepest draft (summer draft = 12, 5 m) below LAT. To the expected severe sea state at the navigational approach and the water demand at the FSRU, we recommend a water depth of at least -15 mLAT due to navigational and operational reasons.

As mentioned above, two main locations are taken into consideration. Location 1 has an approximate water depth of about -16 mLAT and location 2 of about -17 mLAT. Thus, the required water depth of minimum 15 m meets the demands for both locations. For the optimization of location 1 near Churna Island sites are chosen which fulfill this recommendations.

Some Data on the seabed properties were delivered by BF. The locations of the taken samples are shown in Figure EX-6 with pins. Sediment samples were taken with the help of a Ponar grab sampler. The grab samples were collected due to examinations for a single point mooring (SPM) facility that is located approximately 11 km off the shore (purple pin). The gab samples show old coral fragments, poorly-sorted coarse gravel & sand, silty clay, well-sorted coarse sand, poorly sorted muddy gravel & coarse sand, poorly-sorted sands & shell hash, well, sorted fine to medium sand, and well-sorted fine sand. New grab samples were taken in October 2015. General assessment showed the rocky nature of the bottom at most of the places. The samplings shown that the sea ground was covered with either shells, stone, pebbles or gravels.

The drilling samples are marked with yellow pins. The maximum depths of the boreholes vary. The boreholes show basically the same findings. There is fine siltstone overlaid with mostly sandy sediments. The locations of the boreholes though are very close to the shore line.

Figure EX-6: Locations Soil Properties

The seafloor geomorphology and lithology has not yet been investigated profoundly at the proposed locations. However, a survey was undertaken for a single point mooring buoy site that is located approximately 12.2 km offshore from shore landing point. It is expected that the geology is similar thus, it is described in the following section. For a detailed design of the foundation and other offshore structures a comprehensive geotechnical study is shell bring a deeper insight.

Figure EX-7: Locations of bottom sampling collected in October 2015

Two main types of soil properties are expected at a water depth larger than 12 m. The predominated material is bedrock. Bedrock is well indurated conglomerates comprised of well-rounded gravels and shell/coral fragments and sandstones. Additionally, coarse grained gravels and sands are expected to be present in thin layers on top the bedrock. Poorly sorted coarse sands and gravels are in areas without ripple bed forms. Clean well-sorted coarse to very coarse sand with large shell fragments are in areas of rippled bed forms. Sand predominately comprised of shell and coral fragments 1 - 50 mm diameter are present.

The given hydrographical survey show a typical erosion dominated seabed with only thin layers of sediment on the bedrock. This is even more expected to be the situation in the nearer area of Churna Island, where sheer bedrock is expected to dominate the seabed eastern / northeastern of the Island.

Based on this information the construction of a terminal and a breakwater is feasible. Due to the bedrock major capital dredging works will be very expensive. Dredging of small areas for final clearance of the berthing or the navigational approach way can be executed with the equipment for the erection of the breakwater. In this case the dredged bedrock may be used as core material for the breakwater.

The vegetation particularly the trees such as *Prosopis cineraria* (Jand / Kandi) and *Acacia nilotica* (Babul) are quite scarce in the area. Stunted & heavily polarded Babul Trees were observed in barani cultivation areas. *Prosopis juliflora* (Mesquite) is quite dominant along with *Calotopis procera* (AKK) and *Aerva javanica., Arthrocnemum sp*: is quite dominant in the over flooding seawater zone. In addition Salt indicator species like *Sueda fructosa* (Lani) and *Tamarix spp* (Lai / Lao) were also observed.

12 species of mammals were recorded from the coastal area. Among large/medium sized mammals, only Indian Jackal, Red Fox, Indian Porcupine and Desert Cat could be recorded. Among small mammals, Desert Hedgehog, Grey Mongoose, Small Indian Mongoose, Five-striped Palm Squirrel, Roof Rat, House Mouse, Indian Gerbil and Desert Gerbil were also recorded.

Little information is available regarding the important species of coastal birds of Pakistan. Roberts et al. (1986) have given a list of the birds of the Sindh Coast but they have not given the details of occurrence of the birds on any particular locality on Karachi Coast. Khanam and Ahmed (1988) have studied the resident and migratory birds of the Karachi coast based on their four months observations during July to October 1985 along the coastal areas from Clifton to Hawkesbay but they did not include Cape Monze in their study area. Ghalib and Hasnain (1994) reported only 41 species of Warterbirds from Cape Monze area. 30 species of birds have been recorded during the recent survey in the study area during September 2016.

The exposed beaches in the surveyed showed little variation in the types of substrate. The epifaunal animal communities at sampling locations 1 Mubarak Goth and location 2 Manjar Goth were similar. The coastal habitat survey (rocky cum sandy) showed a diversified community of Gastropods, Bivalve Mollusks, and Crustacean fauna on the exposed beaches and rocky pools at low tide. Barnacles were by far the most dominant species sampled at all the 3 sampled locations. The Mudskippers were the only dominant species along with Uca crabs at Sonneri Goth.

Most of the invertebrate epifaunal species (Figure 9) such as Chitin, Limpets, Turbo Spp , Uca crabs and mud skippers were found to be in aggregate associations, while the others species were randomly distributed in the area surveyed. Other invertebrate epifauna such as Turbo spp, and Littorina spp (*periwinkles*) were the most common gastropods observed and were found to inhabit the intertidal zone. Although the crab species are capable of living above the high tide mark for extended periods of time, but for their survival they must keep their gills moist and need to spend time during reproduction close to the shoreline. The local fishermen catch 30-40 kg of lobsters (*Panulirus polyphagus*) daily from nearby area offshore; lobsters inhabit rocky crevices. The spiny lobsters were landed live on Manjar Goth location 2. Coastal Pelagic fish species such as mullets were caught by local fishermen and recreational anglers at Manjar Goth location 2.

Churna island had fairly abundant coral diversity (Ali et al., 2013). North side of Churna Island has rocky bottom constituted of uplifted rocks. Hard corals assemblages, growing on coral roack mounds and ridges. Dominant species found on the northern side of Churna Island uncludes Goniopora albiconus, Alveopora sp., Favites pentagona, Leptastrea cf, bottae, Coscinaraea monile, Pasmmocora supercicialis, Psammocora sp. And Dendrophyllia robusta, On the north western side only two species were found i.e. Goniopora columna and Aveopora sp. No species of soft coral wasreported by Ali et al. (2013), however, recently a number of soft corals and antipatharians (black corals) are observed in the area. The information about corals found around Kaio Island is limited, however, Porites harrisoni and Goniopora albiconus have recently been reported.

Churna-Kaio Islands Complex is known to be important basking and feeding area for megafauna including whale shark (Rhinocodon typus), mobulids (Manta sp. And Mobula spp.), sunfish (Mola Mola and Mola ramsayi) and baleen whales (blue, bryde's and Arabian humpback whales). A diversified cetacean fauna is reported from the area. There was only one authentic record of sperm whale (Physeter macrocephalus) stranding in Pakistan which was reported from Sonara Beach at the mouth of Hub River. Crassostrea grayphoides and C. madrasensis are two main species of oyster occurring in the area (Siddiqui and Ahmed, 2002) Churna-Kaio Islands complex is known to be rich in population of dolphins as their school are frequented in the area.

The comments and concerns of the stakeholders gathered in writing, key informants meeting and stakeholder consultation forum have been identified here:

- Although the FSRU will be located within a non-fishing zone, the small scale fishing in the bay may be affected due to creation of exclusion zones around the FSRU, and restriction of fishing boats during the movement of the LNG vessels, and around the turning basin. There may also be damage to fishing equipment and periodic blocking/obstruction of access to their fishing routes. The fish catch around Sonmiani Bay is already declining due to the impacts mostly emanating from the industrial activities particularly the discharge from Hubco. There will definitely be some impacts on the fish populations in the area from the development of the LNG Terminal, but the severity of the socio-economic impacts on the fishing communities must be evaluated. The project will face resistance from local fisherman if their livelihood is hampered because of LNG terminal activities. In case of severe socio-economic impacts, there should be some relief from the project for the fishermen.
- The project area at Sonmiani Bay has been proposed to be declared as Marine Protected Area (MPA) aiming at Conservation of biodiversity, especially critical habitats of threatened species. The site is also a tourism spot where yearly 4000 tourist visit Churna Island. Some of the very

rare species of fishes have been reported from this site. This is the only site where corals are present in abundance. The proponent has to take cognizance of these issues and must plan their activities in such a way that the ecology remains intact and the development achieve its sustainability.

- The project must strictly comply with the requirements laid down in the Balochistan Environmental Protection Act 2012 and the rules and regulations framed thereunder. The impact associated with the cooling water discharge and likelihood of increase in the sea water temperature above 3°C should be dealt with proper engineering design keeping in view the requirements of NEQS. Any impact beyond permissible limits will badly impact the ecology of the area.
- Online monitoring system must be developed to minimize the hazards. Change of temperature due to discharge of seawater used for regasification will conform to ensured not to exceed the limits set by the NEQS.
- Measures must be in place to minimize the risk of pipeline leakage and explosion. The pipes must have corrosion protective coating followed by a concrete coating.
- The dredging will change the hydrodynamics of the area; the impact of dredging activities has already affected the coastline of Pakistan. The developers undertake extensive dredging without studying the long term impacts of rapidly changing wave pattern. This aspect must be given due importance in the ESIA. Ecological disturbance to the area can be minimized by ensuring that developmental activities are properly planned. All development interventions should be staggered, where possible, to allow the fisheries populations to achieve a natural equilibrium in the shortest possible time.
- Balochistan EPA must ensure that the proponent ensure implementation of environmental management plan in letter and spirit. Solid and liquid waste (fuels, chemicals) are already polluting the coastal waters around the area. Proper waste management mechanisms should be in place for the LNG terminal, no hazardous chemicals/substances should go into the water.
- The fishing grounds are lifeline for the people of Sonmiani. If these grounds it will result in large economic loss for country as well because the area is important for commercial fishing.

The Environmental Management Plan should suggest a budget for the conservation of biodiversity of the area and that money should be spent for the purpose with transparency.

The screening process, besides identifying significant environmental impacts and the existence of residual impact suggests mitigation measures that would be adopted to reduce, minimize or compensate for the negative impact, in case there are any.

The land requirement for proposed project is very limited since the major part of project (LNG storage and re-gasification process) will be in the sea (7.5 km from the coastline in Sonmiani Bay). The estimated land requirement is approximately 100 acres (to be confirmed at design stage) for construction of onshore receiving facilities/landfall gas metering station. There will be no private land procurement for the project. The identified land belongs to the Bahria Foundation and has no human habitation at present. Hence, there will be no direct PAPs (Project Affected People) / PAFs (Project Affected Families) due to this project.

At present project site is vacant with sparse coastal xerophytic vegetation and there is no agriculture or any other activity at site and in the immediate vicinity. This land is within Pakistan Navy operational area and expected to be used for port based activities. Therefore, there will be no change in designated landuse due to proposed project.

Since project site is vacant land with sparse vegetation plantation and does not have any significant natural vegetation / large trees/forest land or any conserved species, the site grading/preparation will not involve cutting of trees.

The existing marine fishing harbor is outside the corridor of impact of the land identified for proposed LNG terminal and associated facilities. The proposed marine jetty construction, dredging, laying of RLNG pipeline is not expected to cause disturbance to the other activity centers in the macroenvironment of the project area.

Bahria Foundation has obtained necessary approvals / NOCs from the GoP for siting the Terminal.
Security Clearance from Ministry of Defence: The Ministry of Defence has issued a security clearance by issuing a No Objection Certificate (NOC) in favor of Bahria Foundation for siting the LNG Terminal Project subject to the fulfilment of the following siting criteria:

i. Restriction / observation of following coordinates:

   24 54' 19.85'' North, 66 36' 31'' East

ii. No construction on North of this position to ensure 3 km separation from upcoming Hubco Coal Jetty planned in the following position:

   24 55' 45.2'' North, 66 37' 22.2'' East

No Objection issued by Ministry of Petroleum & Natural Resources: The Ministry of Petroleum & Natural Resources has issued a No Objection Certificate (NOC) in favor of Bahria Foundation for siting the LNG Terminal Project subject to the fulfilment of the siting criteria laid down in the LNG Policy 2011 / TPA Rules.

Provisional License issued by Oil & Gas Regulatory Authority: The Oil & Gas Regulatory Authority (OGRA) has issued a provisional license in favor of Bahria Foundation for siting the LNG Terminal Project after confirmation of compliance with the rule 33(1) & (2) of OGRA LNG Rules 2007.

It is not possible to ensure that a pipeline is sufficiently strong to withstand the effects of an earthquake by considering factors for increased internal and external forces in stress calculations or by making appropriate additions to the wall thickness of the pipes. The approach that is adopted by various publications is to make a flexibility analysis at various points of a pipeline system which are considered as fixed. In this context, the following points are regarded as fixed points:

- sudden changes in direction (bends);
- branches;
- pipeline ends (e. g. scraper trap stations).
- These fixed points are affected by:
- soil conditions;
- the stiffness of the pipeline;
- friction between the pipeline and the soil;
- maximum vibration level of the soil.

Long buried pipelines without fixed points of the type described above are mainly subject to axial forces. These forces are however no higher than those to which the soil is exposed. In the event of an earthquake, the soil, with the exception of rocks and rocky areas, effectively act as a vibration dampener for the pipeline and there is therefore no risk of a rupture. This of course does not apply if the earthquake leads to faults or cracks in the ground.

Cracks in the pipeline will only occur if there are major differences between deformations of the soil and the pipeline. Provided that the pipeline is sufficiently elastic (i.e. if the wall thickness is low and high strength steel has not been used) it may be possible for the pipeline to accommodate minor soil deformations without rupture. In such cases, however, earthquake damage may lead to bends and/or dents that will need to be repaired. *In order to ensure that the pipeline is not exposed to excessive earthquake damage, sudden changes in direction, rigidly fixed branches and oversized pipes must be avoided.*

The main activities in subsea pipeline laying will include:

- Trenching of seabed and onshore section along pipeline route;
- Weld lengths of pipe on pipe lay barge or at onshore location and float out;
- Connect pipeline to jetty platform and to onshore tie-in point;
- Installation of concrete mattress and backfilling of the trench; and
- Hydro-testing of pipeline

The dredging process has been found to result in loss of biota within the dredged area. This is a short time activity localized to the environment. Most of the area to be dredged consists of soft bottom or soft bottom/rubble with little or no observed epifaunal communities. As per the site investigations, the selected pipeline route foresees a short submarine section connecting the FSRU to the Landfall LNG Terminal End in Northwest Main Land with a length of approx. 7.5 km.

- For dredge projects similar to those proposed for proposed Project, the typical adopted effluent concentration in the water column is in the order of 30-35 NTU (Nephelometric Turbidity Unit) above background. To ensure that the effluent concentration does not exceed this value during this project, regular turbidity measurements will be carried out and operational procedures modified accordingly. It is envisaged that the excess dredged material will be temporarily placed on the shoal (sandbank). Deposition of this material will impact an area in which the benthic habitat is characterized by soft bottom/sand. Although existing benthic habitat will be lost by placement of dredged material on the bottom, the excess spoils shoal itself will form a foundation for a new benthic habitat till such time the excess spoils are harvested by the dredging operation.

- Infaunal organisms in soft bottom sediments are reported to survive burial up to a depth of about 4 inches. Therefore, impacts to benthic organisms from sedimentation would be minor.

- The dredged bedrock will be used as core material for the breakwater. The remaining dredged material will be transported to the proposed dumping site designated by Pakistan Navy. Some sedimentation and temporary turbidity could potentially occur due to transport of fine material into marine habitats during dewatering of dredged material. In order to minimize the impact of sedimentation resulting from dewatering, all dredged material will be deposited within dikes equipped with control weirs. The dikes will contain the discharged dredged material and prevent re-deposition of the material due to waves or overflow. The weirs, used to discharge excess water, will be designed to reduce the discharge of fine sediment including benthic community back into the water column and to moderate the discharge velocity and volume. The benthic community is anticipated to be rehabilitated at the discharge site.

- It is envisaged that no blasting will be involved during the entire site preparation & development phase.

- Fueling of dredge barges and associated vessels used to transport fuel to the dredger, may involve oil spill. As mitigation measure, a *Spill Control Plan* shall be prepared in consultation with Independent Monitoring Consultant (IMC) and the same will be implemented throughout the construction phase of project.

- Upon completion of dredging operations, long-term operational impacts to the benthic communities within the approach channel and turning basin have been found to be minimal. Although, existing biological habitats will be permanently altered in the short-term, new habitats and organisms have been found to rapidly reestablish themselves in previously disturbed areas. In addition, dredging can also alter the bottom in ways that actually aid in establishing habitats in areas where they did not previously exist. Due to natural current movements, it is not anticipated that there will be any long-term sedimentation impacts during operations. Natural currents and tides are expected to serve to minimize or restrain potential sedimentation to developing biological communities and prevent or minimize the need for additional dredging in this area.

Maintenance Dredging

- Maintenance dredging is an essential part of operation of all port activities particularly the LNG terminals. During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by Bahria Foundation within the berthing and turning basin to measure changes in bottom elevation and locate areas of sediment accumulation.

- Primary concerns for dredging are increase in turbidity and suspended sediments, and the loss of benthic organisms in particular. Turbidity will be monitored at each maintenance dredging event to ensure compliance with relevant international standards. If the turbidity exceeds the limits, dredging operation will be stopped temporarily until modifications can be made to the dredging technique so as to normalize the turbidity level.

It is estimated that 11,000 m^3/hr of seawater will be used for regasification. Using seawater pumps the same quantity will be discharged into the sea. The seawater will be brought in contact with LNG with a shell and tube heat exchanger or open rack vaporizer to vaporize LNG flowing through closed tubes. Sea water will absorb cold energy and vaporize LNG. The cooling water at discharge is 3 degrees Celsius (ºC) cooler (at most) than at intake. According to National Environmental Quality Standards (NEQS) the change in discharge temperature is required to be lower than 3ºC over ambient. The FSRU will be adequately equipped to deal with the temperature differences to respond to the national and international standards. The effects of cooling water discharge are expected to be biologically insignificant in view of the small temperature difference between the discharged cooling water and ambient conditions. However, water temperature and diffusion modeling to be considered in detail design to better evaluate the mixing of cooling water with receiving water.

LNG facilities and ships require a higher degree of planning, resources, knowledge, and risk to attack than that required for softer targets. Terrorists want to be successful, so they look for ways to execute crimes that will have a desired impact with a high likelihood of success. Lastly, they work with the resources they can acquire to conduct their acts so they are less likely to attack assets requiring sophisticated and complex methods as is evidenced by the vast majority of events. Their strategic objectives are sometimes profound, but their weapons, tactics, and choice of targets tend to be common.

As a result of the attacks of September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans.

The purpose of the Security code is to: i) prevent and suppress terrorism against ships; ii) improve security aboard ships and ashore; and iii) reduce the risk to vessels, cargoes, and passengers, crew, and port personnel onboard ships and in port areas.

All LNG carriers, as well as other cargo vessels 300 gross tons and larger, and ports servicing those regulated vessels, must adhere to these IMO and SOLAS standards.

Accordingly Bahria Foundation will adhere to the IMO and SOLAS standards stated here:

IMO requirements for the ships:

- Ships must develop security plans and have a Vessel Security Officer (VSO);
- Ships must be provided with a ship security alert system. These alarms transmit ship-to-shore security alerts to a competent authority designated by the Administration, which may include the company, identifying the ship, its location, and indicating that the security of the ship is under threat or has been compromised;
- Ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

Requirement for facilities:

- The facility must have a security plan and a Facility Security Officer (FSO); and
- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and facility security plans must address the following:

- Monitoring and controlling access;
- Monitoring activities of people and cargo;
- Ensuring security communications and that they are readily available; and
- Completion of a Declaration of Security that is signed by the FSO and VSO.

Bahria Foundation has their own contingency plan that will be implemented in letter and spirit. All the relevant safety protocols would be followed by Bahria Foundation; however, “no one can guarantee that a terrorist incident can’t happen.”

Mitigation Measure: Bahria Foundation and their suppliers shall adhere to the requirements set forth by IMO and other related agencies. Maritime Agency has excellent security record and is committed to maintain the same. No additional mitigation measures will be required.

The EMP provides a delivery mechanism to address adverse impacts, to enhance project benefits and to introduce standards of good practice to be adopted for all project works. The primary objectives of the EMP which it is required to achieve are:

- Outlining measures to be taken during the implementation and operation of the Offshore LNG Terminal Project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels.
- Develop a monitoring mechanism & identify parameters that can confirm the implementation of the mitigation measures.
- Taking actions such as defining roles and responsibilities of the project proponent for implementation of EMP and identification of areas where these roles and responsibilities can be shared with other stakeholders.
- Defining the requirements for documentation, training & management and implementation of mitigation measures and giving communication plan with the concerned regulatory agencies.
- Taking actions required for assessing the effectiveness of mitigation measures employing the monitoring mechanism and identifying related parameters to confirm the effective implementation of these measures.
- The scope of the EMP includes the following functional areas in general:
- Planning, design and development: The planning, design and development of the Offshore LNG Terminal and associated infrastructure.

The Environmental & Social Impact Assessment (ESIA) has evaluated the potential environmental, social, economic, cultural, and natural impacts of the proposed Pakistan Floating LNG Terminal Project. This assessment has been carried out to fulfill the regulatory requirements of Baluchistan Environmental Protection Act (BEPA) 2012 and the rules and regulations framed thereunder.

Baseline environmental and socioeconomic information was collected from a variety of sources, including reports of previous studies, published literature, and field surveys. The information collected was used to compose profiles of the natural, socioeconomic, and cultural environments likely to be affected by the project. The impact assessment and proposed mitigation measures are based on the selected site in Sonmiani Bay. The selection of site by the proponent (Bahria Foundation) has been done after a comprehensive qualitative/quantitative risk analysis as part of the techno-economic feasibility.

EMC has carried out analysis on the siting of the LNG terminal. Environmentally the proposed site has been found feasible provided that the mitigations suggested are carried out. It raises minimum social and environmental issues and avoids any adverse environmental impacts; it additionally is economically more viable than the others. Proactive planning and commitment to environmental compliance shall make the project successful.

The specific criteria used for determining the significance of impacts are identified for each resource, and the following assumptions are generally used when evaluating the potential project impacts:

- Bahria Foundation as project proponent shall comply with all applicable laws and regulations;
- The construction phase of the project shall proceed as described in Section 3; and

- Bahria Foundation as proponent shall implement the mitigation measures and Environmental Management Plan in letter and Spirit.

The ESIA study finds that the Offshore LNG Terminal by Bahria Foundation is compatible with the aims and objectives of (a) Sustainable Development in promoting improvement in quality of life, and (b) Energy Sector in making available a sustainable energy source and thus contributing to sustainable economic development in Pakistan.

The cumulative impact of this project on the National economy will be a strongly positive one. Significant additional resources will be realized by the nation as a result of this project, which is consistent with the government's long-term development plan. The additional licensing income, among other sources of additional income, will add to the government revenues and economic growth resulting from expanded and diversified business development in Pakistan.

TABLE OF CONTENTS

ANNEXURES

Chapter 1 Introduction

Name of Project	**Bahria Foundation LNG Terminal**
Project Location	**Sonmiani Bay** Union Council Gadani District Lasbela, Baluchistan, Pakistan
Project Proponent	**Bahria Foundation** 6th Floor, Bahria Complex -II, M.T. Khan Road, Karachi-Pakistan. Tel: +92 21 35610242-3 Fax: +92 21 35610749 E-mail: info@bahriafoundation.com
ESIA Consultant	**EMC Pakistan Pvt. Ltd** Office # 503, Anum Estate Building, Main Shahrahe Faisal, Karachi, Pakistan Tel: +92 21 34311466 Fax: +92 21 34311467 E-mail: mail@emc.com.pk

1.1 Project Overview

The Bahria Foundation (hereinafter referred as *Project Proponent*) intends to establish an Offshore Floating LNG Terminal (The *Project*) at Sonmiani Bay, Balochistan (Figure 1.1). The prospective location is positioned next to Churna Island, a small uninhabited island located in Sonmiani Bay in Balochistan Province. The island lies about 9 km west of the mouth of Hub River. Churna Island is approximately 1.5 km long and 0.5 km wide. In recent history, it was mostly used as a firing target by Pakistan Navy. The area around Churna Island is known for fishing and scuba diving. The site is therefore significant with regard to environmental and social considerations, if the terminal shall be placed in close proximity to Churna Island.

The objective of the LNG terminal is to provide all the required facilities such as jetty, subsea & onshore, interconnection pipeline and all other related facilities to fulfill the function of LNG unloading, storage, regasification, metering and transport the RLNG to the injection point in SSGC pipeline system at SMS Kathore. The Floating Storage & Regasification Unit (FSRU) will be moored along conventional marine facility (Jetty/Berth) in shallow water. Gas will be sent to an onshore receiving point (point of delivery) via a pipeline (subsea/on raised structure) (approximately 5-7 km). The main components of the project include:

- A Floating Storage and Regasification Unit (FSRU) rated for up to 750 MMSCFD of send out and 170,000 m^3 of LNG storage;
- Offshore breakwater designed to maintain a sea state that is conducive to FSRU operations and maneuvering of LNG carriers alongside the FSRU for ship-to-ship transfer operations;
- Jetty with mooring and berthing facilities;
- Pipeline connecting the FSRU to the local transmission network of SSGCL;
- Support Systems such as tug boats and other ancillary systems.

The project will be structured as an unbundled project structure. Under this project structure, LNG will be imported from another country like Qatar by a GOP-designated buyer ("LNG Buyer"), under the LNG SPA (Sale and Purchase Agreement) which could be on a delivered ex-ship basis (CIF) by or collected on a FOB basis from the LNG Seller. The LNG Buyer will enter into an agreement with the REGAS SPV (Special Purpose Vehicle) for the provision of LNG receiving, storage and regasification services at the terminal under tolling-type agreement ("LNG Terminalling Services").

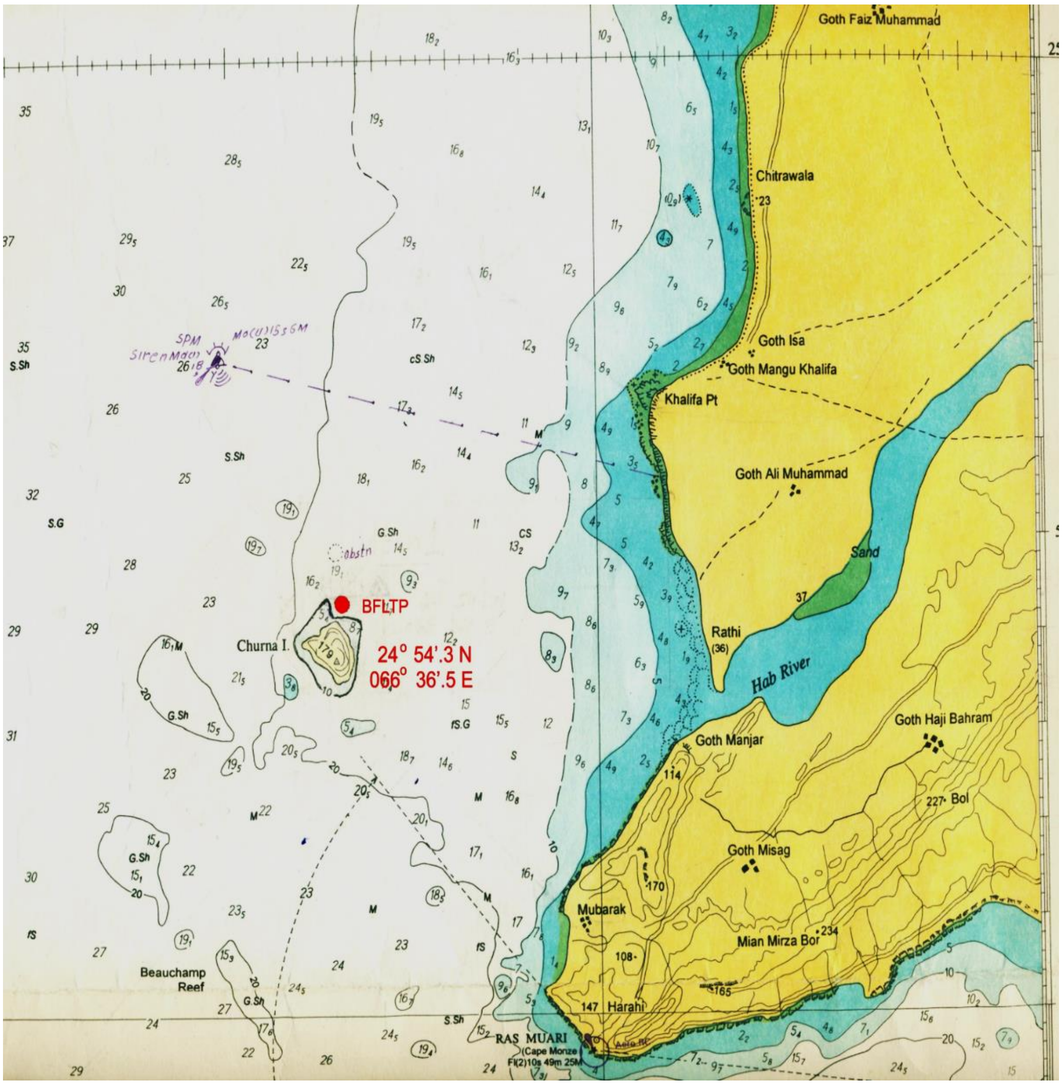
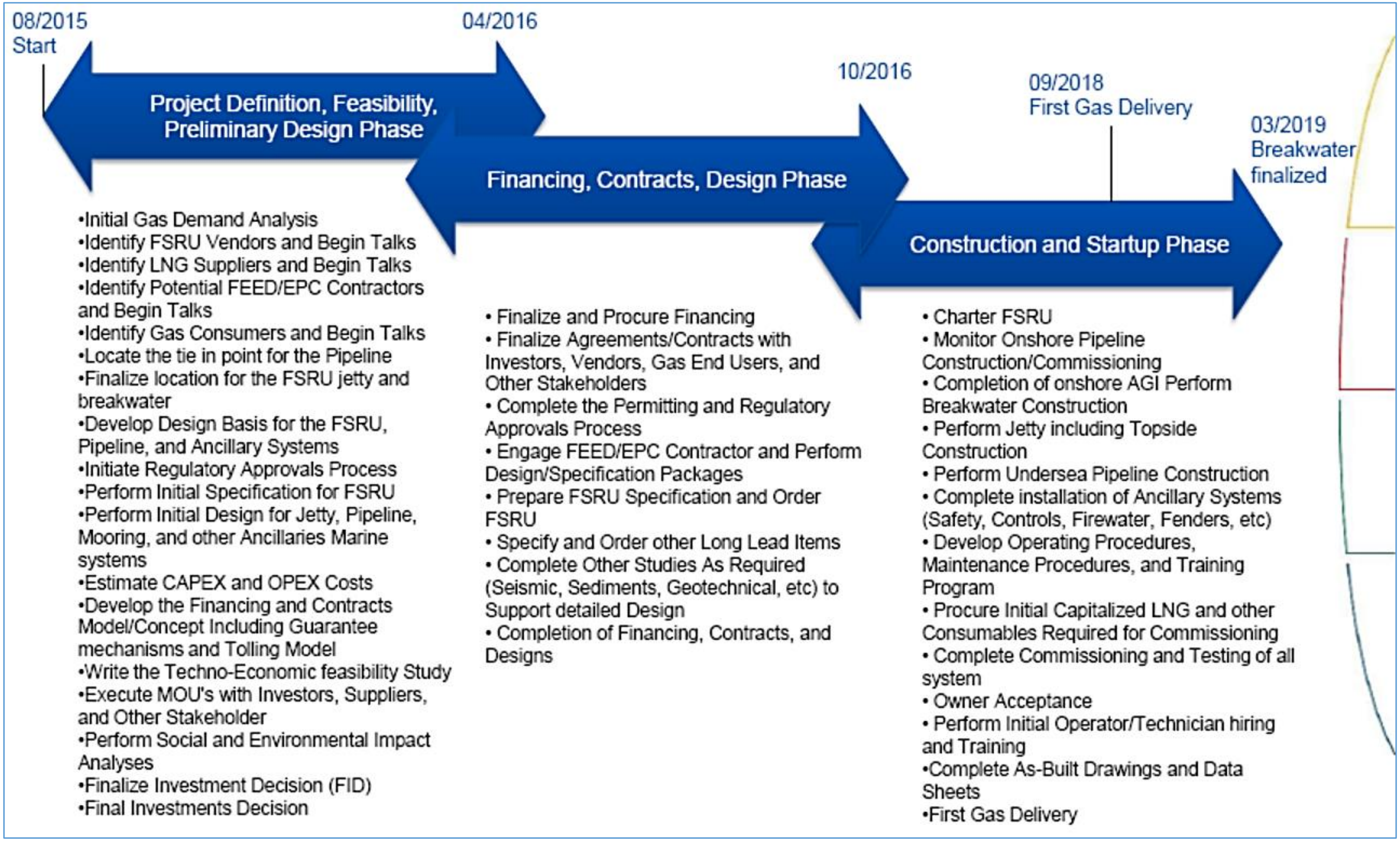


Figure 1.1: Prospective Locations for LNG Terminal in Sonmiani Bay

1.2 Project Implementation Schedule



1.3 Overview of Bahria Foundation

Bahria Foundation was established in January 1982 by the Government of Pakistan as a Charitable Trust under the Endowment Act 1890. The Committee of Administration (COA) headed by the Chief of the Naval Staffs as its Chairman consists of eight members including the Managing Director of Bahria Foundation. Committee of Administration acts as the Supreme Governing body of Bahria Foundation. The Board of Directors headed by Managing Director is the corporate body responsible for overseeing operational activities of the Foundation. The Managing Director being the Executive Head conducts administrative and commercial activities of the Foundation.

The Foundation is engaged in diversified industrial, commercial and developmental activities through its three Regional Offices namely: Bahria Foundation *(South)*, Bahria Foundation *(North)* and Bahria Foundation *(Centre)*. These Regional Offices are responsible for administration and conduct commercial activities of all business divisions within their areas of operation.

Bahria Foundation excels in the field of education where it has established 45 schools/colleges throughout Pakistan. The Foundation is also participating actively in a number of joint ventures with local & foreign entrepreneurs. The Foundation owns three prestigious complexes having an area of about 486,000 sq. ft. office space at Karachi and has over 4141 employees.

1.4 Project Background & Rationale

1.4.1 Gas Shortfall

Pakistan is considered to have one of the most developed gas networks in the region, but due to its increased share in energy consumption, the gap between its demand and supply is widening steeply as shown in Figure 1.2.

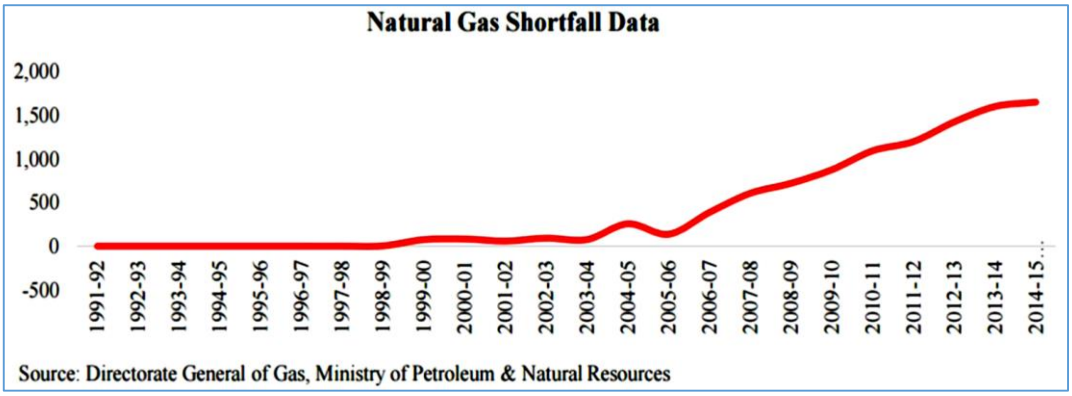


Figure 1.2: Natural Gas shortfall data in MMcfd (Directorate General of Gas)

The gap between supply and demand started when gas was substituted for oil and continued to increase with the expansion of the gas networks and the addition of new customers to the system. Pakistan's natural gas production currently is constant at around 4 Billion cubic feet per day (Bcfd) while the constrained demand is about 6 Bcfd, leaving a gap of 2 Bcfd. Furthermore, the unconstrained demand for gas is estimated to be 8 Bcfd; more than double current domestic production.[1]

[1] MFGOP, (2015). *Energy Survey 2014-2015*, Ministry of Finance Government of Pakistan, Islamabad, Pakistan.

1.4.2 Seasonal Variations

Historically, gas demand during winter rises due to increased consumption of domestic sector consumers. This occurs in almost all the areas of SNGPL's system and in some areas of SSGCL's system. Gas shortage was mainly an issue in winter months in the past, but summer shortages are also being experienced more recently.

On average, based on information provided by *"Pakistan's Economic Survey for 2014-2015"*, there has been an increase in gas demand by 40-50 MMcfd (based on average consumption during summer months) and 80-100 MMcfd (based on average consumption during winter months) each year.[2]

With no considerable increase in gas inputs, small fields that are connected to the system cannot compensate fully the reduction of supply for major gas fields and the rapid increase in demand. Thus, mainly in winter months, consumers located at the tail-end of the distribution network are facing low pressure issues.

1.4.3 Coverage Plan

Government of Pakistan is taking following steps to overcome the shortage of natural gas in the country:

- Contain the natural gas demand at current level & Load Management
- Increase indigenous gas supplies
- Import of LNG
- Import of Gas from Iran
- Import of Gas from Turkmenistan

Aside from Pakistan's internal gas production, several actions and agreements are being attempted by GOP to import natural gas and LNG from neighboring countries to meet the local gas demand. Some information regarding these Projects and their current status of development are presented below.

1. ENGRO LNG Terminal

In 2014, the GOP called bids through Inter State Gas Systems (ISGS), for construction of LNG regasification terminal by private companies. Engro Elengy Terminal Limited (EETL), formerly Elengy Terminal Pakistan Limited (ETPL), a subsidiary of Engro Corporation Limited was selected as the Technically & Financially qualified bidder for construction of LNG regasification terminal at Port Qasim Karachi.

EETPL will take delivery of the LNG cargo at the terminal from the Ministry of Petroleum and Natural Resources (MPNR), re-gasify the LNG, and release the RLNG to the off-taker, SSGC for the next 15 years. This project is Pakistan's first LNG regasification terminal.

The first phase of the project involves the construction and operation of 400 MMcfd. During the second phase SSGC and EETL are expected to double the offloading and regasification capacities

[2] MFGOP, (2015). *Energy Survey 2014-2015*, Ministry of Finance Government of Pakistan, Islamabad, Pakistan.

of the Pakistan LNG terminal. Regarding the first phase, the terminal was completed in March 2015, while in 2019 the second phase is expected to be introduced.

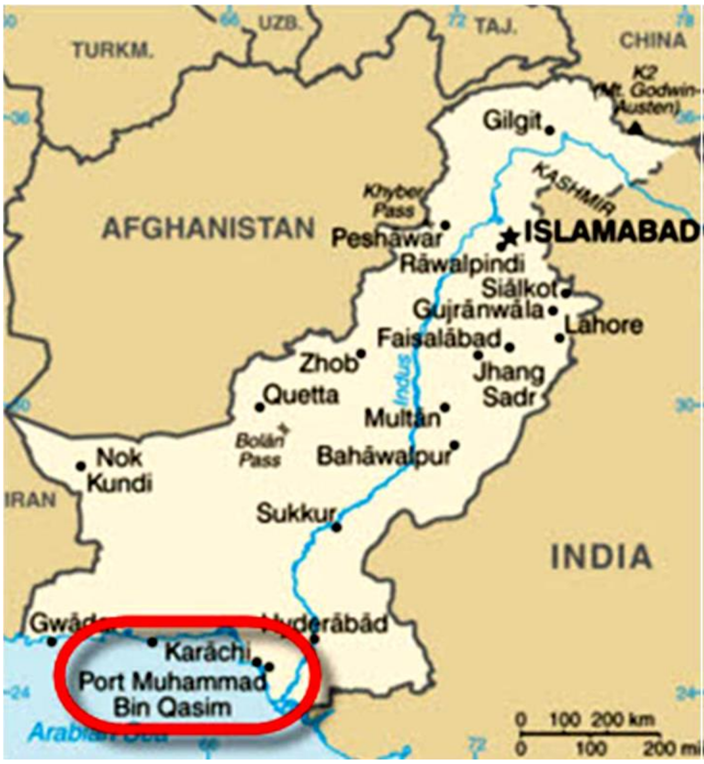


Figure 1.3: Location of the ENGRO LNG Terminal (2B1C, 2014)

2. PGPL – LNG Import Terminal

3. LNG Import From Qatar

The GOP has completed negotiations with Qatar and reached a deal on importing LNG. Under the deal, Qatar will supply 200 MMcfd, which is to be increased up to 400 MMcfd. After three years the supply will automatically increase to 400 MMcfd. The agreement for LNG import from Qatar is set to last 15 years.

4. Gwadar – Nawabshah LNG Terminal & Pipeline Project

Keeping in view the Sanctions on Iran, Ministry of Petroleum & Natural Resources reviewed, Iran-Pakistan Gas Pipeline Project and an Alternative Strategy was developed to undertake project implementation.

As per the Alternative Strategy, 'Gwadar – Nawabshah LNG Terminal and Pipeline Project' was conceived, whereby using the same route and technical specifications, gas pipeline will be constructed from Gwadar to Nawabshah along with LNG Terminal at Gwadar Port. The gas Pipeline will be connected with Iran once international sanctions on Iran are lifted.

Economic Coordination Committee (ECC) in its meeting held on 2nd October, 2014 and subsequently Cabinet in its meeting held on 23rd February, 2015 approved the "Gwadar – Nawabshah LNG Terminal and Pipeline Project" in principle as an Alternative Strategy of Iran – Pakistan Gas Pipeline Project, and authorized ISGS to execute the implementation of the project and directed the Ministry of Petroleum and Natural Resources to finalize funding plan, preferably on Government-to-Government (G to G) arrangement or BOT basis.

Soon after getting ECC approval, Honorable Minister for Petroleum and Natural resources visited Iran 28 – 29th October 2014 to discuss the way forward strategy on the Iran-Pakistan Gas Pipeline Project. Pakistan conveyed that in the wake of sanctions on Iran, the project could not implemented, however, Pakistan is committed with the Project and is making all efforts to complete the same under the Alternative Strategy whereby 700 km gas pipeline will be completed and only a small portion of 80 km will need to be constructed to connect the pipeline with Iranian segment.

In accordance with the ECC decision, Ministry of Petroleum and Natural Resources contacted the Govt. of China to nominate a well-reputed and well-experienced company to implement the project. The Govt. of China through the National Development and Reforms Commission of the owned subsidiary company of China National Petroleum Corporation (CNPC), will undertake project implementation.

A Framework Agreement was signed on 20th April 2015 between the National Energy Administration (NEA) and Ministry of Petroleum and Natural Resources (MPNR) whereby ISGS was nominated from Pakistan and CPP was nominated from China side to engage and undertake project implementation. Since then both companies are engaged to discuss the contractual arrangements.

The state firm China Petroleum Pipelines Bureau (CPP) has already submitted technical and commercial bids. The LNG terminal is expected to have the capacity of 500 MMcfd of LNG and incorporate a floating storage regasification unit. The expected year of operation for the LNG Terminal is 2019. The project has been approved by ECNEC.

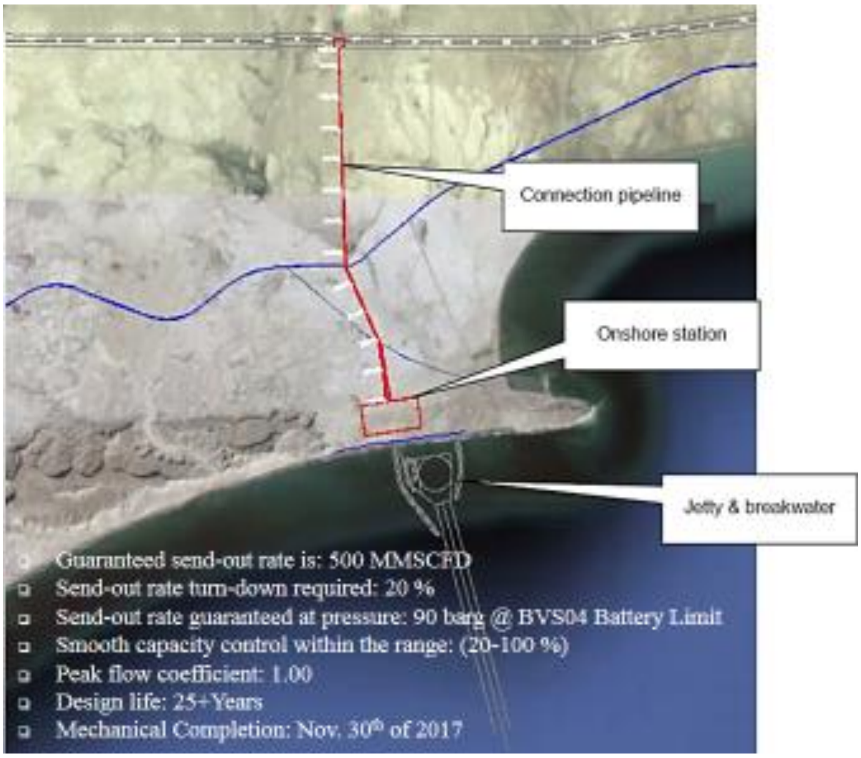


Figure 1.4: Site for Gwadar LNG Terminal

5. Turkmenistan-Afghanistan-Pakistan-India (TAPI) Pipeline

The main aim of the TAPI gas pipeline project is to bring natural gas from the Yoloten and adjacent gas fields in Turkmenistan to Afghanistan, Pakistan and India. With ADB acting as the facilitator and coordinator for the project, a feasibility study was conducted by the British consulting firm PENSPEN.

The feasibility study, proposed to lay a 56-inch diameter 1,680 km pipeline with design capacity of 3.2 billion cubic feet of natural gas per day (Bcfd) from Turkmenistan through Afghanistan and Pakistan up to the Pakistan-India border (Figure 1.5).

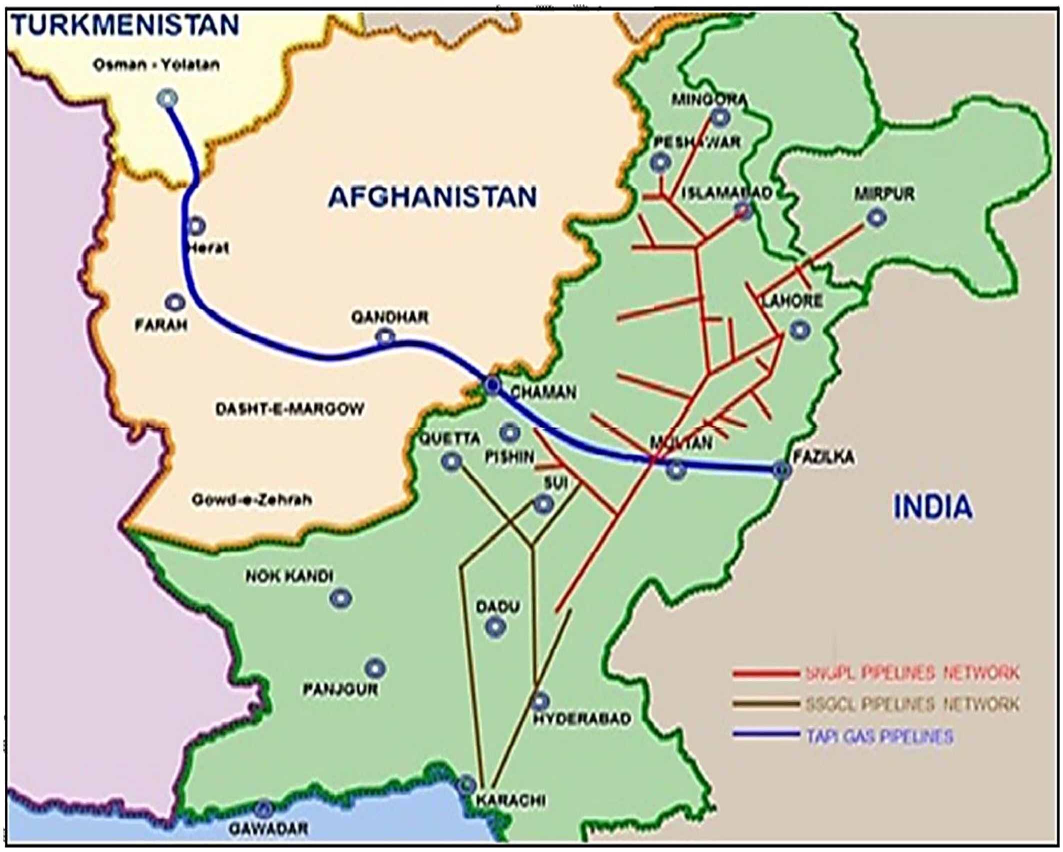


Figure 1.5: Planned Route Map of TAPI pipeline. (BAHRIA FOUNDATION, 2014)

Turkmenistan, Afghanistan, Pakistan and India signed a gas pipeline framework agreement in September 2010, which envisages the import of 1.35 Bcfd gases into Pakistan through Turkmenistan and Afghanistan. This project was expected to come into effect by 2017.

The TAPI pipeline has been proposed for close to two decades now, with little in the way of concrete progress. India has also been reluctant to join the project, as it would put their energy security at the mercy of Pakistan. A writer for the Economic Review has argued that Pakistan has lost a lot of time, mainly to internal wrangling over who should prepare technical studies related to route survey, front-end engineering design …etc. Then security agencies had their concerns over the proposed aerial survey by foreign consultants for the pipeline's route. After a lot of delays, in December 2014 it was decided by Turkmenistan to allow Pakistan's state run oil and gas exploration companies OGDCL and PPL to take part in exploration activities for the export of gas under the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline project.

Currently, the work on the TAPI pipeline is yet to commence as the four nations have not succeeded in finding a reputed international firm that could lead the consortium to construct and operate the pipeline. Specifically, given that no state-owned or private energy firms among the four states has the experience, interest, or capacity to operate a transnational pipeline, an outside firm's participation remains critical to the eventual transition of this project from idea to reality. TurkmenGaz is now leading the TAPI consortium, but it's still unclear how this will lead to the pipeline's actual construction.

1.4.4 LNG Trade Overview and Outlook

Traditionally far more of the LNG trade was done in the Pacific Basin, but with the rising exports from the Middle East, the trade route from the Middle East towards the Pacific is increasing. Figure 1.6 shows the Intra-Basin and Inter-Basin Trade in the years 2000 & 2014 in comparison:

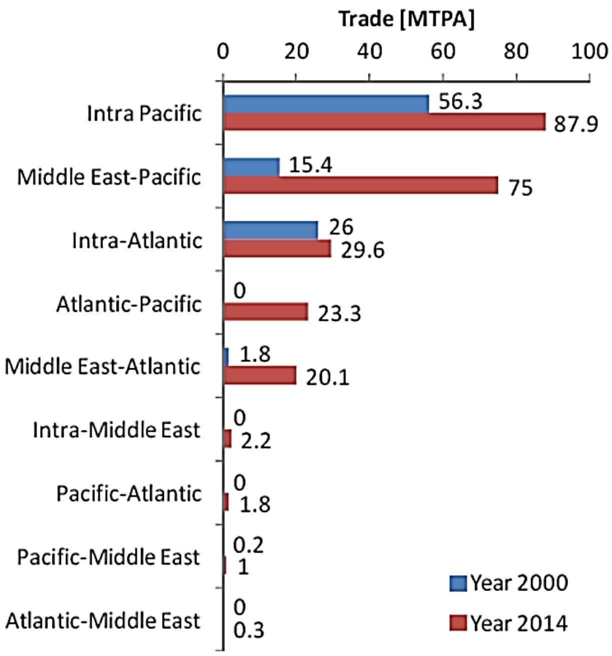


Figure 1.6: Intra- and Inter-Basin-Trade, 2000 vs. 2014, (IGU World LNG Report, 2015)

In the year 2000 56% of global LNG was traded intra pacifically; up from 36% in 2014. LNG from the Middle East to the Pacific region was 31 %, almost as large. The Intra-Atlantic trade has been almost stable in absolute terms at almost 30 MTPA, but has decreased in relative terms from 26% of World volume in 2000 to12 % in 2014. With 10% of the total trade volume, a new trade route is developing from the Atlantic Basin to the Pacific Basin and trading from the Middle East to the Atlantic Basin has increased from 2% in the year 2000 to 8% of the total global trading in 2014. All other trading routes are fairly small in comparison.

Figure 1.7 shows for each region their LNG imports by share:

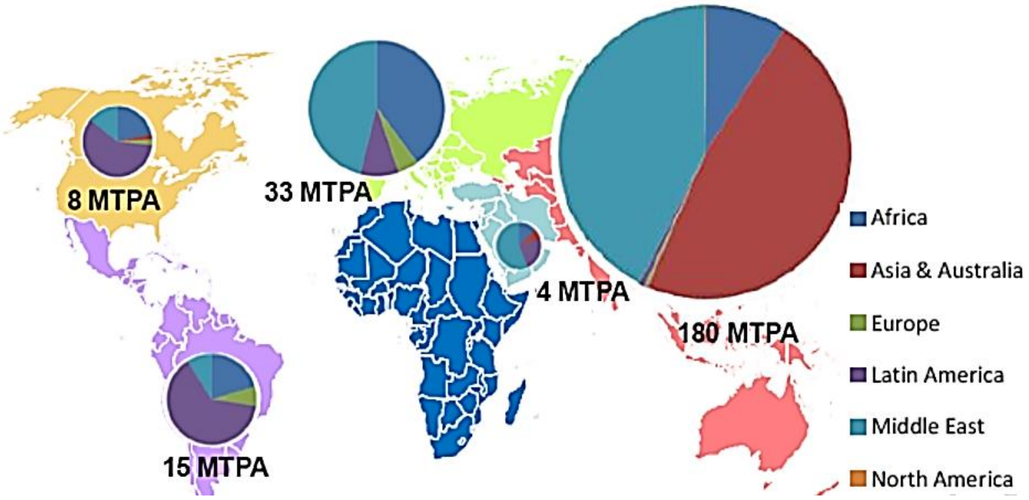


Figure 1.7: Global Import by Region in 2014, (IGU World LNG Report, 2015)

In addition to the numbers presented in Figure 1.6 this graph shows that Europe receives almost one half of its LNG from the Middle East and the other half from Africa. North and South America import more than one half of their LNG from Latin America.

The increase in regasification capacity in Asia will lead to significant changes in the trade flow in the Pacific Basin, will add new trade routes, and cause shifts in existing trade routes.

After the catastrophe at Fukushima and the shutdown of the Japanese nuclear power plants Asian demand for LNG increased very rapidly. Now the demand is decreasing after the first nuclear restarts, possibly causing more LNG flow into European hubs.

The LNG market is in a state of change because of a slow growth of demand, market liberalization, price reforms, new kinds of supply and shocks like the fall in oil price.

1.4.5 LNG Pricing

Generally it is apparent that the Asian contract prices linked to oil fall faster than the European contract prices linked to pipelines which means that the Asian LNG market may undergo a transition to a role of dragging European hub prices lower instead of pulling them higher. Asian LNG spot prices are expected to remain around $7/MMBTU to $10/MMBTU.

1.4.6 Project Rationale

Currently, Pakistan faces severe gas and energy shortages with gas shortages especially assuming acute significance during the winter season when the demand from the residential sector grows.

The average demand in Pakistan is expected to double within a decade and reach at least 2.56 TCFA (72.3 BCMA) by 2020, with about 1.32 TCFA (37.2 BCMA) in Punjab and 949 BCFA (26.9 BCMA) in Sindh. Peak levels of around 2.8 TCFA (79.5 BCMA) are assumed due to seasonality of the demand in the residential sector. In case the initiatives for hydro power capacity additions do not materialize or are considerably delayed, the gas demand will grow even more significantly after 2020.

By 2030, the total demand is expected to reach 3.76 TCFA (106.4 BCMA) in annual average, with 2.0 TCFA (56.8 BCMA) needed in Punjab and 1.35 TCFA (38.22 BCMA) in Sindh; the growth will be triggered mainly by industrial consumption. However significantly higher peak levels of 4.12 TCFA (116.7 BCMA) during winter appear possible.

The demand-supply gap considering domestic supplies reaches about 0.73-0.99 TCFA (20.7-28.0 BCMA) by 2015. The gap is expected to widen to 1.31-1.46 TCFA (37.1-41.32 BCMA) in 2020 and 3.29-3.76 TCFA (93.1-106.4 BCMA) in 2030.

Table 1.1: Natural gas gap in Pakistan, MMCFD

Items	*2015*	*2020*	*2030*
Gas production Pakistan	4,000	3,400	1,200
Gas demand	6,000	7,000	10,300
Peak winter demand	6,700	7,700	11,500
Average demand-supply gap	(2,000)	(3,600)	(9,000)
Peak demand-supply gap	(2,700)	(4,400)	(10,300)

There are several projects meant to bridge the supply-demand gap, including the planned IP pipeline (365 BCFA (10.33 BCMA)), the planned TAPI pipeline (474.5 BCFA (13.43 BCMA)) and the more rapidly growing LNG imports (511 BCFA (14.46 BCMA)). Three suppliers have been granted licenses for 511 BCFA (14.46 BCMA) of LNG imports, with at least 146-182.5 BCFA (4.13-5.16 BCMA). The TAPI pipeline is expected to be finalized by 2017, but due to difficult transit through Afghanistan it has been assumed for this study that completion will be no sooner than in 2020. As a consequence of the sanctions imposed on Iran by UN, USA and EU the Iran-Pakistan Gas Pipeline Project has come to a stand-still.

Table 1.2: Potential natural gas supply in Pakistan, MMCFD

Items	*2015*	*2020*	*2030*
GNGP IP Pipeline	0	1500	1500
LNG terminals (LNG import)	400	900	1,400
TAPI Pipeline	0	1,300	1,300
Total	400	3,700	4,200

Table 1.3: Remaining natural gas gap in Pakistan, MMCFD

Items	*2015*	*2020*	*2030*
Remaining average demand- supply gap	(1,600)	100	(4,800)
Remaining peak demand-supply gap	(2,300)	(700)	(6,100)

The above analysis provides comfort that clearly there is enough demand to justify the construction of the proposed LNG terminal project.

The project will be structured as an unbundled project structure. Under this project structure, LNG will be imported from another country like Qatar by a GOP-designated buyer ("LNG Buyer"), under the LNG SPA (Sale and Purchase Agreement) which could be on a delivered ex-ship basis (CIF) by or collected on a FOB basis from the LNG Seller. The LNG Buyer will enter into an agreement with the REGAS SPV (Special Purpose Vehicle) for the provision of LNG receiving, storage and regasification services at the terminal under tolling-type agreement ("LNG Terminalling Services"). For a FOB purchase, the LNG Buyer will, in addition, enter into an agreement with a shipping company to transport the LNG to the receiving terminal.

1.5 Objectives of the Project

Bahira Foundation LNG Terminal project being proposed by Bahria Foundation, in the environs of Sonmiani Bay, Balochistan is intended to respond to the GoP's LNG Policy 2011 which aims at sustainable development of the energy sector, including the provision of reliable and competitively-priced energy by developing energy infrastructure and resolving the impediment of industrial development and the deterioration of general welfare of the people of Pakistan. The project will open the doors for foreign investors thereby fostering the sustainable economic growth in the country.

1.6 Objectives of ESIA Study

In order to comply with the provisions of Balochistan Environmental Protection Act (BEP Act) 2012, EMC Pakistan Pvt. Ltd was engaged to carry out an Environmental & Social Impact Assessment (ESIA) of the proposed Project.

The ESIA responds to Section 15 of the BEP Act 2012 and the procedures set therein. Applicable World Bank guidelines and environmental assessment procedures prepared by the Pakistan EPA were followed in the preparation of the ESIA. The ESIA has assessed the likely environmental and social impacts arising from the construction and operation of the project and related activities that would take place concurrently or subsequently from project-activities and suggest recommendations to mitigate adverse impacts. It takes into account the likely adverse impact of activities on the physical, biological and social environment on the macroenvironment and microenvironment of the project.

Initial field surveys for the ESIA study were carried out during the period: July & August 2016 by a team of environmentalists, sociologists, botanist, wildlife specialist and marine biologist. Relevant data to establish the baseline and to carry out environmental impact assessment were collected during field observations in the course of surveys; consultations and meetings with government departments, NGOs and communities; and ground truthing of available secondary information. Secondary information was collected from various sources, archives of the consultants, government departments and NGOs.

The ESIA study has been conducted for the purpose of:

- Describing the environmental baseline of the project area;
- Describing the activities pertaining to the Project;
- Ascertaining applicability of relevant rules and regulations to the site and operations;
- Undertaking the environmental assessment from the perspective of environmental & social aspects in the project area, & suggesting mitigation measures for sustained development;
- Identifying the environmental consequences of siting the project and inception of associated activities;

- Identifying conditions that may require detailed design, and specification on activities during construction and operations of the project, besides suggesting measures to mitigate the adverse environmental aspects;
- Assessment of impact of handling the LNG/RLNG and consequential hazards
- Ensuring the adequacy of proposed mitigation measures to deal with residual impacts after implementation of the Project.

1.7 Categorization of the Project

The Pakistan Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 have clearly defined the categories of projects that require an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) in Schedules I & II respectively.

- Schedule II of the regulations includes: "all projects located in environmentally sensitive areas" and "any project likely to cause an adverse environmental effect."

- Ports and harbors having gross ship displacement of less than 500 tons are covered by Schedule-I, while Schedule-II covers ports and harbors having ship gross displacement exceeding 500 tons.

The proposed LNG terminal project involves shipping activity having gross displacement above 500 tons. The Project therefore falls under Schedule-II. Accordingly an ESIA study has been conducted and the report will be submitted to Balochistan EPA for review and approval.

1.8 Methodology Adopted for ESIA Study

EMC organized a team of experts and adopted its own procedures for making assessment of impact of activities during the construction and operational phases on micro environment and macro environment of the project:

1.8.1 Scoping Exercise

Holding meetings with Bahria Foundation and all relevant stakeholders to:

- Discuss and define the scope of ESIA study
- Programme a work schedule for collecting baseline data needed for assessment of status of microenvironment and macroenvironment of project site, and
- Invite and incorporate views and comments of stakeholders on the project and its likely impact in the Study.

1.8.2 Literature Reviews

EMC team undertaken extensive literature review comprising collected of secondary data from all pertinent sources including academia, governmental and non-governmental organizations. EMC contacted Bahria Foundation for the collection of project specific data such as design, Project specifications, construction and operations activities as well as HSE and environmental management plan adopted by them. Additionally the published data on the physical and social environment of the project area was reviewed and incorporated wherever necessary.

1.8.3 Surveys

EMC organized collection of information on settlements around project specific location within 5 km radius through socio-economic surveys. Issues related to project were discussed with the proponent and their concerns were noted. Surveys were also organized by marine biologist to identify the aquatic fauna and benthic community of the project area.

1.8.4 Monitoring & Analysis

EMC acquired the services of professional experts to conduct i) ambient air quality, noise and water quality measurements to establish the environmental profile of the macroenvironment, ii) air dispersion modeling study, and iii) ecological baseline of the project area.

1.8.5 Identification of Aspects & Assessment of Impacts

ESIA specialists available with EMC identified the environmental and social aspects resulting from Project activities and assessed the significance of their impacts. This step required the use of collected data to identify impacts on human health and the environment and risks involved in different activities during construction, commissioning and operation phases of the project.

1.8.6 Preventive Measures & EMP

Based on the impacts identified, mitigation and control measures to minimize the adverse impacts of construction and operations of Offshore Floating LNG Terminal on the environment were proposed. All mitigation measures were documented and the same were used towards development of environmental management plan (EMP). A monitoring plan has also been incorporated in the EMP to verify that the commitments made in the ESIA document are in place and to identify the residual impacts that may need to be mitigated.

1.8.7 Documentation & Review

This is the final step that completes the ESIA study. The data generated during and for the study are compiled and examined by experts of the respective field. Sections of this report were prepared as the study progressed, by EMC office staff in coordination with experts. The report was finally reviewed by Team Leader, to assess its credibility in accordance with Balochistan's Environmental Legislations.

1.9 Organization of this Report

This ESIA Study is structured in the following format:

Chapter-1 (Introduction) provides an introduction, the objectives and background of the Project; justification of ESIA, and categorization of the Project.

Chapter-2 (Legislative Framework and Statutory Requirement) gives an overview of Policy and application of Legislation and International Guidelines relevant to LNG Terminal operations.

Chapter-3 (Description of Project) describes the project, its siting in Sonmiani Bay; design features; Construction and operation activities.

Chapter-4 (Description of Environmental & Social Baseline) provides a description of the microenvironment and macro environment of proposed LNG Terminal. This chapter describes the Physical, Ecological and Socioeconomic condition of the Project area.

Chapter-5 (Screening of Alternatives) presents the analysis of alternatives considered for the project.

Chapter-6 (Stakeholder Consultation) gives a description of the meetings held for information sharing and disclosure and obtaining feedback from stakeholders.

Chapter-7 (Screening of Potential Environmental Impacts and Mitigation Measures) describes the alternatives, potential environmental and social aspects and impact of construction and operation of LNG Terminal on the different features of the microenvironment and macroenvironment, and using the general guidelines presents a screening of potential environmental impacts at the designing, construction and operation stages.

Chapter-8 (Environmental Management and Monitoring Plan) presents the environmental management that has been incorporated in the design and operation of Floating LNG Terminal. It additionally includes the proposal to identify residual impact as a result of adoption of mitigation measures after the Project goes into operation.

Chapter-9 (Conclusion) summarizes the report and presents the findings, conclusions & recommendations.

1.10 ESIA Study Team

This ESIA report has been prepared by EMC Pakistan Pvt. Ltd. EMC organized the following team for conducting the environmental assessment and preparing the Report:

Table 1.4: ESIA Study Team

Team Member	*Position*
Syed Nadeem Arif	Project Director
Mr. Saquib Ejaz Hussain	Project Manager / ESIA Specialist
Mr. Shams Ul Haq Memon	Advisor on Coastal Ecosystem
Dr. M. Mansha	Water Quality Expert
Dr. Shahid Amjad	Oceanography & Marine Biology Expert
Dr. Badar Ghauri	Air Quality Expert
Dr. Syed Ali Ghalib	Ecologist
Mr. S. M. Zaman	Geologist
Mr. Khurram S. Khan	Sociologist

Chapter 2 Legislative Framework and Statutory Requirement

This section identifies and describes those applicable national and provincial laws which apply to this project in the context of environment. There are several acts, regulations and policies in Pakistan that safeguard the natural environment & human health from anthropogenic activities. These laws must be abided by all organizations and individuals at all times as defined in the law.

The national and provincial environmental policies, acts, regulations, guidelines, international conventions and protocols to which Pakistan is party and which have been ratified by government of Pakistan are all identified and described briefly in this chapter.

2.1 Policy Framework

The Pakistan National Conservation Strategy (NCS), which was approved by the Federal Cabinet in March 1992, is the principal policy document for environmental issues in the country. The NCS signifies the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant to the proposed project are biodiversity conservation, restoration of rangelands, pollution prevention and abatement, and the preservation of cultural heritage.

Pakistan is a signatory to the Convention on Biological Diversity, and which made it obligatory to develop a national strategy for the conservation of biodiversity. The Government of Pakistan constituted a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan for the country, which was completed after an extensive consultative exercise. The plan, which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country. The Pakistan Environmental Protection Council (PEPC) has approved the action plan and steering committees at the federal and provincial levels have been formed to implement it.

2.2 Statutory Framework

The Constitution of Pakistan distributes legislative powers between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal List covers the subjects over which the federal government has exclusive legislative power, while the Concurrent List contains subjects regarding which both the federal and provincial governments can enact laws.

The development of statutory and other instruments for environmental management has steadily gained priority in Pakistan since the late 1970s. The Pakistan Environmental Protection Ordinance, 1983 was the first piece of legislation designed specifically for the protection of the environment. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards were established in 1993. The enactment of the Pakistan Environmental Protection Act (PEPA), 1997 has conferred broad-based enforcement powers to the environmental protection agencies. The publication of the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations (IEE-EIA Regulations), 2000 provided the necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA).

2.3 The 18th Amendment in Constitution of Pakistan

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government.

As a result, the Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management have been transferred to the provinces. The international obligations in the context of environment will be managed by the Ministry of Climate Change.

2.4 National Policies

There are the following policies directly related to environment and sustainability related aspects that must be addressed and complied.

2.4.1 National Conservation Strategy 1992

Government of Pakistan approved the National Conservation Strategy in March 1992 which later became the principle document for addressing environmental issues in the country. It has 68 specific programs and 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant to the proposed project are pollution prevention and abatement and increasing energy efficiency.

The current project will help conserve the environment of Pakistan as Natural Gas is among the cleanest of fuels available in the fossil fuel sector today. Natural gas combustion products do not contain any significant pollutants and thus minimal control measures are needed before the release of its combustion products in the atmosphere.

2.4.2 Biodiversity Action Plan 2000

The key to protect the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of the National Conservation Strategy and in becoming a signatory to, and in ratifying, the Convention on

Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss. This ESIA study has addressed all aspects of conservation, including wildlife and forests.

2.4.3 LNG Policy 2011

The LNG Policy 2011 aims to facilitate the potential investors in LNG sector, by bringing more clarity and predictability for investors, on the basis of their experience and the bottlenecks pointed out by the potential investors during various interactions with OGRA. The LNG Policy, 2011 covers Import Project Structure, LNG Procurement, Ownership & Operation of the LNG Terminal, RLNG Marketing & Transportation, and Regulatory Framework during construction period and operational period, Government Incentives, Pricing of RLNG, Government Guarantee, Freedom to Participate in the LNG Business, Technical Codes and Standards, Shipping of LNG, Other Permits and Licenses. Prior permission of GOP for Spot purchase of LNG will not be required. SSGCL/SNGPL will not sell gas priced under weighted average cost of gas mechanism, to industries, which are selected by GOP to use RLNG from time to time. Licensees will be required to furnish guarantee against their delivery commitment. In case of failure of the licensee to deliver LNG by stipulated date, its first right to 3rd Party Access will stand waived off. The involvement of Coast Guards or any other agency to control activities of entry and exit of shipping traffic and requirement of security escort through Coast Guards at the expense of LNG developer, LNG Terminal Owner/Operator and LNG Buyer will no longer be necessary.

Port authorities have been obligated to convey their decision on acceptance of site within one month of submittal of NOC from Balochistan Environmental Protection Agency, Quantitative Risk Assessment Study and Navigational Simulation Study. OGRA's discretionary rights to grant exemptions from mandatory Regulated 3rd Party Access or Negotiated Third Party Access requirements are no longer valid. The project proponents have been allowed to establish gas storage facility subject to applicable rules and OGRA has been mandated to determine storage tariff. The committee will take up the tariff rationalization in the next meeting.

The LNG Policy aims to facilitate expeditious implementation of the LNG Projects. It has laid out the following framework for the Ownership & Operation of LNG Terminals:

The LNG Developer or LNG TO/O, as the case may be, will obtain a license to design, construct, operate and own a LNG terminal from OGRA under the Oil and Gas Regulatory Authority Ordinance, 2002 subject to satisfying the following criteria:

(a) Technical: At least one member of the consortium of LNG Developer or LNG TO/O, as the case may be, should have experience in developing and operating a liquefaction plant or a regasification terminal. The LNG terminal will be constructed based on technical standards as prescribed by the OGRA from time to time, in consultation and approval of Department of Explosives, including internationally acceptable industry technical standards as stipulated in Appendix1.

(b) Financial: The LNG Developer or LNG TO/O consortium (on a several or joint and several basis) should have liquidity, revenues, net income and net worth above prescribed minimum thresholds (to be set by OGRA taking into consideration the financial obligations associated with the development and operation of the LNG import terminal).

(c) Health, Safety & Environmental ("HSE") Standards:

1. The LNG Developer, LNG TO/O or LNG Buyer as the case may be, will ensure that the project complies with World Bank HSE Guidelines, Pakistan's Environmental Protection Act 1997 rules, regulations and guidelines made there under, National Environmental Quality Standards, Pakistan's health, environment and safety standards and is consistent with the best international LNG industry practices.

2. The LNG Developer or LNG TO/O will undertake a comprehensive environmental impact assessment of the design, construction and operational aspects of the project including impact assessment of shipping associated with the project, in accordance with international standards and practices. The studies and approvals required at the planning, construction, commissioning and operating phases are defined in the Pakistan Environmental Protection Act, 1997.

3. All LNG terminals shall be surrounded by safety zones which shall meet the industry standards set forth in safety codes of the National Fire Protection Association of USA and as per the risk assessment studies so as to ensure protection of neighboring communities and shipping traffic.

4. Site approval: The site (either land based terminal or offshore terminal of any type) for setting up an LNG terminal shall be selected by LNG Developer or LNG TO/O, as the case may be, taking into account the following factors:

- ✧ Existing and projected population and demographic characteristics of the location; n Existing and proposed land use near the location; n Physical aspects of the location;
- ✧ Medical, law enforcement and fire protection capabilities near the location that can cope with a risk caused by the facility;
- ✧ Exclusion zone distances from the terminal to property and population as per international standards are complied with;
- ✧ Proximity to existing gas infrastructure and market; n Need to encourage remote sitting;
- ✧ Any other significant community concerns; and
- ✧ Environmental considerations.

In applying for the license, the LNG Developer or LNG TO/O will have the onus of demonstrating compliance with the above criteria through risk assessment & simulation studies.

Port Authorities will convey their decision on acceptance of site within one month of submission of NOC from BEPA, QRA study and navigational simulation study.

The licensee shall:

- ✧ Ensure delivery of LNG on fast track basis.
- ✧ Furnish guarantee against it commitment.

In case of licensee's failure to deliver LNG by stipulated date its right to Third Party Access will be subject to cancellation/review by OGRA.

2.4.4 Maritime Policy of Pakistan

The National Maritime Policy of Pakistan was approved and notified on October 16, 2002. The policy advocates "Management of Assets in a judicious manner with conscientious regard to the environment and international law". The objective of the policy is "protection and conservation of maritime environment/ecosystem" and section IV of the Policy holds the Port Authorities responsible to protect the maritime environment within their prescribed limits. This includes tasks of monitoring and combating spills of all kinds.

2.5 Applicable Acts and Ordinances

2.5.1 Balochistan Environmental Protection Act 2012

The Balochistan Environmental Protection Act, 2012 is a comprehensive legislative measure to regulate and effectively address the peculiar environmental issues of the province of Balochistan.

The Act provides procedures for dealing with a broad spectrum of environmental issues and outlines responsibilities for appropriate measures. It provides for the conservation of the natural environmental whilst simultaneously mitigating and elimination the hazards posed by pollution. Under the Act, the Balochistan Environmental Protection Agency is responsible for preparing environmental policies, establishing and implementing quality standards for Ambient Air, Water and Land, provide information for the public regarding environmental issues in the province. It also sanctions all development projects subject to prior environmental assessments on a scale proportional to the adverse effects anticipated by the construction and/or operation of that particular project. More specifically; under section 15(1) of the Act, no proponent of a project shall commence construction or operation unless he has filled an Initial Environmental Examination with the Government Agency designated by the Balochistan Environmental Protection Agency, as the case may be.

In addition to the BEPA 2012, Pakistan's statute books contain a number of other laws that have clauses concerning the regulation and protection of the environment.

2.5.2 Ports Act 1908 and Pakistan Territorial Waters and Maritime Zones Act, 1976

The Ports Act 1908 ensures safe shipping in the sea and prevention of pollution in waters. Pakistan Territorial Waters and Maritime Act 1976 regulates the exploration, development, conservation, and management of living and non-living resources in Pakistan's Exclusive Economic Zone (EEZ), which extends up to 350 nautical miles from the country's coastal zone.

2.5.3 Balochistan Wildlife Protection Act 2014

The Act was proposed by the Forest and Wildlife Department, Government of Balochistan to replace the existing Balochistan Wildlife Protection Act 1974. The proposed law differs significantly from the existing law in the following aspects:

- An area can be declared "National Park" only if it is the property of the Government or if the government has proprietary rights over it.
- The public is ensured access to the national park for recreation, education & research purposes
- A new category of protected area," private game reserves" has been introduced.

These are private lands that have been dedicated by their owners for protecting and conserving wildlife, in the same manner as the state owned game reserves. Within limits of private game reserve, the owners of the land exercise the same powers as are exercisable by an officer appointed by the government in the game reserve.

The project site does not fall in any desiganted wildlife protected area.

2.5.4 Land Acquisition Act 1894

This act is generally used to establish the rights on the land being acquisitioned for public purposes. The LAA describes the detailed procedures for acquisition of private properties, but does not appropriately cover resettlement and rehabilitation. Additionally, LAA 1984 treats land acquisition as a provincial subject, and allows each province to use it in different ways based on their own interpretation. Federal EPA prepared the National Resettlement Policy 2002, which described the ways relating to calculation of compensation, public participation and consultation, formulation of resettlement action plan, and provisions for transparency and accountability.

Since the land for construction of onshore terminal station and connection pipeline will be acquired for the proposed project, the provisions of LAA 1894 therefore shall apply.

2.5.5 The Antiquities Act 1975

The protection of cultural resources in Pakistan is ensured by the Antiquities Act of 1975. Section 22 specifically prohibits the execution of development schemes and new constructions in proximity to immovable antiquity. Notwithstanding anything contained in any other low for the time being in force, no development plan or scheme or new construction on, or within a distance of two hundred feet of, a protected immovable antiquity shall be undertaken or executed except with the approval of the Director.

The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOP to prohibit excavation in any area that may contain articles of archaeological significance.

2.5.6 Pakistan Penal Code 1860

Pakistan Penal Code of 1860 prohibits anyone from fouling water of public spring or reservoir and also for making the atmosphere noxious to health.

It specifically says: "Whoever voluntarily corrupts or fouls the water of any public spring or reservoir, so as to render it less fit for the purpose for which it is ordinarily used, shall be punished with imprisonment of either description for a term which may extend to three months, or with fine which may extend to one thousand five hundred rupees or with both."

And "Whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighborhood or passing along a public way, shall be punished with fine, one thousand five hundred rupees."

2.5.7 Factories act 1934

The Act is related with the safety and health of workers in industrial establishments / factories employing ten or more workers. The Act provides for regulating the Occupational Safety and Health concerns via cleanliness, disposal of wastes and effluents, ventilation and temperature control, dust and fumes, overcrowding, lighting, supply of wholesome drinking water, latrine and urinals, precautions against contagious/infectious disease etc. Each province has also enacted its own rules within the mandate of Factories Act, thereby making special provisions for enforcement of health and safety measures

2.5.8 Forest act 1927

The Act empowers the provincial forest departments to declare any forest area as reserved or protected. The act also empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce; quarrying and felling, lopping and topping of trees, branches in reserved and protected forests.

The project site is located outside of any protected or reserved forests therefore the project will not contravene with any provisions of this Act.

2.6 Rules and regulations

2.6.1 PEPA Review of IEE and EIA Regulations 2000

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, (The 2000 Regulations) promulgated under PEPA 1997 was enforced in June 2000. These Regulations define the applicability and procedures for preparation, submission and review of IEE and EIA. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by the Federal EPA in 1997.

The Regulation classifies projects on the basis of expected degree of adverse environmental impacts and lists them in two separate schedules. Schedule I lists projects that may not have significant environmental impacts and therefore require an IEE.

- Schedule II lists projects of potentially significant environmental impacts requiring preparation of an EIA. The Regulations also require that all projects located in environmentally sensitive areas require preparation of an EIA.
- Placement of LNG Project in Schedule-II is based on its severity and due to the reason that it involves shipping activity having gross displacement above 500 tons.
- Under EIA/IEE Regulations, Bahria Foundation is liable to file application of EIA approval at Balochistan Environmental Protection Agency (BEPA) on a prescribed format.
- Accordingly, 10 hard copies and 2 soft copies of the EIA report have been are required to be submitted to BEPA. BEPA will grant its decision on the EIA as per the rules and procedures set out in the 2000 Regulations. The following rules apply.
- A review fee of PKR. 100,000 is payable in form of pay order in favor of DG-BEPA.
- The EIA submittal is to be accompanied by an application in the format prescribed in Schedule IV of the 2000 Regulations.

- BEPA is bound to conduct a preliminary scrutiny and reply within 10 days of the submittal of the report a) confirming completeness, or b) asking for additional information, if needed.
- BEPA will publish a public notice in any English or Urdu national newspaper and in a local newspaper of general circulation in the area affected by the project. The public notice will mention the following:
  - The type of project;
  - The location of the project;
  - The name and address of the proponent;
  - The places at which the EIA can be accessed; and
  - The date, time and place for public hearing of any comments on the project or its EIA.
- The date set for public hearing will not be earlier than 30 days from the date of publication of the public notice.
- In the review process BEPA may consult a Committee of Experts, which maybe constituted on the request of the Director General (DG) BEPA.
- On completion of the review process and the public hearing, the decision of BEPA will be communicated to the proponent in the form prescribed in Schedule VI.
- Where an EIA is approved, BEPA can impose additional controls as part of the conditions of approval.
- BEPA is required to make every effort to complete the EIA review process within 90 days of the issue of confirmation of completeness. However, BEPA can take up to 4 months for communication of final decision.
- The approval will remain valid for the project duration mentioned in the EIA but on the condition that the project commences within a period of three years from the date of approval. If the project is initiated after three years from approval date, the proponent will have to apply for an extension in the validity period. BEPA on receiving such request grant extension (not exceeding 3 years at a time) or require the proponent to submit afresh EIA if in the opinion of BEPA changes in baseline conditions or the project so warrant.
- After receiving approval from BEPA the proponent will acknowledge acceptance of the conditions of approval by executing an undertaking in the form prescribed in Schedule VII of the 2000 Regulations.
- The 2000 Regulations also require proponents to obtain from BEPA, after the end of construction phase of the project, a confirmation that the requirements of the EIA and the conditions of approval have been duly complied with.
- The BEPA in granting the confirmation of compliance may impose any additional control regarding the environmental management of the project or the operation, as it deems necessary.
- During project execution Bahria Foundation will be required to comply with the recommendations of the EIA and any conditions of approval set forth by EPA concerned.

- Post EIA monitoring and reporting is mandatory under clause 19 of the 2000 Regulations.
- The Regulations require proponents of all projects to submit monitoring reports on completion of construction, yearly reports during operation, and any additional reports required by the EPA. The format and contents of such reports are not specified in the law.

2.6.2 National Environmental Quality Standards

One of the functions of the Pak EPA under the provision of PEPO of 1983 was to issue NEQS for municipal and liquid industrial effluent, industrial gaseous emissions and motor vehicle exhaust and noise. The Pak EPA issued a statutory regulatory order (S.R.O) in 1994. It required all units coming into production after 1st July 1994 to comply immediately with the new standards. Those already in production at the time of S.R.O were required to comply starting 1st July 1996. The Pak EPA was not able to implement the NEQS effectively for many reasons, including lack of implementation capacity and resistance from industry.

With the PEPA, 1997 the Pak EPA revised the NEQS with full consultation of the private sector, industrialist, trade and business associations and NGOs. The municipal and liquid industrial effluent standards cover 32 parameters. The standards for industrial gaseous emissions specify limits for 16 parameters, and the standards for motor vehicles prescribe maximum permissible limits for smoke, carbon monoxide and noise. Revised standards cover discharges limits of effluents into inland water, sewage treatment plant and the sea. The NEQS are primarily concentration based. Unfortunately, the limits on industrial effluents are neither industry specific nor do they have any relationship with the quantum of production. The NEQS prohibit dilution, but this can be easily circumvented.

Bahria Foundation is committed to comply with the applicable NEQS in letter and spirit.

The chronological list of NEQS is shown in Table 2.1.

Table 2.1: National Environmental Quality Standards

Date	*Number*	*Scope*
1993	742(I)/1993	Liquid Industrial Effluent Industrial Gaseous Emission Vehicle Exhaust and Noise
1995	1023(I)/1995	Industrial Gaseous Emission from Power Plants operating on coal and oil (added)
2000	549(I)/2000	Liquid Industrial Effluent (amended) Industrial Gaseous Emission (amended)
2010	1062(I)/2010	Ambient Air
2010	1063(I)/2010	Drinking Water Quality
2010	1062(I)/2010	Noise

Table 2.2 shows NEQS for ambient air.

Table 2.2: National Environmental Quality Standard for Ambient Air

Pollutant	*Time-weighted average*	*Concentration in Ambient Air*	*Method of measurement*
Sulfur Dioxide (SO_2)	Annual Average*	80 µg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120 µg/m^3	

Table 2.2: National Environmental Quality Standard for Ambient Air

Pollutant	*Time-weighted average*	*Concentration in Ambient Air*	*Method of measurement*
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m³	Gas Phase Chemiluminescence
	24 hours**	40 µg/m³	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m³	Gas Phase Chemiluminescence
	24 hours**	80 µg/m³	
O_3	1 hour	130 µg/m³	Non dispersive UV absorption method
Suspended Particulate Matter	Annual Average*	360 µg/m³	High volume Sampling, (Average flow rate not less than 1.1m³/minute)
	24 hours**	500 µg/m³	
Respirable Particulate Matter (PM_{10})	Annual Average*	120 µg/m³	B Ray absorption method
	24 hours**	150 µg/m³	
Respirable Particulate Matter ($PM_{2.5}$)	Annual Average*	35 µg/m³ ***	B Ray absorption method
	24 hours**	15 µg/m³	
Lead (Pb)	Annual Average*	1 µg/m³	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m³	
Carbon Monoxide (CO)	8hours**	5 mg/m³	Non Dispersive Infra Red (NDIR) method
	1hours	10 mg/m³	

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

**24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

*** or 9 µg/m³ plus baseline, whichever is low

Table 2.3 shows the standards for motor vehicle noise.

Table 2.3: The Motor Vehicle Ordinance (1965) and Roles (1969)

Parameter	*Standards (maximum permissible limit)*	*Measuring method*
Noise	85dB(A)	Sound-meter at 7.5meter from the source

Table 2.4 shows the national environmental quality standard for noise.

Table 2.4: National Environmental Quality Standard for Noise

S. No.	*Category of Area / Zone*	*Effective from 1st January, 2009*		*Effective from 1st January, 2010*	
		*Limit it in dB(A) Leq**			
		Day Time	*Night Time*	*Day Time*	*Night Time*
1	Residential area (A)	65	50	55	45
2	Commercial area (B)	70	60	65	55
3	Industrial area (C)	80	75	75	65
4	Silence Zone (D)	55	45	50	45
Note: 1	Day time hours: 6.00 a. m to 10.00 p. m				

Table 2.4: National Environmental Quality Standard for Noise					
S. No.	*Category of Area / Zone*	*Effective from 1st January, 2009*		*Effective from 1st January, 2010*	
		*Limit it in dB(A) Leq**			
		Day Time	*Night Time*	*Day Time*	*Night Time*
2	Night time hours: 10.00 p. m to 6.00p. m				
3	Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.				
4	Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.				
*dB(A)Leq	Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.				

The NEQS for effluents are shown in Table 2.5

Table 2.5: National Environmental Quality Standard for Municipal & Liquid Industrial Effluents					
S. #	*Parameter*	*Into Inland Waters*	*Into Sewage Treatment*	*Into Sea*	*unit*
1	Temperature or Temp. increase	<3	<3	<3	^{o}C
2	pH value (H^+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at $20^{o}C$	80	250	80	mg/l
4	Chemical Oxygen Demand (COD)	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-)total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide (S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l

Table 2.5: National Environmental Quality Standard for Municipal & Liquid Industrial Effluents

S. #	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l
32	Chlorine	1.0	1.0	1.0	mg/l

The NEQS for drinking water are shown in Table 2.6

Table 2.6: National Environmental Quality Standards for Drinking Waters (mg/l)

S.#	Properties / Parameters	Standard Values for Pakistan	S.#	Properties / Parameters	Standard Values for Pakistan
Bacterial			*Chemical*		
1	All water intended for drinking (E.coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Essential Inorganics (mg/liter)		
			3	Aluminum (Al) mg/l	≤ 0.2
			4	Antimony (Sb)	≤ 0.005
2	Treated water entering the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	5	Arsenic (As)	≤ 0.05
			6	Barium (Ba)	0.7
			7	Boron (B)	0.3
3	Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be Detectable in any 100 ml sample. In case of large supplies, where sufficient samples are examined, must not be resent in 95% of the samples taken throughout any 12 month period.	8	Cadmium (Cd)	0.01
			9	Chloride (Cl-)	< 250
			10	Chromium (Cr)	≤ 0.05
			11	Copper (Cu)	2
			Organic (mg/L)		
			12	Phenolic compounds	<0.0002
			Toxic Inorganics (mg/liter)		
			13	Cyanide (CN)-	≤ 0.05
			14	Fluoride (F)	≤ 1.5
			15	Lead (Pb)	≤ 0.05
			16	Manganese (Mn)	≤ 0.5
Physical			17	Mercury (Hg)	≤ 0.001
4	Color	< 15 TCU	18	Nickel (Ni)	≤ 0.02
5	Taste	Non objectionable/ Acceptable	19	Nitrate $(NO_3)^-$	≤ 50
6	Odor	Non objectionable/ Acceptable	20	Nitrite $(NO_2)^-$	≤ 3
7	Turbidity	< 5 NTU	21	Selenium (Se)	≤ 0.01
8	Total Hardness as $CaCO_3$	< 500 mg/l	22	Residual Chlorine	0.2-0.5 At consumer end
9	TDS	<1000			

Table 2.6: National Environmental Quality Standards for Drinking Waters (mg/l)

S.#	*Properties / Parameters*	*Standard Values for Pakistan*	*S.#*	*Properties / Parameters*	*Standard Values for Pakistan*
10	pH	6.5-8.5			0.5-1.5 at source
Radioactive					
11	Alpha Emitters bq/L	0.1	23	Zinc (Zn)	5.0
12	Beta emitters	1			

2.6.3 Pakistan Environmental Assessment Procedures, 1997

The Pakistan Environmental Protection Agency prepared the Pakistan Environmental Assessment Procedures in 1997. The guidelines pertaining to the review process of EIA's have been given regulatory status in the Review of IEE and EIA Regulations 2000. They are based on much of the existing work done by international donor agencies and NGO's.

The package of regulations prepared by PEPA includes:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments;
- Guidelines for the Preparation and Review of Environmental Reports;
- Guidelines for Public Consultation; and
- Guidelines for Sensitive and Critical Areas.

The guidelines on policy and procedures define the policy context and the administrative procedures that will govern the environmental assessment process, from the project prefeasibility stage, to the approval of the environmental report. According to the procedures laid out in the policy guidelines, IEE's or EIA's are to be filed with the EPA of the province where the project is to be implemented. The federal EPA has, however, been given the right to review any environmental report at any time and the power to revoke the decision of the provincial EPA, if it deems this to be necessary. Projects have been classified in the policy guidelines by expected degree of adverse environmental impacts. All projects proposed in environmentally sensitive areas (including game reserves & wildlife sanctuaries) require an EIA.

The Procedures require proponents to prepare terms of reference for the environmental assessment reports. They require that all IEE/EIA studies should contain baseline data on the area and must contain a detailed assessment of the potential environmental impacts and the recommended mitigation measures. Consultations with the communities that are most likely to be affected as well as relevant NGO's are to be an integral part of the environmental assessment process.

The guidelines on public consultation deals with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.

2.7 International Guidelines, Regulations and Conventions

2.7.1 Society of International Gas Tankers & Terminal Operators (SIGTTO 1997)

The Society of International Gas Tankers and Terminal Operators (SIGTTO 1997) and The International Navigation Association (PIANC 1997) guidelines for LNG Docking facilities will be referred to during project design and construction.

2.7.2 International Maritime Treaties and Environmental Conventions

Bahria Foundation and its suppliers will comply with International Maritime Conventions in the import of LNG. These will include the conventions of the International Maritime Organization, International Labor Organization, United Nations, World Health Organization & others as appropriate.

The primary International Maritime Organization (IMO) safety standard governing the marine transport of LNG is the "International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk," (IGC Code - 1993 Edition).

2.7.3 MARPOL 1973 (modified in 1978)

Ship-generated waste is regulated globally as part of the implementation of the International Convention for the prevention of pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78). The requirement of MARPOL 73/78 is established in 20 Articles, two Protocols and five annexes; these include contamination by oil, noxious liquid substances carried in bulk, harmful substances, sewage and garbage. Pakistan is signatory to all five annexes. Nevertheless, pollution prevention practices consistent with MARPOL requirements will be adhered to during all the phases of project. The Project proponent will be mandated to ensure safe shipping of the LNG Carriers (LNGC)s and besides adopting measures for prevention of pollution of the sea, will follow the International Convention for the prevention of pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

2.7.4 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972

In 1972, The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter defines a Black List of toxic substances, and a Grey List of less hazardous substances that may only be dumped under a prior special permit, the dumping of any other wastes not specified in these lists requires a prior general permit. In 1990 this Convention was amended to require signatory countries to consider whether an adequate scientific basis exists for assessing the environmental impact of a substance (i.e. dredged material) before issuing a permit for dumping. Pakistan is signatory to the London Convention and a Notification came into force on 8th April 1995.

The Project Proponent will ensure to follow the internationally accepted and legally allowed methods for disposal of all wastes generated as a result of maritime operations.

2.7.5 United Nations Convention on the Law of the Sea

The UN Convention on the Law of the Sea was adopted and opened for signature in 1982. On November 16th 1994, it entered into force for 68 countries. Pakistan is signatory to the convention. It establishes a basic structure of obligations, objectives and principles covering all sources of marine pollution that include:

- Pollution by vessels (operational and accidental discharges from ships), and
- Dumping (the deliberate disposal of wastes at sea by ships, aircrafts, platforms, or other manmade structures).

Bahria Foundation is mandated to ensure safe shipping of the LNG Carriers (LNGC)s and follow the Laws of Seas for prevention of pollution by vessels, besides taking measures to avoid dumping of ship wastes into the seas.

2.7.6 The Convention on Biological Diversity

The Convention on Biological Diversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programmes and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

2.7.7 The Convention on Conservation of Migratory Species of Wild Animals, (1979)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), (1979), requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or co-operate with other countries in matters of research on migratory species.

The Convention contains two appendices. Appendix I contain the list of migratory species that are endangered according to the best scientific evidence available. For these species, the member states to the Convention are required endeavor to:

- Conserve and restore their habitats.
- Prohibit their hunting, fishing, capturing, harassing and deliberate killing.
- Remove obstacles and minimize activities that seriously hinder their migration.
- Control other factors that might endanger them, including control of introduced exotic species.

Appendix II lists the migratory species, or groups of species, that have an unfavorable conservation status as well as those that would benefit significantly from the international co-operation that could be achieved through intergovernmental agreements.

2.7.8 The Convention on Wetlands of International Importance, Ramsar 1971

Pakistan is a signatory to the said Convention. The principal obligations of contracting parties to the Convention are:

- To designate wetlands for the List of Wetlands of International Importance.
- To formulate and implement planning so as to promote wise use of wetlands, to make EIA before transformations of wetlands, and to make national wetland inventories.
- To establish nature reserves on wetlands and provide adequately for their wardening and through management to increase waterfowl populations on appropriate wetlands.
- To train personnel competent in wetland research, management and wardening.
- To promote conservation of wetlands by combining far-sighted national policies with coordinated international action, to consult with other contracting parties about implementing obligations arising from the Convention, especially about shared wetlands and water system.
- To promote wetland conservation concerns with development aid agencies.
- To encourage research and exchange of data.

So far 19 sites in Pakistan have been declared as wetlands of International Importance or Ramsar Sites. However no Ramsar site is located within or near the project area.

2.7.9 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This convention came into effect on 03 March 1973 in Washington. In all 130 countries are signatory to this convention with Pakistan signing the convention in 1976. The convention requires the signatories to impose strict regulation (including penalization, confiscation of the specimen etc.) regarding trade of all species threatened with extinction or that may become so, in order not to endanger further their survival.

The Convention contains three appendices. Appendix I include all species threatened with extinction which are or may be affected by trade. The Convention requires that trade in these species should be subject to strict regulation. Appendix II includes species that are not necessarily threatened presently but may become so unless trade in specimens of these species is subject to strict regulation. Appendix III includes species which any contracting party identifies as subject to regulations in trade and requires other parties to co-operate in this matter.

2.7.10 International Union for Conservation of Nature and Natural Resources (IUCN) Red List

The red list is published by IUCN and includes those species that are under potential threat of extinction. These species have been categorized as:

- Endangered: species that are sent to be facing a very high risk of extinction in the wild in the near future, reduction of 50% or more either in the last 10 years or over the last three generations, survive only in small numbers, or have very small populations.
- Vulnerable in Decline: species that are seen to be facing a risk of extinction in the wild, having apparent reductions of 20% or more in the last 10 years or three generations.
- Vulnerable: species that are seen to be facing a high risk of extinction in the wild, but not necessarily experiencing recent reductions in population size.
- Lower Risk: species that are seen to be facing a risk of extinction that is lesser in extent that for any of the above categories.
- Data Deficient: species that may be at risk of extinction in the wild but at the present time there is insufficient information available to make a firm decision about its status.

2.7.11 Technical guidelines, standards and regulations

Design Codes and Standards for Floating LNG terminals

- Pressure Vessels - ASME Boiler and Pressure Vessel Code
- Hydrocarbon Piping – IMO IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) where appropriate.
- Electrical Systems – NFPA 70, National Electrical Code
- Hydrocarbon Pumps – API Standard 610, Centrifugal Pumps for Refinery Service
- Fired Heaters – API Standard 560, Fired Heaters for General Refinery Services
- Shell and Tube Heat Exchangers – API Standard 660, Shell-and-Tube Heat Exchangers for General Refinery Service

- Fire Protection – NFPA, various.
- Structural – AISC, Manual of Steel Construction (including requirements for acceleration due to transportation and in-service motions)

Technical Codes and Standards from LNG Policy 2011

Shipping and Marine Facilities Standards

- Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG) – 2006, NFPA 59A, NFPA.
- Installations and Equipment for Liquefied Natural Gas – Design of Onshore Installations – 1997, (BS EN 1473) CEN.
- Installations and Equipment for Liquefied Natural Gas – Design and Testing of Loading/Unloading Arms – 1996, (BS EN 1474) CEN.
- Installations and Equipment for Liquefied Natural Gas – Ship to Shore Interface for Liquefied Natural Gas – 1996, (BS EN 1532) CEN.
- Installations and Equipment for Liquefied Natural Gas – General Characteristics of Liquefied Natural Gas – 1997, (BS EN 1160) CEN.
- Maritime Structures – Part 1, General Criteria – 1984. (BS 6349), BSI.
- Maritime Structures – Part 4. Code of Practice for Design of Fendering and Mooring Systems – 1994, (BS 6349), BSI.
- IGC Code – IMO-104E – International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk – IGC Code, 1993 including amendments.
- Guidance Notes, Classification and Certification of Floating Offshore Liquefied Gas Installations – Lloyd's Register, April 2004, Revision 2.
- Guidance Notes, Classification and Certification of Offshore Gravity Based Liquefied Gas Terminals – Lloyd's Register, April 2004, Revision 1.

Guidelines

- Site Selection and Design for LNG Ports and Jetties – 1997. SIGTTO, ISBN 1 85609 129 5.
- Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas – 1995, (IMO 290E) IMO, ISBN 92-801-1329-1.
- Dangerous Goods in Ports: Recommendations for Port Designers and Port Operators – 1985, PIANC.
- Mooring Equipment Guidelines – 1996, (OCIMF) Oil Companies International Marine Forum, ISBN 1 85609 088 4.13
- Prediction of Wind Loads on Large Liquefied Gas Carriers – 1985, SIGTTO, ISBN 0 90088697 8.
- Big Tankers and their Reception – 1974, PIANC.
- Guidelines on Port Safety and Environmental Protection – 1989, IAPH.

Operating Practices

- Accident Prevention – the Use of Hoses and Hard-Arms at Marine Terminals Handling Liquefied Gas – 1996 SIGTTO, ISBN 1 85609 1147.
- Manual on Chemical Pollution; Section 1: Problem Assessment and Response Arrangements – 1987, (IMO 630E) IMO, ISBN 92-801-1223-6.
- A Guide to Contingency Planning for Marine Terminals Handling Liquefied Gases in Bulk – 1989, SIGTTO, ISBN 0 948691 81 6.

- APELL: Awareness and Preparedness for Emergencies at Local Level – 1988, (UNEP) United Nations Environment Programme, ISBN 92807 1183 0 –00900P.
- Offshore Loading Safety Guidelines with Special Relevance to Harsh Weather Zones – 1999, OCIMF, ISBN 1 85609 1481.
- Tug Use in Port – H Hensen, Nautical Institute, 1997, ISBN 1 870077 39 3.
- Guidelines for Hazard Analysis as an Aid to Management of Safe Operations – 1992, SIGTTO, ISBN 1 85609 054 X.

Onshore LNG Terminal Standards

- Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG) – 2006, NFPA 59A, NFPA.
- Design and Construction of Large, Welded, Low – Pressure Storage Tanks, Appendix R - Low pressure Storage tanks for Refrigerated Products, (API 620 R).
- Installations and Equipment for Liquefied Natural Gas – Design of Onshore Installations – 1997, (BS EN 1473) CEN.
- Flat-Bottomed, Vertical, Cylindrical Storage Tanks for Low Temperature Service, (BS 7777).
- Installations and Equipment for Liquefied Natural Gas – General Characteristics of Liquefied Natural Gas – 1997, (BS EN 1160) CEN.
- Criteria for design and construction of refrigerated liquefied gas storage tanks – 'EEMUA 147'.
- Other internationally accepted European/American standards as may be required

The National Fire Protection Association (NFPA) develops fire safety codes and standards drawing upon the technical expertise of persons from diverse professional backgrounds that form technical committees. These committees address concerns about specific activities or conditions related to fire safety. The members of these committees use an open consensus process to develop standards for minimizing the possibility and effects of fire. NFPA has adopted two comprehensive standards, NFPA 59A that relate to LNG.

NFPA 59A Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG) 2009 Edition describes the basic methods of equipment fabrication as well as LNG installation and operating practices that provide for protection of persons and property. It also "provides guidance to all persons concerned with the construction and operation of equipment for the production, storage, and handling of liquefied natural gas." This comprehensive standard contains detailed technical requirements to ensure safety of LNG facilities and operations, including general facility considerations, process systems, stationary LNG storage containers, vaporization facilities, piping systems and components, instrumentation and electrical services.

The standard also incorporates, by reference, technical standards developed by a number of other professional organizations, such as American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), the American Petroleum Institute (API), the American Concrete Institute (ACI), and the American Society for Testing and Materials (ASTM).

Chapter 3 Description of Project

3.1 Project Siting

The proposed site for the LNG Terminal is located in Sonmiani Bay, positioned in the Arabian Sea. The selection of preferred location considered the following aspect :

- Local development plan
- Safest possible location.
- Least social and environmental impact.
- No interference on navigation of marine and air traffic.
- Shortest construction duration.
- Least cost of construction (utilities, natural terrain, earth work, foundation treatment, breakwater, dredging work and submarine pipeline length).
- Lowest operating cost.
- Continuous gas supply

3.2 Meeting Exclusion Zone Requirements for Permanently Moored FSRU

Two project locations were investigated in terms of navigational issues, technical, environmental and economic feasibility (Figure 3.1). For both locations, optimizations of the definite sites were considered. The optimization of the locations should ensure that a water depth of at least 15 m (LAT) (which includes 12.5 m summer draft + minimum 2 m under keel clearance) has to be considered as well as navigational approach ways and sea state, especially wave height/wave protection. Due to the sea bed conditions, the preferred location shall require no or minor dredging works. However, it might be possible that dredging is the more economical solution in some circumstances than a bigger breakwater due to water depth when dumping ground is nearby and cutter dredger is useable.

Location 1 (24°54.3''N, 66°36.5''E) is positioned next to Churna Island, a small uninhabited island located in Sonmiani Bay. The island lies about 9 km west of the mouth of Hub River. Churna Island is approximately 1.5 km long and 0.5 km wide. In recent history, it was mostly used as a firing target by Pakistan Navy. Actual the location around Churna Island is used for fishing and scuba diving. For further design phases, environmental and social impact has to be considered, if the terminal shall be placed in close proximity to Churna Island. Location 2 (24°58'N, 66°38.5''E) is positioned in a near shore area northeast of location 1. There is one recently constructed single point mooring (SPM) facility in the bay. The SPM, featuring a draft of 25 meters. The buoy of the SPM moves freely within defined limits. The first vessel was moored to the SPM on December 26, 2012.

Navigational charts show that the water depth at both locations is larger than 15 m. Location 1 is in close proximity to Churna Island. Both locations are favorable in terms of sufficient water depth and from a navigational perspective but do not provide protection against the main wave direction. Due to this, both sites require efficient wave protection by a breakwater, which is for near shore terminals a cost intensive part of the terminal. The breakwater with the length of approx. 1,500 m has to be constructed. The breakwater is designed to reach a wave reduction to less than 2 m for wave events with a recurrence interval of 1 in 10 years. The stability, however, is calculated for the recurrence interval of 1 in 100 year wave events. Consequently, the breakwater freeboard is about 1.8 m. The evaluation draws the conclusion that location 1, which is closer to Churna Island, is the most convenient location.

The jetty itself shall be a reinforced concrete platform founded on sand filled piles. Further equipment covers mooring and breasting dolphins, catwalks, foam filled (floating) fenders as well as an additional pier for crew boats. The nautical approach was proven by a navigational study. The approach is proven even for severe weather conditions with vessel approach from north-westerly direction. Tugboats have to support the vessel in an early stage in order to ensure safe navigation though the approach channel. Minor area with major dredging might be needed due to shallower areas in the preferred approach channel.

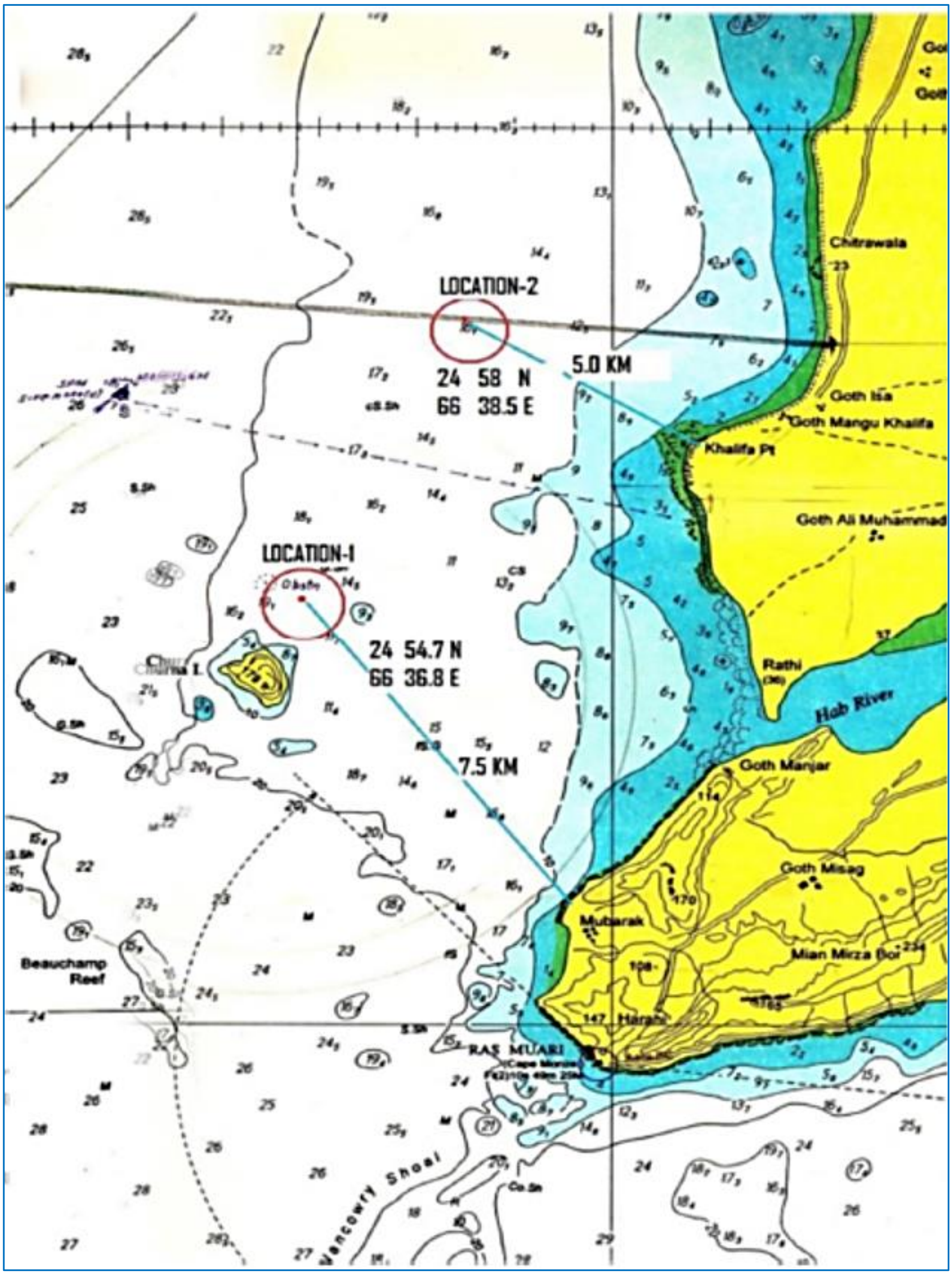


Figure 3.1: Terminal Location

3.3 Project Concept

The proposed LNG Terminal project is component of:

1) **Offshore Facilities comprising FSRU, jetty, & submarine pipeline,**

2) **Onshore Facilities comprising metering station and connection pipeline.**

The LNG from LNG carriers will be received by the FSRU offloading system, stored in tanks, pumped out and regasified into natural gas, delivered to metering station through high-pressure loading arms fixed on the jetty and submarine pipeline. After metering at the Metering station, natural gas will be injected to the gas network at delivery point through connection pipeline.

FSRU is Floating Storage and Regasification Unit with similar shape to LNG Carrier, and with the function of storage & regasification is the core part of Floating LNG Receiving Terminal.

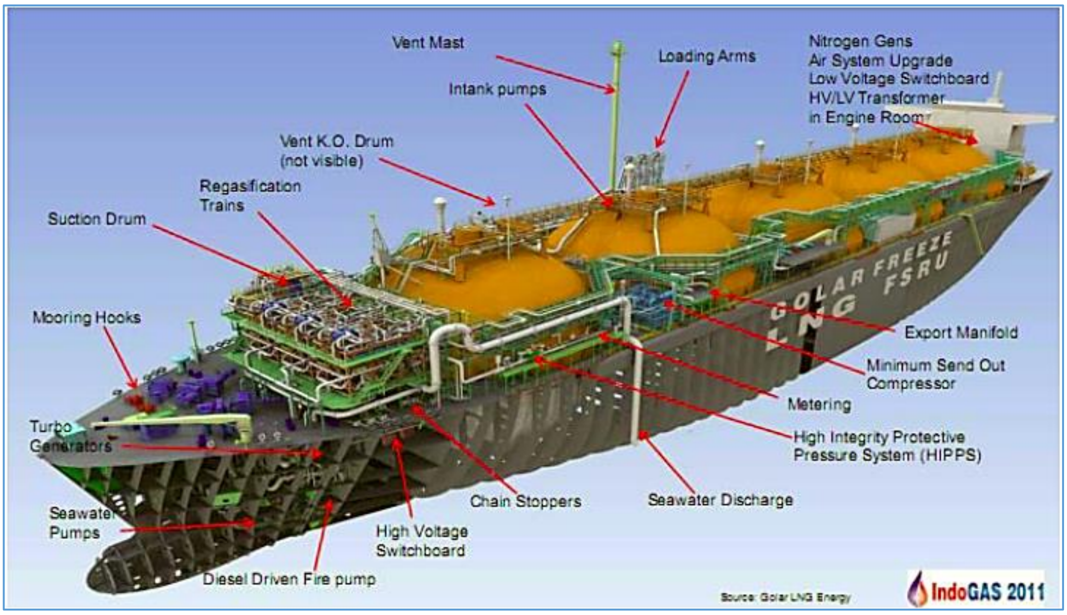


Figure 3.2: Typical Layout of FSRU

FSRU is composed of LNG unloading system, storage system, BOG recovery system, LNG regasification system, flare system and other utilities. Main process flow of FSRU is shown in figure 3.3. The LNG is transported to the FSRU storage tank from the LNG carrier and sent into the LNG vaporizer, after boosted by the high pressure pump in the storage tank. The regasified LNG (RLNG) is metered and then transported to the gas pipeline through the high pressure gas transmission arms. The BOG in storage tank is boosted through the BOG compressor, preheated by the heater and transported to the steam boiler as the fuel. The high temperature high pressure steam expansion in steam turbine, and drive the generators to provide power for FSRU. During normal operation, the pressure in FSRU storage cabin is maintained at a low level. When the LNG transportation quantity is large, the negative pressure may occur in LNG storage tank, the natural gas regulated through the pressure regulating device was sent into the LNG storage tank through the high pressure gas return line drawn from the gasification device to maintain the pressure level in the tank.

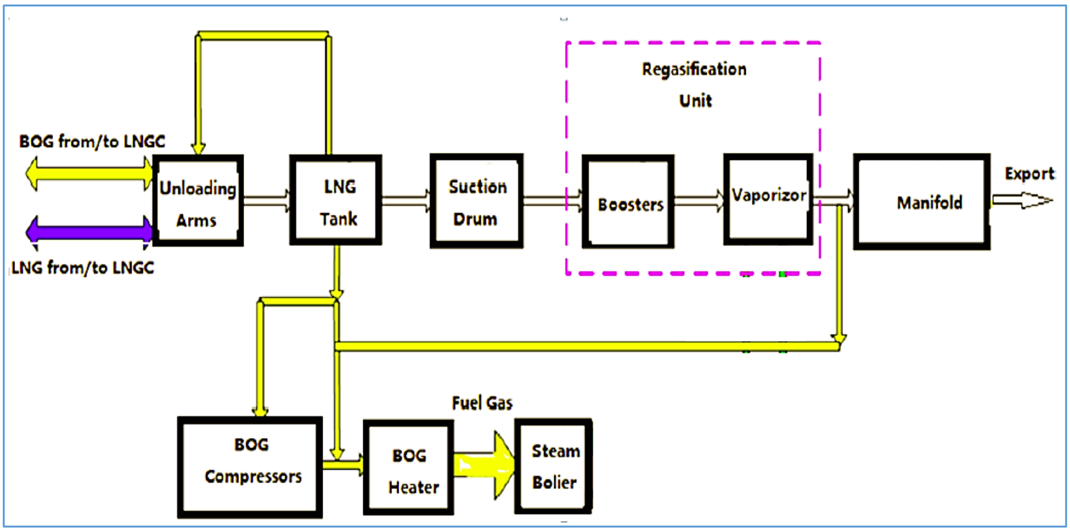


Figure 3.3: FSRU process flow diagram

Components on FSRU may differ according to its site location and special demand. However, typical components of FSRU are much the same as below:

Table 3.1: Typical Components of FSRU

No.	Item
1	Turbine system
1.1	Steam turbine main system
1.2	Dual-fuel main boiler
1.3	Dual-fuel auxiliary boiler
1.4	Steam turbine generator
1.5	Diesel generator
1.6	Emergency generator
1.7	Waste heat recovery system
2	Process system
2.1	LNG cryogenic storage tank
2.2	LNG low-pressure pump
2.3	Stripping pump / spray pump
2.4	Emergency liquid pump
2.5	LNG high-pressure pump
2.6	BOG compressor
2.7	BOG heater
2.8	LNG vaporizer
2.9	Unloading system
3	Auxiliary and utility system
3.1	Fuel gas system
3.2	Fuel oil system
3.2.1	Heavy fuel oil supply system
3.2.2	Marine fuel oil supply system
3.2.3	Light diesel oil supply system
3.3	Chemical system
3.4	Nitrogen system
3.5	Inert Gas System
3.6	Air compression system
3.6.1	Instrument air compressor
3.6.2	Start air compressor
3.6.3	Emergency generator starting air machine

Table 3.1: Typical Components of FSRU	
No.	**Item**
3.7	Lube oil system
3.8	Sea water system
3.8.1	Sea water circulating pump
3.8.2	Sea water cooling pump
3.8.3	Sea water pump of waste heat recovery system
3.9	Fresh water system
3.9.1	Fresh water cooling pump in motor room
3.9.2	Fresh water cooling pump in machine room
3.9.3	Seawater desalination system
3.9.4	Potable water system
3.9.5	Hot water system
3.10	Sewage disposal system
3.10.1	Treatment system of living sewage
3.10.2	Oily water separation system
3.11	Incinerator / flare
3.12	Steam/condensate water system

3.4 Screening of Alternatives

3.4.1 No Action Alternative

The 'No Action Alternative' does not offer the advantages sought by the Energy Policy 2002 and 2011 of the GoP. It also does not respond to:

- The urgent and strategic needs to enhance the availability of NG for power production to meet the demand of industry, agriculture as well as commercial and domestic consumers of the country; nor does it propose better level of service for improvement of quality of life.
- The need to increase the current power production capacity despite the shortfall in energy availability resulting in load shedding of 12 to 16 hours every day.
- The requirement of slowing down on fossil fuel consumption that is adding to global warming on the one hand and on the other hand depleting the national potential of natural resources.

In view of the above shortcomings the *"No Action Alternative"* does not merit further consideration.

3.4.2 Selection of Alternative to Procurement of NG

The NG procurement alternatives comprise

- No alternative (i.e. continuation of import of crude oil and refining;
- Import of petroleum products including high Sulphur furnace oil (HSFO), gasoline, high speed diesel (HSD) oil, and LPG, and
- Import of LNG.

Inadequate refining capacity is a major constraint to alternative (i), while alternative (ii) involves import of petroleum products whose ever-increasing cost demands provision of hydrocarbons in alternative form or providing power from an alternative energy source.

Import of LNG as Regasified LNG offers an economically viable alternative since:

- Regasified LNG constitutes extractable hydrocarbon components other than methane depending upon the source,
- LPG extracted from Regasified LNG has ready market at local and national level.

- Natural gas is an eco-friendly fossil fuel, while the use of HSFO and HSD as fuel for power generation on large scale is least desirable due to high content of Sulphur and consequent emissions of SOx and NOx.

Hence import of LNG as Regasified LNG is the preferred alternative for procurement of NG by which multiple objectives would be achieved. Additionally the project brings environmental benefit on a macro scale to the macroenvironment and global environment.

3.4.3 Types of LNG Terminal Terminals

Two kinds of LNG terminal are widely used now to fulfill LNG regasification function. They are typically conventional LNG terminal and FSRU.

1. Conventional LNG Terminal

The main function of conventional LNG regasification terminal is LNG receiving and storage, boil-off gas (BOG) processing, LNG gasification and NG send-out. Conventional LNG Terminal consists of onshore terminal, jetty and trestle, export pipeline:

Onshore terminal: including LNG storage system, boil-off gas handling system, vaporization / send out system, pressure relief & blow down system and utility system such as fuel gas system, instrument / plant air system, nitrogen system and diesel fuel system.

Jetty: including trestle and LNG unloading system, dredging and breakwater when the sea area condition is limited.

Export pipeline: including metering and pigging facilities (if necessary).

Figure 3.4: Overview of conventional LNG terminal

2. FSRU Terminal

FSRU is Floating Storage and Regasification Unit with similar shape to LNG Carrier, and with the function of storage and regasification.

In recent years, with the rapid development in liquefied natural gas (LNG) market, the LNG receiving terminal has attracted a wide spread attention. With the improvement of environment protection and safety awareness, especially after "9.11", people have a mixed feeling toward the onshore LNG Receiving Terminals. The onshore LNG Receiving Terminals are needed and also considered to be very dangerous. Therefore, the market needs new and safer LNG Receiving Terminals, especially in environment sensitive and population dense areas. In order to overcome some shortages of traditional onshore LNG Receiving Terminals such as difficult to get construction approval long construction duration and high investment, the Floating LNG Receiving Terminal technology which based on the full consideration of technical feasibility, safety & economy has been developed rapidly.

Floating LNG Receiving Terminal is composed of FSRU, jetty, gas transfer pipeline, metering station and downstream users, and the FSRU is the core part of the Floating LNG Receiving Terminal.

Figure 3.5: FSRU used in UAE

3. Comparisons of the Two Kinds of LNG Terminal

The comparisons of the two LNG terminal types are as below:

Table 3.2: Comparison table between conventional LNG terminal and FSRU

Compared Project	Conventional LNG Terminal	FSRU
Construction site conditions	It needs good port; It needs large land areas.	It is suitable for the region where the coastline is scare, and channel depth is no enough; It is applicable to environmental sensitive areas or densely populated areas; Choose mooring position and considering local extreme weather conditions, and the channel characteristics, the marine traffic flow and characteristics; There is no limit in the depth of the water, usually minimum depth in 20 ~ 50 m (minimum depth related to ship type), can be to 200 m or more.
Construction plan	It needs land formation, construction of wharf and jetty, and a good channel to basin excavation.	It doesn't need land formation, construction of wharf and jetty, excavation and dredging.
Design and constructio	The design and construction technology is mature.	FSRU new project needs to be manufactured in modern shipyard; It also can be converted from the existing oil terminal and LNG ship.
Expansion ability and the flexibility	Good expansion ability; It is fixed, unable to move.	Expansion ability is poorer; It can be flexible to move.
NG and LNG transmission scheme	It can be transported through general NG pipeline on the land; It can be LNG loading transmission.	NG needs to be transported by means of a submarine pipeline or trestle; LNG needs to be transported by the trestle structures, etc.
The construction duration	Long, generally 60 months,	Short, generally 32~35 months
Uptime/reliability	The influence of wind flow is small, and it has good reliability.	When the wind flow is bigger, because of the relative displacement between the hull is bigger, discharging operation cannot be undertook.
Safety influence	It has a larger safety influence on the surroundings; Security is higher; Emergency response ability is stronger. In the event of an emergency, external aid and the internal personnel evacuation are more convenient.	It has a smaller safety influence on the surroundings; In the event of an emergency, external aid and the internal personnel evacuation are more difficulty.
Social influence	It has certain influence on the environment.	It has little impact on the environment, simplifies the formalities for examination and approval of land requisition and government, and improves the recognition of local residents to LNG receiving station.
Investment	high	low
Operation cost	low	high

Through the above analysis, it can be concluded: on the condition of sufficient land and a good port condition, conventional LNG terminal should be preferred to construct. When the shoreline is scarce, channel depth and port condition is not allowed, FSRU is considered to choose.

The conventional LNG terminal will take about 60 months and has more environmental and social concerns as compared to the FSRU. So, conventional LNG terminal is not fit for this project.

4. Comparisons of FSRU and FSU

Availability Analysis: FSRU is an integrated Floating Storage and Regasification Unit, which can independently fulfill the functions of storage and regasification. With the regasification unit on deck, FSRU can be used for other project according to actual demand. This will enlarge its potential value. If the regasification unit is arranged on land, its value decreases.

Safety Analysis: If the regasification unit is arranged on land, it will be far away from storage tanks. This will lengthen cryogenic liquid LNG pipeline, increase the probability of piping system accidents, enlarge fire risk and extend emergency reaction time.

If the regasification unit is arranged on deck, integrated modular equipment is to be used. This option has the features of shorter LNG pipeline (only on board), less fire risk, faster response to emergency and fire equipment onboard with international authority certificate has higher reliability.

Construction Duration Analysis: FSRU can be conversed at shipyards in China. The duration can be optimized, because it's not subject to land acquisition and security factor of Sonmiani Bay.

Land Acquisition Analysis: The regasification unit is arranged on deck can avoid land acquisition and corresponding civil work.

Piping System Analysis: If the regasification unit is arranged on land, pipelines of LNG liquid, BOG and seawater are to be constructed from offshore to onshore. While if it is set on board, existing piping system on LNG can be checked and reused. And the seawater pipeline can be saved.

Unloading Arms Analysis: For FSRU option, unloading arms are selected for regasified LNG. While FSU option unloading arms for LNG liquid are used. The former takes advantages of less cost and easier operation.

Operation and Management Analysis: If the regasification unit is arranged on land, operation and management of regasification equipment and FSU shall be separate, which will cause more staff and cost and vice versa.

Construction Experience Analysis: FSRU option is widely used for offshore LNG terminal. FSU has little experience.

Influence on surroundings: For FSU option, if LNG tanks are extended in the future, it will have big influence on the master plan of fishing village and proposed power station. Besides, a single 160,000m^3 tank is as high as nearly 50 meters which is more vulnerable to terrorist attack.

3.5 Terminal Arrangement

The LNG Offshore Terminal will be operated in order to transfer LNG from the shuttle tanker (LNGC) into the Floating Storage and Regasification Unit (FSRU) by means of unloading/loading arms or hoses either ship to ship or mounted on the jetty platform via interconnecting headers.

3.5.1 Screening of Alternatives for Jetty Design

Two basic design concepts (*alternatives)* have been considered:

i. **The twin-jetty design with an LNGC-Terminal-FSRU arrangement**

ii. **The single-jetty design with a ship-to-ship arrangement.**

The FSRU facility will be moored permanently several kilometers offshore in both cases. There are no significant differences in the systems from an environmental impact point of view.

i. LNGC-Terminal-FSRU (Twin Jetty)

A 'Twin Jetty' is an offshore jetty providing berthing provisions on each side of the jetty. The FSRU will be moored on one side and the LNGC directly on the opposite side of the jetty. This layout requires two sets of cryogenic hard arms installed on the jetty, one serving the FSRU, the other one the LNGC. This configuration shows the more traditional principle.

Figure 3.6 shows an illustration of the principle.

Figure 3.6: Cargo-Terminal-FSRU Transfer

ii. Side-by-Side Transfer (Single Jetty)

The side-by-side transfer of the LNG with the help of a single jetty is the second possible operating principle and is illustrated in Figure 3.7. The term 'Single Jetty' describes an offshore jetty with berthing provisions typically alongside where the FSRU is moored. The shuttle LNGC may either be moored alongside the FSRU or before or behind the FSRU. In the first case only the FSRU needs cryogenic hard arms (loading arms) installed on deck, in the latter case there need to be installed two sets of cryogenic hard arms on the jetty, one for the LNGC and the other one for the FSRU.

Figure 3.7: Side-by-side Transfer

iii. Evaluation of Preferred Alternative

The criteria for evaluating the two terminal operating philosophies has been summarized below:

Table 3.3: Comparison table between Twin Jetty and Single Jetty

Criteria	Cargo-Terminal-FSRU (Twin jetty)	Side-by-side transfer (Single jetty)
Berthing Principle	The LNGC might collide with the jetty while berthing. The jetty itself is a solid structure. Thus, no influence to the FSRU.	A collision of the FSRU and LNGC is more likely to cause damage at both ships.
Mooring Principle	Mooring facilities independent for FSRU and carrier, layout for carrier will be optimized	Mooring facilities for FSRU must consider carrier size
Navigational Safety and Risk	Equivalent	
Wave-ship-Interaction	FSRU and Carrier may have different resonances, no ship-ship resonances	FSRU and Carrier may have different resonances, in addition risk of ship-ship resonance
Wind-ship Interaction		
Breakwater	wave reduction necessary	more efficient wave reduction recommended
Tidal Range	The jetty with the unloading equipment is a solid construction. However, the FSRU and LNGC move vertically due to the tides. Flexible design of the unloading equipment needs to be ensured in order to compensate the tidal range.	
LNGC Sizing and Delivery Frequency	Equivalent	
LNG Unloading Arms	Loading arms would be used. Loading arms are generally easier to manipulate and safer than hoses. Since the LNBC and FSRU would utilize independent loading arms, the issues around ship motions due to waves etc. are minimized.	Hoses would be used most likely. Hoses are more difficult to handle than loading arms. Hoses are generally not considered as safe and as robust as loading arms. Hoses are usually only used where it is impractical to use loading arms (transfer at sea for example).
FSRU Boil-Off Gas Handling	Equivalent	
Power Island versus Onshore Power Supply	The terminal jetty provides potentially more space for locating generators etc.	Side-by-side doesn't provide space for generators etc., but such space could be provided on a separate platform nearby.
Spill Containment/ Diversion	Placement of spill trenches or diversion plates is better facilitated if a jetty platform is present. The platform also allows for more distance between the ships which may be safer under some spill scenarios.	The ships would be very close during LNG transfer. If a loading hose were to fail there is a greater possibility that cold LNG would impact one of the ships possibly leading to brittle failure of a portion of the carbon steel hull.
Fire and Gas Detection	The jetty platform provides a superior platform for locating fire and gas detection devices.	Side-by-side arrangement provides no location for placing fire and gas detection devices between the ships.
Firewater/Foam Systems	The jetty platform provides a superior platform for locating firewater monitors.	Side-by-side arrangement provides no location for placing firewater monitors between the ships.
Operator Staffing	Equivalent	

Table 3.3: Comparison table between Twin Jetty and Single Jetty		
Criteria	**Cargo-Terminal-FSRU (Twin jetty)**	**Side-by-side transfer (Single jetty)**
ESD & Control System	Equivalent	
Piping Aspects	Equivalent	
Risk Assessment – Emergency FSRU	In case of emergency after berthing/during unloading, FSRU is in safe distance to LNGC	In case of emergency after berthing/during unloading, FSRU is connected to LNGC, to remove FSRU, LNGC must be removed previously
Emergency exit routes	independent emergency exit routes	Emergency exit routes from LNGC muss cross FRSU
CAPEX	It is expected to be higher mainly due to the addition of extra loading arms	It is expected to be lower due to being able to substitute hose for loading arms.
OPEX	Slightly higher due to longer cool-down cycle at the start of LNG transfer	Slightly lower, however, additional mechanical integrity efforts required for hoses (hoses require more testing and care than do loading arms) will likely tend to equal out OPEX costs

Based on the comparison of the aspects presented in the above table, *Single Jetty is the preferred alternative* for the terminal arrangement. The single jetty has benefits due to lower CAPEX and OPEX and most of the mentioned risks can be mitigated in the design and operation phase.

3.5.2 Vessel Characteristics

For the design of the LNG Terminal, the dimensions of the expected vessels are defined as follows:

The FSRU is permanently moored at the terminal. The Basis of Design requires an FSRU in the range of 170,000 m³ storage capacity. The given range determines the dimensions of the FSRU. The length can be estimated to 294 m and the breadth to 46 m. The draft for the FSRU is maximum 12.00 m but can increase up to 12.5 m summer draft due to sea water density differences.

The marine facilities have to be designed for handling LNG carriers in the rage of 70,000 m³ size to Qmax (266,000m³ capacity) size. The dimensions of both vessels are summarized below. The dimensions for the vessel size with a capacity of 70,000 m³ were calculated by the use of linear interpolation between 40,000 m³ and 75,000 m³. The maximum draught is given with 12.5 m in summer.

Table 3.4: Range of LNG Dimensions							
Capacity	**DWT**	**MD**	**LOD**	**LBP**	**B**	**H**	**Dmax**
[m³]	[t]	[t]	[m]	[m]	[m]	[m]	[m]
266,000	125,000	175,000	345.0	333.0	53.8	26.2	12.0
70,000	48,429	55,429	241.7	226.0	34.0	20.1	9.5

3.6 Breakwater

A breakwater is required in order to protect ships during the final navigational approach, berthing and operation at the terminal. The breakwater will be designed to protect the terminal from adverse sea conditions. Specifically it is designed to reduce the maximum significant wave height to less than 2 m at the terminal position as given as a recommendation of the design basis. The limited wave height is to provide safe condition for the berthing of the LNGC and safe operation of the FSRU and the transfer of LNG to the FSRU.

The target availability for the LNG terminal facilities shall be 99.5 % according to the Basis of Design. The Project Basis of Design requires as well a minimum return period of 100 years for offshore installations. This is applied for the stability calculations for the breakwater.

A technical drawing of the planned breakwater cross section is shown in Figure 3.8.

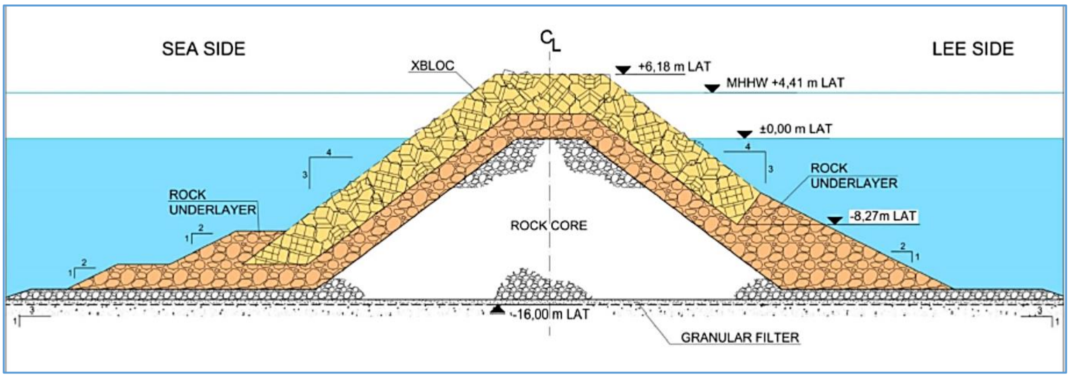


Figure 3.8: Cross section of planned breakwater

3.6.1 Screening of Alternatives for siting the Breakwater

Four alternative layouts of the breakwater have been considered. In each case, the breakwater is placed directly connected to Churna Island. The main criteria were to build the jetty in sufficient water depth. With respect to meet the limited water depth is defined above with a minimum of about 15 m LAT. All locations are shown in Figure 3.9.

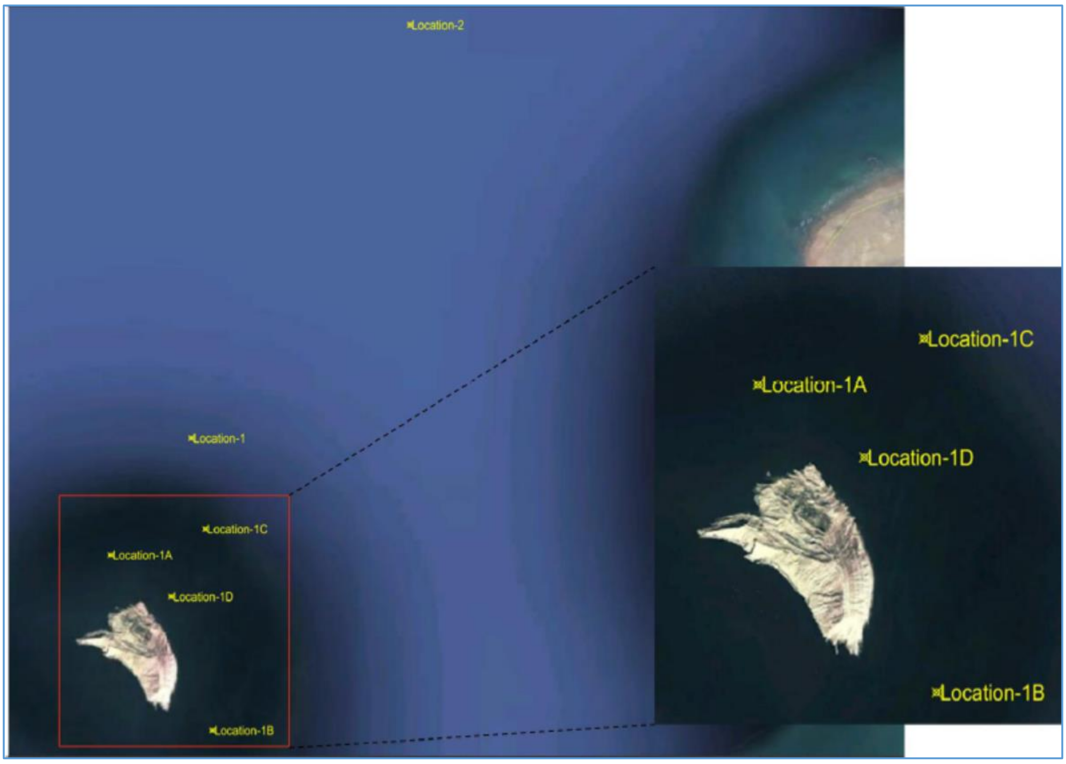


Figure 3.9: Alternative for siting the breakwater

Figure 3.10 shows the breakwater configuration for location-1A at the north of Churna Island. The breakwater is directly connected to the island. However, dredging is required in order to meet the water depth limitation. Since the water depth decreases towards the island therefore less breakwater volume is needed.

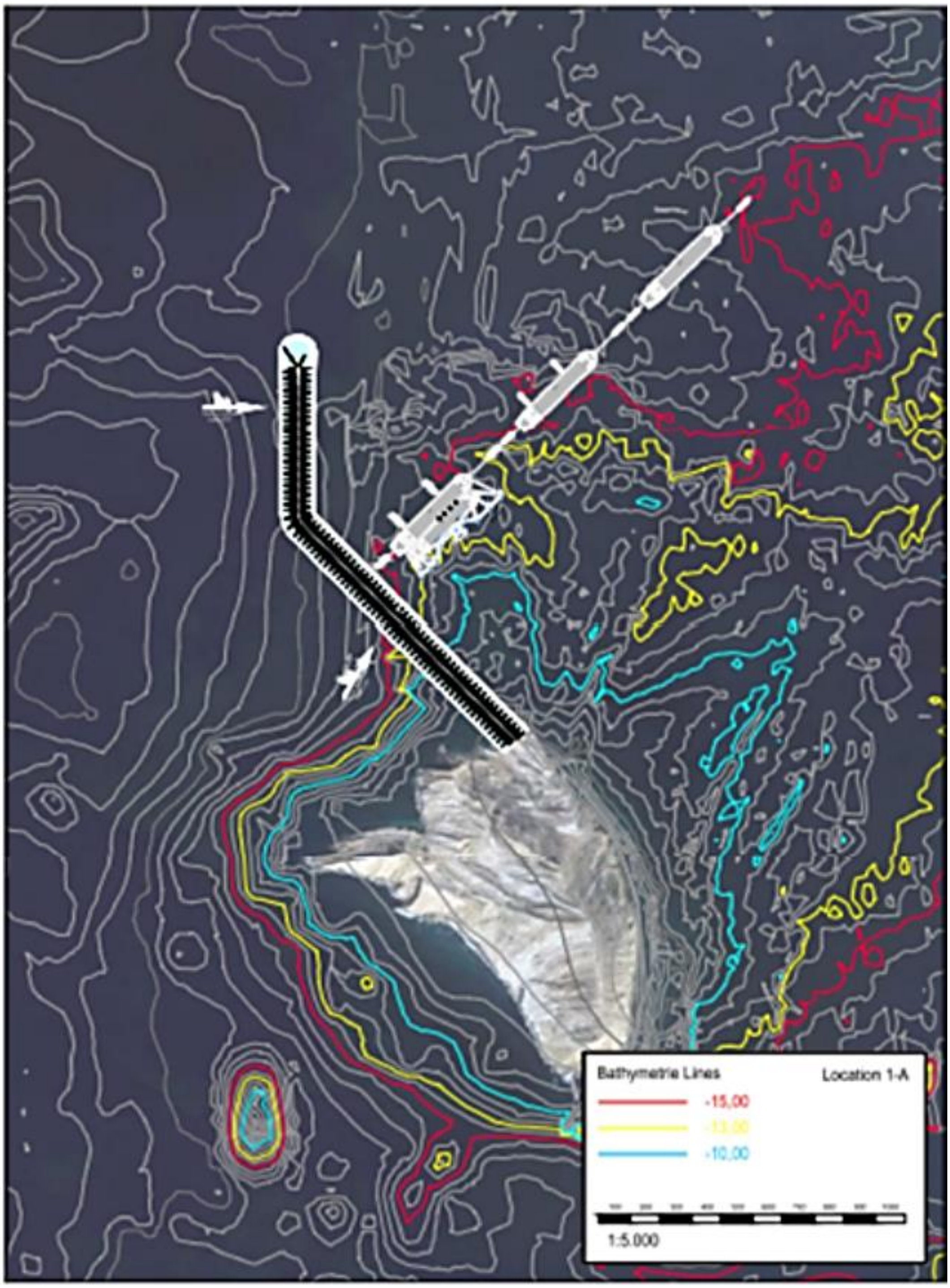


Figure 3.10 Position breakwater at location 1A

The breakwater configuration for the south-easterly position of Churna Island is shown in Figure 3.11. In that case the jetty configuration needs to be mirrored compared to the other location. The bathymetry shows several shallow spots thus, dredging might be required for the save navigational approach. Additionally, the navigational approach needs to be from the southerly side of the island, the navigational charts show several shallow spots which might be reefs and need to be examined in further the design.

The navigability is assessed to be by far more difficult in maneuvers coming from the south. For this reason tug assistance is required at an earlier approach phase compare to the other cases. Additionally, the approach channel is considered to be narrow since underwater obstacles need to be circuited. The volume of the breakwater is significantly lower compared to location-1A. However, the navigational safety is questionable.

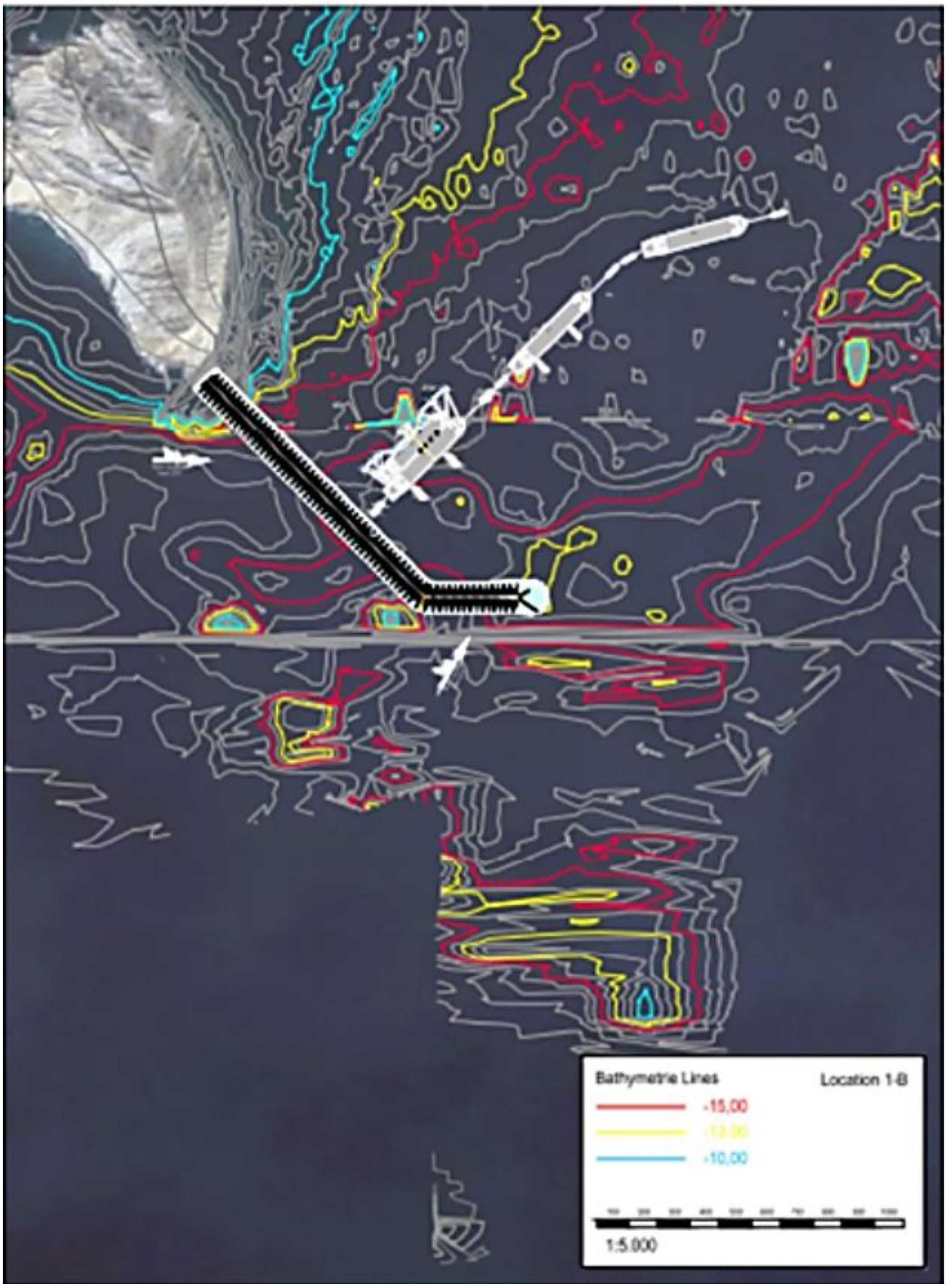


Figure 3.11: Position breakwater at location 1B

Figure 3.12 shows the terminal arrangement of location-1C. The breakwater needs to be constructed closer to the island compared to other two options discussed earlier. This circumstance leads to smaller water depth at the breakwater location. There is no dredging or merely minor dredging required in this option.

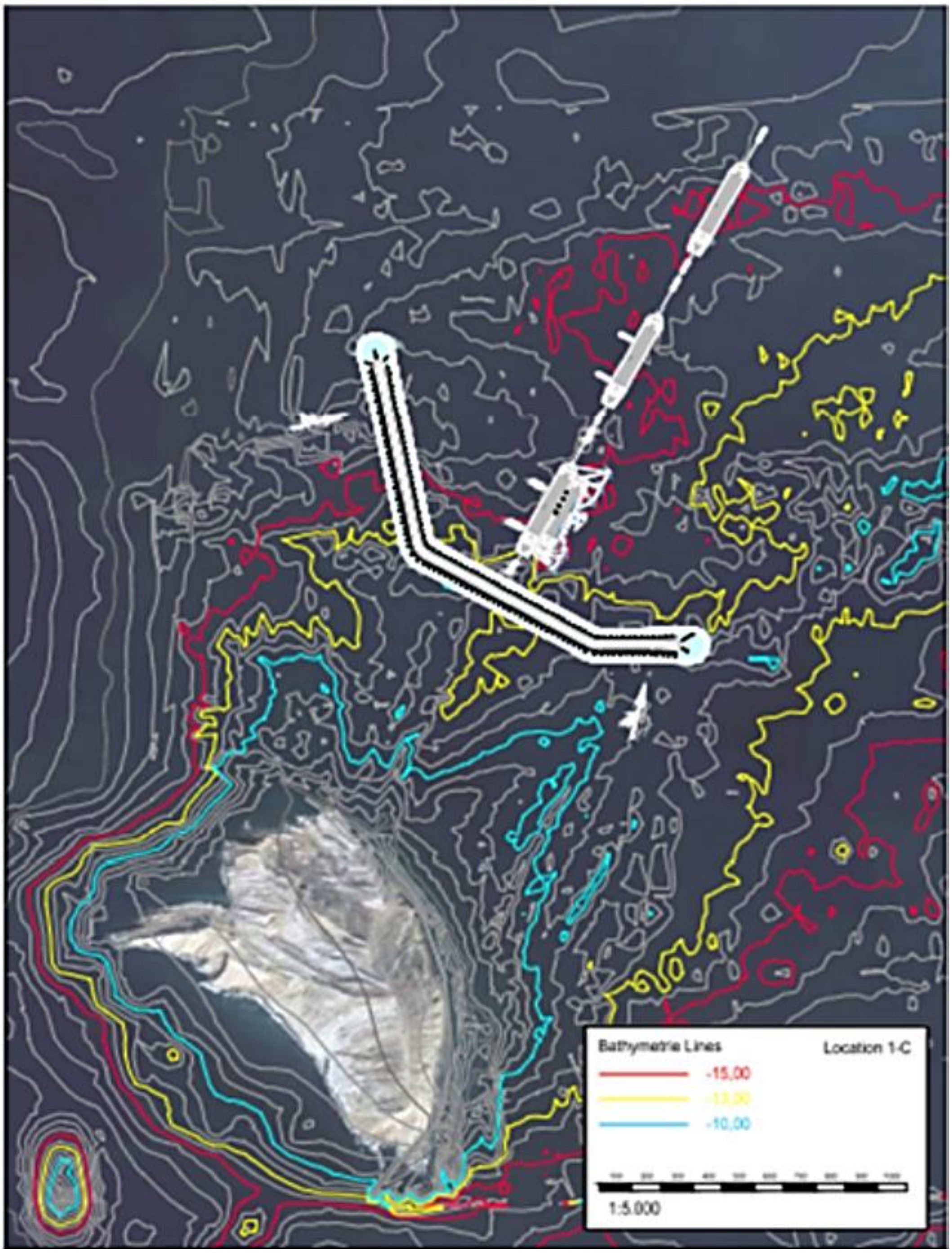


Figure 3.12: Position breakwater at location 1C

Location-1D is shown in Figure 3.13. The breakwater consist of two flanges which are directly connected to Churna Island with two flanges.

In this case major dredging works are required. The depth until dredging is required, is set to -16 mLAT since minor sedimentation processes have to be considered. In order to ensure a sufficient entrance in the wave height reduced area of the breakwaters, a volume of 2.43 Million. m³ have to be dredged and dumped.

In case of hard bed rock, the appropriate construction equipment would be the cutter dredger. The obvious advantage of this location is the smaller water depth. This has two major effects on the breakwater costs. Firstly, the volume is significantly smaller. Secondly, wave breaking is dependent from the water depth. The smaller the water depth the higher is the possibility that the waves are already broken. Broken waves carry consequently less energy which may have a positive effect on the size of the armor units as well as the material for the rock core and the rock under layer.

For calculating the breakwater costs, the possibility to use the rock material for the breakwater from Churna Island and/or dredged material was considered. The breakwater costs are calculated to roughly 48 Mio. USD. Additionally, the dredging costs have to be considered with approximately 25 Mio. USD.

Sedimentation within the dredged area is expected to be low. Thus, low maintenance costs are expected to be low as well. The location-1D for the LNG-terminal has the highest potential for extension such as the construction of a second terminal.

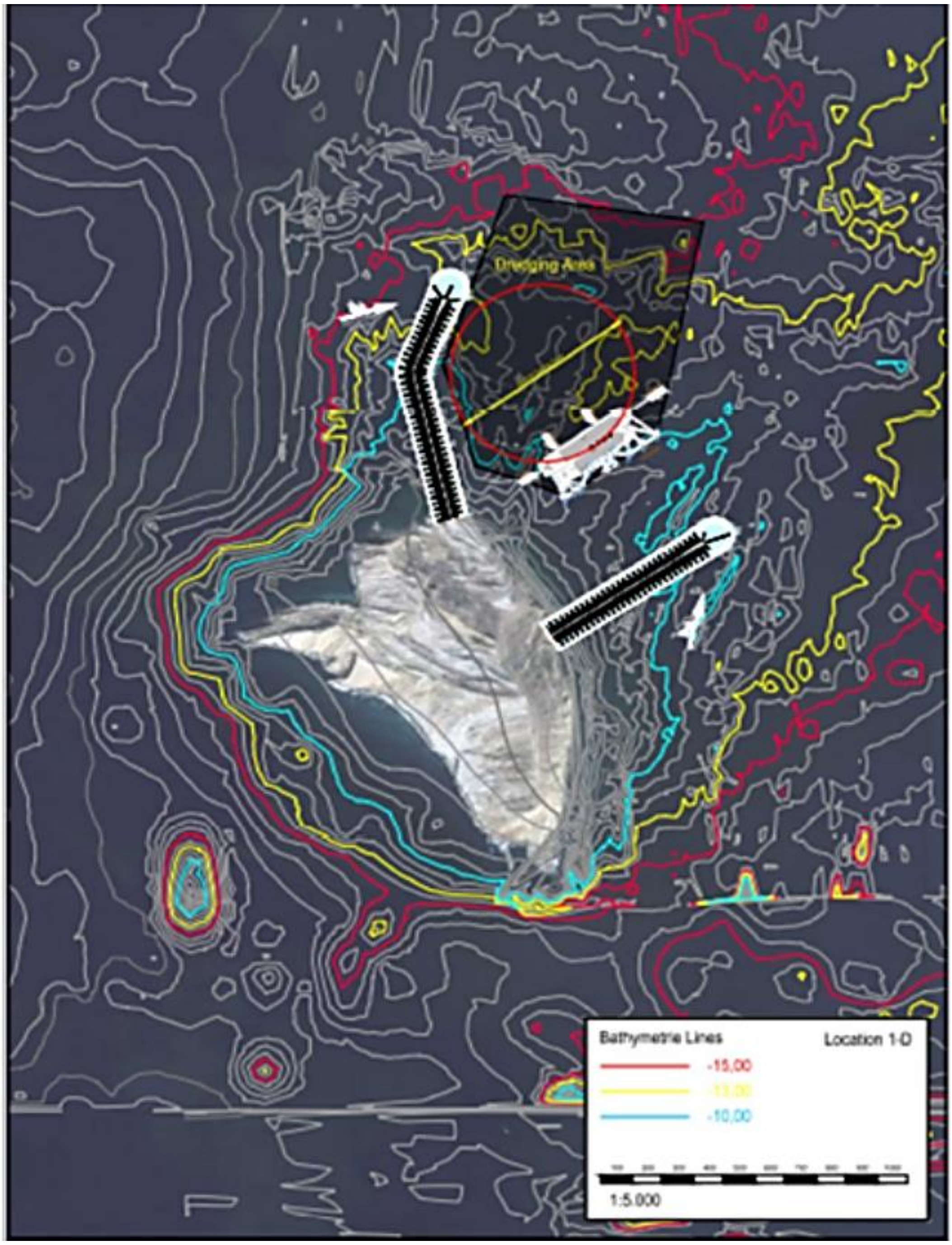


Figure 3.13: Position breakwater at location 1D

Longitudinal sections of the breakwater with the respective sea bed profile are shown in Figure 3.10 till Figure 3.13.

Table 3.5: Evaluation of Breakwater and Jetty Locations

Category	Location 1-A	Location 1-B	Location 1-C	Location 1-D
Schedule	Breakwater volume: 1,564,000 m³	Breakwater volume: 1,161,000 m³	Breakwater volume: 1,378,000 m³	Breakwater volume: 880300 m³
CAPEX	Breakwater length ≈ 1,500 m, 117,000,000 USD	Breakwater length ≈ 1,300 m, least breakwater volume 68,000,000 USD additional dredging costs of 15,000,000 USD	Breakwater length ≈ 1,500 m 80,000,000 USD	Breakwater length ≈ 1,350 m, least breakwater volume 46,000,000 additional dredging costs of 25,000,000 USD
Environmental	Minor dredging is required, effects on environment have to be considered	Major dredging is required, severe effects on environment have to be considered	No dredging required	Major dredging is required, severe effects on environment have to be considered
Navigational	Feasible but sufficient approach corridor needs to be ensured	Not feasible	Feasible but sufficient approach corridor needs to be ensured	Feasible after mayor dredging activities

Table 3.5 shows an evaluation matrix. The evaluation criteria are: schedule, CAPEX, environment and navigational impacts. The highest value was given to navigational risks since the save approach of the LNG vessels ensures a continuous LNG transfer to the onshore facilities. The negative effect on the environment is due to dredging. The effects on CAPEX and Schedule are significant by means of higher or respectively lower material consumption.

Based on the given data and implemented evaluation, the preferred location for the breakwater and LNG terminal is location-1D. *Location-1D is the most suitable solution* since it combines the balance of navigational, environmental and monetary aspects.

3.7 Conceptual Design

The civil works contain the following main elements:

- Breakwater
- An unloading platform
- Mooring dolphins
- Breasting dolphins
- Gangways
- Fenders
- Pier for crew and supply ship

3.7.1 Jetty

The proposed design of the jetty is an open structure like a concrete deck supported by a pile foundation with cross beams. The piles will be covered with corrosion protection paint and filled with sand. The jetty is not connected to the shore by a trestle bridge because this would be uneconomic.

The alignment of the jetty will be straight in southwest-northeast direction based on the assumption, that the ships shall be moored along the major wind and wave direction. The length will be designed in order to moor a Qmax LNG Carrier on the one side and an FSRU with the 294 m length and 46 m breadth on the other side. The berthing is required to have a depth of at least 15 m LAT for Qmax vessels as well as the FSRU with a maximum summer draught of 12.5 m providing under keel clearance of at least 3 m. The jetty construction includes the firewater pumps with diesel tank, bikeway, and pipe rack for supporting piping (gas pipeline, Firewater, Nitrogen etc.) and cables.

The conceptual jetty layout is shown in Figure 3.14.

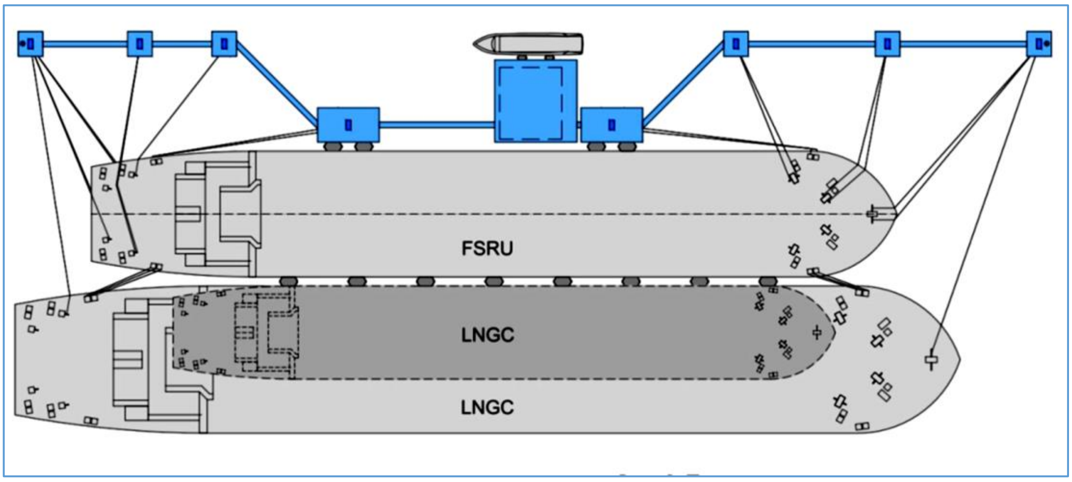


Figure 3.14: Jetty Layout

3.7.2 Unloading platform

One terminal platform is planned for the unloading equipment. The area of the unloading platform is estimated to 30.00 m by 30.00 m. The working platform is placed at a secure elevation above water Level during storm surges considering wave approach. The necessary elevation is estimated with +7 mLAT. The platform with girders is grounded by to sand filled piles. The platform and the girders are made out of reinforced concrete using prefabricated segments. The grounding piles have to be embed in the bedrock with approximately 2-3 m length. About four piles should be connected to one beam and beams should be installed every 10 m apart.

3.7.3 Breasting dolphins

The jetty structure will include two breasting dolphins both connected by the gangway to the unloading platform. The area of the breasting dolphins is approximately 12.5 m by 22 m. It is designed to have a reinforced concrete deck with girders and pile foundation. Technical drawings of the dolphins are attached. The dolphins are equipped with firefighting systems, quick release hocks, bollards, and an escape ladder.

3.7.4 Mooring dolphins

Six mooring dolphins are needed in order to provide a safe harbor operation. Mooring dolphins are designed with the dimensions of about 9m by 9m. The dolphins deck is made out of reinforced concrete connected to sand filled piles. Technical drawings of the dolphins are attached. The mooring dolphins are equipped with quick release hocks, bollards, and escape ladders.

3.7.5 Catwalks

The catwalks connects the dolphins and the platform for save and fast access. It is made out of a steel construction with foundation. The total length of the walkway is about 270 m. Technical drawings of the catwalk is attached.

3.7.6 Fenders

Fenders are placed between ship and berth to reduce the forces due to ship movement on ship and structure. Fenders are designed based on the PIANC (2002) Method. The selection of the fender size is calculated for the largest vessel that is the Q-max LNGC.

Design criteria:

- Vessel size: 266 000 m³; 125 000 DWT
- Kind of vessel: LNG Carrier
- Approach berthing velocity: 0.1 m/s
- Berthing Mode: Dolphin Berthing
- Structure Type: Open structure

The berthing energy leads with the above mentioned requirements and a safety factor of 2.0 to approximately 1900 kNm. The fender systems between the FSRU and LNG carrier consists of eight foam filled floating fenders including fixing chains permanently placed at the FSRU. The use and the fastening of the fenders are shown in Figure 3.15 and Figure 3.16.

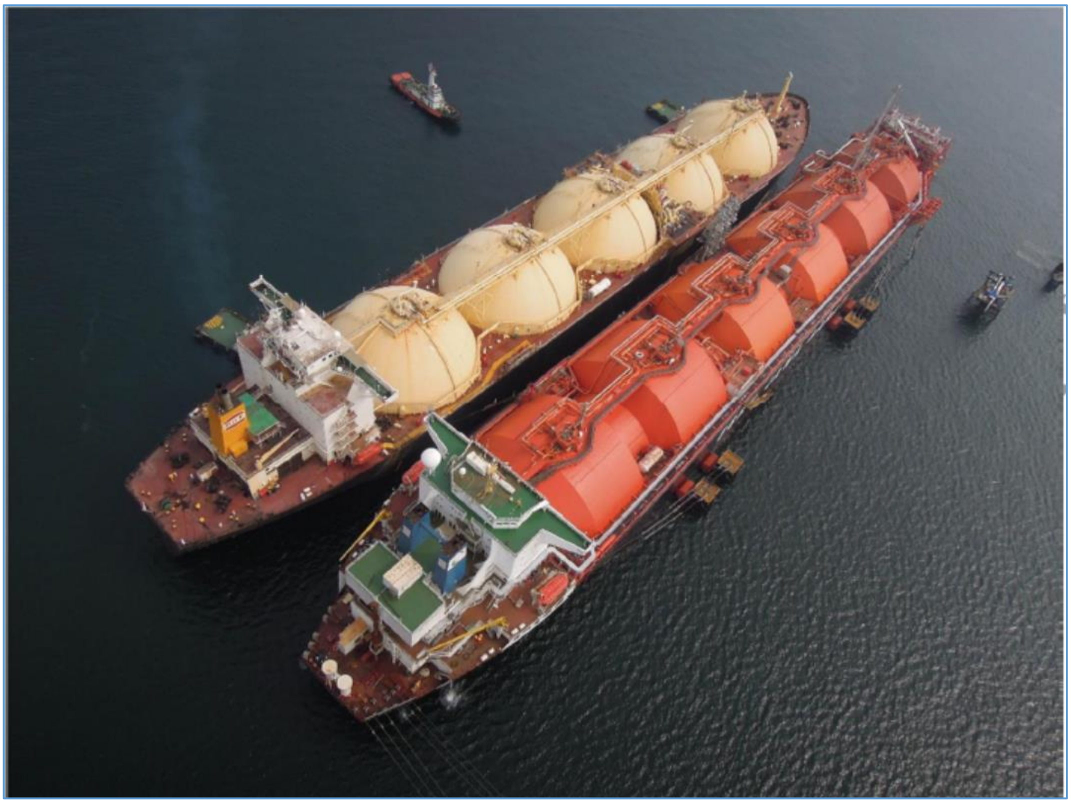


Figure 3.15: Use of fenders at side-by-side transfer ©Shibata Fender Team

Figure 3.16: Breasting dolphin with foam filled floating fenders ©Shibata Fender Team

3.7.7 Pier for crew boats

At the opposite site of the jetty, a pier for crew boats is planned. The pier is equipped with ladders, bollards, rubbing strakes and fenders.

3.8 Terminal Operating Philosophy, Requirements, and Design

Basically, the FSRU is to be designed to:

- Accept LNG from an LNGC on a periodic basis
- Store and regasify the LNG at send out pressure and flow rate per the conditions outlined
- Operate independently from outside utilities or sources of power
- Monitor process conditions on and off the FSRU that are critical to safe operations
- Provide adequate mooring, berthing, jetty, and breakwater facilities to safely support the FSRU operation
- Make good economic use of the LNG and other resources required by the terminal operation
- Provide for good accessibility to all systems for operations and maintenance

3.8.1 Main Operating Modes

- Startup and cool down after maintenance or after other shutdown
- Normal Shutdown, but remaining cold
- Normal Shutdown and degas/warm-up
- Emergency Shutdown and Emergency Release of the LNGC and/or Emergency release from the mooring lines
- Nominal gas sendout while accepting LNG from an LNGC
- Nominal gas sendout without accepting LNG from an LNGC
- Minimum gas Sendout while accepting LNG from an LNGC

- Minimum gas sendout without accepting LNG from an LNGC

3.8.2 LNG Composition Design Basis

The base case design is for LNG from Qatar. However, the FSRU should be capable of receiving and revaporizing typical LNG compositions that might be encountered throughout the life of the project. It is anticipated that variations in the LNG composition will have some minor impacts on the operation of the FSRU.

3.8.3 LNG Transfer

The FSRU will likely receive LNG form an LNGC via loading hoses and return vapor to the FSRU via hoses. Means to safely cool down, monitor the transfer, and purge/warm up after shall be provided. Additionally, safe means to stop the transfer and isolate the transfer lines shall be provided for both routine and emergency situations. The means and ownership for custody transfer (on the FSRU or part of the LNGC) shall be established.

3.8.4 Emergency Gas Release

Consideration for pressure safety relief and discretionary vents will be included in the design. The design basis for the Pressure relief and venting system shall be documented. The pressure relief system shall be routed to vent stacks at a safe location. The necessity of heating for cold vents to ensure they are buoyant in the atmosphere will be considered.

3.8.5 Emergency Shutdown

The FSRU will include the following important safety systems:

- Fire and Gas Detection
- ESD Control
- SCS (incorporates ESD and Fire and Gas Detection) separate from the normal process control system.

SCS and its ancillaries and components will:

- Rapidly and reliably detect fire, LNG spills, gas leaks, or other hazardous conditions as outlined in the interlock/shutdown in either the FSRU, the LNGC, or the jetty and
- Place the FSRU and Jetty systems in a safe state and isolate itself from the LNGC as appropriate.
- A detailed ESD philosophy along with specific design documents and specifications will be developed in the FEED stage.

3.9 Process Description and Logistics

The FSRU will receive LNG from an LNGC periodically. The frequency of the deliveries from the LNGC depends primarily on four parameters:

- **FSRU Size** – Larger FSRU's can receive larger cargoes which will tend to reduce the frequency requirement for LNG deliveries.

- **LNGC Size** – Larger LNGC's generally mean that fewer deliveries will be required. However, LNGC's are limited in the range of cargoes they can carry due to sloshing concerns associated with partial cargoes. For example, a Qmax's acceptable cargo range is below 10% and above 70%. 70% of a Qmax's full cargo is too much for a 170,000 m3 FSRU to accept. Therefore, the

Qflex will probably be the maximum acceptable LNGC size due to FSRU cargo acceptance limits.

- **Minimum Operating Buffer** – The FSRU operator will have to decide how many days of sendout they will allow their inventory to fall to before they resupply. If the minimum buffer is too low, and the LNGC is late, the sendout may have to be reduced or suspended. Additionally, the LNG tanks can't be completely emptied due to pumping limitations and tank warm-up considerations.

- **Sendout Rate** – Obviously the more sendout gas that's put into the pipeline the more frequently the LNGC's will have to come. The following tables outline the expected frequency of LNGC offloading for two cases, 500 MMSCFD and 750 MMSCFD sendout rates with an offload rate of 8,000 m³ per hour. The other relevant parameters include: the size of the LNGC (a variable), the size of the FSRU (170,000 m³, fixed)

Table 3.6: LNGC Planning for 500 MMSCFD Send out, 170,000m³ FSRU

LNGC Nominal Size (m³)	Estimated Net Delivery	Offload Flowing Time	Days of Operation
70,000	63,000	7.88	2.6
125,000	112,500	14.06	4.6
150,000	135,000	16.88	5.5
160,000	144,000	18.00	5.9
170,000	153,000	19.13	6.3

Table 3.7: LNGC Planning for 750 MMSCFD Send out, 170,000m3 FSRU

LNGC Nominal Size (m³)	Estimated Net Delivery	Offload Flowing Time	Days of Operation
70,000	63,000	7.88	1.7
125,000	112,500	14.06	3.1
150,000	135,000	16.88	3.7
160,000	144,000	18.00	3.9
170,000	153,000	19.13	4.2

3.9.1 Ship to Ship to Jetty Configuration

The single jetty configuration chosen by the client will result in the LNGC mooring alongside the FSRU as shown below:

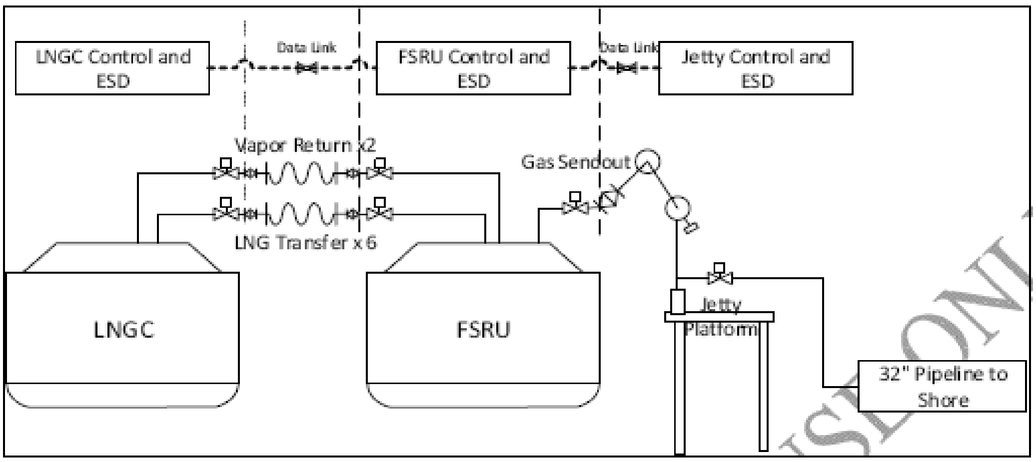


Figure 3.17: Single Jetty LNG Transfer Scheme

To help insure that the flow of LNG, vapor return gas, and sendout gas to shore can be safely isolated in an emergency several actuated ESD valves will be located in the system. The ESD philosophy and interlock logic diagram will be finalized in the FEED stage. The three relevant control and ESD control systems (LNGC, FSRU, and Jetty) will communicate via intrinsically safe standardized AF series, or equivalent, connectors that will carry phone/communication signal, ESD contact signals, and other data relevant to the STS process. More specifically, the communications/control measures for each entity are outlined below (to be finalized or modified in FEED):

- **Jetty:** The jetty control room may be normally unmanned. However, monitoring of the Met Ocean data, berthing data, mooring line tensions, etc. should be possible form the jetty control room. Additionally, it should be possible to activate and ESD and Emergency Mooring Release from the jetty control room. The jetty firewater system, gas detectors, sendout pipeline process parameters (pressure/flow) will also be controlled or monitored as appropriate in the jetty control room.

- **FSRU:** The FSRU will receive monitor signals from the LNGC, the Jetty, and its own process parameters related to inventory management, LNG inflow, sendout gas outflow, safety and emergency systems, etc. The FSRU will also be capable of monitoring all relevant mooring line loads and berthing data. ESD activation and emergency mooring release will be possible form the FSRU. Of course the FSRU control system will be capable of monitoring its own important process parameters.

- **LNGC:** In addition to monitoring and control of its own processes, the LNGC should receive relevant information about the berthing and mooring line data. The LNGC should also be capable of activating the ESD and emergency release of its mooring lines.

3.9.2 FSRU Process Flow and Material Balance

The FSRU base operating is for 500 MMSCFD of sendout to the pipeline. The individual vaporization trains are sized for 125 MMSCFD each. To achieve 750 MMSCD, therefore, a total of six vaporization trains will be required. The following diagram outlines a conceptual process arrangement.

The final process design will be developed in the FEED stage in cooperation with the FSRU supplier.

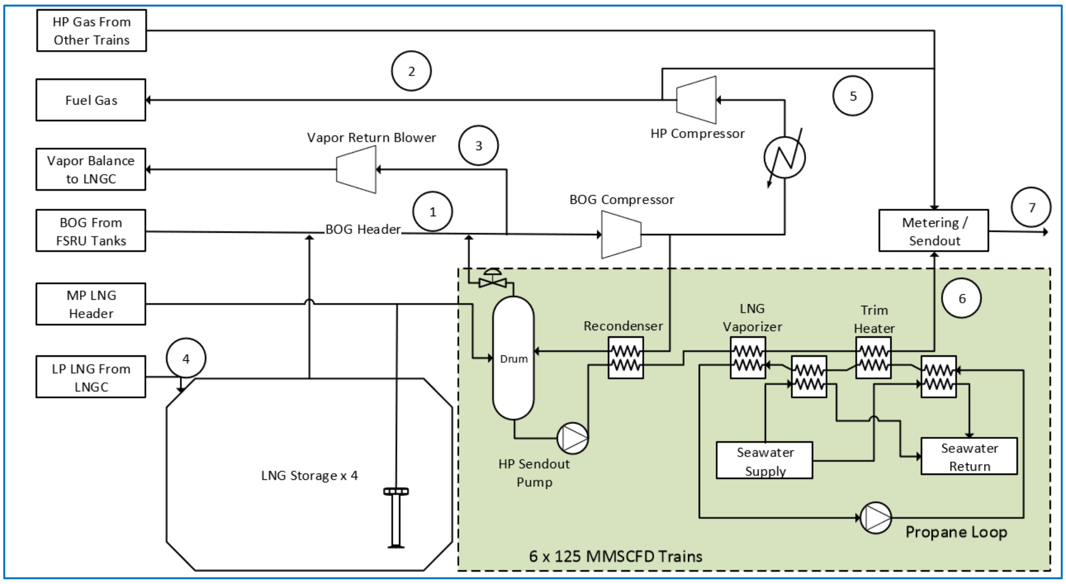


Figure 3.18: FSRU Process Flow Concept Diagram

3.9.3 Vessel Certification

The vessel will be certified by one of the following agencies:

- DNV (Det Norske Veritas)
- ABS (American Bureau of Shipping)
- Lloyds

3.9.4 Design Basis

The FSRU shall be designed and constructed according to generally recognized international design codes and standards and generally accepted good engineering practices. The following table is meant to communicate the design basis at a high level and should serve as a starting point for the FEED contractor and the FSRU supplier.

Table 3.8: Design Basis FSRU

Parameter	Value
Nominal FSRU Storage	170,000 m^3
BOG Rate from FSRU due to heat inleak	0.15 Vol% per day
LNGC Transfer Rate to FSRU	8,000 m^3/hr or max achievable using hose technology.
Maximum gas send out rate	750 MMSCFD (capable of 5:1 turndown at least)
Maximum gas send out pressure	80 barg at the pipeline entry
LNG Vaporizer Type	Per Vendor
Safety Systems	Per guidelines and standards. To include communication link between LNGC, FSRU, and Jetty.
Design Reviews, HAZID, HAZOP, etc.	The design will be subject to various design reviews and risk analyses.

3.9.5 Utilities

The FSRU will be self-sufficient regarding power, steam, nitrogen, fresh water, and other utilities.

3.9.6 Availability and Design Life

The design life shall be for 25 years.

3.10 Offshore Pipeline

3.10.1 General Design Condition

Table 3.9: General design data offshore pipeline

Design Data	Parameter
Design Pressure	100 barg
Design Pressure Class (ANSI)	600#
Maximum Operating Pressure	90 barg
SSGC Grid Operating Pressure	48-55 barg
Design Temperature	50°C
Maximum Operating Temperature	+40°C
Minimum Operating Temperature	+5°C

3.10.2 Flow Quantities

The gas quantities to be transported through the pipeline system form the basis for the system design, i.e. the sizing of the pipeline. Maximum & minimum flow quantities are shown in Table 3.10.

Table 3.10: Flow Quantities

Design Parameter	Value
Maximum Send Out	940 MMSCFD
Minimum Send Out	400 MMSCFD

3.10.3 Mechanical Design

The mechanical design of the submarine pipeline has been carried out to demonstrate technical feasibility and provide a basis for cost estimating purposes only. It is intended only to provide a preliminary engineering design.

- From the results of the hydraulic analyses, the recommended pipe size is 32".
- The design pressure for the pipeline system is established at 100bar.

3.10.4 Corrosion Protection

(1) Anti-Corrosion Coatings

There are several line pipe coatings suitable for use with the submarine section RLNG pipeline in accordance with DNV RP F106. These systems can be divided into four generic groups as follows:

- Elastomers
- Polymeric coatings
- Epoxy coating
- Asphalt/CTE Systems

Polymeric and asphalt coating system are well suited for corrosion protection of submarine RLNG pipeline. The selected anti-corrosion coating system is 3 layer polyethylene (3LPE) as per CDS No. 2 of DNV RP F106.

(2) Cathodic Protection System

All aspects of the cathodic protection system for the offshore and landfall pipeline sections are considered in relation to DNV RP F103 "CATHODIC PROTECTION OF SUBMARINE PIPELINES BY GALVANIC ANODES" as representing standard industry requirements and practice.

Due to low fluid temperature and burial requirement the recommended anode system is a half shell (bracelet) zinc anode.

3.10.5 Pre-lay Construction Works

(1) Seabed Rectification

To avoid overstressing or excessive displacements, seabed intervention may be needed prior to or concurrent with pipelaying. Possible modifications of the natural seabed include:

- Soil replacement to improve the foundation properties, e.g. to prevent the pipeline from sinking into soft mud
- Trenching to reduce the actions from waves and current

- Protection of existing pipelines or cables in connection with crossings
- Reduction of free span heights to reduce the forces due to overtrawling
- Smoothing of the pipeline profile to reduce the length of free spans or prevent contact pressures that could damage the coating or dent the pipe steel.

Spans that are unacceptable in the unstressed, air-filled condition must be rectified before installation of the pipeline. Other free span rectification may be postponed until after the pipe string has been placed (post-lay intervention).

For the fatigue verification it is common industry practice to require that no more than 10 % of the allowable damage ratio be reached during the temporary installation phases, which include a period in which the pipeline is empty on the seabed and a period in which it is water filled. As the free spans are typically larger in the former case the accumulated damage can be reduced by flooding the pipeline shortly after installation, thus obviating the need for pre-lay span rectification.

Once the pipeline is ready for operation it will be known what fatigue damage may have occurred during installation (pipelaying) and how long time free spans will have been exposed in the empty and in the water filled condition (it is not necessarily the same pipeline sections in the three cases). The remaining fatigue life of the free spans in the operating condition can then be calculated, and post-lay free span rectification carried out if necessary.

The construction of pipeline trenches or the removal of outcrops to reduce free spans are normally achieved by dredging. As the trench must be sufficiently wide to receive the pipeline, pre-trenching is an attractive option only for the shore approaches.

As an alternative to the removal of seabed material a suitable support for the pipeline may be created by rock dumping, below, either along the entire section affected, or - more likely - as isolated gravel berms.

Pre-lay free span supports will have to be made sufficiently wide to cater for the pipe lay tolerance as well as the horizontal tolerance on rock dumping, which is greater when the gravel berm cannot be related to a fixed object (e.g. the pipeline) on the seabed. Thus there is an economic incentive to use post-lay rather than pre-lay intervention.

Unacceptable free spans may also be reduced by structural supports, established on the seabed during the installation. Proprietary systems have been developed where the pipeline can be supported at variable height above the seabed, and the supports can be placed by divers or diverless. This may be the only alternative at very large water depths, where neither dredging nor rock dumping is viable. Isolated supports made from grout bags or similar may also be installed under the pipeline to prevent it from sinking deeply into very soft seabed soil, e.g. organic mud.

It may also be necessary to establish lateral supports to guide the pipeline in the horizontal plane to achieve the desired lay radius in case the lateral soil friction is insufficient. Rather than gravel berms such counteracts may take the form of structural elements which can be retrieved and reused. A typical design would be a hollow concrete cylinder, possibly provided with a steel skirt that penetrates the seabed to enhance the lateral resistance. To increase the support capacity further the cylinder can be filled with gravel.

(2) Crossings

In case of an abandoned pipelines or cable the only concern is that it may prevent trenching of the pipeline. The crossing of live pipelines or cables, however, calls for special measures, including negotiations with the third party owners. To avoid damage to any of the installations the pipeline and the pipeline or cable should be separated by minimum 0.3 m. Accounting for penetration or self-burial of the pipeline the soil cover on the cable should be at least 0.8 m to obviate the need for dedicated protective measures. The existing pipeline or cable may already be trenched into the seabed, or it may be allowed and feasible to carry out such trenching. In that case is suffices to lay the pipeline on top. Since it then cannot be trenched any required protection will have to be performed by post-lay rock dumping or similar.

A more likely scenario is that the live pipeline or cable is on the seabed or buried less than 0.8 m, and cannot be touched. Then it is necessary to engineer a pipeline crossing using rock berms, mattresses, grout bags or similar, so the new pipeline can be laid across without damage to the pipeline existing pipeline or cable, and the entire crossing covered, if required. A typical cable crossing in shallow water, involving the use of mattresses of bitumen and concrete, is shown below. Bitumen mattresses are made from asphalt and crushed rock, held together by wire mesh and/or geotextile, whereas concrete mattresses are made from concrete blocks linked together to form a flexible mat. A typical mattress thickness is 300 mm.

As shown in figure above a row of bitumen (inner) mattresses is placed over the existing pipeline or cable, with a row of (outer) mattresses at either side. The length to be covered depends upon the crossing angle, as the dimension perpendicularly to the future pipeline should be sufficiently large to ensure that the pipeline will be laid on the prepared crossing with the specified lateral lay tolerance, typically 2.5 m. After laying, thinner bitumen support mattresses may be pulled-in under the pipeline to ease the transition between the seabed and the covered crossing. Protection and stabilization, particularly to prevent the pipeline from being dislocated from the crossing, may be achieved by concrete mattresses placed over the pipeline. Scour protection of the exposed edges of the bitumen mattresses is achieved by shingles, deployed in bags that are placed and cut open by divers.

If the existing pipeline or cable is exposed on the seabed its integrity could be compromised even by the installation of mattresses or rock berms, in which case it would be needed to establish support piers on either side of the cable, effectively creating a free span of the pipeline over the existing pipeline or cable. The support piers could take the form of rock berms or be made from mattresses. In either case, the penetration into the seabed must be taken into account to ensure a free space of 0.3 m over the crossed pipeline or cable.

(3) Pipe laying

Submarine pipelines can be laid in different methods. Due to the shallow water depth and the short pipeline length to be installed only the two following methods namely S-Lay and Surface Tow are presented more detailed.

(a) S-Lay: A typical pipelay configuration is sketched in Figure below, the pipeline describing an S-curve from the laybarge to the seabed. In the upper part (the over- bend) the curvature is controlled by the laybarge stinger, a steel structure pro-truding from the stern of the vessel, which supports the pipeline on rollers. The curvature in the lower part (the sagbend) is controlled by lay tension transferred to the pipeline by tension machines gripping the pipe string on the lay barge. The tensioners are equipped with rolling tracks to allow movement of the pipe- line whilst under tension.

In most cases with shallow water depths the lay barge is moored to eight or twelve anchors, and moves forward by pulling on the anchor cables. The anchors are relocated by tugboats, which together with the supply ships, survey boats and possibly diving support vessels constitute the lay barge spread.

The coated pipe joints are transported to the lay barge on pipe supply ships and stored onboard.

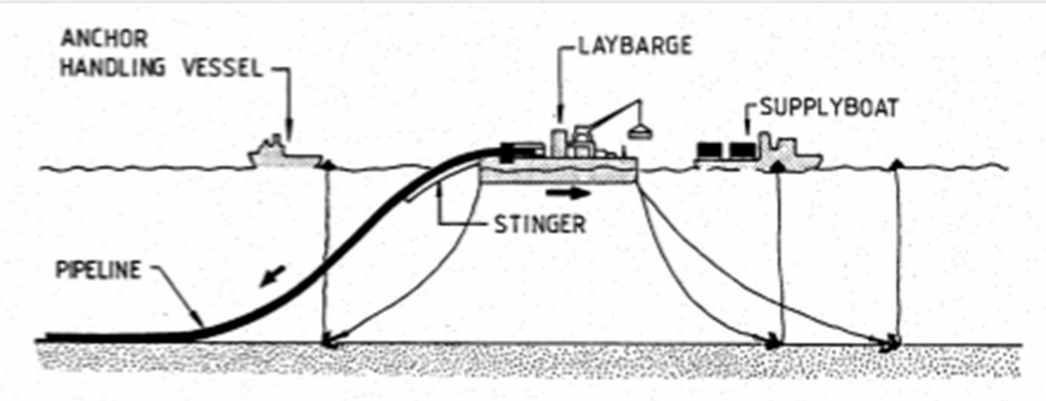


Figure 3.19: Typical S-Lay vessel arrangement

Some major lay barges have double jointing facilities, implying that two 12.2 m pipe joints are welded together, usually by automatic submerged arc welding before they are transferred to the end of the pipe string (the firing line), and welded onto the pipeline. To save time the welding on the firing line is carried out at a number of stations, and as the weld is completed the pipeline goes into the tensioners. The field joint coating, however, is carried out just before the stinger, usually at two stations working in parallel. The lay barge advances one pipe joint (or two joints, in case of double jointing and two field joint stations), moving under the pipeline, which goes out over the stinger. The lay rate is highly dependent upon pipe size, welding conditions, etc, but under optimal conditions a daily production (working 24 h) of 4-5 km is not unusual.

Pipe laying of the RLNG pipeline is envisaged to be initiated at a shore approach, where the lay barge picks up a previously laid pipe string. During pipe laying the steel stresses and strains are monitored in accordance with procedures detailed in the contractor's installation manual, to document compliance with the specified limits. The DNV OS F-101 stipulates that for any accumulated plastic strain exceeding 0.3 % an engineering criticality assessment is carried out for the girth welds, and that the fracture toughness properties required to tolerate the adopted defect acceptance criteria are documented. The assessment shall take account of stress intensification due to the passage over the rollers of anodes, as well as of dynamic effects.

On the concrete coated sections the anodes are either flush with the concrete, or the coating is chamfered down to the anode. The anodes on sections with anticorrosion coating only are tapered and/or provided with taper cones. In case such anodes are installed during laying then the two half shells are bolted together onto the pipeline after it has passed through the tensioners. Alternatively, each anode may consist of only one (top) half shell, the bottom half being replaced by steel rings only. The anodes should be secured on the pipeline, either by high friction or by stick welding of protruding insert strips onto doubler plates on the pipe. In the latter case the cable connection can be omitted, provided the cross-section of the steel strips ensures sufficiently low electrical resistance. During the pipe laying campaign measures shall be taken to prevent collision between third party marine traffic and the pipe lay vessel or its anchor spread.

(b) Surface Tow (Flow-Lay®): Developed by Land & Marine, a wholly-owned subsidiary of Murphy, Flow-Lay® is a proprietary surface tow and flood technique for offshore pipeline installation. Designed to reduce costs and to provide an economical alternative to conventional methods as S-Lay, the construction method allows pipelines to be fabricated on land, launched and towed to location in a single length.

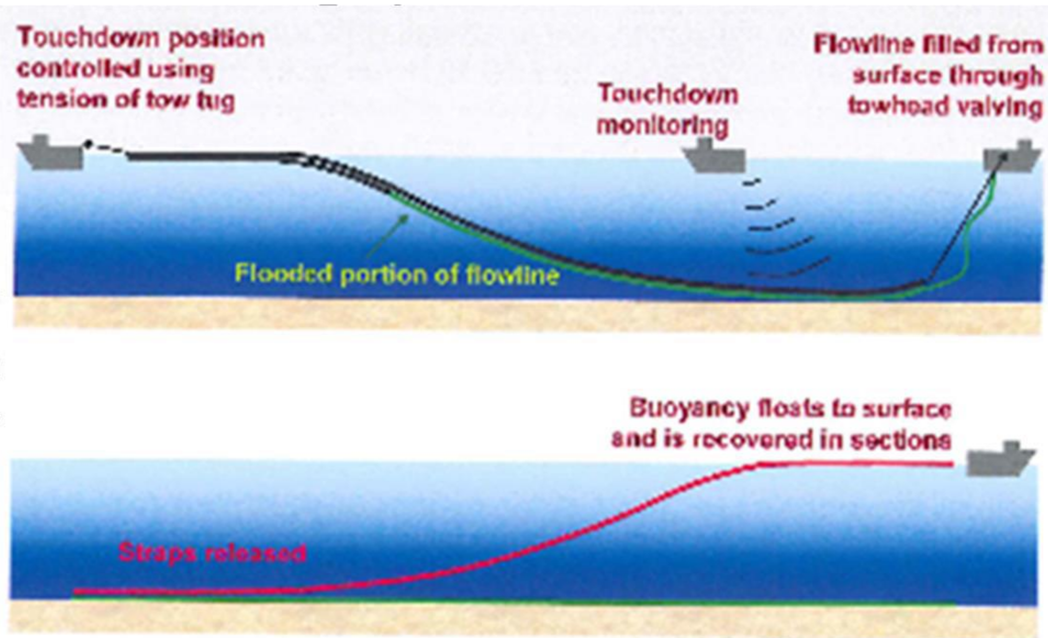


Figure 3.20: Flow-Lay® process

A polyethylene (PE) pipe, attached to the steel pipeline, acts as a carrier, providing buoyancy and allowing the pipeline to be towed on the surface. Tow and trail tugs maintain tension in the pipeline during the tow and installation, reducing the effect of wave action hence reducing stresses and fatigue effects.

When aligned over the target, controlled flooding is initiated to deploy the pipeline to the seabed and alignment along the route is maintained by adjusting the position of the trail tug as the deployment progresses. The process is reversible so that small adjustments can easily be made if necessary.

Once the pipeline has been laid on the seabed and the carrier pipe flooded, the latter is released by divers. Due to its natural buoyancy, the PE pipe will gently rise to the surface, where it can be recovered for re-use Flow-Lay® can be used for the installation of flow lines or bundles. It has been used to install a 5.5 km long 20" steel concrete coated oil pipeline in Ecuador.

(4) Landfall Construction Works

(a) Shore Pull: The most common method of shore approach installation is by bottom pull, either to shore (shore pull) or from shore (offshore pull). The pipe is pulled in a pre-dredged trench through the surf zone to a point above the high water mark. The depth of the trench shall be sufficient to ensure that the pipeline is not exposed by seasonal or long-term variations of the seabed profile.

For offshore pull a pipe-stringing site is set up on shore, and the landfall pipe is welded into one string. The laybarge is positioned at the pre-dredged trench, and using the barge winches the already prepared pipe string is pulled through the trench onto the barge, from where pipelaying is continued. A fairly large onshore area is needed for the pipe-stringing works.

A shore pull requires the preparation of an onshore pulling station, usually consisting of two linear winches connected to a hold-back anchor, which may be a sheet pile wall. The winch cables are by means of a sheave arrangement connected to the pull cable, which has been pulled in from the laybarge stationed offshore, at the mouth of the trench. On the barge the pull cable is connected to a pull head, which is welded onto the first pipe joint, and the pipeline is pulled ashore as it is produced on the barge. The maximum length of the shore pull is approx. 2 km, and to reduce the required pull force buoyancy elements may be attached to the pipeline, particularly the pull head.

If the landfall site conditions make it unpractical to install an onshore pulling station the shore pull may be performed by barge-based winches, using an anchored sheave block on shore. This is less efficient; however, as the barge winch must overcome the friction of the return cable as well. The construction of the shore approach trench (onshore as well as nearshore) is carried out by traditional digging or dredging equipment, and the cover to the pipeline shall be minimum 2 m. Depending upon the soil characteristics backhoes, bucket dredgers, cutter-suction dredgers or dustpan dredgers may be used. In the shallow near-shore waters the dredging may be carried out from jack-up platforms, or even fixed structures. When the pulling is completed the pull head is cut off, and using land based pipelay equipment additional pipe joints are added (back-laying) up to a point where the tie-in to the onshore pipeline can conveniently be carried out. Isolating couplings (isolation flanges or monoblocks), separating the offshore from the onshore pipeline, would normally be installed at the nearest valve stations. The section between the shoreline and the valve station will be cathodically protected by the sacrificial anodes on the offshore line, at least if the distance does not exceed approximately 1,000 m. If the distance is longer or if the line crosses region of dry sand with high resistivity, monitoring probes and a backup impressed current system could be installed.

After completion of the construction activities the cofferdam is removed, the onshore trench filled in and the beach area reinstated. Also the near-shore trench shall be backfilled, a process that may often be left to nature. As the coast-near areas are also the most environmentally sensitive, the trenching activities are likely to be subjected to severe restrictions, including concerning the disposal of the dredged material. Cutting a trench through coastal cliffs and near-shore reefs may well be environmentally unacceptable, in which case horizontal directional drilling could be an attractive option.

(b) Directional Drilling: Horizontal Directional Drilling (HDD) is a technique used in hydrocarbon exploration and production whereby the drill bit at the end of the originally vertical drill string is diverted sideways to an eventually horizontal direction, which allows the tapping of a large and shallow reservoir area from a single production platform. In the context of pipeline installation the term is used to designate an installation method in which the prefabricated pipe string is pulled through a hole in the ground made by a directed drill string. The method is illustrated schematically in figure below.

The drill rig is placed at the pipeline entry point, and a pilot string is inserted into the ground. The drill bit is hydraulically powered by bentonite drilling mud fed through the pilot string. The bentonite mud transports the soil away and fills the hole behind the drill head, preventing it from collapsing. The drill head is connected to the non-rotating pilot string by a swivel. The diameter of the cutting head is larger than that of the pilot string, which is encased by a drill string, and additional lengths of pilot string and drill pipe are added as the drill bit advances through the soil.

When the cutting head emerges at the exit point it is removed, and the pilot string is withdrawn through the drill pipe. A reamer is then attached to the drill string, which is pulled back through the hole, wash pipe being attached behind the reamer. In the process the hole is enlarged by the reamer, and if necessary the process is repeated with larger reamers. When the hole is sufficiently large to accommodate the topical pipe string, it is attached to the wash pipe and pulled through the hole with a reamer attached to the pull head as a precaution- ary measure. Typical diameters would be 63 mm (2 1⁄2)" for the pilot string and 125 mm (5") for the drill string, with reamers of 350 mm (14"), 600 mm (24") and 900 mm (36"). The latter will leave a hole sufficiently large to accommodate a 32" pipeline.

The route of the pilot string is determined by the entry angle and by the design of the drilling unit. The cutting head includes a hydraulic motor that uses the energy of the circulating drilling mud to rotate the bit. The cutting head is mounted on a bent transition unit (bent sub), the angle of which determines the curvature of the pilot hole, and forms the transition to the non-rotating pilot string. Any deviation from the prescribed path is corrected by rotating the pilot string, thus forcing the drilling unit into a revised direction. In this way the drill can be made to exit within a few metres from a target point located several kilometres away. If the exit point is unacceptable the pilot string is withdrawn a certain distance and the route corrected.

Determination of the current position of the cutting head is accomplished by one or more of the following devices:

- A pendulum providing inclination with horizontal
- A single shot survey camera providing tool face inclination and compass bearing
- A plumb bob arrangement providing inclination
- A triangulation system using sonar stations providing azimuth.

The success of the directional drilling method depends on the soil conditions, fairly uniform clay or soft rock being the most appropriate. Thus sediment rock types like limestone, sandstone or mudstone are very appropriate. If the cutting head should hit a large boulder or hard inclusion the string is retracted, and the hole redirected to avoid the obstruction. To avoid damage to the anti-corrosion coating as the pipe string is pulled through the ground, the coating must be abrasion-resistant, and 3 – 4 mm polypropylene is a typical choice. Alternatively, a dual powder FBE system can be used, or a conventional fusion bonded epoxy coating may be protected by a layer of polymer epoxy concrete or similar. Concrete weight coating is obviously not needed, as the pipeline is deeply embedded in the soil.

Directional drilling does not involve any activities between the entry point and the exit point, and is therefore a preferred method for crossing environmentally sensitive areas. Applied to a shore approach the drill rig is set up on shore, and a pilot hole drilled to a pre-dredged trench at the marine exit point. The drill string is pulled onto a crane barge (or jack-up platform) with supporting equipment to handle drill pipe and hole openers (reamers).

A number of hole opening passes are carried out, until the drilled hole is sufficiently large to accommodate the 32" pipeline. The crane barge is then replaced by a laybarge, from where the pipe string is pulled trough the hole unto the barge, and pipelaying continued.

It is also possible to make the pipe string on the laybarge using a dead man anchor, connect the initiation head to the drill string, and pull in the pipeline from a shore-based pulling station. This is not likely to prove cost effective, however, as onshore construction activities would be replaced by more expensive laybarge time.

In addition to environmental-friendliness an attractive feature of HDD is speed, due to the fact that the hole may be prepared in a couple of weeks, and reinstatement is minimal.

(5) Jetty Approach

At the end of normal laying operation the line string is laid down in close proximity to the platform. The connection between submarine pipeline and topside piping will achieved installing a riser and spool. The riser will be attached to jetty structure using rigid clamps. Connection between spool, riser and pipeline can be made using swivel flanges.

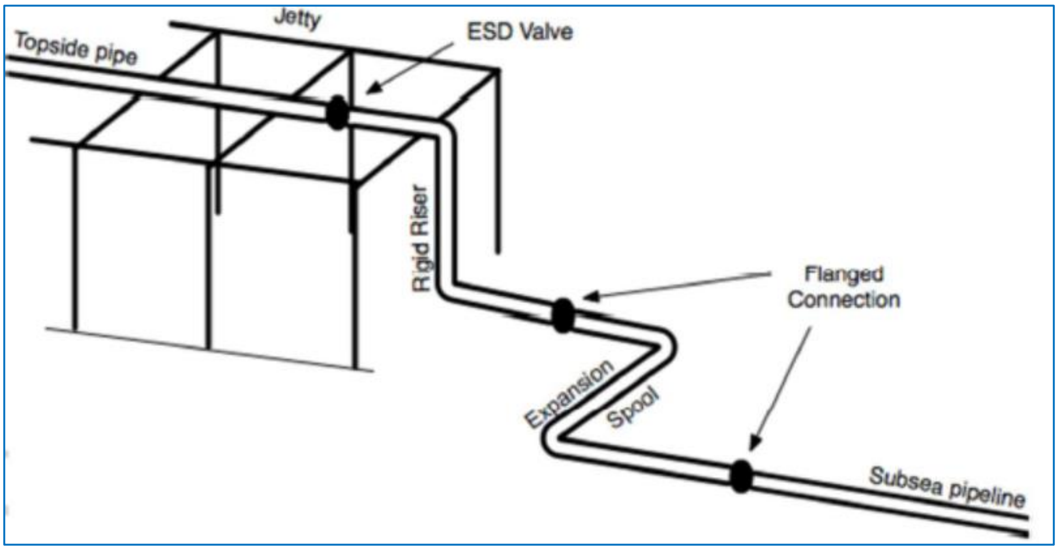


Figure 3.21: Typical platform approach

3.10.6 Post-Lay Construction Activities

(a) Post-Lay Trenching: On some sections permanent installation of the pipeline below the natural seabed is required for hydrodynamic stability and for mechanical protection. Outside the shore approaches, which are installed in pre-dredged trenches, this is carried out by post-lay trenching methods, which include:

- Water-jetting
- Mechanical cutting
- Ploughing.

Water-jetting is performed by means of a jet sled, which is riding on the pipe- line, guided by rollers at the top and the sides of the pipe. The jet sled is pulled by a trench barge, which also delivers the compressed water that is ejected trough nozzles at each side of the pipeline. The nozzles may be arrayed vertically or mounted on inclined swords of adjustable length. The water liquefies and displaces the seabed soil, leaving a trench into which the pipeline sinks. This process is aided if the trenching is carried out when the pipeline is water-filled, but it must be documented that this will not lead to overstressing of the linepipe steel. Several passes of the jet sled may be necessary to achieve the specified distance from the natural seabed to the top of the pipe.

The trenching vehicle may also be self-propelled on tracks or skids, and remotely operated. This obviates the need for a pull cable, but power and control will still have to be delivered from a surface vessel.

Jetting is most efficient in soft or sandy seabeds, but can also be used in cohesive soils with shear strengths up to approximately 100kPa. In stiff clay mechanical cutting is preferred. The trenching tool is riding on the pipeline, being pulled by a trench barge or self-propelled and remotely operated.

Instead of water nozzles it is equipped with cutting heads, which excavate a V-shaped ditch in the seabed. The trench may also be excavated by a plough, which is clamped around the pipeline is such a way that the shears displace the soil from under the pipeline, depositing it in ridges alongside the trench. The plough is supported on skid beams or wheels, and is pulled by a surface vessel, being guided along the pipeline by rollers. Depending upon the specified trench depth and the nature of the soil more than one pass of the plough may be necessary. Trenching ploughs have been developed that can deal with all soil types, from soft mud to shale or limestone, and ploughing may be an option for any post-lay trenching. Alternatively, the entire trench may be performed as pre-lay trenching in connection with the shore approach construction.

(b) Backfilling and Protection: The mere trenching of the pipeline will normally be sufficient to ensure hydrodynamic stability, and if a soil cover is necessary for long-term integrity this will often be achieved by natural backfilling. Indeed, in sandy soils where the trenching is performed by water-jetting, some soil will be suspended rather than displaced, and will settle around the pipeline.

Seasonal storms will ensure a complete filling of the trench. When the trenching is carried out with a pipeline plough backfilling may be achieved by a second pass with a set of shears that scoops the displaced soil back on top of the pipeline.

Trenching of the pipeline may be obviated by reliance upon self-burial, i.e. the tendency of any heavy object to sink into a sandy seabed due to the scouring action of waves and current. An attractive possibility is to leave the pipeline water-filled on the seabed during a winter season, and the following spring only post-trench those sections that have not embedded themselves sufficiently to be stable when the pipe is emptied.

On some pipeline sections a soil cover may be needed to protect the pipe from mechanical damage from fishing gear or minor anchors, or to prevent upheaval buckling. If natural backfilling (or ploughing, see above) cannot be relied upon the cover will have to be established by dumping rock material on the pipeline. The size of the individual stone or gravel particles shall be adjusted to the environmental conditions to ensure that the material will not be removed by wave and current action. The rock dumping may be performed by split barges, but much more economical use of material is obtained by using a rock dumping vessel equipped with a fall pipe, through which the material may be placed over the pipeline with great accuracy. Fall pipe rock dumping is routinely performed at water depths exceeding 300m, the vertical tolerance being +/- 200 mm, and has been carried out at depths up to 1000 m.

At the hot end of the pipeline in-service buckling may occur due to the axial compressive loads caused by thermal and internal pressure actions. If the pipeline is resting on the seabed a lateral deflection mode will prevail (snaking), whereas a vertical deflection mode will take place in case the pipeline is trenched and buried (upheaval buckling). Horizontal snaking can be controlled by intermittent rock berms designed to prevent axial movements, thus isolating the pipeline sections on either side from each other. The design principle is that distance between the intermittent berms shall allow all expansion in the corresponding pipeline section to be safely fed into a single buckle. If the pipeline is trenched additional backfill may have to be applied to prevent upheaval buckling. In either case, rock dumping is the most likely intervention method.

3.10.7 Testing and Pre-Commissioning

(1) General

Pre-commissioning, also known as RFO (ready for operation), covers all activities from performance of the acceptance pressure test, normally part of the scopeor the installation contractor, up to the filling of product into the completed pipeline, and the commencing of product transportation:

- Flooding
- Hydrotesting
- Cleaning
- Gauging
- De-watering
- Drying
- Nitrogen filling (if required).

The activities of de-watering and drying are particularly important for gas pipelines, because any remaining water may react with the gas to form hydrocarbon hydrates, which can obstruct the flow and in particular the proper functioning of valves.

(2) Flooding and Hydro testing

When all construction activities have been carried out the final integrity of the installed pipeline is documented by hydrostatic testing. This requires that the pipeline be water-filled, and seawater is envisaged to be used for this purpose. The seawater is pumped into the pipeline through a simple water winning arrangement that includes filtering to remove particles larger than 50 micron, and possibly treatment of the seawater with oxygen scavengers and biocides to pre-vent internal corrosion of the linepipe steel.

The oxygen scavenger removes the oxygen which may fuel corrosion, and the biocide prevents the growth of an-aerobic bacteria. A typical oxygen scavenger is sodium bisulphite ($NaHSO_3$), a dosage of 65 mg/l (ppm) being required to for an oxygen concentration of 10 ppm. A common biocide is glutaraldehyde at an active concentration of 50-75 mg/l (ppm). As glutaraldehyde reacts with sodium bisulphite the oxygen scavenger should be given a few minutes reaction time before the biocide is added, or alternatively an over dosage must be used. Some commercially available sodium bisulphites are combined with a catalyst, which may reduce the requirement for time delay or over dosage. An alternative biocide is sodium hydroxide (NaOH), also known as caustic soda or lye. To reach a pH of 10.3, which is lethal to most organisms, a dosage of 0.4 – 0.6 l/m3 of 30 % NaOH is needed. However, the use of lye will result in large amounts of precipitated carbonates and hydroxides, which may impede the function of valves, and form calcarious deposits that are not easily removed from the pipe wall.

The requirements to chemical treatment are very much dependent upon the residence time of the test water in the pipeline, and if it is less than 60 days biocides may be obviated. If sterilisation of the test water is required, treatment with ultra violet light could be considered as an environment friendly alternative. Oxygen scavenger, which is widely viewed as considerably less environmentally foreign than biocide, should always be added to avoid corrosion of the field joint areas, which are not protected by the internal flow coating.

The hydrostatic testing comprises a strength test as well as a leak test, and is carried out by pressurising the water to the specified leak test pressure, which is kept during the specified holding period. The holding period shall take into account that there needs to be time for temperature variation stabilisation, and should not be taken less than 24 hours after stabilisation has been documented. During the holding period the pressure is closely monitored, and any pressure drop which cannot be ascribed to variations in atmospheric pressure, water levels or seawater temperature signals a leak, which must then be localised. To facilitate leak detection the test water can be mixed with a powerful dye or a hydrocarbon tracer, which can be sensed by a 'sniffer' fish that is towed along the pipeline. Due to environmental concerns, however, dyes should be avoided.

Should a leak occur, which has been known to happen, it normally takes the form of a violent rupture, which is easily localised even if the pipeline has been trenched and backfilled. If a visual survey does not suffice to locate the failure it is possible to launch a 'pinger' pig, which can be tracked acoustically until it stops at the rupture.

(3) Gauging and Cleaning

Even if the pipeline survives the hydr- testing it shall be documented that there are no dents in the line pipe wall, which could induce failure in the long term, or obstruct the passage of cleaning and batching pigs. For this purpose gauging and caliper pigs are propelled through the pipeline.

The caliper pig is a so-called intelligent pig, equipped with sensors that measure the internal diameter at a number of points around the circumference, and it is not normally used during construction. The device is sufficiently sensitive to pick up the individual girth welds, and produces a chart showing the average bore against the distance travelled. In this way any anomaly can be located for diver or ROV inspection and cut out if necessary.

The gauging pig is normally a simple aluminium plate, which during construction activities is recovered and inspected. Gauge plates are often sent through the line more than once, particularly if the installation including pre-commissioning is split between more contracts, and a successful gauging run is likely to be a contractual interface.

According to DNV OS-F101 the diameter of the gauge plate should be 97 % of the nominal pipe ID, but a smaller plate diameter may well be topical in order to take account of weld root penetration and misalignment. The gauging pig is normally incorporated in one of the pig trains used to clean the pipeline interior during and after water filling. Due to the internal flow coating the amount of rust and mill scale is limited, but other debris may well have accumulated during construction.

The cleaning trains include both brush pigs and swapping pigs, the latter removing any brushes that may have broken off. The pig trains are normally propelled by the treated seawater pumped in for the purpose of the hydro-test, but further cleaning by running brush and swapping pigs in air may take place during and after de-watering.

The length of the train is 900 m; the cleaning operation may be facilitated by gel-plug technology. A gel is a plastic fluid with the capability to pick up loose and loosely adhering solids. The gel slug is inserted into the pipeline, followed by an appropriately designed scraper pig. The train will consist of more scraper pigs that will collect any gel slipping by the pig driving the gel. The plastic fluid will move through the pipeline in a manner known as plug flow. The central part of the slug moves as a semi-solid plug with little exchange of material with the fluid making up the annular flow region adjacent to the pipe wall, which moves at a velocity lower that the mean velocity of the total gel plug. The core of the gel in front of the mechanical pig, moving faster than the gel on the outside closer to the wall, creates a tractor action, pulling and lifting the debris laden gel away from the front of the pig and into the gel plug. The debris, which would remain in front of the pig in a conventional operation, is thus picked up and eventually distributed throughout the length of the slug. Gels can be produced with a range of viscosities, including solid gel pigs, capable of removing wax or paraffin deposits.

(4) De-Watering and Drying

The de-watering operation must be planned with a view towards the disposal of the water, particularly if it is treated with chemicals, as dumping in coastal areas is not likely to be acceptable. Thus a temporary outfall pipeline must be constructed, and the water is discharged through a diffuser head to ensure a dilution to a concentration that is not harmful to marine life, a fact which must be documented by environmental impact studies. Dewatering of the pipeline is carried out by means of air-propelled pig trains during or after cleaning.

A complete drying of the pipeline is necessary, as any residual water may react with the gas to form hydrates, which may obstruct the flow and impair the proper functioning of valves. The presence of water will also make any impurities of hydrogen sulphide (H_2S) and carbon dioxide (CO_2) highly corrosive. To dry the pipeline the following methods may be used, alone or in combination:

- Methanol (or glycol) swapping
- Hot air drying
- Vacuum drying

In the swapping method a batch of methanol or tri-ethylene glycol (TEG) is enclosed between pigs and propelled through the pipeline by compressed air. Residual water will be dissolved in the hygroscopic substance, leaving a film that is mostly methanol or glycol.

An alternative procedure, which combines cleaning and drying in one operation, is gel pigging, as described above. Modern gel-forming agents can produce gels from an array of liquid components. By incorporating gels based on hygroscopic fluids, such as methanol, into the cleaning train the water is removed along with the debris.

Hot air drying utilizes the ability of hot air to contain a large amount of water as vapor, whereas vacuum drying relies upon the lowering of the boiling point of water at low pressures. The vacuum pumps will have to work for several days or weeks to reduce the pipeline pressure to a few millibars. At that pressure the water dew point will be less than minus 30°C, indicating adequate dryness of the pipeline. To limit the time vacuum drying is often used as the last step, i.e. after most of the water has been removed by swapping or gel pigging.

(5) Nitrogen Filling

To prevent any internal corrosion between pre-commissioning and operation the pipeline should be filled with a non-corrosive gas, such as nitrogen with a typical purity greater than 95 % (i.e. 95 % N2, 5 % atmospheric gasses). However, nitrogen with 5 % atmospheric air should not be considered noncorrosive if there is free water in the pipe. The amount of oxygen is large enough to cause severe corrosion over a prolonged period of time, and if aerobic/anaerobic bacteria are also present the pitting tendency may be large. To achieve non-corrosive conditions in a pipeline that is not completely dry the nitrogen should constitute more than 99.98 % of the gas.

For a vacuum dried gas pipeline the nitrogen is simply let in, in other cases the air in the pipeline is displaced by nitrogen, a process known as purging. Liquid nitrogen is vaporized through heat exchangers and injected into the pipeline. To guarantee a low level of oxygen the amount of injected nitrogen should be approximately twice the volume of the pipeline.

Nitrogen is introduced at the upstream end of the pipeline with a –50 °C dew point or lower, at a controlled rate to prevent over-compression and subsequent re-condensation of water. Dew point control is critical, and the infill rate and controlling pressure shall be determined to ensure that at no time the dew point is above –20 °C. During the purging regular monitoring of the oxygen content of the atmosphere in the vicinity of the discharge point shall take place.

Nitrogen shall be discharged and the dew point monitored until the separation pig has been received, during which time the nitrogen dew point is to be –20 °C or drier at atmospheric pressure at the outlet end of the pipeline. The pipeline is then packed with nitrogen to a slight overpressure of 0.1 barg (absolute pressure 1.1 bara).

When completed the pipeline is left in the final ‘hand-over’ condition, and the installation or pre-commissioning contractor will de-mobilise. Product filling for operation will be the responsibility of the pipeline owner and operator.

Chapter 4 Environmental & Social Baseline

This Chapter provides a description of the macroenvironment and microenvironment of the Pakistan Floating LNG Terminal Project. The macroenvironment includes i) the offshore location of Floating Terminal 7.5 km off the Sonmiani Bay coastline, ii) the 7.5 km sub-sea/seabed where the 32" pipeline will be buried in trenches, iii) its land based terminal, and iv) the onshore Right of Way for trenching the pipeline from the Landfall area to the tie-in point. The offshore locations include: (i) Floating Terminal site at 24° 52' 42" N 66° 36' 48" E, just within the territorial water limits set at 22,236 meter, and ii) The 7.5 km seabed which will be trenched from the Terminal site at 24° 52' 42" N 66° 36' 48" E to the Landfall site at coordinates 24° 51' 5.18" N 66° 39' 36.47" E.

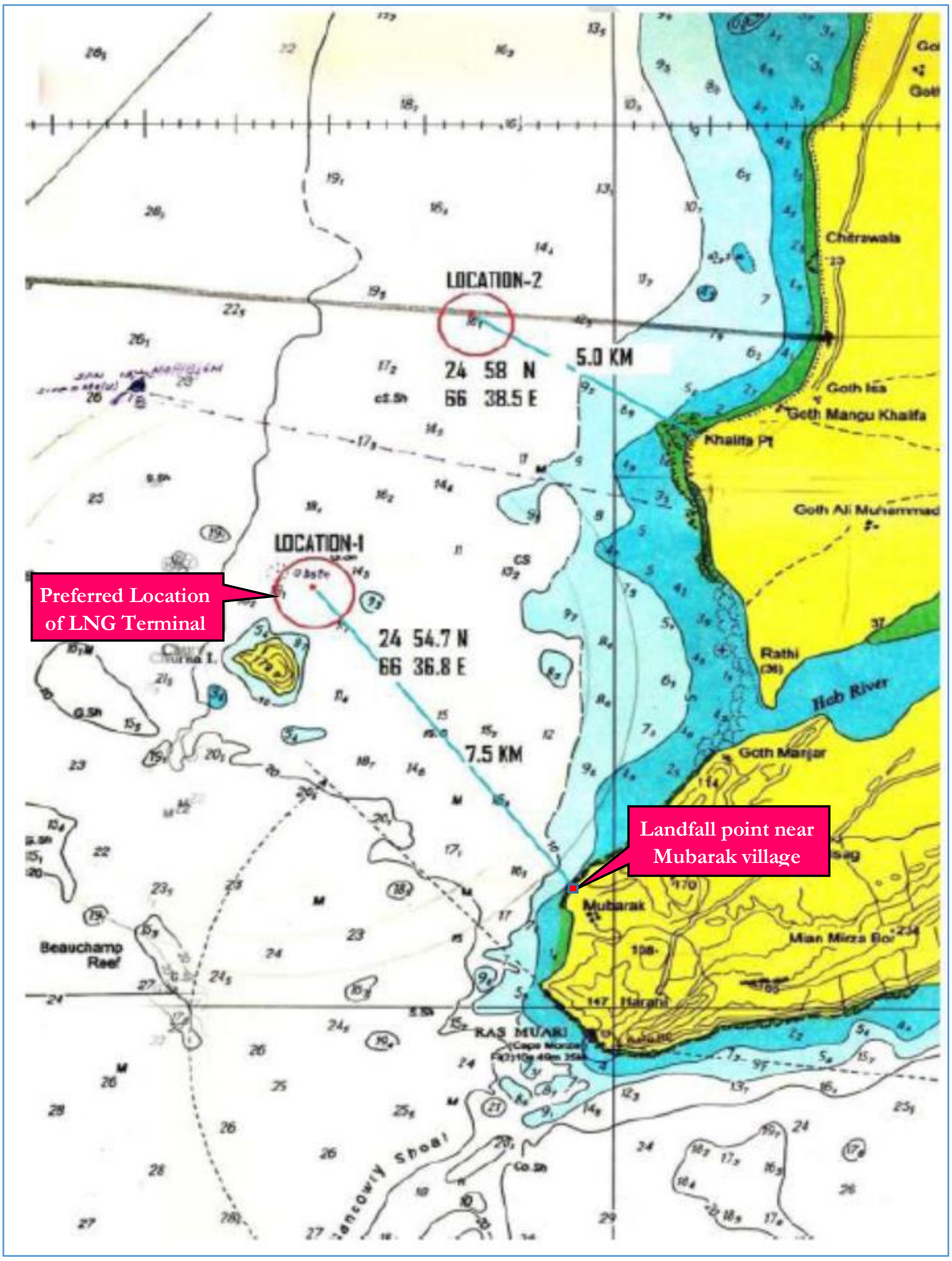


Figure 4.1: Project Location

The prospective location is positioned next to Churna Island, a small uninhabited island located in Sonmiani Bay in Balochistan Province. The island lies about 9 km west of the mouth of Hub River. Churna Island is approximately 1.2 km long and 0.5 km wide. In recent history, it was mostly used as a firing range by Pakistan Navy. The area around Churna Island is known for fishing and scuba diving. The site is therefore significant with regard to environmental and social considerations, if the terminal shall be placed in close proximity to Churna Island.

The environmental and social baseline of the offshore, and onshore area has been described here in terms of physical environment, ecological and human resources and prevailing socio economic conditions including health conditions, water and energy resources and income distribution in the population resident in the administrative district of Karachi South. The baseline information was generated by conducting field surveys and collecting secondary data available from the archives of the Consultants. The surveys include focused group discussions to assess the quality of life values including Socio-economic, and Cultural values.

According to the Government of Pakistan Territorial Waters and Maritime Zone Act 1976, the Territorial Waters limits are set at 12 nautical miles or 22,236 meters. The Maritime Zone Act 1976 has distributed the jurisdiction of governance as follows: (i) Federal government has jurisdiction over management in the zone outside the Territorial Waters i.e. between the territorial waters base line and the outermost limits of the exclusive economic zone (EEZ); (ii) Provincial governments, the two provinces (Sindh and Baluchistan) have jurisdiction over management in the waters in their respective territorial waters (12 nautical mile zone). Each province has its own administrative set-up. In addition, several other agencies involved have own plans for development and management.

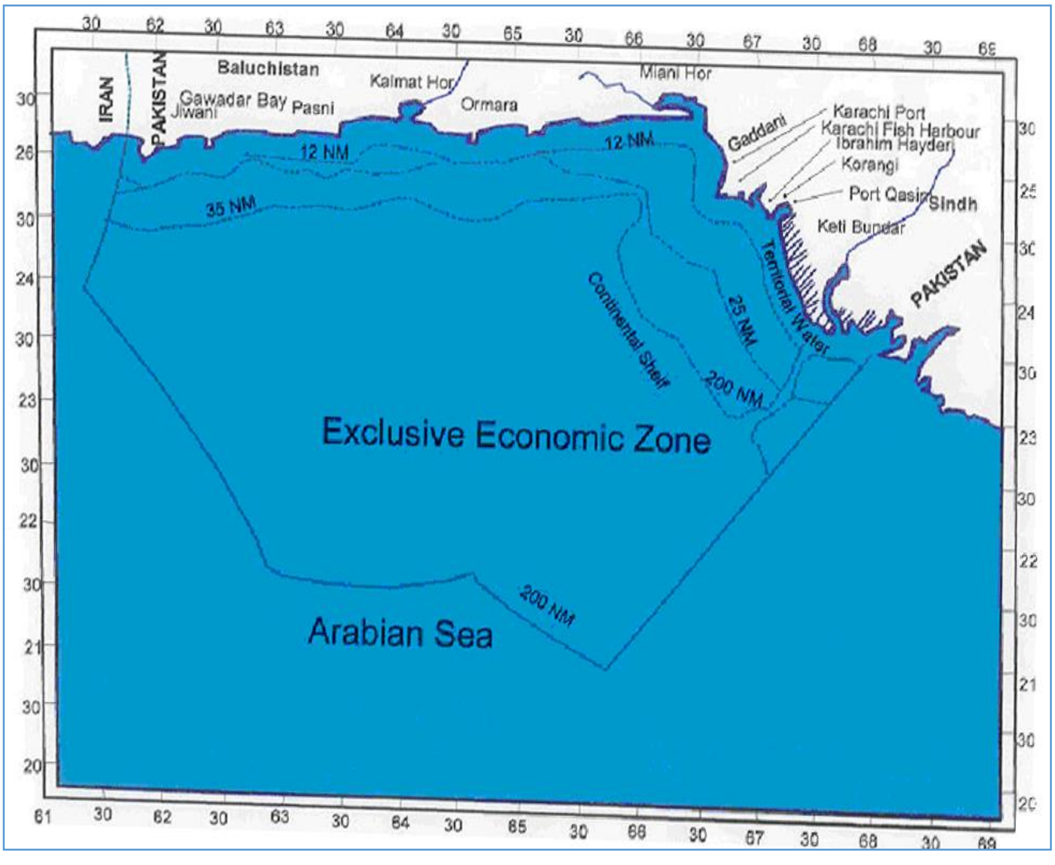


Figure 4.2: Showing Territorial Water Limits of Pakistan

The two components of the offshore marine environment namely the Floating LNG Terminal that will be just within or almost at Territorial Waters limits, and the 7.5 km seabed in which the 32” pipeline will be trenched fall in the territorial waters limits of the Provincial Government of Balochistan. The Landfall point for the 7.5 km seabed pipeline lies at Mubarak Village off the Sonmiani Bay in Balochistan, while the onshore pipeline as well as the Grid Tie-In Point fall in the jurisdiction of the Provincial Government of Sindh.

Sonmiani Bay: Sonmiani bay is 58 miles NW to Karachi and the continental shelf of the coastline extends up to 15-40 Km. The shore of the bay is indented between rocky points, it becomes sandy towards the NW and W and is covered by low forest cover, with scattered sand hills in between. The creeks in Sonmiani Bay influence high tidal fluctuations from which a large amount of energy can be harnessed by suitable conversion technology. The tidal range in the site varies in between 2.5m to 3.4m. Sonmiani Hor just southeast can be exploited for tidal power generation.

Churna Island: Churna Island is a small Island located in the Arabian Sea off the west coast of Karachi and North West of fishing settlement known as Mubarak Village at 24 53.48N 66 36.16E on an area of 400sq.km. Major part of the Island is located in the territorial waters therefore, it is under the jurisdiction of provincial government.

Churna Island has a small coral reef which supports rich biodiversity and is ecologically significant. Churna Island is triangular in shape and its dimensions are 1.5 x 1.5 x 0.8 km. There is a protected site of the island which is used for recreational purposes like angling and recreational diving. Around the Churna island small patches of living coral reefs has been reported furthermore no studies are recorded. Churna Island is one of the five sites that are proposed as the Coastal and Marine protected Areas on the coast of Pakistan

The area that lies around the island has sandy cum rocky bottom and sub tidal rocky patches; ideal for growth of coral and assemblages of coral. The coast is effected the reversal of monsoon which results as deep convective mixing particularly during the north-east monsoon which brings nutrient rich water to the surface supporting high productivity in the Arabian Sea.

Cape Monze: Cape Monze 24^{o}49’N 66^{o}40’E is entirely composed of nummlitic rocks chiefly limestone of the Oligocene and lower Miocene period. It is a relatively stable beach with a sharply steep vertical cliff. The bottom is flat but rough and uneven. Various sizes of boulders and stones are present throughout the littoral zone.

Nathiagali: Nathiagali is a semisheltered coast and there are large boulders present on the high and low littoral zones. At several places, the area is sandy between each site.

4.1 Physical Environment

4.1.1 Topography

Geographically, the macroenvironment can be divided into the alluvial plain surrounding Lasbela extending southwards up-to the Bay of Sonmiani and the hilly regions situated in the East and West of this plain. The plain itself consists of alluvium deposits of Porali and other rivers.

At the edge of the plain are adjoining hilly regions and near the coast, lie raised sea-beaches, situated some 15 to 25 meters above the sea level. The East of alluvial plain exhibits the greatest variety of rocks forming the Anticline Ranges separated by various valleys. The hilly region is situated to the West of the alluvial plain of the Porali and extends along the Makran coast. The whole of the eastern part of the district is mountainous. The plain in the center, comprising of a greater portion of the district is in a triangular shape. The principal hill ranges are on the western slopes of Kirthar Mountains, and Lak Phusi in the North. The other side includes main ridge of the Pub Range with parts of Khude or Khudo and part of Pub Range. The third side comprises of lower slopes of the Makran coast. Consisting of plains, mountains and terrain elevation range, the Lasbela District is situated at 0-1494 meters above Mean Sea Level (MSL). The Mor range and Khude are surrounded by Saman branch of Kolachi River on the South; Hub River on the East and Gidar Dhor River on the West. Valleys of the Kharari or Kanrach and the Mithri, Mohbar and Chebechi torrents are situated in the South. From its entrance into Lasbela District, the Porali River runs over a stony course and has low banks as far as Mangia, where it passes through clay soil. At Shah Lakhra, a dam has been constructed at about 89 km to North of Shah Lakhra, a branch of the Porali River, known as the Titian River, takes off and eventually flows into the Siranda Lake.

4.1.2 Geology and Geophysics of North Arabian Sea

Geological and geophysical investigations of the area in the Arabian Sea related to the Project show that the shelf basement has a sharp deepening, and that the Murray Ridge is underlain by oceanic crust. The observation that the depth of the basement ocean-ward of the escarpment lies close to that of oceanic crust of that age is a strong argument for the crust being oceanic and not continental.

The coast as well as the shelf is rugged and tectonic in origin as evidenced by the uplifted terraces, headlands and fluted beds. The presence of mud volcanoes is due to collision of oceanic plates, and is the result of subduction of one plate under the other. Magma from the mantle rises to form volcanoes in the vicinity. The shores and cliffs westward from Cape Monze are rocky. They are generally composed of conglomerates of soft mudstone and sandstone, which are highly vulnerable to erosion.

A chain of northeast–southwest-trending volcanic seamounts in the central part of the deep-water basin formed topographic highs for the development of shallow-water carbonates during the Eocene post-rift phase. The basalts show stacked pro-grading reflection patterns on seismic data. The passive margin stratigraphy includes up to 9 km of Oligocene–Recent age clastic sediments from the Indus River system.

Trap types include: extensional rollover anticlines at the shelf edge; drape structures over the Eocene carbonate highs; stratigraphic traps along the Murray Ridge and folds associated with strike-slip faults along the Murray Ridge.

The relevant region of the Arabian Sea is suggested to be the result of construction of the Indus Fan in the Late Miocene Recent. The Indus Fan was built in response to High Himalayan uplift and unroofing of the Karakorum and Himalayas starting at ~20 Ma, together with the Early Miocene (~22 Ma) uplift of the Murray and Owen Ridges that prevented sedimentation towards the west into the Gulf of Oman.

Paleogene clastic sediments, presumed to be part of the paleo-Indus Fan system, have been found at several locations around the Arabian Sea. Thick sections of PaleoceneEocene turbidites have been identified in the Makran Accretionary Complex in western Pakistan and eastern Iran. These observations suggest that the Indus Fan was centered more to the west of its present location during the Paleogene. Since that time this part of the early Indus Fan system has largely been accreted to the Asian margin due to ongoing northward subduction along the Makran coast. Those parts of the Paleogene Indus Fan still present in that area are now buried under Neogene clastic sediment eroded from the Makran and Oman margins.

Although the center of fan deposition may have been west of the current location, it is apparent that some material was deposited in the area of the modern fan during the Paleogene. New seismic data collected on the upper and middle Indus Fan shows a tilted Paleogene section, predating uplift of the Owen and Murray Ridges in the Early Miocene.

In addition to deep buried parts of the Indus Fan, Eocene and Oligocene siltstones and sandstones have been recovered from the Owen Ridge. These sedimentary rocks are presumed to be parts of the Paleogene Indus Fan elevated by uplift of the Owen Ridge, and saved from the deep burial that makes sampling of this time interval difficult elsewhere offshore. Although distal, muddy turbidities they provide evidence of fan sedimentation in the central and northern Arabian Sea back into the Paleogene. The sedimentary record of the Arabian Sea thus reflects both orogenic processes as well as changes in the ocean and atmospheric circulation.

Physiographically the area lying between the Hub River and Pab Range is occupied by gravels derived from rocks of Jurassic to Miocene ages which are covered all over with Aeolian sand deposits. Agricultural fields on the inland from Sonneri Beach are mostly dry-cropped land dependent upon rain, which is often scanty.

Stratigraphically, the rocks exposed in the area are sedimentary in origin; they were laid down in shallow marine conditions and range in age from Eocene to recent.

This section has badly eroded surface and has topography comprising rough terrain. It can be described as a thick deposit of loosely compacted sand, stretching from the Pab to the coast where it terminates in a raised terrace with a wall-like façade overlooking the low beached shores. Wide and deep gullies have been formed by numerous hill torrents which are cause for extensive erosive action and enlarging the ravines and gullies on the one hand and transporting the sand and silt to the shores on the other hand. The land use is presently limited to grazing and incoherent cultivation.

4.1.3 Soils

Soils of the land fall area are mostly of recent or early recent age. A small part of the rocks is sedimentary of Oligocene to Palaeocene Epoch. The area has vulnerability risks associated with soil e.g. gravel and cobbles found in the area. The surface is dry, contains loose sands and loose conglomerates. The soil, when wet becomes dark colored. Loose sand of the area contains small percentage of silt.

Generally, the soils can be described as composite of shale, loose conglomerate, shale concrete, indurate sand and loose silt sand fractions. Fine sand is found to be the most prevalent component of the upper surface but small fractions of silt are also present and hence, it can be described as loose silty sand.

The upper soil is porous in nature due to the low degree of compactness. Below the loose silty sand, indurate sand is found spread over a large area. The loose silty sand and indurate sand together account for the numerous sand dunes in the Project area. Below the indurate sand a sample at a depth of 3 feet appears to be semi loose conglomerated. A thick layer of shale along with isolated shale concrete consisting of dead micro-organisms is also found at the coastal site. These shale layers appear to be a part of Nari formation of Oligocene age.

4.1.4 The Beaches

There are a number of beaches, some of them several kilometers long, which mark the shoreline between the Phor Nai and the Hub River. The beaches are known by their name: Birar, Damb, Sonmiani, Gadani, Kalar, and kund. Birar is about 50 km long, and Sonmiani from Lak Bidok to Damb is about 40 km in length.

Sonmiani & Damb: Beach ridges and strand lines are seen in the westernmost part of the Birar Sandbar and just behind the Sonmiani Beach south of the Winder River mouth. The 90 km stretch of the two beaches indicates recession of the sea, most likely subsidence of the land during recent geological times.

Sonmiani has silted up in the living memory of the people resident there while the considerable recession of the sea is visible at Damb, where a large patch of the area under mangrove cover seems abandoned and the mangrove trees are mostly dwarfed.

Inward from the coastline at Sonmiani and Damb, there are large sand dunes, generally 30 to 50 ft and a maximum of 80 to 100 ft. The beaches that line the coast are generally sandy. At Gadani the sandy beach is littered with pebbles and boulders that are detatchment from the outcrops of the hills in the surrounding.

Miani Hor: Miani Hor is a 60 km long and 4 to 5 km wide swampy lagoon, with 4 km wide mouth. It was designated a Ramsar site in May 2001. The seasonal rivers, Porali and Windor enter into this bay. It can be described as a large shallow sea bay and estuarine system with several low lying islands and extensive mangrove swamps and intertidal mudflats (area 55000 ha) separated from the adjacent Sonmiani Bay in the Arabian Sea by a broad peninsula of sand dunes.

Khalifa Point: The beach sediment along the Khalifa Point is generally sandy with dominance of medium to fine sand size fraction. Khalifa Point, like other beaches mentioned is exposed to high waves. This high energy condition in the depositional environment is also reflected by the sediment characteristics i.e. well to very well sorted and presence of fossiliferous shell debris and rock fragments.

Gadani Beach: Gadani beach is composed of medium to fine brown sand with little or no mica and large proportion of quartz and feldspar. The sandy beach is almost flat having a low beach angle (slope), and is being eroded by the strong monsoon waves. Due to strong wave action the beach sediments are well sorted.

Gadani Beach is also home to the Ship Breaking Yard located across a 10 km long beachfront, about 50 kilometres northwest of Karachi. In the 2009-2010 fiscal year, a record 107 ships, with a combined light displacement tonnage (LDT) of 852,000 tons, were broken at Gadani Ship Breaking Yard.

Cape Monze: The Cape Monze beach is an example of raised beaches along the coast of Karachi. From Bulleji to Cape Monze the coast consists of hard conglomerate and shale cliffs. Beyond Hawkes Bay towards west up to the Cape Monze, the unconsolidated sandy clays are exposed to coastal weathering and erosion.

Hub: The Hub River area towards Gadani has sandy beaches adjacent to the river mouth. The area is protected from the open sea and has significant amount of mud fraction. This area possesses the coral reef extending from the river outfall to the Churna Island. It is also a habitat for oysters.

The Hub Valley: At the deltaic region of The Hub, there are mangrove islands that have alluvium deposited by land drainages and river discharge and contain a large amount of clay. Rich in salts such as sodium chloride, sodium carbonate and nitrates, the soil also contains shell fragments. This muddy clayey soil is impervious and is poor in other mineral matter. The analytical data on the soil samples indicates the presence of substantial organic matter and shows that the soil has good proportion of shale[3].

4.1.5 General Geology

Marine Geology: The geological survey of the deltaic region showed that most underlying rocks are of marine origin and are greatly folded, faulted and fissured throughout. For the most part, these rocks are composed of lime stone and clay.

Surface Geology: The rocks encountered in locations in the Hub River Delta area extending northwards to Gadani Hills are mainly sandstone, siltstone and shale with traces of limestone. The surrounding area is dotted with a number of small outcrops of melange and quaternary deposits of silt, sand, gravels, conglomerate and boulder. Outcrops are exposed in the surrounding area in the form of small hillock ridges. The hillock seems to represent a small part of the denuded outcrop. Igneous intrusive rocks are also present in the surrounding area and this is evidenced by the Rati hill consisting of granite as the dominant rock.

Landforms: The inland area is composed of flat topped, tabular steep hill sloping towards the north as well as south, which appears to be a Mesa. In the east and southwest of this Mesa, there are small hills showing the same trend as the Mesa. These hills are triangular, tabular shaped and with knobbly top they appear to be buttes. Apart from this, there are also some oblong scattered hills seen on the southern plain track and north-western slopes. The hills show steep slopes and pointed tops and can be taken in the same category as the buttes. Besides these landforms, the site also shows small-scattered elongated hillocks.

Stratigraphy and Subsurface Lithology: Parh formation dating back to the age of Cretaceous is the oldest formation observed in the area. This formation is overlain by Pab formation of Palaeocene age and Nari formation of Oligocene age.

[3] Source: PERAC Research and Development Foundation

Rich in foraminifers, Parh formation is hard, light grey, white, cream, olive green and thin-to-medium-bedded. On the other hand, Pab formation typically consists of quartzose sandstone, which is white, cream, weathers yellow brown, medium to coarse grained and thick bedded to massive. Nari formation is mostly composed of hard, compact, thick to thin bedded clayey limestone and marl with intercalation of shale.

The lately risen ranges have coarse clastics deposited in isolated depressions. Most of the conglomerates are locally derived from the hills surrounding the depressions. With the exception of the sediments located near the present coast (where they exist as littoral marines) all are continental. These deposits are of varied nature including wind-blown sand, alluvial fans, recent floodplain deposits, mud deposits, present-day shingle beaches and others.

Going by the formation of exposed rock and the resulting geological evidence derived from it, it appears that the subsurface lithology of the area northeast of the Hub River delta has the same formation that is dominant in the area.

4.1.6 Seismicity of the Offshore-Onshore LNG Facility Area

Earthquakes: Over 50 earthquakes of magnitude 8 and above have been reported in last 75 years along the coastline of Pakistan. The earthquakes that affected Karachi-Lasbela area in the past were mostly generated along the Khirther-PAB range, Surjan-Jhampir-Jati-Alabund range and Murray ridge were mostly of minor/ moderate magnitudes.

Over the last sixty years, earthquakes of intensity lower than 5 on Richter scale, (including those experienced in 1945 and 1985) have struck Karachi and the south of Lasbela. Earthquakes in the last decade were recorded in Karachi, with one occurring on July 16, 2005 followed by another on August 6, and others on August 13, October 9 and October 11, 2005. They were all of magnitude between 4 and 5.1 on Richter scale.

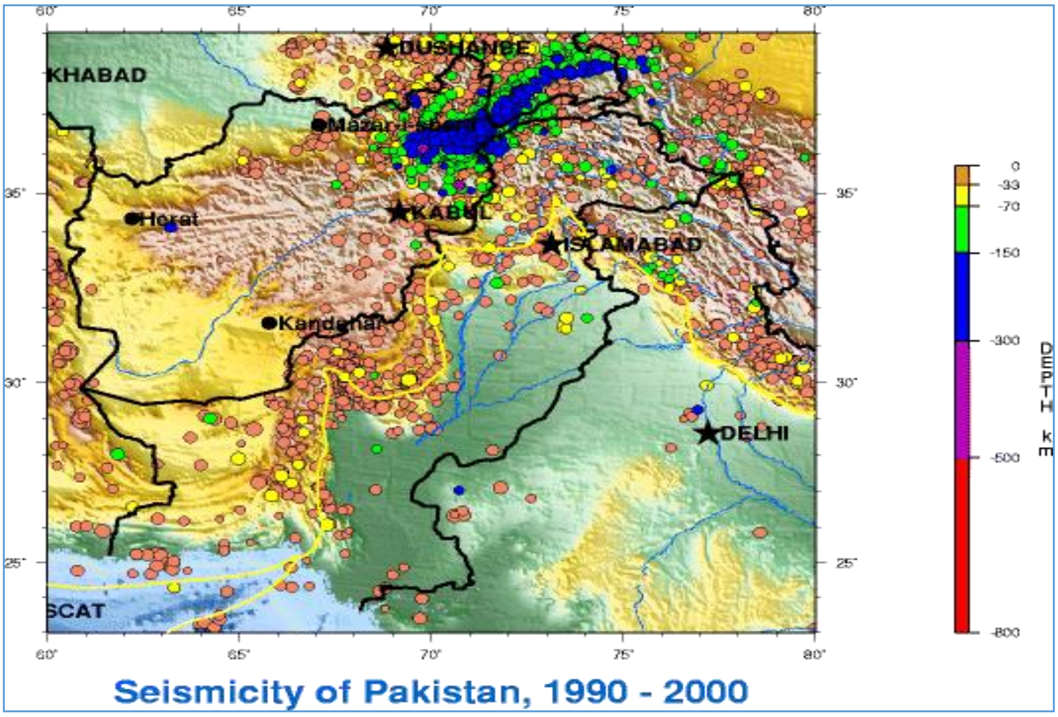


Figure 4.3: Seismic events history of Pakistan

The above seismicity map of Pakistan shows that the earthquake zones have been hit by earthquakes a number of times, but the depth of their epicenter has not been found to exceed 33 km. The yellow line in the map marks the frequency zones as well as the fault lines and shows that on entering the Arabian Sea it bifurcates into two lines: one that travels along just south of the coastline while the other goes southwest over the Murray Ridge.

Seismic activity in the macroenvironment of the Project area is caused by the dynamics of slow but constant relative motion of the active Karachi Triple Junction (KTJ) of three major tectonic plates viz. the Indian Plate, the Arabian Plate, and the Eurasian Plate of the earth's crust. The presence of a recently discovered active Sonne fault indicates that the Arabian plate has been fragmented across the southwest corner of the KTJ defining a triangular plate: the Ormara plate[4] whose velocity relative to the Arabian plate increases the subduction velocities to over 40mm per year compared with the rate at the west.

Murray ridge is located at 100-200 km southwest of Karachi in North Arabian Sea; it extends up to Sonmiani Bay that is the triple plate junction, mentioned earlier. It has experienced more than 25 earthquakes (1904 onward) of intensity about 7-8 on modified Mecalli scale and it is also an active area of seismicity. However, this fault is a “spreading plate boundary” type which cannot create a tsunami of any significant order so as to affect any coastal area of Pakistan.

The Macroenvironment of the Project, besides holding the Triple Point and the highly active Makran Subduction Zone, has the extremely active Chaman Transverse Fault in the region; it is moving at a rate of 40mm yearly. The cumulative effect of the activity in the area is suggested to be responsible for the sudden rise on November 16, 2010 of the soft muddy island that appeared a few kilometers offshore in Hingol on the Makran coast of Balochistan.

Appearance of mud volcanoes and mud domes is associated with the subduction activity at the Makran coastal area that has the triple junction of the Eurasian, Arabian and Indian plates in close proximity. Appearance and also disappearance of mud domes is not uncommon here. An island of soft muddy nature was reported here 12 years ago. That island disappeared into the sea after four months. It is inferred that the 2010 mud dome nick-named Khizr, will also disappear with passage of time.[5]

A strong earthquake (M6.0-6.9 termed as "moderate") occurred in the Chiltan Hills in Balochistan to the north-east of Quetta, on 29 October 2008. The epicenter of the quake was in Chiltan Mountains. It had a magnitude of Mw=6.4 and resulted in damage as well as several fatalities. The event of October 29 2008 was the strongest earthquake in Balochistan since a Mw=7.0 earthquake on 27 February 1997 near Harnai that left at least 70 people dead and caused widespread damage at Duki, Harnai, Mustang, Sibi and Quetta. Other significant earthquakes in this immediate region including a Mw=7.0 earthquake near Duki on 1 August 1966, a Mw=7.8 near Quetta earthquake on 30 May 1935, a Mw=7.3 near Mach on 27 August 1931 and a Mw=7.1 in the Kachhi Plain on 20 October 1909. The 27 August 1931 earthquake followed a Mw=6.8 earthquake near Sharigh on 24 August while the 1 August 1966 Duki earthquake was preceded by a Mw=6.6 earthquake near Barkhan on

[4] “Newly identified strike-slip plate boundary in the northeastern Arabian Sea, Kukowski, N.,T Schillhorn, E. R. Flueh, and K. Huhn, *Geology* **28**, 355-358 (2000), [Abstract/Free Full Text][CrossRef][ISI][GeoRef]

[5] (http://dawn.com/2011/02/27/a-geologists-view-of-the-hingol-island/).

7 February 1966. One of the earliest known earthquakes in this region was a Mw~6.6 earthquake that occurred on 24 January 1852 and resulted in at least 300 deaths near Kaghan(http://asc-india.org/lib/20081028-baloch.htm).

An earthquake of 4.1 magnitude on the Richter scale was recorded recently (November 2010) in the Chiltan area due to activity of the Chaman Fault. The Chamman fault extends from Kharan, Pakistan to Kabul, Afghanistan a distance of about 850 to 900km; it is capable of generating earthquakes of various magnitudes. The interaction between thrust and strike slip fault systems is well documented in Pakistan. The Chaman transform zone has been described as connecting the Makran and Himalayan convergence zones and also containing an internal convergence zone in the Zhob district. The transform zone contains numerous strike slip faults of which the Chaman fault proper is the westernmost. It is possible to demonstrate at least 200 km of left lateral displacement along the Chaman fault alone, and N-S shortening by folds and a major thrust fault amounting at several dozen kilometres in the Zhob belt. The 400 km wide Makran convergence zone is now being shortened by E-W oriented folds, thrust faults, and reverse faults. As these faults in the Makran zone approach the transform zone, their traces bend to the N and motion on each of them becomes oblique, combining reverse and left lateral slip. They merge continuously with the strike slip faults of the Chaman transform zone.

The Makran thrust system and the Chaman transform zone first became active in the late Oligocene or early Miocene. Later, a component of left lateral shear occurred across the entire Makran Zone in association with the opening of the newly identified Hamun-i-Mashkel fault trough south of the Chagai Hills and west of the Ras Koh. The total displacement and displacement rate across the Chaman transform zone varies in response to the rates of convergence in the plates east and west of the zone.

In addition to the clearly defined plate boundaries and the Chaman transform zone, the following are the other active structural zones that have produced damaging earthquakes which were felt in the macroenvironment of Project site in the past 200 years: *(1) Karachi-Jati, (2) Surjan-Jhimpir, (3) Pab Fault (4) Hab Fault (5) Allah Bund-Rann of Kutch, these fault systems have been described in a subsequent section.*

From an examination of the actual events, the past observance of fault movement and seismic activities it has been inferred that Karachi-Cape Monze-Pab belt is situated in a region where a moderate earthquake of magnitude 5.0 to 6.0 on Richter scale equivalent to intensity between VII and VIII on Modified Mercallis Scale may occur (M6.0-6.9 termed as "moderate"). On the basis of correlation of different scales and zoning, it has been established that Karachi-Cape Monze-Pab belt is situated in a noticeably moderate earthquake zone.

Seismic Risk: Figure 4.3 indicates that the fault lines of the Triple Junction travel along just south of the coastline and also pass southwest over the Murray Ridge. It is also noted that the area lies in the seismic zone that is frequented by earthquakes of intensity 4.5 on Richter scale. Accordingly the seismic risk is not of high order.

Keeping in view the proximity of the Project activity site to the above fault lines as well as both Allah Bund Fault line and Pab Fault, it is suggested that the belt should be placed between Zone 2 and

Zone 3. Such Seismic Zoning would correspond to Magnitude between 5.0 and 6.5 on Richter scale and Intensity between VII and IX on Modified Mercallis Scale and hence Ground Force in terms of Assumed Approximate Acceleration equivalent to 0.3 g is recommended while designing and for siting the structures of the Project, for operating basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-VII to IX).

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones on the basis of expected ground acceleration. The areas surrounding Quetta, along the Makran coast and parts of the NWFP along the Afghan border fall in Zone 4. The rest of the NWFP lies in Zone 3, with the exception of southern parts of Sindh Province, which lie in Zone 2. The remaining parts of the Pakistani coast upto Karachi also lie in Zone 3. The remaining parts of the country lie in Zone 2.

4.1.7 Tsunamis

Out of the 50 earthquakes of magnitude 8.0 on Richter scale that occurred during the past 75 years, four were accompanied by tsunamis 1919, 1943, 1945 and 1956. The Makran Subduction Zone can create a destructive tsunami and pose some real threat to the coastal areas of Pakistan. This Subduction zone is located to the southwest of Makran coast in Arabian Sea, this zone and its associated thrust fault are oriented in the east west direction which is in alignment with Karachi. Any thrusting in the Arabian Sea may generate tsunami, the distance between Makran coast and this Subduction zone is approximately 100 km. The generated tsunami may take a few minutes to reach the coastline and prove destructive to the coastal cities further west e.g. Pasni, Ormara and Gawadar. Karachi being on the east of the Triple point where subduction is likely to create the seismic hazard, will be exposed to much less threat of tsunami generated from the Makran Subduction Zone(Humeira Hafeez, Pakistan Journal of Meteorology Vol. 4 Issue 7: July, 2007).

Karachi shore line is East-West oriented and it is separated from North-South trending Gadani coast, by the Cape Monze promontory that provides a barrier to the city. Furthermore the location and the direction of the fault in the Arabian Sea is north-south oriented. Tsunami generated from the Makran Subduction zone or its associated thrust faults (East-West oriented) will hit Gadani coast at very high angle but it may strike Karachi at low angle because East-West propagating waves will be very weak and will be parallel to the Karachi coast. Hence, probably Karachi is in least danger to the devastation of tsunami as compared to the cities like Gawadar, Pasni and Ormara. That is stated to be the reason for an earthquake triggered tsunami of 1945 being recorded even at the Australian coast but causing heavy destruction at the coast of Makran yet only lowly affecting Karachi.

The offshore earthquake of intensity 8 M with its epicenter at 24.5oN and 63.0oE in 1945 caused widespread damages in Las Bela but only minor damages in Port Qasim area. It originated off the Makran coast in Pakistan and was centred at 97.6 kilometres SSW of Pasni, 98.5 kilometres SE of Gwadar, and 408 kilometres W of Karachi. It reached a height of 40 feet in some Makran ports and caused great damage to the entire coastal region. The fishing village of Khudi, some 30 miles west of Karachi, was wiped out completely. All the inhabitants and their huts were washed away. The towns of Pasni and Ormara were badly affected. Both were reportedly under water after the tsunami event. The underwater cable link between Karachi and Muscat was damaged, and the communication link was disrupted. The lighthouse at Cape Monze as well as at Manora was partly damaged. This event was followed by another Tidal wave that was recorded in 1953.

At Karachi, the tsunami arrived from the direction of Clifton and Gizri. It ran along the oil installations at Keamari and flooded a few compounds. The waves were 6.5 feet or 2.0 meter high when they reached Karachi. There was a delay of more than one hour between the main shock and arrival of the damaging tsunami at Karachi.

The sea is about only 1.0 meter (3.3 ft) below the land area at Gadani and 2.7 meters (8.8 ft) below the average ground level at Damb and Sonmiani. This would suggest that a tsunami of magnitude similar to the 1945 Tsunami would affect the 1.0 to 2.5 meter contour on the beach front at Mubarak village and Sonmiani. Such events are less likely to occur in the north of the Arabian Sea however.

Tsunami hazards exist on the contiguous coastline. The > 1-hour delay between the main shock and the arrival of the damaging tsunami associated with the 1945 earthquake was very probably caused by submarine slumping offshore rather than direct uplift of the coast. If this were indeed the case, even a modest earthquake in the Rann of Cutch region would be sufficient to trigger a submarine slide that would endanger the shoreline of District Thatta, which however is more than 150 km from the Project site. There is therefore no likelihood of Tsunami threat to the site.

Tsunamis in Indo-Pak region are relatively rare. Destructive tsunamis that may have occurred in the Arabian Sea have not been documented. The oldest known tsunamis in North Indian Ocean are:

- 326 BC
- 1st April and 9th May 1008
- 1884
- 26th June 1941
- 27th /28th November 1945 (origin Makran)

The Tsunami of December 26, 2004 had no impact on the macroenvironment of Karachi and its offshore. There are reports that the tsunami 2004 devastated the coastlines of the Indian Ocean, but in the west coast of Makran the effect of tsunami were quite different in that it brought new spawn of different/ new species of corals from neighboring coral reefs. The mass migrating off-springs started cloning and forming new reefs at incredible speed. During last few years over 30 new species have been noticed.

4.1.8 Tectonics

About 12 million seismic events occur each year throughout the world. Most of the seismicity is restricted along the plate boundaries. Three lithospheric plates i.e. India, Eurasia and Arabia are interacting along active plate boundaries in Pakistan, while the Arabian plate is subducting under Afghan and Lut Blocks of Eurasia along Makran Coast in the southwest. In the offshore region, the Owen Fracture Zone makes an active boundary between the Arabian and Indian Plates.

In the north, the Indus-Zangbo suture is a collision boundary between Eurasia and India. The two convergent plate boundaries are connected by sinistral transform fault, called the Chaman-Ornach Nal fault zone. The Triple junction is located to the west of Karachi. Permian to Cretaceous rifting from Africa and the northward movement of India with anticlockwise rotation is recorded as rifted features at the western margins. Its subsequent collision with Eurasia and ongoing northward movement resulted in the formation of fold and thrust belts and wrench faults.

The rifted features are represented by horst and graben structures at the western edge of the Indian plate. The EW trending Kutch rift is located in the westernmost limit and separated from NW trending rifted feature by Nagarparkar and Allah Bund Faults. The NW trending Panno Aquil graben with Khairpur high in south and Kandhkot horst in north are dislocated by a dextral fault, from their analogues the Nagar Parkar horst and the Cambay graben. The Cretaceous rifting is also recorded by the older sediments in southern Pakistan.

The Kirthar fold and thrust belt is a consequence of collision of India with Eurasia and its ongoing northward movement. Karachi is located at its southern arcuate termination, named as Karachi Arc. The structures in southern Kirthar are a product of distributive sinistral Cenozoic transpressive wrench faults. The Kirthar Fault is a major thrust in the frontal part of the range. In the north it is westward dipping fault and its southward extension near Kot Diji consists of foreland dipping fault zone. It can be traced up to Dureji in the south. The Karachi Arc is bounded by Bela-Khuzdar block to the west and Indus foreland to the east. The arc opens up in the Arabian Sea and terminates in Murray ridge area. The wedge shaped Bela-Khuzdar Block is sandwiched between Ornach Nal Fault in the west and ophiolitic mélange of Mor range to the east. It is marked by arcuate folds and thrusts in the north, formed due to anti-clockwise rotation of the block. The Khuzdar knot is its northern termination.

The Pab fault is 135 Km in length and lies approximately 30 km west of Karachi. It is north- northwest-south-southeast trending, and is known to have produced an earthquake of magnitude 7.0 on the Richter scale. It terminates near the Cape Monze, which is close to the Project site. Categorized as transcurrent, these faults traverse most of the structural grain of the Karachi-Cape Monze-Pab region.

The Pab Fault lies in a west-dipping segmented fault zone which loses its throw southwards and dies out in Sonari Range near Musa Goth. The ophiolites are thrust over sediments along the Mor Range Fault. The Bela fault, concealed under alluvium bounding the mélanges to the west, probably extends up to Murray Ridge on the offshore (Elliot and Lallemont, 2000).

Surjan Fault, located in the Frontal Part of Kirthar fold and thrust belt, is a hinterland dipping high angle fault, which extends from Jhimpir to San area. Some NS trending thrusts along Thano Bulla Khan Ranges collectively constitute Thano Bulla Khan fault zone. A number of strike slip faults with limited aerial extent cut obliquely the strata at many places. The northern Kirthar is dominated by NE trending while southernmost part is dominated by NW trending strike slip faults.

To the east, the sinistral Ornach Nal fault constitutes the western boundary of the Indian Plate and joins the Murray Ridge in the Arabian Sea. The Murray Ridge is represented by seamounts with strike slip and normal faulting. The Great Rann of Kutch and Bani plain of India are located to the southeast of Karachi. Low lying marshy land, saltpans and mud flats of Kutch are bounded by EW trending faults. To the north, the Allah Bund and Nagar Parkar faults mark the boundary of Great Rann of Kutch. The EW-trending faults of the Rann take a swing to attain NWW trend and seem to be converging in Jati area giving way to the Indus Delta.

The dextral fault offsetting Sukkur Rift Zone is probably the western limit of the Kutch and northwest swing of the Allah Bund fault may be due to drag of the dextral fault. It is claimed that the Allah Bund fault does not extend to Karachi area. The Manghopir anticline, NW trending strike slip faults of Sonari and Jhil Range and EW trending minor fracture in Gharo area have been misinterpreted as extension of Allah Bund fault. All these different types of structures cannot represent a single fault.

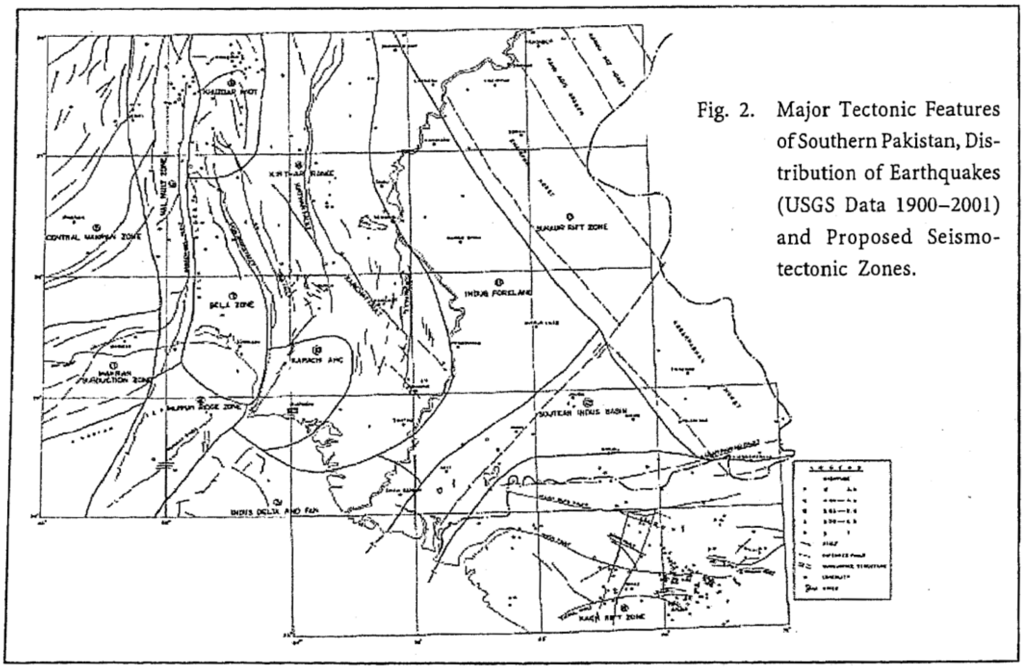


Fig. 2. Major Tectonic Features of Southern Pakistan, Distribution of Earthquakes (USGS Data 1900–2001) and Proposed Seismotectonic Zones.

Figure 4.4: Seismotectonic Zones of Southern Pakistan

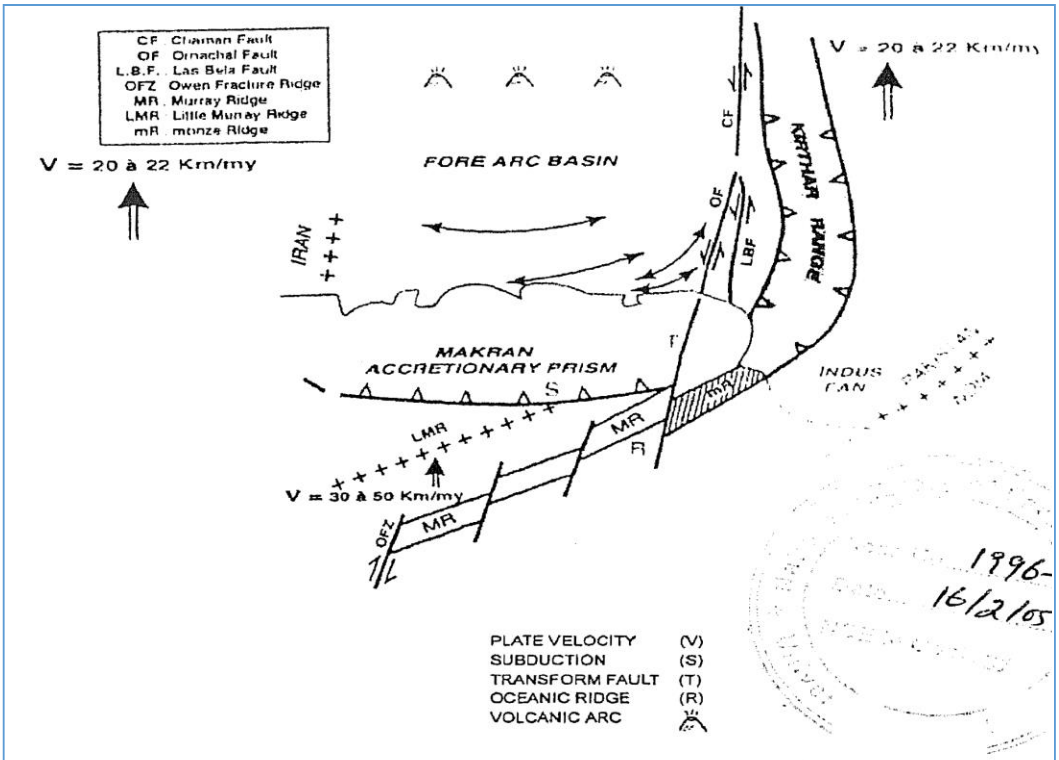


Fig. 3. Major Tectonic Features of South West Pakistan
(After Ellouz & Lallement, 2000)

Figure 4.5: Major Tectonic features of South West Pakistan

4.1.9 Neotectonic Features

Neotectonic features are associated with Surjan fault, Karchat fault, Thano Bulla Khan and Baran nai faults. Along Surjan fault alluvium is in contact with limestone and shale of Laki formation near Super Highway M-9. In the north of Kalu Kahar-Jhimpir Road, sandstone of Laki Formation is in faulted contact with recent alluvium. The alluvial silt is sheared along the fault. In northern parts of the fault, terraced tilt and joints were observed in the recent sediments. All these seismites indicate that the Surjan fault is an active structure.

Northern segment of Pab fault is a thrust fault line while Ornach – Nal fault shows predominately strike slip motion. Murray Ridge source is the nearest source marked with strike slip and normal faulting. All these sources are line sources. The Sonmiani area has been considered as a zone of diffused seismicity and floating earthquakes have been assessed by using seismic parameters of the zone shown in the below Figure.

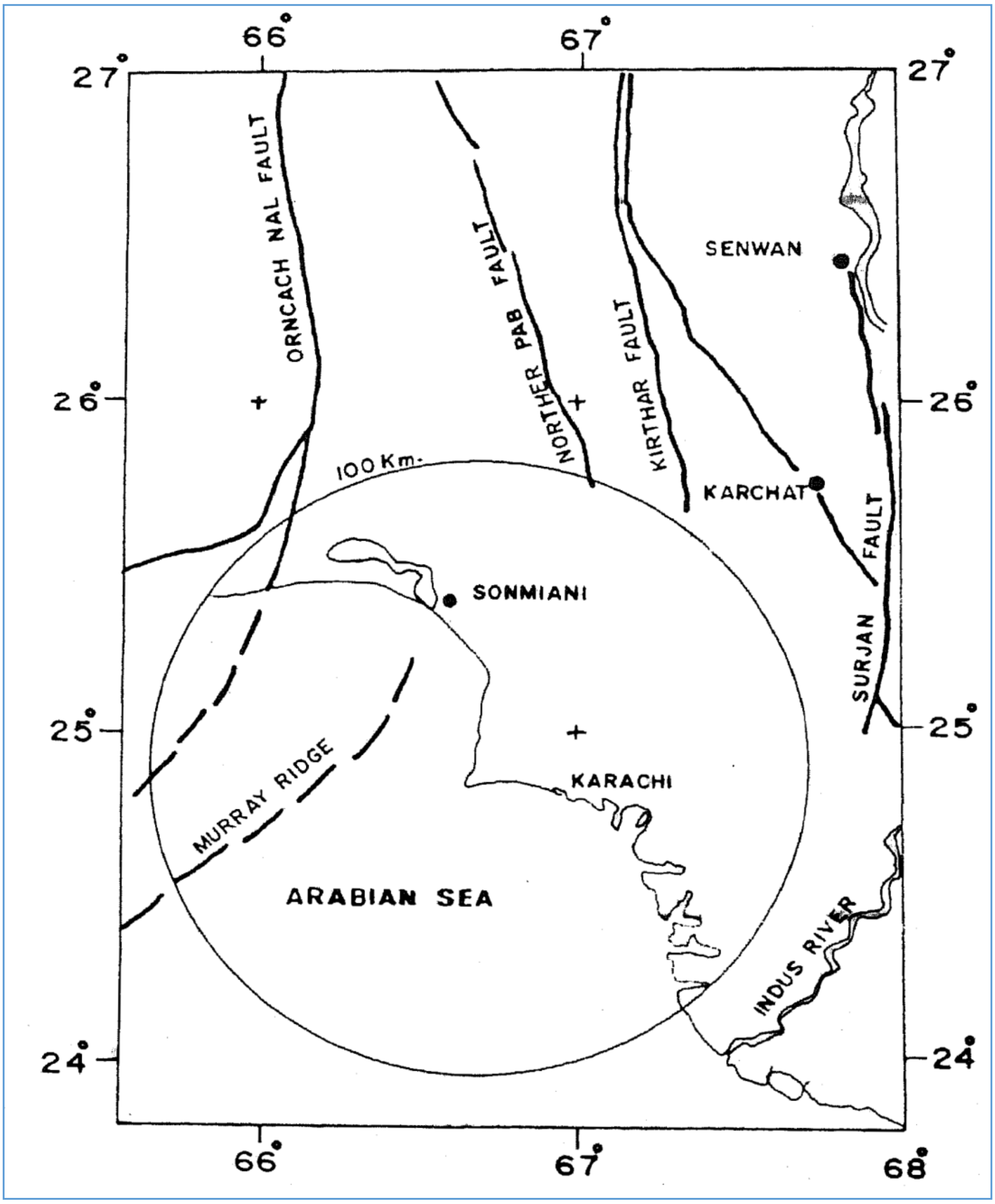


Figure 4.6: Fault lines in the Sonmiani Region

4.1.10 Oceanographic Parameters

Seawater Temperature: The record of monthly temperature ranges for the Northern Arabian Sea is given in figure 4.7. On the basis of this sea surface temperature of the project area is expected to range from 23-24°C during the NE monsoon (December, January and February) period to approximately 27-29°C during the SW Monsoon period (May, June and July). Sub-surface sea water temperature below 1000 meters depth does not vary significantly and generally ranges between 8.4-8.9°C throughout the year.

According to UNESCAP Report (1996) the average annual sea-surface temperature in near shore waters along Coastal belt on the west of Cape Monze ranges between 20.7°C and 29.3°C. At Cape Monze it has been reported to range between 21°C and 29.5°C with the average at 24.8°C. The temperatures at a depth of 100 m are lower and generally have an annual range between 19.5°C to 24.5°C[6].

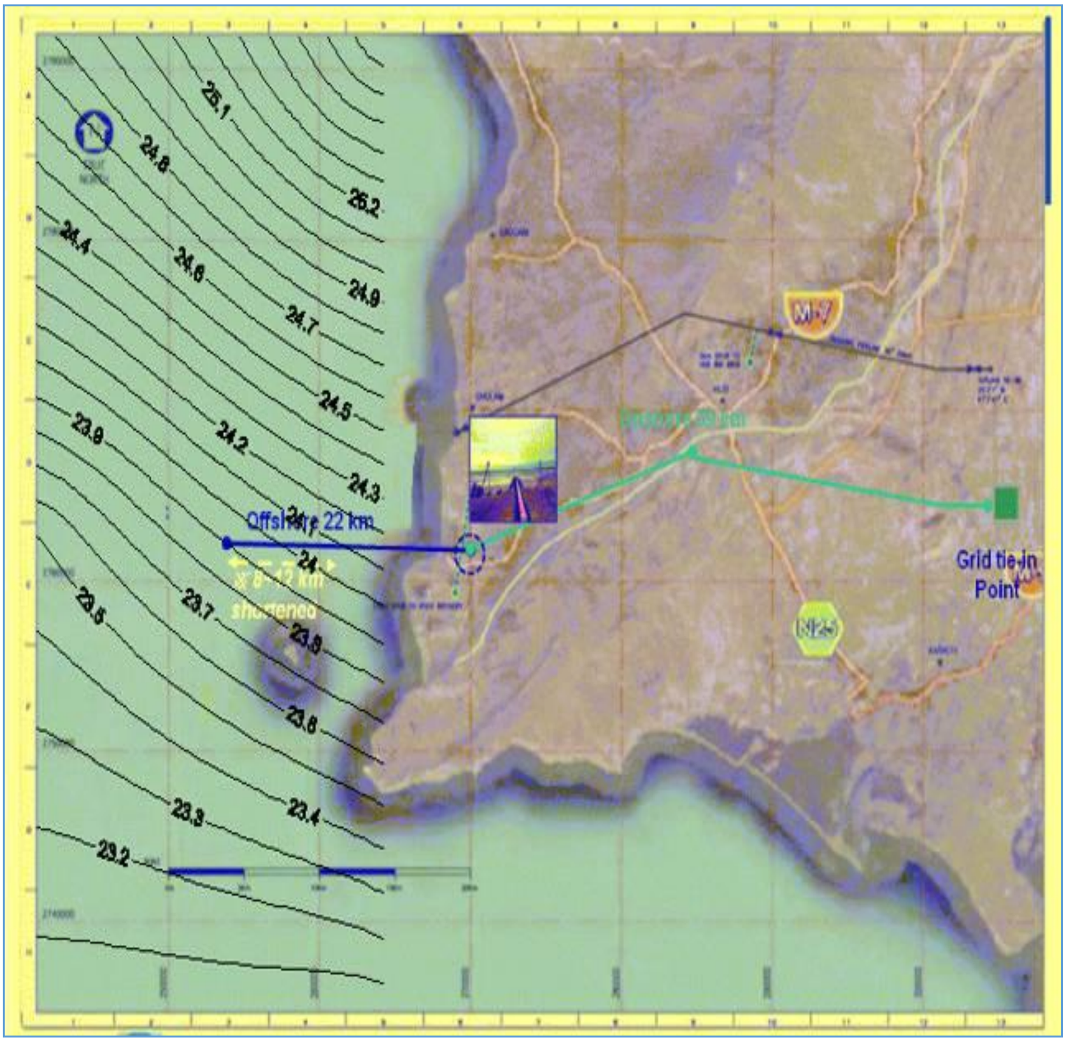


Fig 4.7: Sea surface temperatures during NE Monsoon period at the project area
Source: EMC Archives

6 (http://prr.hec.gov.pk/Chapters/10-8.pdf).

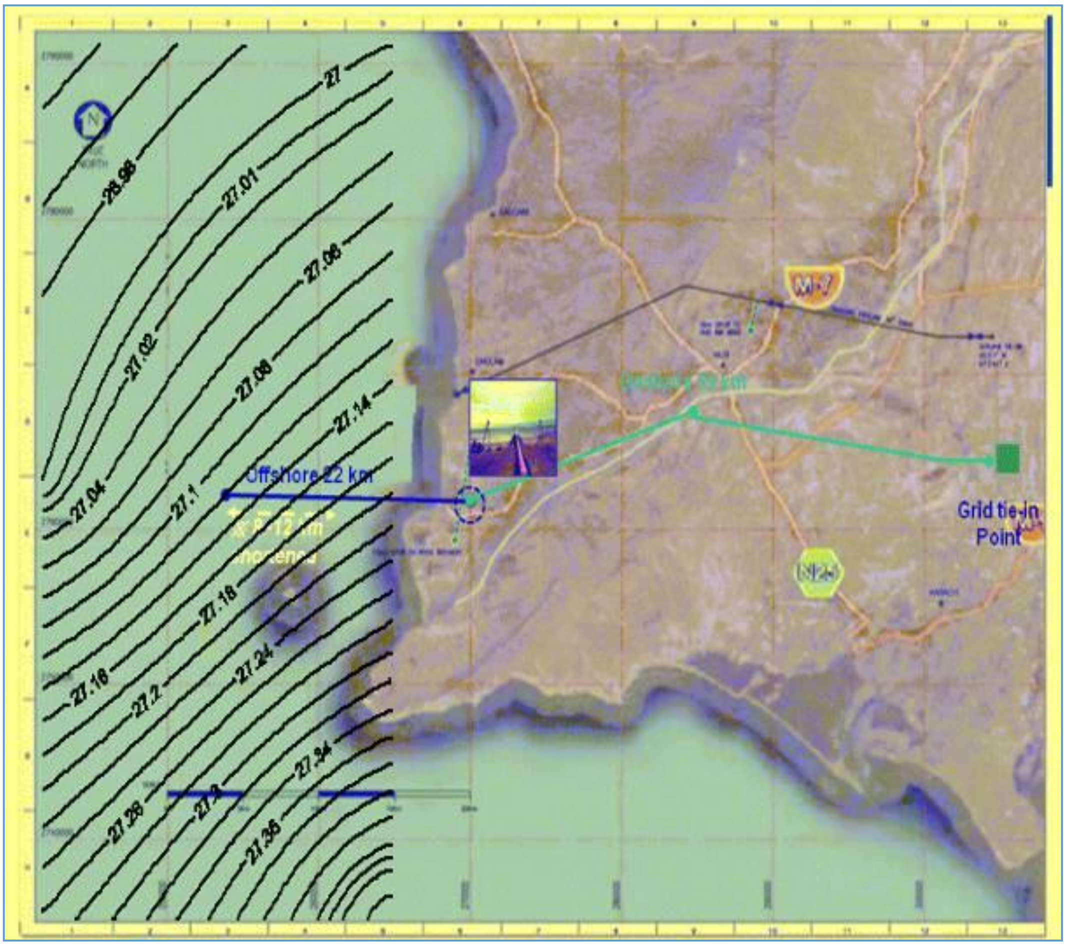


Fig 4.8: Sea surface temperatures during SW Monsoon period at the project area
Source: EMC Archives

Sea Surface Salinity: Surface salinity values and the salinity of the mixed layer depth ranges from 36.2-36.8 psu. The salinity values tend to be higher towards the shore. At a depth of 1000 meters the seasonal variations in salinity are small and range between 35.3-35.45 (ppt) psu throughout the year.

Figure 4.9 Shows Sea surface salinity values during the NE Monsoon period and Figure 4.10 shows salinity values plotted for the SW Monsoon from oceanographic cruise that lies west of the project area and is considered to be representative for the project area.

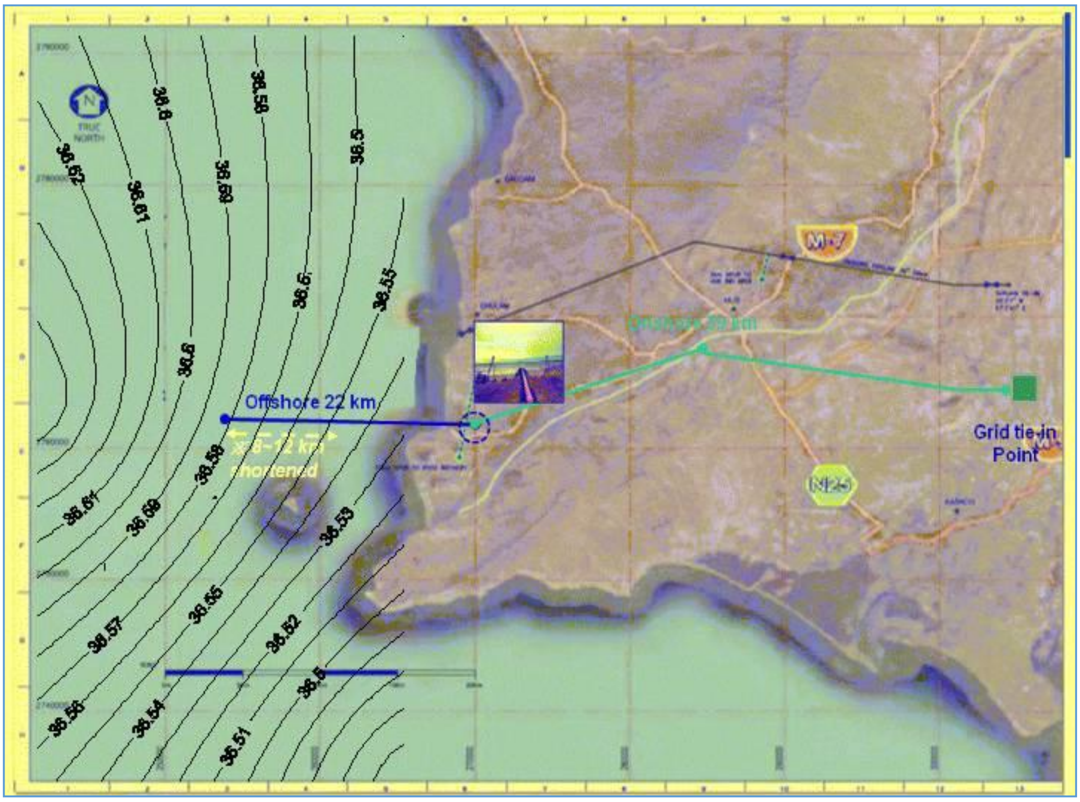


Figure 4.9: Sea surface Salinity (psu) during the NE Monsoon period in the project area and the North Arabian Sea. (Source: EMC Archives)

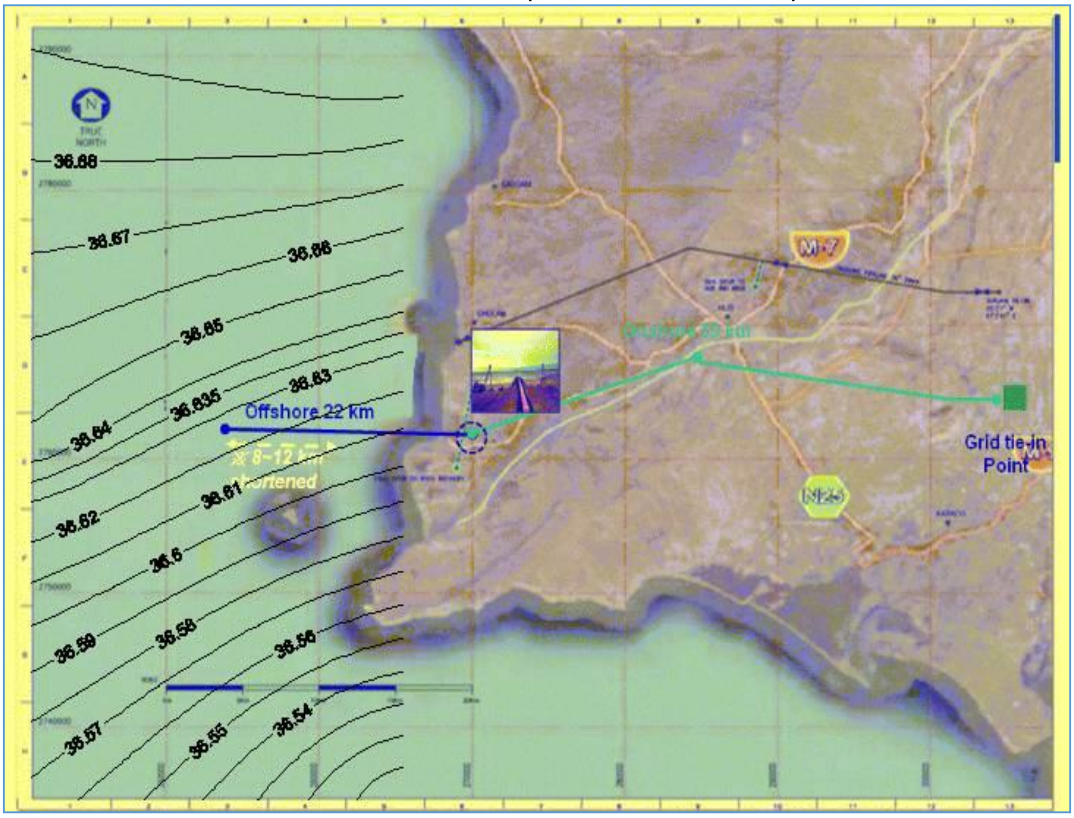


Figure 4.10: Sea surface Salinity (psu) during the SW Monsoon period in the project area and the North Arabian Sea. (Source: EMC Archives)

Surface and Ground water Quality in Coastal Area West of Cape Monze: The seawater is highly saline with its salinity ranging from 3.6 to 4.0 percent. The ground water table at the lies at 1.6 to 2.3

meters depth. The ground water quality is very saline having total dissolved solids about 20,000mg/l. The chloride content ranges from 7500 to 9550 mg/l and the concentration of sulfate ranges between 1188 and 1242 mg/liter. It is therefore, very poor quality ground water and unsafe for any use.

Dissolved Oxygen in Sea Surface: The seawater layer immediately below the surface of the Arabian Sea has dissolved oxygen ranging between 3.5 and 4.5 mgL^{-1} as determined by the Oceanographic surveys mentioned earlier. In the offshore areas of Pakistan, the oxygen minimum layer is found at a depth of about 30 m. The nutrient value also drops at this depth. Therefore, the surface water up to a depth of 30 m, which is also a typical emphatic zone, has very high productivity. The oxygen minimum is due to a number of factors, some of which include: i) strong stratification in the upper 200 m, which reduces the exchange of oxygen between the atmosphere and sub-surface layers; ii) seasonal reversal of the intermediate depth currents which lack trans-equatorial water transport to get aerated, and iii) high productivity creating large oxygen demand on the water column. The near shore water has a high oxygen concentration and it drops sharply from 4 ml/L near the shore to 1 ml/L at a distance of 25 km towards the sea. The near shore oxygen distribution indicates an upward sloping of the oxygen minimum layer, which forces the demersal fish to move towards the coast.

Wind Speed and Current Direction: During the south-west monsoon season (from June to August) winds blow from the south-west with wind speed exceeding 11 m/sec (22 knots) for about 71% of the time. Maximum wind speed during this period is approximately 13 m/sec (27 knots). Inter-monsoon transitions occur during the October- November and March-May period (Amjad et. al. 1995). The surface oceanic currents in the project area in the north Arabian Sea follow in the easterly direction as shown in Figure 4.11.

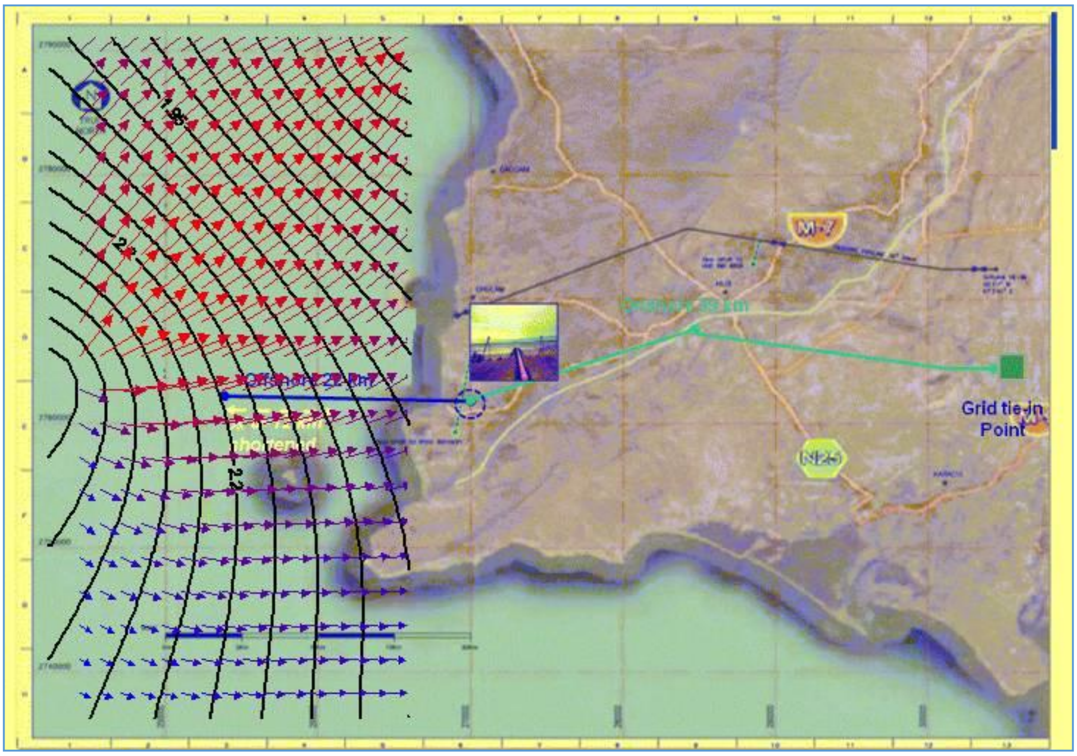


Figure 4.11: Wind speed and direction of the surface oceanic in the offshore project area during the SW Monsoon period. The darker shade vectors indicate the magnitude and intensity of the surface currents. (Source: EMC Archives)

The Figure shows wind speed and direction for the north-east Arabian Sea during the north-east monsoon (from December to February), when winds blow from the north-easterly direction and wind speeds are lower than 5.0 m.sec^{-1}(11 knots). The wind speed and current direction in the project area and the North Arabian Sea are shown in Figure 4.12. The brightly shaded vectors indicate the intensity and magnitude of the winds and the surface currents.

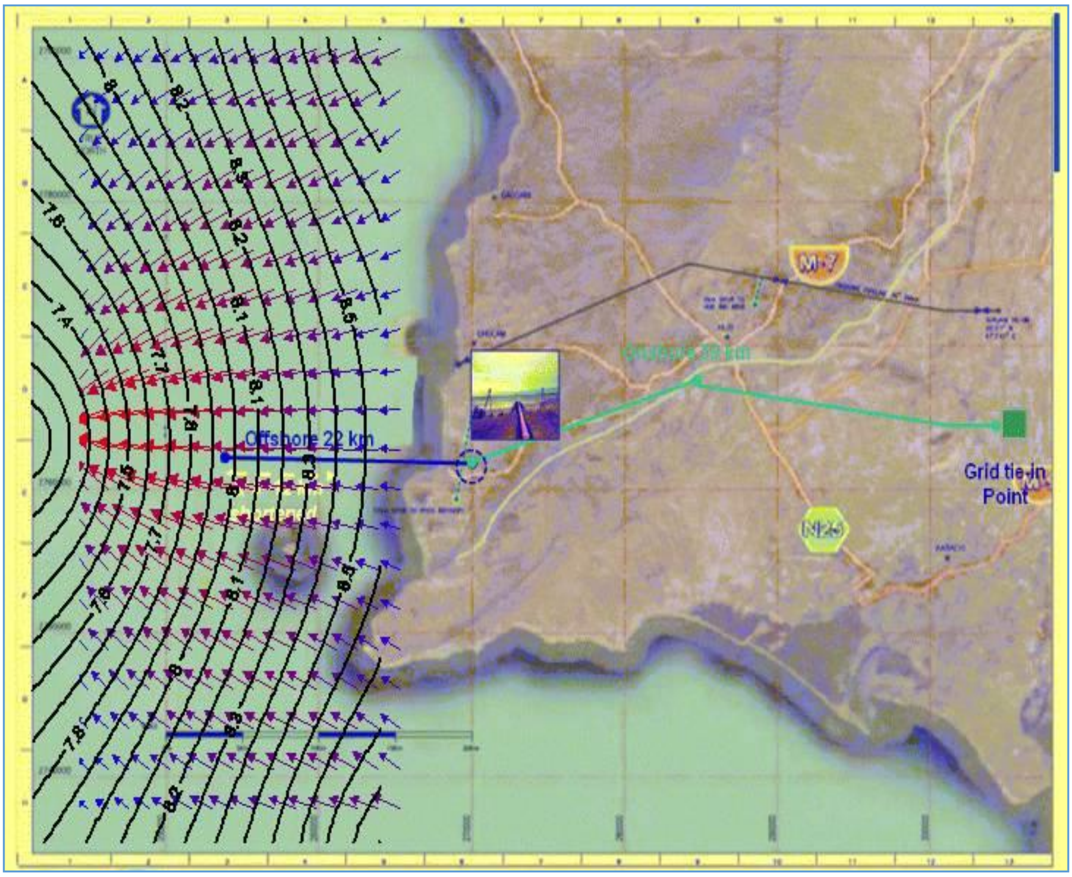


Figure 4.12: Wind speed and direction of the surface oceanic in the offshore project area during the NE Monsoon period. The darker shade vectors indicate the magnitude and intensity of the surface currents. (Source: EMC Archives)

Surface Currents: The predominant direction and speed of the oceanic currents in the offshore area is generally low at about 0.25 m/s. The speed increases to 0.5 m/s during the SW monsoons. The constancy in direction varies from 33 percent to 66 percent during the SW monsoons due to a variation of the wind direction, which affects the current. The direction is directly related to the prevailing wind system. The current is generally easterly in the SW monsoon and westerly in the NE monsoon. The slight difference in direction in the Western and Eastern part of the Karachi Coast is due to circulatory pattern of the current around gyrations, which are usually formed at the center of the sea. There is a clock-wise gyre during SW monsoons and anti-clockwise gyre during the NE monsoons.

4.1.11 Metocean Data

Waves: The wave conditions at the proposed site area are relatively severe during the monsoon month of May to September and especially during cyclones.

A computational wave modeling study by HR Wallingford (2008) was given as a design basis. The study was initially carried out in order to understand the wave climate at the site of a nearby Single Point Mooring (SPM) facility which was installed at 24.950°N, 66.572°E. The study by HR Wallingford used the TELURAY model in order to transform offshore wave conditions to near shore locations of interest by representing the effects of refraction and shoaling. HR Wallingford (2008) introduces to numerous wave height measurements. The results of the different systems show high discrepancies in the range of 5.3 m and 9.3 m for the 1 in 100 year conditions.

The offshore wave conditions used for calculations in the HR Wallingford study have a significant wave height HS of 4 – 4.5 m and a mean wave period of 6 -8 s with a mean wave direction from the sectors centered on 210° N and 240°N.

The effects of shoaling and refraction were calculated by the use of the Shore Protection Manual. The results show that the wave height reduction from deep water conditions (h ≈ 40 m) to a water depth of 16 m estimate to 7.5 % due to refraction and approximately 11.3 % due to shoaling. By applying these reduction coefficient to the offshore wave height the reduced significant height is estimated to approximately 3.7 m. Since the mathematical theory of wave propagation is far from complete, it is necessary to make simplifying assumptions and use approximate methods which are sufficient for a feasibility study. Assumptions which were made: (1) waves follow broadly the linear wave theory (2) wave period is constant over the entire depth of the shore.

The annual wave rose gives information on the wave direction. Figure 4.13 represents the wave rose at the FSRU location, which is understood to be in the area for the proposed site.

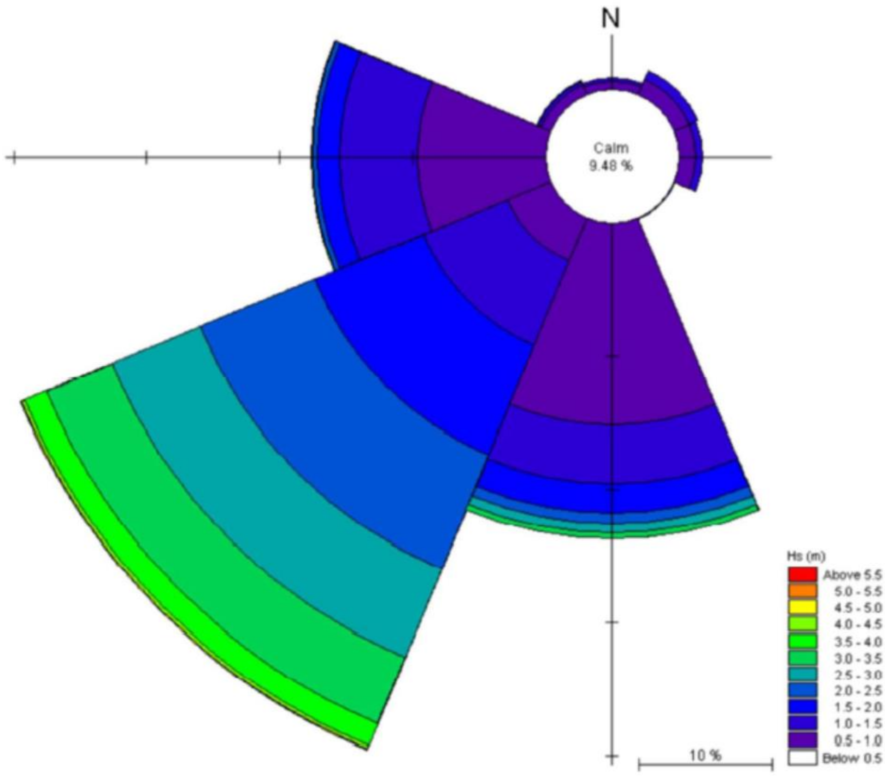


Figure 4.13: Wave rose at FSRU location

It is required that the FSRU and mooring system as well as all stability calculations for terminal equipment and breakwater shall be designed for the 100 year return conditions.

The maximum recorded wave heights are in the range of 3m to 4m from June to August (HS = 3.0 m) and 1m to 2m in September and October in 1979. Wave direction in deep water is estimated to follow the direction of wind, however waves caused by southwest monsoon are expected to slightly change direction to the right when meeting the shallow water area. The main wave directions are in the range of 210°N to 270°N.The mean wave direction however is observed between 237°N and 235°N.

Tides: The tides at Sonmiani Bay are semi-diurnal which means that there are two high waters and two low waters each day. Diurnal inequality exists whereby the two high tides and low tides vary considerably from each other in tidal range. Reliable data about the tidal range exists at a datum near Karachi Port. Mean high water is 2.4 m above datum and mean low water is 0.4 m above datum, which results to mean tidal range of 2.0 m. It is expected that the tidal range in the bay will be significantly lower. Tidal currents can be substantially. Since there is no contraction or channel present tidal currents are considered to be low.

Table 4.1: Tides

Tide	*Level*
MHHW	2.4 m
MLHW	2.3 m
MHLW	1.1 m
MLLW	0.4 m

Currents: The current pattern over the whole of the Arabian Sea varies continually. From January to March, these currents have a common tendency to set towards the west and northwest. Near the coast of Pakistan, a current setting to southeast becomes evident in late January or February and gains in constancy and strength during the next few months. From February through mid-April, the transition period of the northwest and southwest monsoon, the currents are extremely variable. By the end of April, south and southwest winds prevail and give rise to an east and southeast drift that builds up to a maximum in July and August and decreases during September. During November a generally clockwise circulation is set up in the Arabian Sea as a result of the northeast monsoon. In December, the northeast winds prevail over the sea and the period of west drift begins.

Mean velocity of accumulated wind drift and tidal current for the top 10 m in Sonmiani Bay for 100 years return period is 1.6 kt. Recently recorded current data show low current speeds of maximum 0.27 m/s with directions mainly coming from straight north to south. The data was recorded by the use of a current meter on October 6th and 7th 2015 at the South Easterly end of Churna Island. Remark that the current data was not taken during the monsoon season though, it expected that higher currents occur from May till September.

Water Depth: The recommended water depth for LNGCs and the FSRU are at minimum 2 m below the deepest draft (summer draft = 12, 5 m) below LAT. To the expected severe sea state at the navigational approach and the water demand at the FSRU, we recommend a water depth of at least -15 mLAT due to navigational and operational reasons.

As mentioned above, two main locations are taken into consideration. Location 1 has an approximate water depth of about -16 mLAT and location 2 of about -17 mLAT. Thus, the required water depth of minimum 15 m meets the demands for both locations. For the optimization of location 1 near Churna Island sites are chosen which fulfill this recommendations.

Seabed Properties/ Geotechnical Data: Some Data on the seabed properties were delivered by BF. The locations of the taken samples are shown in Figure 4.15 with pins. Sediment samples were taken with the help of a Ponar grab sampler. The grab samples were collected due to examinations for a single point mooring (SPM) facility that is located approximately 11 km off the shore (purple pin). The gab samples show old coral fragments, poorly-sorted coarse gravel & sand, silty clay, well-sorted coarse sand, poorly sorted muddy gravel & coarse sand, poorly-sorted sands & shell hash, well, sorted fine to medium sand, and well-sorted fine sand. New grab samples were taken in October 2015. General assessment showed the rocky nature of the bottom at most of the places. The samplings shown that the sea ground was covered with either shells, stone, pebbles or gravels.

The drilling samples are marked with yellow pins. The maximum depths of the boreholes vary. The boreholes show basically the same findings. There is fine siltstone overlaid with mostly sandy sediments. The locations of the boreholes though are very close to the shore line.

Figure 4.15: Locations Soil Properties

The seafloor geomorphology and lithology has not yet been investigated profoundly at the proposed locations. However, a survey was undertaken for a single point mooring buoy site that is located approximately 12.2 km offshore from shore landing point. It is expected that the geology is similar thus, it is described in the following section. For a detailed design of the foundation and other offshore structures a comprehensive geotechnical study is shell bring a deeper insight.

Figure 4.16: Locations of bottom sampling collected in October 2015

Two main types of soil properties are expected at a water depth larger than 12 m. The predominated material is bedrock. Bedrock is well indurated conglomerates comprised of well-rounded gravels and shell/coral fragments and sandstones. Additionally, coarse grained gravels and sands are expected to be present in thin layers on top the bedrock. Poorly sorted coarse sands and gravels are in areas without ripple bed forms. Clean well-sorted coarse to very coarse sand with large shell fragments are in areas of rippled bed forms. Sand predominately comprised of shell and coral fragments 1 - 50 mm diameter are present.

The given hydrographical survey show a typical erosion dominated seabed with only thin layers of sediment on the bedrock. This is even more expected to be the situation in the nearer area of Churna Island, where sheer bedrock is expected to dominate the seabed eastern / northeastern of the Island.

Based on this information the construction of a terminal and a breakwater is feasible. Due to the bedrock major capital dredging works will be very expensive. Dredging of small areas for final clearance of the berthing or the navigational approach way can be executed with the equipment for the erection of the breakwater. In this case the dredged bedrock may be used as core material for the breakwater.

Based on the given seabed properties sedimentation rate at all considered locations is supposed to be very low. Due to this no maintenance dredging works are estimated in the OPEX.

4.1.12 Climate

The coastal area of the Lasbela District including Sonmiani, Hub and Gadani, has a moderate and moist climate compared with the land in the interior. The weather is generally fine. Generally speaking, the winter extends from October to February, and from mid-February to mid-March the climate is moderate typical of spring elsewhere. April to September constitute summer and also monsoon from the western system. Lasbela town often records the highest temperature (43.3oC in the month of May 1995) during the hottest months of May and June, in Pakistan.

The north-western wind, known locally as Gorich, sets in and prevails from October to February and becomes particularly strong towards the end of February. The hot wind Liwar takes over from the Gorich and brings in aridity and extremely hot conditions from April to June.

Temperatures: Many abnormalities in climatic norms appeared after the mid-1980s in the form of failure of the monsoon system in completing the western segment of its cycle and widespread precipitation of moisture in its eastern segment with heavy rains causing devastating floods each time. The Abnormalities being noticed are in the magnitude and intensity of heat wave but not in the range in the mean maximum and mean minimum temperature and in the erratic nature of precipitation, snowmelt and river flow since early 1990s.

The Earth's surface temperature, according to data provided by satellites, indicates little if any warming of the low-to mid- troposphere. The disparity between the surface temperature and upper-air temperature has nevertheless been noted. Higher temperature of the Arabian Sea and its high heat capacity makes more water vapor available over the sea surface which in turn produces more rain bearing clouds and more than usual rainfall and snowfall.

The minimum temperature recorded during the years 1993 - 95 show that the average annual minimum temperature was 18.6°C, while the minimum was 8.3°C in the month of January, 1994. The maximum temperature 43.3°C was noted in the month of May, 1995, while the mean annual maximum temperature was 35.8°C.

The maximum temperatures recorded by PMD on land have remained at the same level during the last 30 years but the minimum average has decreased by 5 to 7 degrees. Analysis of data on the mean monthly maximum and minimum temperatures recorded during the ten years (2002 – 20011) at Lasbela Meteorological Station of Pakistan Meteorological Department (PMD) indicate:

i) The mean monthly maximum temperature in Lasbela ranged between 35.0 °C and 36.6 °C, with mean at 35.6 °C during the 2002-20011 periods, while the mean monthly minimum temperature ranged between 20.6 °C and 16.1 °C, with the mean at 19.0.

ii) The annual mean maximum and mean minimum temperature during 1993-95 were 35.8 °C and 18.6 °C respectively. This indicates that there has been a slight but significant lowering of about 0.4 °C in the mean minimum temperature during the last 20 years.

Humidity: Relative Humidity (RH) remains low during the first four months of the year, starts rising from May and is maximum at 51.1% in August, and after reducing to an average 43%, it falls to the same levels during the remaining 3 months of the year. In that respect it follows a mixed trend observed for mean minimum temperature and mean annual rainfall.

The overall low RH reflects on the generally arid environment with hillocks of shale with no vegetation on them. With slight amount of precipitation in May the humidity starts rising and then it is aridity again. Aridity raises the particulate matter concentration in air and that should be cause for reflectance of infra-red radiation and this together with the latent heat of evaporation required to evaporate the moisture from the soil is responsible for lowering the temperature of air. This explains the lower mean minimum temperature observed at Lasbela.

Annual Mean Rainfall: Rainfall is unpredictable; it normally falls in summer from July to August. There is little rain in January and February. The three years data of rainfall show great variation in precipitation in the district. The maximum precipitation noted was 192.6 mm in the month of July 1995.

Climate Change Effect: The much too low relative humidity and also insufficient rainfall of 177 cm in 10 years in Lasbela area produces unfavorable conditions that will put any crop under stress and negatively affect the normal growth / yield in the following summer days. This aspect of anomalous variation in temperature and humidity / rainfall incidentally also marks the end of the La Niña effect and onset of El-Nino. The La Nina effect brought down global temperatures in 2011, while the temperature rise occurred in the period described as ENSO Neutral, the phase when neither La Niña nor El Niño occur and ocean temperatures, tropical rainfall patterns and atmospheric winds over the Pacific Ocean nearly matched the long-term average. There has been a significant variation in global temperatures following the end of March, resulting in the January-May temperature average being the 11th highest overall (See 'Global year to date temperature anomalies).

The high mean monthly temperature of 41.85 ^{o}C was recorded at Lasbela in the year 2011. The minimum temperature of ~25 oC continues until May and the monthly average of ~40 ^{o}C continues until April. The change that is fast emerging is the delay in the onset of summer, which is more likely due to large range between the minimum and maximum temperatures. The mean maximum temperatures vary between 30 oC and 35 oC, while the mean minimum temperatures are noted at 10 oC to 15 oC in February and March. Normally it remains somewhere at 35 degrees in March. Such weather conditions are not conducive to the growth of sensitive crops that can be harvested in the east of the Hub Valley.

The low cloud cover, increased sunshine, low humidity has resulted in rise in aridity and low heat retention capacity of the vegetation deficient/ desertified landmass in the hinterland of the Arabian Sea that includes the Project area. Because of high aridity, the evaporative demand of the atmosphere has generally been high, while extraction of heat during the loss of moisture from the soil cooled its surface. This is the most likely reason for the slight but significant lowering in the mean minimum temperature observed at Lasbela station of the Pakistan Meteorological Department.

The desertified land mass north of the Arabian Sea comprises the heat zone and serves as the main heat engine for the monsoon system. The significant rise in temperature of the Arabian Sea recorded elsewhere has led to high evaporation rates over the sea surface. This has led to higher salinity and hence to higher heat content of the Arabian Sea. The higher salinity and higher heat content of the sea are sufficient conditions to create salinity steep gradient in addition to thermal gradients and trigger cyclones in the high seas, as will be observed from the oceanographic data recorded during the cruises in the Arabian Sea.

Figure 4.17: Deposition of material around vegetation deprived site is evidence of wind erosion of desiccated soil

Higher temperature of the Arabian Sea and heat retention capacity imparted to the slightly salinized sea makes more water vapor available over the sea surface. Water in all its forms viz. gas, liquid, ice, and snow is an essential component of the hydrologic cycle. Water vapor is responsible for cloud formation, precipitation and for severe storm development. It acts as a buffer for the rise and fall of temperatures in the atmosphere. Once the temperature drops to the dew point, water vapor condenses, releasing heat of condensation, and the temperature rises again. Conversely, as temperature rises, water evaporates, taking up the heat of evaporation and cools the atmosphere.

Water vapor has a short half-life period as a greenhouse gas, but its accumulation in the atmosphere enhances its influence on the Earth's radiation budget by absorbing outgoing long-wave radiation. Anthropogenic activity adds about 33 billion tons of CO_2 and an almost equivalent amount of water vapour. Additional input of CO_2 and water vapor due to anthropogenic activity alters the mass and energy balance in the atmosphere. This alteration in mass and heat balance is held responsible for the anomalies observed as climate change by the New Theory on Climate Change postulated by the Team Leader.

Rise in temperature of the sea indicates onset and persistence of low-pressure zone on land and temperatures higher than the critical 26^{o}C that may induce thermal gradient at the sea. High salinity will induce steep gradient on the sea. The former parameter i.e. heat zone can attract rain bearing winds in case they are around, while the latter can nucleate cyclones/storms. Such attraction of moisture laden winds did cause severe storms, the latest September 2012, and in August and September 2011; June 6, 2010; and on June 5, 2007; on August 21, 2007; and on August 17, 2006, when it brought sudden heavy rains of as much as 50 to 100 mm in two to three hours.

Over the past three decades, the pertinent findings on climate change indicate that the abnormal changes have occurred because of:

i) Typical geographical location of the country in the arid region at the head of the Arabian Sea that has a surplus heat budget, and

ii) Manmade interventions in the form of anthropogenic activity that has added over a trillion tons of CO_2 and almost another trillion m3 of water during the last 30 years.

On an overall basis the surplus heat budget due to the high temperatures on land has:

i) Induced high evaporation rates all over; on land it has increased the aridity of soil and on seas it has increased the vapour content over the sea surface,

ii) Increased the heat content of the land and the seas; this allows retention of thermal energy in the two systems, and thus raised the temperature of the Arabian Sea by at least 1°C to 1.5°C and higher near the shoreline

iii) Higher temperature of the Arabian Sea and capacity of the slightly salinized sea to retain more heat corresponding to the rise in temperature, thus making more water vapor available over the sea surface which in turn produces more rain bearing clouds and more than usual rainfall and snowfall,

iv) Additional quantities of CO_2 and water have altered the mass balance of the sea and the atmosphere while the extraction of fuel and water has created mass deficiencies on land.

The high heat content of the Arabian Sea and its hinterland as well as formation of extensive heat zone over Pakistan have disturbed the heat balance and water-balance of the region, and have, if the past three years performance has any meaning, substantially modified the monsoon cycle

4.1.13 Ambient Air Quality

In compliance to Balochistan Environmental Act 2012, the baseline data of air quality of the project site was assessed using its USEPA recommended monitoring equipment at the landfall point near Mubarak village. Air Quality data (concentration) of criteria pollutants such as NOx (as sum of NO & NO_2), SO_2, CO, PM_{10}, $PM_{2.5}$ along with Noise Levels were collected for 24 hours at each sites. The meteorological parameters (wind speed, wind direction, temperature & relative humidity) were also measured onsite. Samples were collected and analyzed in the Quality Testing Services Lab.

Results of these pollutants were compared with NEQS and found well within the limits. However, it is expected that the pollutant level will increase but not beyond the permissible limits (NEQS) in construction and operation phase of the proposed project except the particulate matter.

The results are presented below:

1. Oxides of Nitrogen (NOx)

Nitrogen oxides (NOx), a mixture of Nitric oxide (NO) and Nitrogen dioxide (NO_2), are produced from natural sources, motor vehicles and other fuel combustion processes. NO is colorless and odorless and is oxidized in the atmosphere to form NO_2. NO_2 is an odorous, brown, acidic, highly corrosive gas that can affect our health and environment. NOx are critical components of photochemical smog, NO_2 produces the yellowish-brown color of the smog.

The measured average concentration of NOx (µg/m^3) were ranging between 33 - 41 which are well within the prescribed limits of international and national standards for ambient air quality.

2. Sulfur Dioxide (SO_2)

SO_2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include children, the elderly people, and people with heart or lung diseases specifically the asthma patients are more vulnerable.

The measured average concentrations of SO_2 (µg/m^3) were 17 - 21 which are well within the prescribed limits of international and national standards for ambient air quality.

3. Carbon Monoxide (CO)

Carbon Monoxide (CO) is a colorless, odorless, and tasteless gas. It consists of one Carbon atom covalently bonded to one Oxygen atom. Carbon monoxide forms in preference to the more usual Carbon dioxide when there is a reduced availability of Oxygen present during the combustion process. Carbon monoxide has significant fuel value, burning in air with a characteristic blue flame, producing Carbon dioxide. Despite its serious toxicity, CO plays a highly useful role in modern technology, being a precursor to myriad products.

The measured average concentrations of CO (mg/m^3) were 0.4 – 0.9 which are well within the prescribed limits of international and national standards for ambient air quality.

4. Ozone (O_3)

Ozone in the air we breathe can harm our health—typically on hot, sunny days when ozone can reach unhealthy levels. Even relatively low levels of ozone can cause health effects. Children, people with lung disease, older adults, and people who are active outdoors, including outdoor workers, may be particularly sensitive to ozone.

Ozone is particularly likely to reach unhealthy levels on hot sunny days in urban environments. It is a major part of urban smog. Ozone can also be transported long distances by wind. For this reason, even rural areas can experience high ozone levels. And, in some cases, ozone can occur throughout the year in some southern and mountain region

The measured average concentrations of O_3 (mg/m^3) were 32 – 37 which are well within the prescribed limits of international and national standards for ambient air quality.

5. Particulate Matter (PM_{10},$PM_{2.5}$ and TSP)

Particulate matter (PM) is a complex mixture consisting of varying combinations of dry solid fragments, solid cores with liquid coatings and small droplets of liquid. These tiny particles vary greatly in shape, size and chemical composition, and can be made up of different materials such as metals, soot, soil and dust. PM may also contain sulfate particles. PM may be divided into many size fractions, measured in microns (*a micron is one-millionth of a meter)*.Pak EPA regulates three classes of particles - particles up to 10 microns (PM_{10}), particles up to 2.5 microns in size ($PM_{2.5}$) and Total

Suspended Particulate as TSP. $PM_{2.5}$ particles are a subset of PM_{10} whereas PM_{10} particles are subset of TSP.

Monitoring Results of $PM_{2.5}$: The measured average concentrations of $PM_{2.5}$ (µg/m^3) were 11 – 14 which are well within the prescribed limits of international & national standards for ambient air quality.

Monitoring Results of PM_{10}: The measured average concentrations of PM_{10} (µg/m^3) were 38 – 44 which are well also within the prescribed limits of international & national standards for ambient air quality

Monitoring Results of SPM: The measured average concentrations of SPM (µg/m^3) were 110 – 132 which are well also within the prescribed limits of international and national standards for ambient air quality.

6. Noise Level Measurement

Environmental noise is unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport - road traffic, rail traffic, air traffic and from sites of industrial activity. It is monitored to prevent and reduce its impact on the environment, including human health. The Noise Level of 50 (dBA) for day and 45 (dBA) for night time for silent areas prescribed in NEQS is used.

The measured average noise level (dBA) during day time was observed at 44 and during Night time it was observed at 23 which are well also within the prescribed limits of national standards for Noise.

4.2 Terrestrial Ecology

The Balochistan Coast extends from the mouth of Hub River in the east to the Iranian Border at a distance of about 760km. The coastline of Balochistan is divided into the Lasbella Coast and the Mekran Coast. Mekran coast, being the most important area of the Balochistan Coast forms the western part of the Coast from the Lasbella Coast to Jiwani. It contains such important sites such as Hingol National Park, Ras Malan, Ormara Turtle Beaches, Pasni, Sur Bunder, Gwadar, Pishukan, Ganz and Jiwani Coastal Wetland.

Churna Island is situated approx. at a distance of 9 km west of mouth of Hub River in Lasbela District of Balochistan and on the extreme south west of Karachi City on the border between the coastal areas of Sindh and Balochistan Provinces. It is around 2 km long and 1 km wide. It is roughly 7 km away from Mubarak Village. Thus a small portion of the area falls under jurisdiction of the Sindh Government whereas remaining areas comes under the control of Government of Baluchistan.

Churna Island, tehsil Gadani, District Lasbella is known for high biodiversity because of a variety of habitats such as its diversified coral assemblage and the rich mudflats and oyster reefs. Churna island is also important basking and feeding area for marine megafauna including baleen whales, whaleshark, mobulids and sunfishes. Due to power plant & substantially large ship breaking industry present in the area, the ecology is seriously being affected.

Important & noteworthy corals are *Favitespentagona, Alveopora sp., Goniopora sp., Leptastrea sp., Coscinaraeasp.,Psammocora sp.* and *Denrophyllia sp.*

The landward site has diversified habitats in the form of muddy, sandy and rocky areas in the supratidal zone adjoining Sonehri Goth, Manjhar, Bhit and Mubarak Village located in District West of Karachi. No detailed studies on the ecology and fauna of study area have been made so far. Ghalib and Hasnain (1997) have identified Cape Monze/Sonehri area as an important coastal wetland along Arabian Sea for the migratory avifauna. They recorded 81 species of birds from the study area during 1988-1993. Current studies were conducted in the macro habitat of Churna Island during September, 2016 and important fauna and flora were recorded from the nearby coastal areas from Sonehri to Mubarak village.

4.2.1 Results of Faunal/Floral Survey

1. **Flora:** The vegetation particularly the trees such as *Prosopis cineraria* (Jand / Kandi) and *Acacia nilotica* (Babul) are quite scarce in the area. Stunted & heavily polarded Babul Trees were observed in barani cultivation areas. *Prosopis juliflora* (Mesquite) is quite dominant along with *Calotopis procera* (AKK) and *Aerva javanica., Arthrocnemum sp*: is quite dominant in the over flooding seawater zone. In addition Salt indicator species like *Sueda fructosa* (Lani) and *Tamarix spp* (Lai / Lao) were also observed.

   Mammals, birds, reptiles and vegetation assessment has been conducted from the area. Details are as under:

2. **Mammals:** 12 species of mammals were recorded from the coastal area. Among large/medium sized mammals, only Indian Jackal, Red Fox, Indian Porcupine and Desert Cat could be recorded. Among small mammals, Desert Hedgehog, Grey Mongoose, Small Indian Mongoose, Five-striped Palm Squirrel, Roof Rat, House Mouse, Indian Gerbil and Desert Gerbil were also recorded.

Table 4.2: List of Mammals

S.No.	Order	Family	Scientific Name	Common Name
1.	Insectivora	Erinaceidae	*Hemiechinuscollaris*	Desert Hedgehog
2.	Carnivora	Canidae	*Canisaureus*	Indian Jackal
3.	Carnivora	Canidae	*Vulpesvulpes*	Red Fox
4.	Carnivora	Herpestidae	*Herpestesedwardsi*	Grey Mongoose
5.	Carnivora	Herpestidae	*Herpestesjavanicus*	Small Indian Mongoose
6.	Carnivora	Felidae	*Felissylvestris*	Desert Cat
7.	Rodentia	Sciuridae	*Funambuluspennanti*	Five striped Palm Squirrel
8.	Rodentia	Hystricidae	*Hystrixindica*	Indian Crested Porcupine
9.	Rodentia	Muridae	*Rattusrattus*	Roof Rat
10.	Rodentia	Muridae	*Musmusculus*	House Mouse
11.	Rodentia	Muridae	*Nateraindica*	Indian Gerbil
12.	Rodentia	Muridae	*Meroineshurrianae*	Balochistan Gerbil

3. **Birds:** Little information is available regarding the important species of coastal birds of Pakistan. Roberts et al. (1986) have given a list of the birds of the Sindh Coast but they have not given the details of occurrence of the birds on any particular locality on Karachi Coast. Khanam and Ahmed (1988) have studied the resident and migratory birds of the Karachi coast based on their four months

observations during July to October 1985 along the coastal areas from Clifton to Hawkesbay but they did not include Cape Monze in their study area. Ghalib and Hasnain (1994) reported only 41 species of Warterbirds from Cape Monze area. 30 species of birds have been recorded during the recent survey in the study area during September 2016.

Table 4.3: List of Birds Recorded

S.#	Order	Family	Species	Common name	Status *	Habitat
1.	Pelecaniformes	Phalacrocoracidae	*Phalacrocoraxcarbo*	Common cormorant	W	Marshes, mudflats
2.	Ciconiformes	Ardeidae	*Ardeolagrayii*	Indian Pond Heron	R	Marshes, Coast
3.	Ciconiformes	Ardeidae	*Egrettagarzetta*	Little Egret	R	Marshes, mudflats
4.	Ciconiformes	Ardeidae	*Egretta alba*	Large Egret	R	Marshes, mudflats
5.	Ciconiformes	Ardeidae	*Ardeacinerea*	Grey Heron	W	Marshes, mudflats
6.	Ciconiformes	Phoenicopteridae	*Phoenicopterusruber*	Greater Flamingo	LM	Tidal mudflats
7.	Anseriformes	Anatidae	*Todornatadorna*	Common Shelduck	W	Mudflats
8.	Anseriformes	Anatidae	*Anascrecca*	Common Teal	W	Marshes
9.	Anseriformes	Anatidae	*Aythyaferina*	Common Pochard	W	Marshes
10.	Falconiformes	Pandionidae	*Pandionhaliaelus*	Osprey	W	Marshes
11.	Falconiformes	Accipitridae	*Milvusmigrans*	Black Kite	R	Plains, marshes, coast
12.	Falconiformes	Accipitridae	*Haliasturindus*	Brahminy Kite	R	Marshes
13.	Falconiformes	Accipitridae	*Gyps fulvus*	Eurasian Griffon	R	Over hills
14.	Falconiformes	Accipitridae	*Aegyplusmonachus*	Cinereous Vulture	R	Plains
15.	Falconiformes	Accipitridae	*Aquila heliacal*	Imperial Eagle	W	Plains, marshes
16.	Falconiformes	Accipitridae	*Aquila rapax*	Steppe Eagle	W	Near the coast
17.	Falconiformes	Falconidae	*Falco tinnunculus*	Common Kestrel	W	Near the coast
18.	Charadriformes	Charadriae	*Vanellusindicus*	Red wattled Lapwing	R	Marshes
19.	Charadriformes	Charadriae	*Charadriusalexandrines*	Kentish Plover	R	Mudflats, sandflats
20.	Charadriformes	Charadriae	*Charadriusmongolus*	Mongolian Plover	R	Mudflats, sandflats
21.	Charadriformes	Scolopacidae	*Limosalapponica*	Bar tailed Godwit	W	Sandflats
22.	Charadriformes	Scolopacidae	*Actitishypoleucos*	Common Sandpiper	W	Marshes
23.	Charadriformes	Scolopacidae	*Calidrisminuta*	Little Stint	W	Mudflats

Table 4.3: List of Birds Recorded						
S.#	*Order*	*Family*	*Species*	*Common name*	*Status **	*Habitat*
24.	Charadriformes	Recurvirostridae	*Himantopushimantopus*	Black winged Stilt	R	Marshes, Mudflats
25.	Charadriformes	Laridae	*Larusargentatus*	Herring Gull	W	Coast, Marshes
26.	Charadriformes	Laridae	*Larusridibundus*	Black headed Gull	W	Coast, Marshes
27.	Charadriformes	Laridae	*Larusgenei*	Slender billed Gull	W	Coast, Marshes
28.	Charadriformes	Laridae	*Hydroprognecaspia*	Caspian Tern	YRV	Coast, Marshes
29.	Charadriformes	Laridae	*Sterna albifrons*	Little Tern	W	Coast
30.	Charadriformes	Laridae	*Sterna sandvicensis*	Sandwich Tern	YRV	Coast, Marshes

*Status: W =, R =, LH =, YRV =

The study area supports major concentration of several species of gulls and terns whose populations sometimes exceeds 4000 during winter. Some species of gulls and terns like black headed gull *(Larusridibundus)*, sandwich tern *(Thalasseussandvicensis)*, Caspian tern *(Hydroprognecaspia)*, winter visitors, have been recorded in summer months between April and September.

The study area also supports small populations of cormorants, flamingoes and egrets and herons which were sighted on the sandy beach. Little egret *(Egrettagarzetta),* pond heron *(Areola grayii)* and grey heron *(Ardeacinerea)* have been observed in summer as well.

There are some poultry farms located near Cape Monze which attract main species of birds of prey including some rare species like imperial Eagle *(Aquila heliacal)*, griffon vulture *(Gyps fuscus)* and cinereous vulture *(Aegypiusmonachus)* in winter.

The population of the shorebirds is declining due to increasing recreational and fishing activities in the area while the raptor population has increased due to establishment of poultry farms. The larids population is stable as they still get opportunities for food due to fisherman's village, fishing trawlers and fish landing sites. The overall population of birds recorded from the area so far ranged from 200 to 7000. The peak season is January.

4. **Reptiles:** 11 species of reptiles were recorded. These species are mostly rare/scarce due to less favourable habitat and disturbance.

Table 4.4: Species of Reptiles recorded				
S.No.	*Order*	*Family*	*Scientific Name*	*Common Name*
1.	Squamata	Gekkonidae	*Hemidactylusflaviviridis*	Yellow-bellied Common House Gecko
2.	Squamata	Gekkonidae	*Hemidactyluspersicus*	Persian House Gecko
3.	Squamata	Scincidae	*Ophiomorousraithmai*	Indian Fringetoed Lizard
4.	Squamata	Eublepharidea	*Eublepharusmacularius*	Fat-tailed Gecko
5.	Squamata	Gekkonidae	*Crossobomonorientalis*	Sind Sand Gecko
6.	Squamata	Lacertidae	*Acanthodactylus cantoris*	Blue Tail Sand Lizard

7.	Squamata	Scincidae	*Ophiomoroustridactylus*	Indian Sand Swimmer
8.	Squamata	Varanidae	*Varanusbengalensis*	Bengal Monitor
9.	Serpentes	Colubridae	*Platycepsrhodorachis*	Glossybellied Racer
10.	Serpentes	Elapidae	*Najanaja*	Black Cobra
11.	Serpentes	Viperidae	*Echiscarinatus*	Saw Scale Viper

Figure 4.18: Arthrocnemum macrostachyum (Moric.)C

4.3 Marine Ecology

The ecological survey was undertaken on the 25 August 2016 to cover an approximate area within the radius of 10 km in and around the proposed LNG site location to identify marine habitats. The purpose of the survey was to establish preliminary baseline data and information on the fauna and coastal marine habitats and coastal fishery in the area of interest. The survey was undertaken during the low tide. All habitat surveys were done during daylight hours. The habitat stations were selected randomly to represent different ecological zones. The survey was carried out from high water mark to intertidal low water mark. The surveys were consistent with low tidal levels. (Table 4.5).

A hand held GPS (Garmin) was used to mark changes in the coastal configuration, and any significant sightings (Physical structure, rocky cum sandy coastal substrate, flock of bird, artisan fishing activity etc.) was noted. A 200mx20m linear corridor was sampled from Highest High water mark moving towards the low tide level. The coordinates were recorded and saved in GPS as waypoint.

Table 4.5: Marine and Terrestrial ecological Sampling locations.

Station No.	*Time Hrs*	*Location*	*Latitude*	*Longitude*	*Habitat*	*Tide Position*
St 1	1205	Goth Mubarak	N 24.851323	E 66.659236	Rocky cum sandy	Flow
St 2	1315	Goth Manjar	N 24.881480	E 66.694780	Rocky cum sandy	Flow
St 3	1430	Sonnhri Beach	N 24.884650	E 66.703868	Sandy cum Muddy	Flow
St 4	1550	Goth Musa	N 24.865111	E 66.693086	Consolidated sand	Terrestrial

Figure 4.19: Map showing the location of sampled stations

The coastal survey along the eroded coastal rocky cum sandy topographic environment is shown as location 1, while the topographic Manjar Goth is shown as location 2.

Figure 4.20. Sampling location 1 Goth Mubarak, and sampling Location 2 Manjar Goth.

Figure 4.21: Sampling locations 3 Sonneri Goth.

Figure 4.22: Shows the general topographic area of location 4 Musa Goth, located 6 km away from the coast (inland) designated as a terrestrial location.

Figure 4.23: Sampling Location 4 Musa Goth and beyond

A digital camera was used to capture images of the marine habitats and fauna. The marine invertebrate specimens (Gastropods, Bivalves, borrowing worms, Crustaceans etc.) encountered during the survey on exposed low tidal areas were enumerated, documented and identified as taxonomic groups or to the genus level by referring to standard field guides.

Coastal fish survey was undertaken by evaluating the fish catch of the local fishermen and by visiting the fish landing jetty. The fish are generally caught by the gill set nets by the local artisanal fishermen on daily basis. The fish shrimps caught were documented and identified by referring to FAO species identification sheets: *A Field guide for Pakistan*. The fish catches of local fishermen fishing in the area were also examined for calculating the diversity of coastal fish and Crustacean species.

A statistical package was used to perform statistical analysis on the coastal habitat survey data collected during the surveys. The data analysis included descriptive statistics of the invertebrate fauna, species diversity, and species distribution pattern in the area of interest, to constitute a baseline study. The results of the survey are presented under section survey results.

4.3.1 Survey Results

Descriptive Statistics: The descriptive statistical analysis of results from the 3 coastal locations in the area of interest shows that 12 species were reported with 52 individuals per m^2, location 2 Manjar Goth shows 61 individuals per m^2, represented by 13 species. Sampling Location 3 was represented by three species with 20 individuals per m^2 (table 4.6).

Table 4.6: Descriptive statistical analysis of sampling station.

Sample	*Mean Ind*	*Variance*	*Std Dev*	*Std Error*	*Total Ind*	*Total Species*	*Min*	*Max*	*Mean Confidence Interval*
Sample 1	3.25	17.667	4.203	1.051	52	12	0	15	8.657
Sample 2	3.813	15.896	3.987	0.997	61	13	0	12	7.789
Sample 3	1.25	8.333	2.887	0.722	20	3	0	10	4.083

4.3.2 Marine Habitat Survey

The exposed beaches in the surveyed showed little variation in the types of substrate. The epifaunal animal communities at sampling locations 1 Mubarak Goth and location 2 Manjar Goth were similar. The coastal habitat survey (rocky cum sandy) showed a diversified community of Gastropods, Bivalve Mollusks, and Crustacean fauna on the exposed beaches and rocky pools at low tide. Barnacles were by far the most dominant species sampled at all the 3 sampled locations. The Mudskippers were the only dominant species along with Uca crabs at Sonneri Goth. (Figure 4.24)

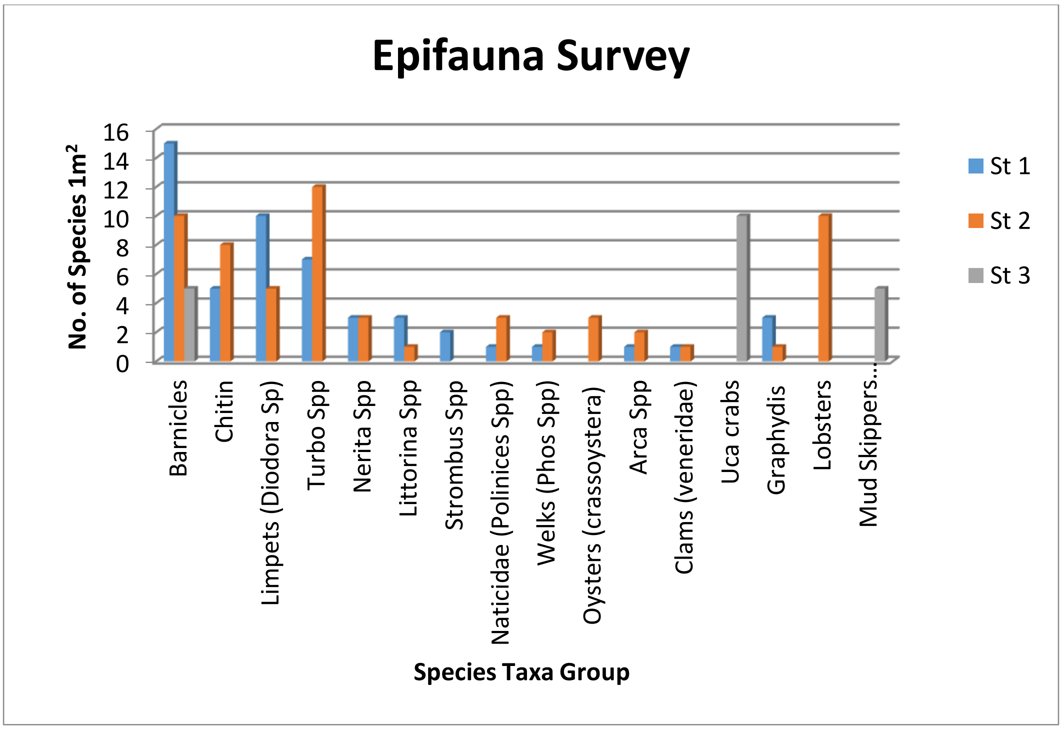


Figure 4.24: Number of taxanomic groups & species observed at sampling locations 1, 2 & 3.

4.3.3 Distribution pattern of Epifaunal species

The result of the spatial dispersion of the animal population and the distribution pattern within the habitat is given in table 4.7.

Table 4.7: Spatial dispersion of the animal population & the distribution pattern within the habitat

Species	*Variance*	*Mean*	*Chi-sq*	*d.f.*	*Aggregation*
Barnicles	25	10	5	2	Random
Chitin	16.3333	4.3333	7.5385	2	Aggregated
Limpets (Diodora Sp)	25	5	10	2	Aggregated
Turbo Spp	36.3333	6.3333	11.4737	2	Aggregated
Nerita Spp	3	2	3	2	Random
Littorina Spp	2.3333	1.3333	3.5	2	Random
Strombus Spp	1.3333	0.6667	4	2	Random
Naticidae (Polinices Spp)	2.3333	1.3333	3.5	2	Random
Welks (Phos Spp)	1	1	2	2	Random
Oysters (crassoystera)	3	1	6	2	Random
Arca Spp	1	1	2	2	Random
Clams (veneridae)	0.3333	0.6667	1	2	Random
Uca crabs	33.3333	3.3333	20	2	Aggregated
Graphydis	2.3333	1.3333	3.5	2	Random
Lobsters	33.3333	3.3333	20	2	Aggregated
Mud Skippers (Balomepthus)	8.3333	1.6667	10	2	Aggregated

Most of the invertebrate epifaunal species (Figure 9) such as Chitin, Limpets, Turbo Spp , Uca crabs and mud skippers were found to be in aggregate associations, while the others species were randomly distributed in the area surveyed. Other invertebrate epifauna such as Turbo spp, and Littorina spp (*periwinkles*) were the most common gastropods observed and were found to inhabit the intertidal zone. Although the crab species are capable of living above the high tide mark for extended periods of time, but for their survival they must keep their gills moist and need to spend time during reproduction close to the shoreline. The local fishermen catch 30-40 kg of lobsters (*Panulirus polyphagus*) daily from nearby area offshore; lobsters inhabit rocky crevices. The spiny lobsters were landed live on Manjar Goth location 2. Coastal Pelagic fish species such as mullets were caught by local fishermen and recreational anglers at Manjar Goth location 2. Epifauna observed at the 3 locations surveyed are given in Figure 4.25.

The species distribution pattern of invertebrates animals inhabiting the coastal areas are dependent on the availability food they prey on and on their mode of reproduction. The distribution of planktonic larval stages of invertebrate animals in the coastal habitats are at the mercy of ebb and flow of tides, beach drift currents, wave action, and long shore currents that carry the adults and the larval forms and redistributed them randomly on the beach. Although none of the taxonomic groups/species observed are listed as endangered or threatened under the red list published by IUCN.

4.3.4 Coral Diversity

Churna island had fairly abundant coral diversity (Ali et al., 2013). North side of Churna Island has rocky bottom constituted of uplifted rocks. Hard corals assemblages, growing on coral roack mounds and ridges. Dominant species found on the northern side of Churna Island uncludes Goniopora albiconus, Alveopora sp., Favites pentagona, Leptastrea cf, bottae, Coscinaraea monile, Pasmmocora supercicialis, Psammocora sp. And Dendrophyllia robusta, On the north western side only two species were found i.e. Goniopora columna and Aveopora sp. No species of soft coral wasreported by Ali et al. (2013), however, recently a number of soft corals and antipatharians (black corals) are observed in the area. The information about corals found around Kaio Island is limited, however, Porites harrisoni and Goniopora albiconus have recently been reported.

Churna-Kaio Islands Complex is known to be important basking and feeding area for megafauna including whale shark (Rhinocodon typus), mobulids (Manta sp. And Mobula spp.), sunfish (Mola Mola and Mola ramsayi) and baleen whales (blue, bryde's and Arabian humpback whales). A diversified cetacean fauna is reported from the area. There was only one authentic record of sperm whale (Physeter macrocephalus) stranding in Pakistan which was reported from Sonara Beach at the mouth of Hub River. Crassostrea grayphoides and C. madrasensis are two main species of oyster occurring in the area (Siddiqui and Ahmed, 2002) Churna-Kaio Islands complex is known to be rich in population of dolphins as their school are frequented in the area[7].

[7] Scientific Information to Describe Areas Meeting Scientific Criteria for Ecologically or Biologically Significant Marine Areas

Figure 4.25: The ubiquitous barnacles on rocky ledges at locations 1, 2. Gastropods (turbo) were observed to aggregate.

Figure 4.26:Chitin

Figure 4.27: Egg casings of gastropods in rocky pools

Figure 4.28: Gastropods and Nerita species

Figure 4.29:Turrid

Figure 4.30: Venus Clam shells on the sandy beaches of Mubarak and Manjar goths.

Figure 4.31: Venus Clam shells on the sandy beaches of Mubarak and Manjar goths.

Figure 4.32: Oyster

Figure 4.33: bivalves

Figure 4.34: Shore crabs at location 2

Figure 4.35: Shore crabs at location 2


Figure 4.36: Uca (Male) crabs at location 3


Figure 4.37: Female Uca crab at location 3

Figure 4.38: Spiny lobster Panulirus polyphagus female with sperms sac and P. orientalis observed at manjar goth location 2.

Figure 4.39: Spiny lobsters landed at Manjar goth

Figure 4.40: Lobster tails

Figure 4.41: Mud Skipper at Sonneri, location 3.

Figure 4.42: Barnacles at Sonneri, location 3.

Figure 4.43: (continued) Brown Seaweed in rocky pools at low tide in Mubarak goth.

Figure 4.44: Pelagic fishes caught by local fishermen at Manjar goth.

4.3.5 Shannon Weiner Diversity Index

The biodiversity values calculated for the epifaunal communities was relatively high (2.14 and 2.37 respectively) at sampled locations 1 (Mubarak goth) and location 2 (Manjar goth). Sonneri Goth location 3, show relatively low diversity (1.04) Table 4.8.

Table 4.8: Shannon Weiner diversity index calculated for locations 1, 2 and 3

	Sample 1 Mubarak Goth	Sample 2 Manjar Goth	Sample 3 Sonneri Goth
Shannon Hmax Log Base 10.	2.14	2.37	1.04
Shannon J'	0.86	0.9	0.95

Diversity index ranges from 0.1 (low) to 3.0 (high). The Shannon evenness (J’) demonstrates that the epifaunal species are evenly distributed at each of the 3 sampled locations. The evenness values calculated are closer to 1 which suggest that the number of species observed were high and the ecosystem supports the habitat they inhibit. Evenness J’ Ranges from 0.1 low – 1.0 high.

4.3.6 Water Birds

The coastal locations of Mubarak, Manjar goth and adjoining areas attract a large number of migratory birds, particularly waterfowl. Roberts T. J. 1991, Hassan (1995) have reported approximately 56 species of birds belonging to 6 orders and 14 families are found in the coastal waters. Some of these birds are resident while most are migratory. Ducks, geese and other waterfowl generally stop over at coastal wetlands during their seasonal migration. Species that are common in coastal and open sea areas of Pakistan include various species of grebe, shearwater, petrel, pelican, cormorant, shag, gull, tern, booby and tropicbird (Roberts T. J. 1991).

The Survey team was able to observe the ubiquitous sea gulls and petrel in the area during the observation period. (Figure 4.45.)

Figure 4.45: Seabirds Terns' bask in along the sand coastline at Manjar goth location 2

4.3.7 Whales and Dolphins (Cetaceans)

Among the marine mammals some species of Cetaceans (dolphins, porpoises), and whales can be found in the area. However due to insufficient data, information on their numbers and abundance in Pakistan's maritime area is limited. The mammals which are reported in the area are; Finless Porpoise, Indo-Pacific Hump-Backed Dolphin, Bottlenose Dolphin, Spinner Dolphin, Striped Dolphin, Common Dolphin, Melon-Headed Whale, Dwarf Sperm Whale, Bryde's Whale, and Humback Whale (Roberts T. J. 1997). Most of the information reported about the presence of marine mammals is based on sightings by fishermen or stranding data.

Dr Mauvis Gore along with Pakistani research team has for the first time identified and recorded the presence of 12 species of marine dolphins and whales in the Sindh-Balochistan waters. The identified species include five dolphin species, one porpoise species, two species of the toothed whale and four species of the baleen whale.

The threats the cetacean included falling fish stocks (less food available), the silting of rivers because of dwindling mangrove forests, the growth of toxic algae and the presence of hazardous waste and plastic bags in the sea which could prove fatal for whales and dolphins as well as turtles. Additionally, deadly collisions with large sea-faring vessels, some fishing practices, seismic surveys and military operations all posed a risk for these species' survival.

4.3.8 Marine Turtles

The members of the local community informed the team that the marine green turtles have been reported from the other coastal and offshore areas of Balochistan such as Ormara, Jiwani etc. The Green Turtle (*Chelonia mydas*) and Olive Ridley (*Lepidochelys Olivacea*) frequently visit the sandy beaches of Sindh and Balochistan for breeding and nesting. Literature sources report turtle nesting at Sandspit, Hawks Bay, Jiwani (Daran), Haft Talar (Astola Island), Ganz, Ormara and the Sonmiani Many nests are reported on the beach at the foot of the "Lighthouse Cliff" at Jiwani. Extensive nesting is also recorded on the beach at the foot of the Kamgar Hills on the eastern side of Ormara West Bay, with sparse nests along the northern margin of the same bay. There are small sandy coves and inlets at eight kilometers beyond Hawks Bay where green turtles are occasionally found (Firdous 1988). Green turtle (the more common species in Sindh) breeds throughout the year with a maximum nesting period during October and November. Olive Ridley turtle, a comparatively smaller species, has a shorter breeding season. Its peak-hatching season is between August and December.

4.4 Social Environment

This section describes the socio-economic conditions of the project area and its surroundings, covering both the macro-environment and the micro-environment. The macro-environment presents a comprehensive review of the socio-economic conditions of District Lasbela based on available secondary data. The micro-environment describes the socio-economic conditions of the nearest human settlements of the project site. Socio-economic conditions are based on observations during site visit, village surveys and consultations with stakeholders at the local level including representatives of the Local Government, NGOs, and CBOs.

4.4.1 Macroenvironment

Location and Boundary: Lasbela was separated from Kalat after granting district status on 30 June, 1954. The district is located in the South of Quetta City, the provincial capital of Balochistan, sharing its boundaries in the East with Sindh Province. Awaran and Gwadar Districts are on the West and Khuzdar District is in the North. This district is mountainous in the East and has central alluvial lowland drained by the Porali and Kud Rivers, whereas in the West, there is a narrow coastal strip dotted with mangrove swamps.

The headquarters of the district are in “Uthal” town, while the district consists of nine tehsils; Bela, Uthal, Hub, Lakhra, Somiani, Dureaji, Lairi, Gaddani and Konnaj. Area-wise district Lasbela is the 7th largest district in Balochistan and has an area of 15,153 square kilometers. Lasbela District, lies between 65°12'11"-67°25'39" East longitudes and 24°53'2"-26°39'20" North latitudes. Location of Lasbela is at 1,075km (aerial distance) south-east (218 degrees bearing) of Pakistan's Capital City Islamabad and 116 km north-west (333 degrees bearing) from Karachi.

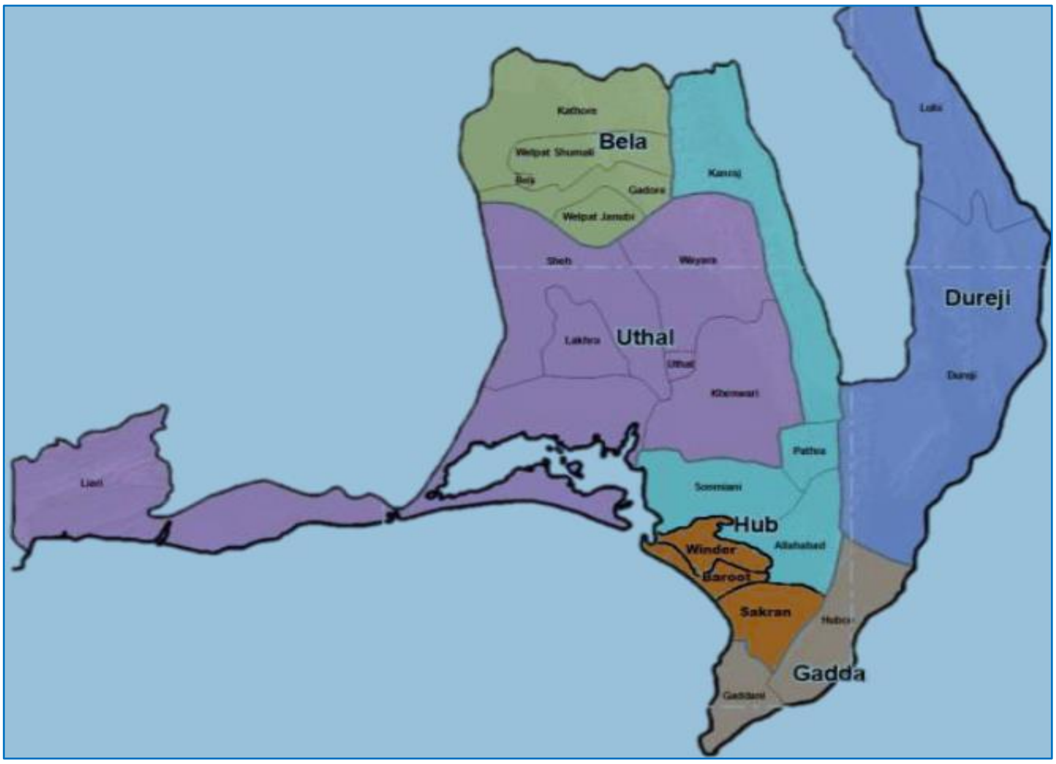


Figure 4.46: Map of Lasbela District (Sources: District Development Atlas of Balochistan 2010, P&D Department Government of Balochistan and UNICEF)

Tribes, Ethnic Groups and Languages: The social setup of the district is tribal. All the tribes other than the Baloch and Brahui, Med, Khoja and Hindus who have settled in Lasbela are known as “Lasi". The principal Lasi tribes are five in number; the Jamoot, Runjhas, Sheikh, Angaria and the Burra. Together they are called Panjraj and constitute a tribal confederation under each “raj” are a large number of heterogeneous groups.

4.4.2 Socio-Economic Profile of the District

1. Education and Literacy

This section highlights the major characteristics of schooling in the district by providing a situation analysis in terms of access, equality and quality of primary and secondary education. Moreover, besides providing the level of adult literacy, school facilities and physical characteristics are collated to provide an idea of the quality of education in the district.

Access to education is generally gauged with reference to the gross and net enrolment rates, based on the relevant age group. Traditionally in Pakistan, enrolment rates are calculated on the basis of the age group 5-9 years and 10-14 years for primary and secondary levels of education respectively. Therefore, following this precedent, these age groups are preferred for documentation of the educational status of children in terms of out-of-schooling and enrolments in public, private or religious institutions. Access and equality indicators are derived from Pakistan Social and Living Standard Measurement (PSLM) surveys, while the available physical facilities in primary and secondary schools are ascertained from the Development Statistics of the province.

Table 4.9 displays the educational status of children for the 5-9 years age group. Overall, about 54 percent of children of the primary age group were out of school in the year 2013. The private schools do not exist as such in the district. Overall, about 8 percent of children were enrolled in private institutions according to the estimates from the household survey (PSLM, 2013). Moreover, the table indicates that about 1 percent of children in the 5-9 years age group were enrolled in religious schools during the survey year 2013. Interestingly, enrollment ratios in private and religious school are higher for girls than boys, perhaps due to hosting the worst infrastructure and an almost non-existence of facilities in government schools.

Table 4.9: Educational Status of Children of 5-9 Years Age Group
[Percentage Distribution, 2012-13]

	Overall%	Boys%	Girls%
Out of School	54.03	54.98	52.64
Enrolled in Public Schools	36.92	39.18	33.61
Enrolled in Private Schools	7.61	5.84	10.20
Enrolled in Religious Schools (Madrasa)	1.44	0.00	3.55
Enrolled in Schools Run by NGOs	0.00	0.00	0.00

Source: Estimated from Household Level Data of PSLM, 2012-13

Table 4.10 documents the educational status of children in the 10-14 years age group. Overall, about 49 percent of children of the 10-14 years age group were not attending school during 2013. The majority (about 43 percent out of 49 percent) of students were enrolled in government schools. Moreover, about 2 percent enrollment in religious school is also estimated from the PSLM 2013 data.

Table 4.10: Educational Status of Children of 10-14 Age Group
[Percentage Distribution, 2012-13]

	Overall%	Boys%	Girls%
Out of School	49.11	42.15	57.42

Table 4.10: Educational Status of Children of 10-14 Age Group [Percentage Distribution, 2012-13]

	Overall%	Boys%	Girls%
Enrolled in Public Schools	43.14	51.80	32.8
Enrolled in Private Schools	5.95	4.96	7.13
Enrolled in Religious Schools (Madrasa)	1.80	1.09	2.64
Enrolled in Schools Run by NGOs	0.00	0.00	0.00

Source: Estimated from Household Level Data of PSLM, 2012-13

A summary index "Gender Parity Index (GPI)" is commonly used to assess gender differences. It is the value of an indicator for girls divided by that for boys. A value of less than one indicates differences in favor of boys, whereas a value near one indicates that parity has been more or less achieved. Figure 4.47 is developed to document the prevalence in gender disparities in school enrolment for the children in primary and secondary age groups respectively. Relatively lower gender disparity is observed in the district as compared with the province for the school enrolment in the 5-9 years age cohort (0.72 versus 0.69). A similar trend is observed in the secondary school enrolment where the district magnitude of GPI is high as compared with that estimated for the province (0.62 versus 0.47).

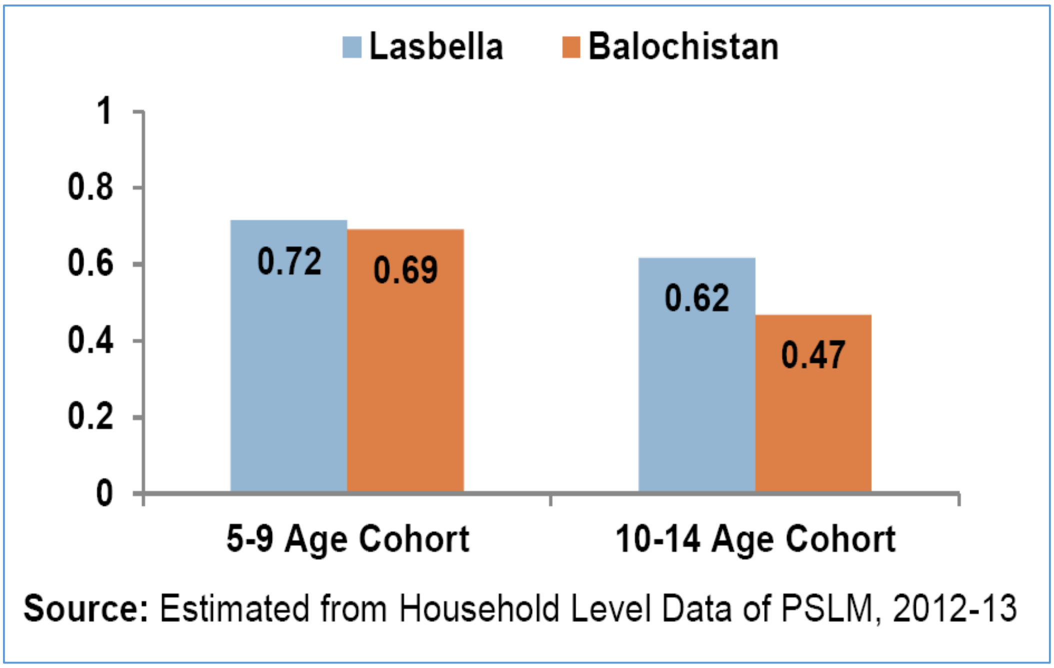


Figure 4.47: Gender Parity Index in Primary and Secondary Enrollment [2012-13]

Table 4.11 furnishes information regarding the number and type of educational institutions as well as the number of teachers. This supply-side information is obtained from the provincial Development Statistics.

Due to data constraints in terms of various indicators of quality inputs, this section only describes the available physical facilities in schools, which is the most important pillar of quality input to education. School buildings, drinking water, boundary walls, electricity and toilets for students are considered basic facilities.

Table 4.12 summarizes the extent of available facilities across various levels (primary, middle and high) of education. Electricity is available in only 9 percent of primary schools, while only 7 percent of primary schools operate in a building of satisfactory condition. About 5 percent of primary schools have no building, whereas about 77 percent run without boundary walls. The situation in middle and high schools is however comparatively better. Electricity and drinking water are available in 16 percent and 73 percent of schools respectively. About 92-96 percent of school buildings have a "pacca" structure in middle and high schools, while about 14 percent to 19 percent of secondary school buildings are in satisfactory conditions.

Table 4.11: Teaching Institutions and Staff – Numbers [2011]

Description	Schools	Total	Teachers	
			Male	Female
Primary School	482	865	621	244
Middle School	53	578	396	182
High School	28	650	464	186
Community School	28	34	23	11
Private School	6	26	19	7
Intermediate/Degree College	4	22	10	12

Source: Development Statistics of Balochistan, 2012-13, Government of Balochistan

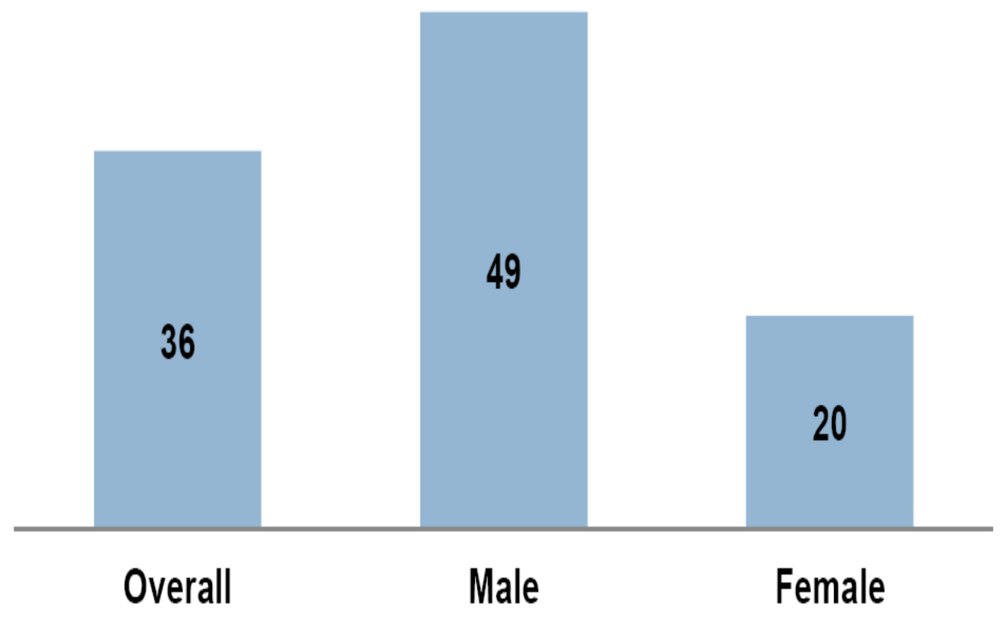
Table 4.12: School Facilities and Physical Characteristic – 2011 [Percentage of Schools]

Description	Primary%	Middle%	High%	Total%
Building Availability	94.61	100.00	100.00	95.38
Boundary Wall Exists	22.61	58.49	75.00	28.60
Satisfactory Building Condition	6.85	18.87	14.29	8.35
'*Pacca*' Structure of Schools	83.82	92.45	96.43	85.26
Electricity Availability	9.34	41.51	78.57	15.81
Drinking Water Availability	78.63	26.42	50.00	72.29
Latrine Availability	18.67	69.81	82.14	26.64

Source: Development Statistics of Balochistan, 2012-13, Government of Balochistan

According to UNDP Human Development Report (2014), Pakistan has been placed 146th out of 187 countries in terms of the Human Development Index with overall adult literacy rate of 54.9 percent. Over the years, several non-formal literacy programs were launched but these suffered from lack of political commitment, adequate financial support, weak implementation structures and an absence of effective supervision and monitoring.

Figure 4.48 documents the adult (15 plus age cohort) literacy rates for the district. According to the table, literacy rates in the district are 36 percent for the overall population; with 49 percent for males and 20 percent for females during the year 2012-13. The estimated corresponding literacy rates for the province are; 42 percent, 61 percent & 19 percent for overall, male & female population respectively.



Source: Estimated from Household Level Data of PSLM, 2012-13

Figure 4.48: Adult Literacy Rate (%) - [2012-13]

2. Health

Health is the most important factor which plays a key role in determining the human capital. Better health improves the efficiency and the productivity of the labor force and thus ultimately contributes to economic growth and leads to human welfare. On the other hand, there is a strong relationship between poverty and poor health.

The health status of a region may be evaluated in terms of either input indicators (doctors, institutions etc.) or output indicators (Infant Mortality, Maternal Mortality, Life Expectancy etc.). Unfortunately, district-wise data on output indicators are not available in Pakistan from either published or unpublished materials. The latest Multiple Indicators Cluster Survey (MICS) which was conducted in 2010 in the province, although reports district-wise indicators, doesn't provide data on the district-wise morality rates and life expectancy. Therefore, to gauge an idea about the health status in the target districts, data on the maximum possible input indicators is collated in the following tables.

A rough sketch on child health is furnished in 4.13. Only about 54 percent of children in the 12-23 months age cohort were reported fully immunized according to recall and record method, while the corresponding percentage is even lower (42 percent) in households which provided records of immunization. It is encouraging that almost all households reported the use of ORS for the treatment of diarrhea; however the percentage who consulted physicians in cases of diarrhea is about 79 percent. No gender discrimination is evident from the data.

Table 4.13: Status of Child Health - Percentages [2012-13]

Children (12-23 Months) – Fully Immunized	Overall%	Boys%	Girls%
Record Only	42	40	45

Table 4.13: Status of Child Health - Percentages [2012-13]			
Children (12-23 Months) – Fully Immunized	**Overall%**	**Boys%**	**Girls%**
Recall and Record	54	56	51
Diarrhea in Children Under 5			
Physician Consulted	79	73	78
Treatment of Diarrhea – ORS	96	95	100

Source: PSLM, 2012-13

Some indicators of maternal health care are compiled in Table 4.14. The information in the table reveals that only 48 percent reported having Tetanus Toxoid Injections, while this percentage is quite low (29 percent) for the rural population. While an insignificant percentage of women reported post-natal care, about 74 percent of surveyed women confirmed pre-natal consultation. The situation in terms of child delivery is also miserable. Child delivery at home is reported by about 68 percent of rural area households. The corresponding percentage for urban population is about 25 percent.

Table 4.14: Status of Maternal Health – Percentage of Pertinent Women [2012-13]			
	Overall %	**Urban %**	**Rural %**
Have Received Tetanus Toxoid Injection	48	82	29
Pre-Natal Consultations	74	88	66
Child Delivery at Home	53	25	68
Post-Natal Consultations	4	2	5

Source: PSLM, 2012-13

Numbers of health institutions in the district during the year 2011-12 are collated in Table 4.15, while the strength of the health staff in the district is depicted in Table 4.16. A gloomy picture is evident in terms of the strength of the district in providing health facilities. Only 16 doctors and 5 nurses are available for one hundred thousand population, according to the statistics provided by the provincial official publications.

Table 4.15: Health Institutions – Numbers [2011-12]	
	Numbers
Hospital	4
Dispensary	27
Rural Health Centre	40
Basic Health Units	42
Maternal and Child Health Centre	4
TB Clinic	1

Source: Development Statistics of Balochistan, 2012-13

Table 4.16: Health Staffs – Numbers [2011-12]		
	Total	Per One Hundred Thousand population
Doctors	81	16
Nurses	24	5
Paramedics	79	15

Source: Estimated from Development Statistics of Balochistan, 2012-13

3. Housing Quality and Housing Services

It is of interest to assess the means and standard of living directly provided by the government and those that are acquired by the household. Shelter is one of the basic needs, and housing conditions are one of the key determinants of the quality of life.

To observe the access to housing facilities, three indicators are used Vis a Vis, proportion of households using electricity, cooking gas and tap water, while the quality of housing stock is evaluated in terms of the material used in the wall and roof, and the type of toilet in the house. All this information is obtained at the household level from the household survey (PSLM) and thus truly reflects the conditions of living standards in the district.

Information regarding the type of material used in the roof is displayed in Table 4.17. The table reveals that about 46 percent of households (12 percent urban and 62 percent rural) reported inadequate (wood) roof material. Iron and cement are used in about 22 percent of rural households, while 52 percent of urban households reported RCC/RBC roofing.

Table 4.17: Material Used in Roof - Percentage of Household [2012-13]			
	Overall %	Urban %	Rural %
RCC, RBC	24	52	9
Iron, Cement	21	19	22
Garder, T-Iron	10	17	7
Wood etc.	46	12	62

Source: PSLM, 2012-13

In terms of material used in the wall, the majority (51 percent) of households reported the use of mud bricks or mud (Table 4.18). The corresponding percentage for rural areas is 62 percent. Burnt bricks or blocks are used in about 34 percent and 69 percent of rural and urban households respectively.

Table 4.18: Wall Structure – Percentage of Households [2012-13]			
	Overall %	Urban %	Rural %
Burnt Brick-Blocks	46	69	34
Mud Bricks/ MUD	51	31	62
Wood etc.	3	0	4

Source: PSLM, 2012-13

Information regarding the type of toilet used by households is furnished in Table 4.19. About 25 percent of rural households reported unavailability of toilet facilities in the house. Even in urban areas, about 5 percent of households do not have in-house toilet facilities. The table also reveals that the bulk of households reported the use of non-flush toilets.

Table 4.19: Type of Toilet – Percentage of Households [2012-13]

	Overall %	Urban %	Rural %
Flush	28	73	5
Non-Flush	54	21	70
No Toilet	18	5	25

Source: PSLM, 2012-13

About 61 percent of district households are connected with the grid and use electricity for lighting purposes as evident from Table 4.20. However, sharp rural-urban differences exist. About 99 percent and 41 percent of households reported the use of electricity in urban and rural areas respectively. Moreover, about 22 percent of rural households reported non-traditional (candle, wood etc.) sources for lighting.

Table 4.20: Source of Lighting – Percentage of Households [2012-13]

	Overall %	Urban %	Rural %
Electricity	61	99	41
Oil	25	1	36
Other	15	0	22

Source: PSLM, 2012-13

Table 4.21 furnishes information regarding the sources of cooking fuel. Wood and charcoal are the main sources of cooking fuel according to the table. About 51 percent and 100 percent of urban and rural households use either wood or charcoal. Although the PSLM data doesn't provide the separate estimates of the use of wood and charcoal, it is plausible to assume that the use of wood is dominant due to relatively low cost as compared with coal.

Table 4.21: Cooking Fuel – Percentage of Households [2012-13]

	Overall%	Urban%	Rural%
Gas/Oil	16	48	0
Wood/Charcoal	84	51	100
Other	0	1	0

Source: PSLM, 2012-13

The provision of safe drinking water is an important part of planning for a healthy population. Table 4.22 displays sources of drinking water in the district with an urban-rural division. About 54 percent of households fetch water from unsafe sources (uncovered water reservoirs and dug well). The matching percentage for rural areas is 74 percent. The source of tap water is reported by 28 percent households; 74 percent and 6 percent in urban and rural areas respectively.

Table 4.22: Source of Drinking Water – Percentage of Households [2012-13]			
Description	**Overall**	**Urban**	**Rural**
Tap Water	28	74	6
Hand Pump	6	3	7
Motor Pump	12	7	14
Dug Well	23	9	30
Other (Uncovered)	31	7	44

Source: PSLM, 2012-13

4. Transport and Communication

Roads, transportation and telecommunication networks have a significant impact on socialization and modernization. Three indicators have been considered to portray the level of development of the transport and communication sector in a district; road mileage per 100 square kilometers of geographical area, availability of public and private transport and vehicles, and the number of telephone and internet connections per one hundred thousand persons. These indicators, depicted in the Table 4.23, are estimated from the latest published data of the provincial Development Statistics.

Table 4.23: Indicators of Communication [2011-12]		
	Numbers	**Per one Hundred Thousand Population**
Number of Connections		
Landline	2593	514
V-Phone	908	180
Broadband	749	149
Road Kilometers	**Kilometers**	**Per '000' Square Kilometers**
Black Topped	1140	75
Shingle	1232	81
Total	2372	156
Motor Vehicles Registered	**Numbers**	
Public Service Vehicles	1398	
Private Vehicles	6200	
Government Goods Vehicles	1211	
Private Goods Vehicles	20395	
Others	30384	
Total Vehicles	59588	

Source: Development Statistics of Balochistan, 2012-13

The table reveals that about 514 and 180 persons out of one lakh (one hundred thousand) population were connected with PTCL landlines and V-Phones respectively during the year 2011-12. About 749 broadband connections are also reported which is equivalent to 149 persons per one lakh population.

About 75 and 81 kilometers mettle (black topped) and Shingle road is available out of one thousand kilometers of geographical area respectively for about 60 thousand registered vehicles.

5. Population and Employed Labor Force

The characteristics of the employed force are important to understand economic structure and potential of any region. This section provides information with respect to the distribution of the labor force into sectors, occupational groups and working status.

The population of the district is projected using inter-census (1981-1988) growth rates. According to the Table 4.24, the estimated current population of the district is about 5 lakh (0.5 million) with an average growth rate of about 3 percent per annum. Although population growth rates seem high, in the absence of any reliable reference, this growth rate is used for the projection. It is perhaps of interest to know that UNICEF has also used this growth rate while compiling Baluchistan's district profiles for the year 2010. About 0.141 million persons are estimated as the active labor force by applying the crude activity rate of Balochistan.

Table 4.24: Estimated Population

	Overall	Urban	Rural
1998 – Census	313,000	116,000	197,000
2010 – Projected – UNICEF	447,000	165,000	282,000
2014 – Projected – Census Growth Rate 1981-998	504,000	186,000	318,000
Growth Rate (%) [1998-2014]	2.97%	2.95%	2.99%

Source: Estimated from District Census Report, 1998

The distribution of the employed labor force by major economic sectors is furnished in Table 4.25. The table reveals that the agriculture sector absorbs the majority of the labor force. About 45 percent of employment is recorded in this sector during 2012-13 (PSLM survey), whereas about 60 percent of the employed labor force work in the agriculture sector in the rural areas of the district. The trade sector is the next largest employment provider; which absorbs about 17 percent (23 percent in urban and 14 percent in rural) of the employed labor force. About 20 percent of the urban employed labor force is absorbed in the manufacturing sector, while service sector provides employment to about 28 percent of the employed labor force.

Table 4.25: Percentage of Employed Labor Force by Major Sectors [2012-13]

	Overall%	Urban%	Rural%
Agriculture	45.09	13.14	59.64.60
Mining	1.47	20.12	2.15
Manufacturing	8.15		2.69
Construction	.88	1.51	.60
Trade	16.91	23.17	14.05

Table 4.25: Percentage of Employed Labor Force by Major Sectors [2012-13]			
	Overall%	Urban%	Rural%
Other Service Sectors	27.50	42.06	20.87

Source: Estimated from Household Level Data of PSLM, 2012-13

Table 4.26 reports the distribution of labor force in the major occupational groups. About 26 percent of the rural labor force is working in the occupational group „Skilled Agriculture and Fisheries Workers", while about 7 percent of the urban labor force is also reported employed as „Skilled Agriculture and Fisheries Workers". About 9 percent of the labor is employed as craft and related trade workers.

Table 4.26: Percentage of Employed Labor Force by Major Occupational Group [2012-13]			
	Overall %	Urban %	Rural %
Professionals	18.12	31.19	12.16
Clerks/Sales Workers	10.66	16.20	8.14
Skilled Agriculture and Fisheries Workers	20.21	6.93	26.26
Craft and Related Trade Workers	9.24	15.23	6.51
Other	41.78	30.45	46.94

Source: Estimated from Household Level Data of PSLM, 2012-13

Wage employees constitute the largest group with respect to the work status of employed labor force. According to Table 4.27, about 69 percent and 64 percent of the labor force is working as employees. This is followed by a self-employed (own-account workers) group with an estimates of 29 percent and 16 percent for urban and rural areas respectively. Only 16 percent of owner cultivators in rural areas are evident from the table, while the percentage of labor force working as sharecroppers is about 2 percent. The table also reveals that only 1 percent of the employed labor force is linked with the livestock profession.

Table 4.27: Employment Status [Percentage of Employed Persons, 2012-13]			
	Overall %	Urban %	Rural %
Employer Owner cultivator	0.90	0.60	1.04 -
Self Employed	20.13	29.05	16.06
Wage Employee	65.41	68.55	63.98
Un-Paid Family Worker	-	-	-
Owner cultivator	11.30	0.96	16.02
Sharecropper	1.56	-	2.27
Contract cultivator	-	-	-
Livestock	0.70	0.84	0.64

Source: Estimated from Household Level Data of PSLM, 2012-13

6. Livelihood Sources

Sources of livelihood represent the economic base of the district. Various features of agriculture, livestock, mining and forestry are compiled in this section, while district-wise manufacturing and fisheries data are not available.

Lasbela is the most fertile district in terms of cultivation. The main crop is wheat followed by castor, sesame, gaur seeds and fodder. Vegetables include onions and red chilies, and fruit such as bananas, chiko, and papaya are grown. There are three main sources of irrigation; canals, tube wells and dug wells. Majority of the crop cultivation with an area of 13,503 hectares was irrigated by means of tube wells, encompassing 63% of the total irrigation sources followed by dug wells, which covered (4,408 hectares) 21% of the total irrigation sources in District Lasbela. However, canals irrigate 16% of the area (3,421 hectares).

The land utilization statistics in terms of cultivated, cropped and irrigated areas is furnished in Table 4.28. Accordingly, the district shares are about 2 percent, 4 percent and 5 percent in the province respectively, while the share of geographical area is about 4 percent. As evident in the table, tube-wells are the major source of irrigation with about an 86 percent share in total irrigated areas.

Table 4.28: Land Utilization Statistics [2011-12]

		(Hectares)	As percent of the Province
Geographical Area		1515300	4.36
Cultivated Area		48480	1.84
Cropped Area		48808	4.35
Irrigated Area		47914	4.70
Sources of Irrigation	Canal	5959	1.1
	Wells	2160	3.1
	Tube Wells	39795	7.6

Source: Development Statistics of Balochistan, 2012-13

Major crops with a share of at least 10 percent of cropped area of the district are shown in the Table 4.29. With the largest share in the cropped area, Caster Seed is sown on 3410 hectares. This is followed by Moong (2010 hectares) and Coconut (1038 hectares). Among the fruits, Banana and Papaya are sown on about 900 hectares, while tomatoes are an important crop among the vegetables.

Table 4.29: Area and Production of Major Crops [2011-12]

	Area [Hectares]	Production ['00' Tons]
Crops		
Citrus	141	762
Banana	864	2823
Guava	219	1501
Papaya	849	4313

Table 4.29: Area and Production of Major Crops [2011-12]		
	Area [Hectares]	Production ['00' Tons]
Coconut	1038	8156
Tomatoes	614	6068
Ladyfingers	494	2774
Radish	133	2096
Bottle Gourd	127	895
Beet Root	298	16390
Brinjal	285	2169
Moong	2010	1347
Sesamun	112	49
Caster Seed	3410	3818

Note: Those crops are included which are sown on least 10 percent of the total cropped area.

Source: Development Statistics of Balochistan, 2012-13

The numbers and share of agricultural machinery reflect the extent of modernization of agriculture. This information is collated in Table 4.30. Extremely low shares of agricultural machinery with respect to cropped areas portray a gloomy picture. Only 7 tractors are available per one thousand cropped areas, while the share of other machinery is insignificant

Table 4.30: Agriculture Machinery - [2011-12]		
	Numbers	As percent of '000' cropped area
Tractors	322	6.6
Threshers	40	0.8
Harvesters	0	0
Reapers	10	0.2
Bulldozers	17	0.4

Source: Development Statistics of Balochistan, 2012-13

Livestock is also an important source of livelihood in rural areas. Table 4.31 displays the availability of various livestock per one thousand rural population. The table reveals that Goats and Sheep are the major type of livestock in the district.

In terms of livestock, Lasbela is rich amongst the 26 districts. 68% of households owns livestock. For most of them it's an asset and is used meet their expenses. The most preferred form of livestock is goat, sheep followed by cattle, camels, buffaloes and poultry. Despite being the most significant traditional activity in the district, the importance of livestock as a major source of livelihood has decreased due to the growing of orchards and vegetable cropping with irrigation.

Table 4.31: Population of Livestock - [2011-12]		
	Numbers	Per thousand Rural Population
Cattle	140,397	442
Buffalo	12,779	40
Sheep	401,473	12,62
Goats	902,426	2,837
Camel	34,717	109
Horse	2,288	7
Mule	964	3
Asses	29,906	94
Poultry (Non-Commercial)	257,435	809

Source: Development Statistics of Balochistan, 2012-13

The information regarding mineral production in the district is furnished in Table 4.32. Major minerals with almost 100 percent share in the province include; limestone, shale, serpentine, clay, basalt and zinc. Production of ordinary marble is also reported which possesses a provincial share of about 45 percent.

Table 4.32: Mineral Production - [2011-12]		
	(Tons)	As percent of the Province
Marble (ord)	335544	44.7
Baryte	2040	4.3
Limestone	1007239	98.4
Shale	1689994	100
Serpentine	1378	100
Iron Ore	27378	14.0
Clay	35	100
Basalt	550	100
Zinc	11123	100

Source: Development Statistics of Balochistan, 2012-13

Table 4.33 reports the area under the control of the Forest Department of the province. The table reveals that the district has about 0.4 million acres of forest area which is only 14 percent of the provincial forest area.

Table 4.33: Area Under the Control of Forest Department – [2011-12]		
	(Acres)	As percent of the Province
Coniferous	0	0
Irrigated Plantation	0	0
Reverian Bela Forest	2,000	6

Table 4.33: Area Under the Control of Forest Department – [2011-12]		
	(Acres)	As percent of the Province
Scrub Forest	301,252	21
Coastal Forest	1,494	4
Range Lands	87,040	9
Total	391,786	14

Source: Development Statistics of Balochistan, 2012-13

7. Displacement and Migration

There has been no temporary displacement observed in district Lasbela, however, Lasbela is an industrial city which attracts traders, skilled and unskilled laborers. This causes lots of people to migrate to Lasbela. It has permanent migration both from outside districts and far flung areas of district Lasbela by people searching for employment.

There have been no reforms introduced to conflict resolution systems in district Lasbela and the system remains the same.

Chapter 5 Consultation & Information Disclosure

5.1 Objectives of Stakeholder Consultation

This section provides an overview and scope of the public consultation process that will be adopted by the project proponent (Bahria Foundation) throughout the project cycle. Providing the stakeholders with adequate, reliable information of the planned project is of significant importance in creating public trust and acceptance.

An effective public consultation provides concrete suggestions that can help improve project design, resolve conflicts at an early stage, identify management solutions to mitigate potentially adverse consequences and enhance positive impacts, and develop guidelines for effective monitoring and reporting of project activities throughout the project cycle.

The stakeholder consultation process developed for the proposed Offshore LNG Terminal Project is in line with the key objectives of stakeholder consultation identified below:

- Provide information related to proposed project activities;
- Facilitate and maintain dialogue;
- Seek participation of all interested parties;
- Identify stakeholder interests and issues;
- Identify solutions for addressing these concerns and integrating them into project design, operations, and management; and
- Enhance the project by learning from, and incorporating, the expertise of individuals, professionals, communities and organizations.

5.2 Identification of Stakeholders

A broad range of stakeholders from various backgrounds were identified for the proposed Project.

- **Primary Stakeholders:** individuals/groups/institutions that will directly be affected (positively and/or negatively) by the project activities and outcomes

- **Secondary Stakeholders:** individuals/groups/institutions that are important intermediaries in achieving the project activities and outcomes

For the purpose of this project, the primary stakeholders are the local communities and local-level organizations representing community interests. The secondary stakeholders are relevant government departments, NGOs and academia.

5.3 Project Consultation Framework

An effective consultation process ensures that a clear plan/framework is developed during the inception phase of the project that provides guidance for stakeholder engagement throughout the project life-cycle. Stakeholder consultation is viewed as a continuous process that not only provides for improvements in the project activities during the pre-construction, construction, and operation phases, but also seeks to enhance the stakeholder engagement process itself. Therefore, a robust consultation framework ensures that public consultation provides for developing long-term relationships with stakeholders for the mutual benefit of all interested parties. This comprehensive approach to stakeholder engagement at different stages of the project life is recommended by the

World Bank and is in line with the Equator Principles approach to environmental and social risk management.

For the proposed Offshore LNG Terminal project, a Consultation Framework was developed based on the following 5 principles of stakeholder engagement:

- Develop and maintain an open and transparent dialogue with all parties who have an interest or influence on the proposed project;
- Be iterative and flexible (so that decisions can be continually fed into design, construction and operation) and to demonstrate how, when and why input from stakeholders was or was not utilized;
- Learn from stakeholder experience so as to modify and adapt future consultation activities and project design;
- Recognize that there exists different levels of understanding amongst the stakeholders and to develop the consultation program accordingly; and
- Provide complete information about the project, with regards to such issues as construction methodology, engineering and operating design, and mitigation.

The consultation framework adopted for the pre-construction, construction and subsequent phases of the Project is elaborated in the Table 5.1:

Table 5.1: Consultation Framework for Offshore LNG Terminal Project

Project Phase	Proposed Tools	Stakeholders Consulted/ To be Consulted	Responsibility
Pre-Construction	Correspondence, Formal and informal meetings, focus group discussions	Institutional stakeholders; Grass root stakeholders, including communities in neighborhood likely to be involved during the Project Implementation Stage	EMC, Bahria Foundation
Construction	i. Formal and informal contact and liaison with the community and other relevant stakeholders (e.g. EPA, Wildlife and Forest department)	i. Institutional stakeholders ii. Grass root stakeholders, including communities in neighborhood involved during Project Implementation Stage	Independent Monitoring Consultant (IMC), Bahria Foundation
	ii. Grievance Redress iii. Consultations with communities during environmental compliance & Impacts monitoring iv. during external monitoring v. during site visits by IFC/ Equator Principles Financial Institutions (EPFIs) Monitoring Mission	Communities in neighborhood involved during Project Implementation Stage	Independent Monitoring Consultant, Bahria Foundation
Operation	Liaison with communities in neighborhood	Communities in neighborhood Involved during the Project Operation Stage	Independent Monitoring Consultant, Bahria Foundation

5.4 Scoping

The stakeholder consultation carried out for the ESIA of the project is part of the pre-construction / planning stage consultation process.

Stakeholder consultation was initiated through correspondence with a consultation letter highlighting the background of the proposed project, the role of the stakeholder consultation process and the importance of stakeholder engagement. A 'Background Information Document' (BID) with relevant project details and proposed consultation framework were also shared with the stakeholders. Moreover, stakeholders were requested to share their concerns/suggestions through e-mail or in writing to EMC's Office in Karachi. The consultation letter was sent to a total of 30major stakeholders and several follow-up calls were made to stakeholders over the next couple weeks to encourage them to share their feedback.

A scoping meeting was held at Karachi on August 01, 2016 at the Services Mess. The purpose of the forum was to engage experts and identify their concerns and suggestions for the project. A detailed presentation was made to participants informing them of the project details including an overview of the project site. The forum was then opened for discussion on all aspects of the project, including potential positive and negative aspects. Participants from the following institutions / organizations participated in the forum:

- Pakistan Coast Guards
- National Institute of Oceanography
- SUPARCO
- WWF-Pakistan
- IUCN Pakistan
- Department of Sociology, University of Karachi
- Department of Environmental Sciences, Bahria University
- Environment and Energy Department, Institute of Business Management

5.5 Stakeholder Engagement at Local Level

As the primary stakeholders, the fishing community and the local-level organizations that reflect their concerns were consulted in local villages. The focus of engagement with the community was to contextualize the socio-economic conditions of the settlement and identify their general concerns and needs. This was achieved through a village survey that involved meeting with the 'gatekeepers' at Mubarak Village and Sonehri Village and conducting site visits of the. Information regarding the following key socio-economic parameters were collected through the village survey:

- Demography and Housing
- Ethno-cultural aspects (religion, language, ethnicity)
- Income, Expenses and Wealth Profile
- Availability, Access and Quality of Education and Health Facilities
- Availability and Quality of Utilities
- Drainage and Waste Management
- Religious and Cultural Facilities
- Role of Women

5.6 Consultation Findings

The aforementioned sections provided a detailed overview of the consultation process that was followed and the tools that were used to engage stakeholders. The concerns, suggestions and recommendations shared by stakeholders have been collated in this section. Due to the significant impacts that may be faced by the local communities, perspectives of the local community have been separated from the views of all other stakeholders to give due importance to local communities' needs, interests and concerns.

5.6.1 Stakeholders Perspective

The comments and concerns of the stakeholders gathered in writing, key informants meeting and stakeholder consultation forum have been identified here:

- Although the FSRU will be located within a non-fishing zone, the small scale fishing in the bay may be affected due to creation of exclusion zones around the FSRU, and restriction of fishing boats during the movement of the LNG vessels, and around the turning basin. There may also be damage to fishing equipment and periodic blocking/obstruction of access to their fishing routes. The fish catch around Sonmiani Bay is already declining due to the impacts mostly emanating from the industrial activities particularly the discharge from Hubco. There will definitely be some impacts on the fish populations in the area from the development of the LNG Terminal, but the severity of the socio-economic impacts on the fishing communities must be evaluated. The project will face resistance from local fisherman if their livelihood is hampered because of LNG terminal activities. In case of severe socio-economic impacts, there should be some relief from the project for the fishermen.
- The project area at Sonmiani Bay has been proposed to be declared as Marine Protected Area (MPA) aiming at Conservation of biodiversity, especially critical habitats of threatened species. The site is also a tourism spot where yearly 4000 tourist visit Churna Island. Some of the very rare species of fishes have been reported from this site. This is the only site where corals are present in abundance. The proponent has to take cognizance of these issues and must plan their activities in such a way that the ecology remains intact and the development achieve its sustainability.
- The project must strictly comply with the requirements laid down in the Balochistan Environmental Protection Act 2012 and the rules and regulations framed thereunder. The impact associated with the cooling water discharge and likelihood of increase in the sea water temperature above 3°C should be dealt with proper engineering design keeping in view the requirements of NEQS. Any impact beyond permissible limits will badly impact the ecology of the area.
- Online monitoring system must be developed to minimize the hazards. Change of temperature due to discharge of seawater used for regasification will conform to ensured not to exceed the limits set by the NEQS.
- Measures must be in place to minimize the risk of pipeline leakage and explosion. The pipes must have corrosion protective coating followed by a concrete coating.
- The dredging will change the hydrodynamics of the area; the impact of dredging activities has already affected the coastline of Pakistan. The developers undertake extensive dredging without studying the long term impacts of rapidly changing wave pattern. This aspect must be given due importance in the ESIA. Ecological disturbance to the area can be minimized by ensuring that developmental activities are properly planned. All development interventions should be staggered, where possible, to allow the fisheries populations to achieve a natural equilibrium in the shortest possible time.
- Balochistan EPA must ensure that the proponent ensure implementation of environmental management plan in letter and spirit. Solid and liquid waste (fuels, chemicals) are already polluting

the coastal waters around the area. Proper waste management mechanisms should be in place for the LNG terminal, no hazardous chemicals/substances should go into the water.

- The fishing grounds are lifeline for the people of Sonmiani. If these grounds it will result in large economic loss for country as well because the area is important for commercial fishing.
- The Environmental Management Plan should suggest a budget for the conservation of biodiversity of the area and that money should be spent for the purpose with transparency.

5.6.2 Community Perspectives

Overall, the community welcomed the project and offered to collaborate with the project proponent as and when required. They believed that development of their area would improve the economic status of there are however, they expressed concern regarding employment of locals in the project. Locals should be provided benefits from the project. Their needs and aspirations should not be ignored. They desired that the proponent should offer employment opportunities to local people, wherever possible. Moreover the area s devoid of natural gas, arrangements should also be made to ensure that natural gas is also supplied to their village. Stakeholder concerns and suggestions are shared below.

Table 6.5: Issues and Concerns of Local Community and Suggestions for Mitigations

Themes	Issues and Concerns	Community Expectations	Remarks
Impact on Fishing activities	✧ Fishermen raised the concern that the proposed terminal may disturb access to their fishing grounds, their only source of livelihoods ✧ Fish catch is already decreasing, resulting in reduced incomes, if there is further suppression of the existing resources, fishermen will have nowhere to go ✧ Special consideration, in this regard should be given to fishermen with small boats who are most economically vulnerable in the area	✧ Development of LNG Terminal should ensure minimal disturbance to existing fishing grounds ✧ Where possible, access of fishermen to their fishing grounds should be allowed within a 'safe' distance from the terminal operations ✧ Identification of no-go areas for the fishermen must be clearly identified and the same communicated to them for the construction and operation phase.	✧ The proponent shall take necessary mitigation measures to minimize any adverse impact on the fishing activities due to the development of LNG Terminal
Impact on livelihood and Grievance Redressal	✧ The local fishermen should be consulted regarding all developments in and around Sonmiani, as we have been living in the area for generations, our interests should be safeguarded. ✧ As part of the development of proposed LNG Terminal, alternative livelihood earning be provided to locals who do not have any earning during monsoon season. They are not allowed by the government to go to the sea for fishing because of high tides and rough sea conditions. ✧ Fishermen should be able to approach the authorities	✧ Grievance Redress Mechanism (GRM) should established for the project to effectively address all types of complaints and suggestions of the community ✧ CSR Plans will consider some programs for alternate livelihood opportunities for the fisherman. ✧ The GRM with all related components should be in place before commencement of project construction phase and should continue throughout project operations	✧ GRM will be part of institutional arrangements for LNG terminal

Table 6.5: Issues and Concerns of Local Community and Suggestions for Mitigations			
Themes	**Issues and Concerns**	**Community Expectations**	**Remarks**
	directly in case of any problems and issues		
Debt-Cycle	✧ Most inputs for fishing such as boats, engine, nets all require huge investments that poor fishermen cannot afford. This forces fishermen to take loans at exorbitant rates from their seths, which fishermen are not able to pay off completely. This keeps fishermen dependent on the seths for generations and therefore majority of the fishing communities are locked in a 'debt-trap' unable to improve their economic situation. ✧ According to the fishermen, the government has provided minimal assistance to local fishermen for provision of their fishing inputs.	✧ Local fishermen should be relieved of existing hefty loans (e.g. through utilization of district/provincial zakat) ✧ Loans should be offered to fishing communities on relaxed repayment terms ✧ Government should subsidize business inputs (boats, engine, nets) for fishermen ✧ Government should control fish rates as done in Iran to avoid exploitation of local fishermen	✧ Not related to Bahria Foundation
Potable Water Supply to Local Community	✧ Water is one of the biggest problems in the area. Safe drinking water is not available and people are suffering from water borne disease. 90% of the population is suffering from Hepatitis. ✧ Underground water is brackish.	✧ Reliable source of drinking and domestic water is urgently required for growing needs of Sonmiani ✧ Option of introducing desalination plant must be reviewed	✧ Potable water supply to this area will be facilitated due to new project's contributing to local economy.
Education facilities for local communities	✧ There is a significant need to improve both the quantity and quality of education facilities in the area. ✧ The government schools have very few rooms, which limits the number of classes that can be conducted. The physical structure of some of the government schools is in poor condition	✧ Number of rooms in government schools should be increased and physical structure of the schools should be reinforced ✧ Number of government schools (especially at primary level) should match requirements	✧ Educational facilities improvement will be may be facilitated due to new project's contributing to local economy.
Health care facilities for local communities	✧ Quality healthcare is completely lacking in the area. People have to visit Karachi for treatment which cost them much higher than their incomes.	✧ Number of public health facilities, including lab and ultrasound should match the population ✧ Ambulatory services should be significantly enhanced ✧ Appropriate quantity and quality of medicine	✧ Healthcare facilities improvement will be may be facilitated due to new project's contributing to local economy.

Table 6.5: Issues and Concerns of Local Community and Suggestions for Mitigations			
Themes	**Issues and Concerns**	**Community Expectations**	**Remarks**
		should be available all-year round	
Solid Waste disposal system	✧ Piles of garbage can be found in residential and market areas of the village, which poses a huge health hazard for the locals ✧ No solid waste management system is in place ✧ Local Government representatives complained of not being given funds to employ workforce for solid waste management	✧ Appropriate budgetary allocations must be made and disbursed to the local UC for solid waste management ✧ UC representatives should be provided technical expertise for introduction of a proper solid waste management system for the village	✧ Bahria Foundation shall take care of the solid waste generated from the project
Employment Opportunity	✧ During off-peak seasons, fishermen hardly earn enough to meet their basic needs ✧ Those residents who have earned graduate degrees do not have job opportunities in the area; their capabilities are being wasted ✧ Local residents, therefore demanded employment opportunities both for skilled and unskilled workers ✧ Moreover, local leaders suggested that training programs should be held for local residents in the area of expertise required during the construction and operation phase. This would increase their chance of being hired for employment by the proponent	✧ Employment opportunities should be provided for skilled and unskilled workers ✧ Training Needs Assessment should be conducted to identify training needs of locals ✧ An appropriate Training Center should be established that would manage the training and job placement needs of locals in the project	✧ Local people will be preferred for unskilled & semi-skilled jobs to the extent possible.






Chapter 6 Environmental Impacts & Mitigation Measures

This Section of the ESIA report presents the screening of potential environmental and social impacts of different activities of Offshore LNG Terminal Project during its different stages of designing, construction and operation. Using the general guidelines as well as professional judgment the screening process makes an assessment on severity of the positive and negative impact of emissions and waste discharges on the air shed, watershed, fauna, flora and the living environment at the offshore site, the landfall site, and the hinterland which will host the associated facilities of the proposed LNG Terminal.

The screening process, besides identifying significant environmental impacts and the existence of residual impact suggests mitigation measures that would be adopted to reduce, minimize or compensate for the negative impact, in case there are any.

6.1 Screening of Potential Environmental Impacts

The process of screening of potential Environmental Impacts requires information on the performance of the Project. Based on this information it should be possible to identify the aspect that require mitigation measures to minimize the negative impact and enhance the quality of environment.

Establishment of the Offshore LNG Terminal Project at Sonmiani Bay will require the following environmental aspects to be addressed:

6.1.1 Siting of the LNG Terminal at Sonmiani Bay

For setting up the proposed FSRU based LNG terminal, the site has been finalized after considering the available various alternatives discusses in earlier sections. The siting criteria was based on “Site Selection and Design for LNG Ports and Jetties – 1997. SIGTTO, ISBN 1 85609 129 5.”

The land requirement for proposed project is very limited since the major part of project (LNG storage and re-gasification process) will be in the sea (7.5 km from the coastline in Sonmiani Bay). The estimated land requirement is approximately 100 acres (to be confirmed at design stage) for construction of onshore receiving facilities/landfall gas metering station. There will be no private land procurement for the project. The identified land belongs to the Bahria Foundation and has no human habitation at present. Hence, there will be no direct PAPs (Project Affected People) / PAFs (Project Affected Families) due to this project.

At present project site is vacant with sparse coastal xerophytic vegetation and there is no agriculture or any other activity at site and in the immediate vicinity. This land is within Pakistan Navy operational area and expected to be used for port based activities. Therefore, there will be no change in designated landuse due to proposed project.

Since project site is vacant land with sparse vegetation plantation and does not have any significant natural vegetation / large trees/forest land or any conserved species, the site grading/preparation will not involve cutting of trees.

The existing marine fishing harbor is outside the corridor of impact of the land identified for proposed LNG terminal and associated facilities. The proposed marine jetty construction, dredging, laying of

RLNG pipeline is not expected to cause disturbance to the other activity centers in the macroenvironment of the project area.

Bahria Foundation has obtained necessary approvals / NOCs from the GoP for siting the Terminal. **Security Clearance from Ministry of Defence:** The Ministry of Defence has issued a security clearance by issuing a No Objection Certificate (NOC) in favor of Bahria Foundation for siting the LNG Terminal Project subject to the fulfilment of the following siting criteria:

i. Restriction / observation of following coordinates:

24 54’ 19.85’’ North, 66 36’ 31’’ East

ii. No construction on North of this position to ensure 3 km separation from upcoming Hubco Coal Jetty planned in the following position:

24 55’ 45.2’’ North, 66 37’ 22.2’’ East

No Objection issued by Ministry of Petroleum & Natural Resources: The Ministry of Petroleum & Natural Resources has issued a No Objection Certificate (NOC) in favor of Bahria Foundation for siting the LNG Terminal Project subject to the fulfilment of the siting criteria laid down in the LNG Policy 2011 / TPA Rules.

Provisional License issued by Oil & Gas Regulatory Authority: The Oil & Gas Regulatory Authority (OGRA) has issued a provisional license in favor of Bahria Foundation for siting the LNG Terminal Project after confirmation of compliance with the rule 33(1) & (2) of OGRA LNG Rules 2007.

There will be significant engineering work and preparation required on the part of Bahria Foundation LNG Terminal Project to complete the future tasks required in siting the LNG Terminal Project and its execution including:

Pre-Front End Engineering Design (FEED) Tasks

- Extensive data for wind conditions at the chosen site location;
- Numerical study to validate and optimize wave and current data; breakwater size and location Geotechnical investigations for chosen site;
- Environmental and social impact study (Done)

Front End Engineering Design (FEED) Tasks

- Preparing, reviewing and confirming a Plan of Execution and Master Schedule;
- Obtaining all site information, surveys, geotechnical studies and other technical information;
- required for executing the FEED;
- Setting up project management controls, Quality Assurance/Quality Control (QA/QC) procedures and document approval procedures;
- Preparing Request for Quotation (RFQ) documents and packages required for soliciting bids for FEED;
- Identifying and pre-qualifying engineering firms to be included in the FEED bid list;
- Tendering and evaluating bids for FEED including both technical and commercial;

- Monitoring progress and interfacing with FEED contractor;
- Checking FEED contractor technical data, calculations, drawing and specification performance;
- Manage and monitor permitting activities and regulatory compliance; and
- Managing and monitoring cost and schedule.

Engineering Procurement Construction (EPC) Tasks

- Preparing documents and contracts for soliciting bids for EPC;
- Identifying and pre-qualifying contractors to be included in the EPC bid list;
- Tendering and evaluating bids for EPC;
- Monitoring progress and interfacing with EPC contractor;
- Checking EPC contractor technical data, calculations, drawing and specification performance;
- Reviewing and approving technical detail design documents and drawings;
- Monitoring QA/QC of equipment fabrication, welding, and construction;
- Monitoring procurement activities;
- Witnessing equipment testing and performance run tests;
- Monitoring field construction; and
- Monitoring costs and schedule.

Facility Operations

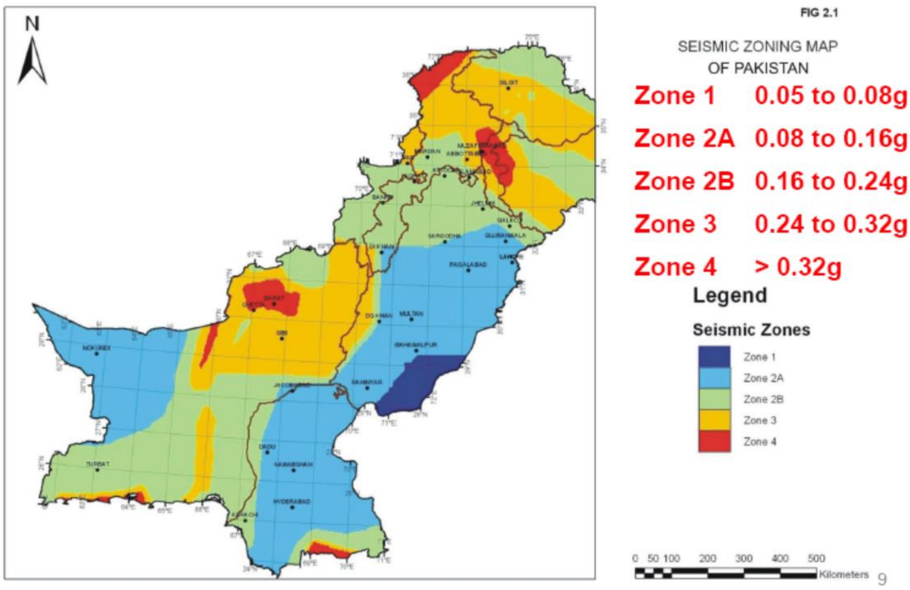
- Preparing Startup and Operation Manuals;
- Preparing Plan of Operation for Facilities;
- Preparing Plans for Managing LNG or Gas Supply;
- Preparing Plans for Maintenance and Repair Programs;
- Coordinating staffing plans;
- Coordinating operator training program; and
- Preparing Procedures for Managing Health, Safety and Environmental (HSE) Compliance for the Project.

6.1.2 Geotectonic Setting

South-western Pakistan has an important geotectonic setting where Eurasian, Arabian and Indian plates are interacting. In the west the oceanic floor of the Gulf of Oman is actively subducting northwards beneath the Afghan and Lut blocks of Eurasia forming a continental margin (Farhoudi & Karig, 1977). The subduction and resulting geological features constitute a tectonic province, called as Makran. The eastern limit of Makran is the sinistral Ornach Nal Fault (ONF), which is a southern extension of the Chaman fault: a boundary between Indian and Eurasiall plates. Southwards in the offshore region, the ONF extend as northeast trending Murray ridge, which is a volcanic ridge of sea mounts (White, 1983). Further to the south, the boundary between the Arabian and Indian plate is represented by the Owen Fracture Zone. The triple junction is located to the south of **Sonmiani bay** which forms the macroenvironment of the proposed LNG Terminal Project.

Keeping in view the proximity of the Project activity site to the above fault lines as well as both Allah Bund Fault line and Pab Fault, it is suggested that the belt should be placed between Zone 2 and Zone 3 and hence the Ground Force in terms of Assumed Approximate Acceleration equivalent to 0.3 g is recommended while designing and for siting the structures of the Project, for operating basis earthquakes (OBE) pertaining to damage due to moderate to major level earthquakes.

SEISMIC ZONING MAP OF PAKISTAN



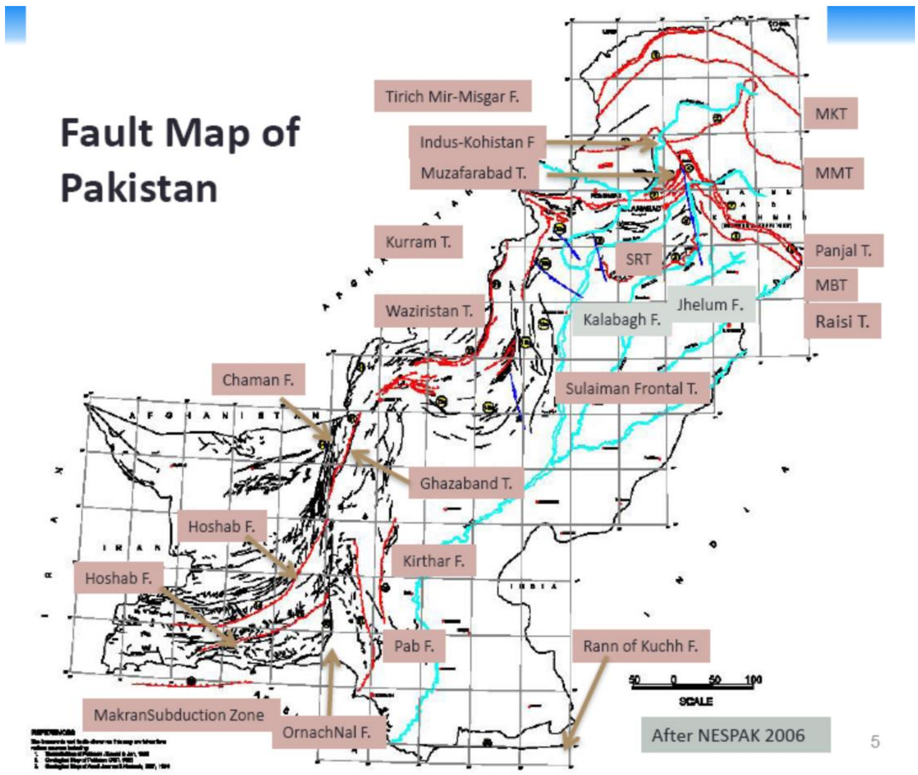


Figure 6.1: Geotectonic Consideration of the Project

***Crossing of Pipeline in Seismic Active Area**:* It is not possible to ensure that a pipeline is sufficiently strong to withstand the effects of an earthquake by considering factors for increased internal and external forces in stress calculations or by making appropriate additions to the wall thickness of the pipes. The approach that is adopted by various publications is to make a flexibility analysis at various points of a pipeline system which are considered as fixed. In this context, the following points are regarded as fixed points:

- sudden changes in direction (bends);
- branches;
- pipeline ends (e. g. scraper trap stations).
- These fixed points are affected by:
- soil conditions;
- the stiffness of the pipeline;
- friction between the pipeline and the soil;
- maximum vibration level of the soil.

Long buried pipelines without fixed points of the type described above are mainly subject to axial forces. These forces are however no higher than those to which the soil is exposed. In the event of an earthquake, the soil, with the exception of rocks and rocky areas, effectively act as a vibration dampener for the pipeline and there is therefore no risk of a rupture. This of course does not apply if the earthquake leads to faults or cracks in the ground.

Cracks in the pipeline will only occur if there are major differences between deformations of the soil and the pipeline. Provided that the pipeline is sufficiently elastic (i.e. if the wall thickness is low and high strength steel has not been used) it may be possible for the pipeline to accommodate minor soil deformations without rupture. In such cases, however, earthquake damage may lead to bends and/or dents that will need to be repaired. *In order to ensure that the pipeline is not exposed to excessive earthquake damage, sudden changes in direction, rigidly fixed branches and oversized pipes must be avoided.*

***Fault Crossings**:* Faulting is the relative displacement associated with the movement of adjacent parts of the earth's crust. The seismic design philosophy for the pipeline system is to minimize the possibility of a pipeline rupture due to large differential soil displacement at fault crossings during an earthquake that has a low probability of occurrence during the operational life of the Gas Transmission System.

The design criteria such as pipe diameter, wall thickness, material properties and design strain limits along with anchor points and surrounding soil backfill characteristics are important factors requiring consideration in regard to their relationship to the implementation of the design philosophy.

The pipeline will to be designed to accommodate the large relative movements through axial straining of the ductile steel pipe. Bending strains in the pipeline in close proximity of the fault zone shall be evaluated to ensure combined bending plus the axial strain does not exceed the strain capacity of the steel pipe. The most common approach is to utilize the ability of the pipeline to deform well into the inelastic range in tension in order to conform to ground distortions without rupture. To accomplish the angle of the pipeline alignment to the fault crossing should be designed such that the pipeline will be subjected to tension plus a moderate amount of bending. Alignments that place the pipeline into compression are to be avoided due to the reduced ability of the pipeline to withstand compressive strain without rupture. The fault movement capacity of a pipeline is much less for compressive crossings than for tensile crossings.

The capacity of the pipeline to accommodate fault movement is highly sensitive to surrounding soil characteristics, of which include the depth of cover, lateral passive soil capacity and coefficient of friction between pipe and soil. Pipe elongation is resisted by the longitudinal friction forces between the pipe and the surrounding soil. Because of the resistance by these forces, pipe elongation does not take place uniformly over the entire distance between anchors but instead, is concentrated in the region within a few hundred feet of the fault. Immediately adjacent to the fault the axial strain is maximum and is considerably greater than the average axial strain over the entire length of the pipe between the anchor points. The greater the friction, the more concentrated is the zone over which the pipe elongation must be accommodated and axial strains are increased for any given pipe elongation. Therefore, shallow burial, special backfill, and smooth hard coatings are recommended for pipelines to minimize frictional forces resulting in lower axial strains and good pipe behavior at fault crossings.

Such special considerations are important over a distance of 185 m to 300 m on each side of the fault crossing to maximize fault movement capability. The lateral component of movement forces the pipe to displace laterally with respect to the surrounding soil. This lateral displacement is accommodated by the pipe pushing the soil aside with the soil placing a lateral pressure on the pipe. The lateral forces result in horizontal curvature strains in the pipe near the fault. Additionally the pipe is further elongated because the length is slightly greater than the straight line length between the anchor points. Very little lateral movement of the pipe relative to the soil is needed to develop the full passive lateral soil capacity. Therefore one must design the pipeline to withstand this full passive lateral force capacity.

This lateral force capacity should also be reduced by shallow burial depth along with special backfill and special trench configurations in the immediate area of the fault zone.

6.1.3 Site Preparation & Dredging

The proposed site for the LNG Terminal is located in Sonmiani Bay, positioned in the Arabian Sea. The optimization of the selected site has to ensure that a water depth of at least 15 m (LAT) (which includes 12.5 m summer draft + minimum 2 m under keel clearance) has to be considered as well as navigational approach ways and sea state, especially wave height / wave protection. Due to the sea bed conditions, the selected location shall require minor dredging works. However, it might be possible that dredging is the more economical solution in some circumstances than a bigger breakwater due to water depth when dumping ground is nearby and cutter dredger is useable.

The breakwater consist of two flanges which are directly connected to Churna Island with two flanges which will require major dredging works. The depth until dredging is required, is set to -16 mLAT since minor sedimentation processes have to be considered. In order to ensure a sufficient entrance in the wave height reduced area of the breakwaters, a volume of 2.43 Million. m³ have to be dredged and dumped. Sedimentation within the dredged area is expected to be low. The dredged bedrock will be used as core material for the breakwater.

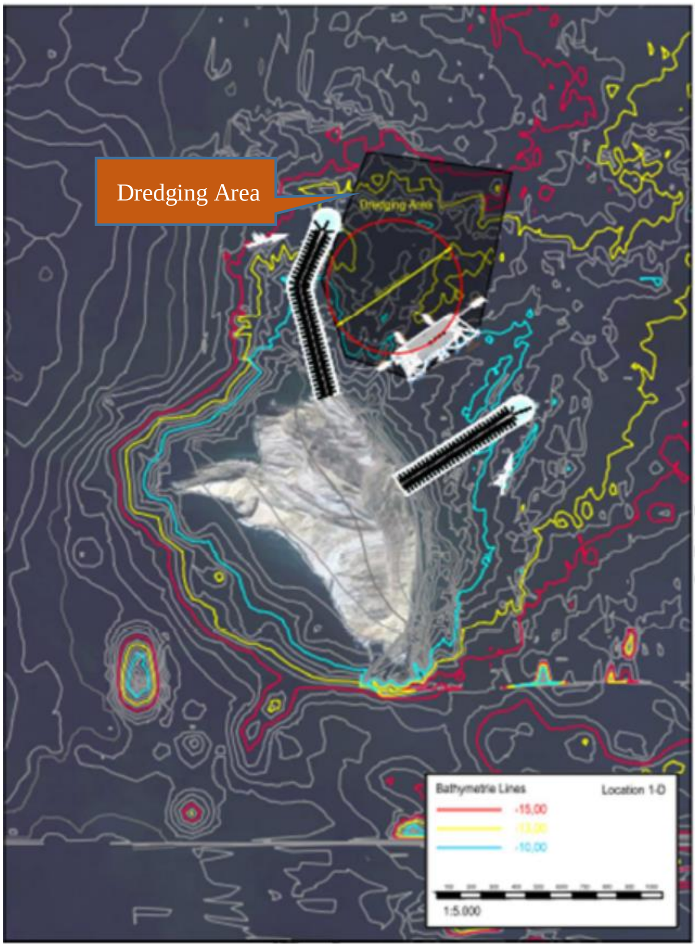


Figure 6.2: Dredging required for construction of breakwater

A pipeline is proposed to be laid from the LNG island jetty platform up to the land based facility. Construction equipment for subsea pipeline & cable laying will include barge laying machinery, trenching machines, diesel generator sets, cranes, compressors etc. Offshore pipeline laying is proposed to be installed by pull-in method, either by pulling inshore through shore based winches or by fabricating the strings at the shore and pulling offshore through barge winches depending upon the availability of the equipment and availability of space at shore location. The onshore pipeline will be laid by conventional trenching.

The main activities in subsea pipeline laying will include:

- Trenching of seabed and onshore section along pipeline route;
- Weld lengths of pipe on pipe lay barge or at onshore location and float out;
- Connect pipeline to jetty platform and to onshore tie-in point;
- Installation of concrete mattress and backfilling of the trench; and
- Hydro-testing of pipeline

The dredging process has been found to result in loss of biota within the dredged area. This is a short time activity localized to the environment. Most of the area to be dredged consists of soft bottom or soft bottom/rubble with little or no observed epifaunal communities. As per the site investigations, the selected pipeline route foresees a short submarine section connecting the FSRU to the Landfall LNG Terminal End in Northwest Main Land with a length of approx. 7.5 km.

Anchors and trenching during construction of the proposed pipeline would directly affect the seafloor, and most sessile invertebrates and some mobile invertebrates could suffer mortality or be displaced. Recovery of the benthic communities disturbed by trenching and anchoring would occur at varying rates following construction, dependent on a variety of environmental parameters and the severity of the impact. Because the width of the proposed trench plus spoil piles would be approximately 5 to 10 feet, it is expected that natural recruitment from adjacent areas would provide a source from which biological communities could re-establish in the disturbed areas. Larger mobile species and life stages that move away during active construction likely would return to the area when construction was completed. Epifaunal sessile components & infaunal communities would take longer to recover.

According to the findings of the study conducted by the National Institute of Oceanography (NIO) in 2003, the benthic population is restricted to the top 10 cm of the substrate. Once construction is completed, habitats and associated organisms have been found to reestablish/re-colonize themselves quickly as the regeneration time is short (2-3 weeks) within the newly constructed berthing and turning basin.

Impact of dredging on benthic communities has been reviewed by Newell et al. (1998) whose findings indicated that although a variety of environmental parameters affect benthic recovery rates, some general recovery time frames are associated with habitat type. Benthic communities that inhabit muds and swamp, e.g. those along most of the proposed dredging site and pipeline route, typically recover within 1 year whereas communities that inhabit sandy and gravely sites can take from 2 to 3 years to recover, and may be longer where rare slow-growing components are present.

In a subsequent study conducted by Newell et al. (2004) in the United Kingdom it was found that the recovery of species diversity to within 70 to 80 percent of surrounding undisturbed areas generally occurred within 100 days. Recovery of population density generally occurred within 175 days, but biomass restoration was incomplete after 18 months. These data agree with other literature, where biomass recovery on sands and gravels has been reported to take from 2 to 3 years (Desprez 2000; Kenny and Rees 1994, 1996; Newell et al. 1998; 2002).

Researches by Lewis et.al. (2002) on benthic recovery estimates indicates that invertebrate samples collected after pipeline construction in Ireland had no live invertebrates 1 month after construction; at 6 months, there was no significant difference in the mean number of invertebrates between the sample sites and reference sites.

Siltation and sedimentation impacts at the dredging site are expected to be localized and short-term in duration. Potential impacts will be further reduced through the use of appropriate dredging technique. The increase in local water turbidity levels produced by dredging operations is directly related to the type and quantity of material being dredged. In addition, sloughing of the material along the side slopes of the cut and prop wash from operational tug boats operating in shallow waters alongside the channel can add to localized increase in water turbidity. According to the U.S. Army Corps of Engineers Manual entitled Engineering and Design – Dredging and Dredged Material Disposal (ACOE 1983), the increase in the level of suspended material appears to be concentrated in the immediate vicinity of the dredger. Within 5 m (16 ft) of the cutter head of a dredger, suspended solids concentrations can reach levels on the order of tens of milligrams per liter (mg/l) above background. However, these concentrations decrease exponentially away from the cutter towards the water surface, as well as laterally and in the downstream direction. Typically, near seabed, concentrations are reduced to a few tenths of a mg/l within a lateral distance of 300 m (984 ft) from the cutter head of dredger, although these may extend farther in the downstream direction in the presence of a significant mean current to a distance of 1000 m (Hayes 2000). Other variables, such as particle size, may affect the distribution of suspended materials, but overall the turbidity effects are expected to be both short-term and localized in nature.

- For dredge projects similar to those proposed for proposed Project, the typical adopted effluent concentration in the water column is in the order of 30-35 NTU (Nephelometric Turbidity Unit) above background. To ensure that the effluent concentration does not exceed this value during this project, regular turbidity measurements will be carried out and operational procedures modified accordingly. It is envisaged that the excess dredged material will be temporarily placed on the shoal (sandbank). Deposition of this material will impact an area in which the benthic habitat is characterized by soft bottom/sand. Although existing benthic habitat will be lost by placement of dredged material on the bottom, the excess spoils shoal itself will form a foundation for a new benthic habitat till such time the excess spoils are harvested by the dredging operation.

- Infaunal organisms in soft bottom sediments are reported to survive burial up to a depth of about 4 inches. Therefore, impacts to benthic organisms from sedimentation would be minor.

- The dredged bedrock will be used as core material for the breakwater. The remaining dredged material will be transported to the proposed dumping site designated by Pakistan Navy. Some sedimentation and temporary turbidity could potentially occur due to transport of fine material into marine habitats during dewatering of dredged material. In order to minimize the impact of sedimentation resulting from dewatering, all dredged material will be deposited within dikes equipped with control weirs. The dikes will contain the discharged dredged material and prevent re-deposition of the material due to waves or overflow. The weirs, used to discharge excess water, will be designed to reduce the discharge of fine sediment including benthic community back into the water column and to moderate the discharge velocity and volume. The benthic community is anticipated to be rehabilitated at the discharge site.

- It is envisaged that no blasting will be involved during the entire site preparation & development phase.

- Fueling of dredge barges and associated vessels used to transport fuel to the dredger, may involve oil spill. As mitigation measure, a *Spill Control Plan* shall be prepared in consultation with Independent Monitoring Consultant (IMC) and the same will be implemented throughout the construction phase of project.

- Upon completion of dredging operations, long-term operational impacts to the benthic communities within the approach channel and turning basin have been found to be minimal. Although, existing biological habitats will be permanently altered in the short-term, new habitats and organisms have been found to rapidly reestablish themselves in previously disturbed areas. In addition, dredging can also alter the bottom in ways that actually aid in establishing habitats in areas where they did not previously exist. Due to natural current movements, it is not anticipated that there will be any long-term sedimentation impacts during operations. Natural currents and tides are expected to serve to minimize or restrain potential sedimentation to developing biological communities and prevent or minimize the need for additional dredging in this area.

Maintenance Dredging

- Maintenance dredging is an essential part of operation of all port activities particularly the LNG terminals. During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by Bahria Foundation within the berthing and turning basin to measure changes in bottom elevation and locate areas of sediment accumulation.
- Primary concerns for dredging are increase in turbidity and suspended sediments, and the loss of benthic organisms in particular. Turbidity will be monitored at each maintenance dredging event to ensure compliance with relevant international standards. If the turbidity exceeds the limits, dredging operation will be stopped temporarily until modifications can be made to the dredging technique so as to normalize the turbidity level.

Shore Protection

- A comprehensive shore protection system around the perimeter of the project site is proposed to prevent coastal erosion and provide protection for project facilities against coastal flooding. The shore protection system will be designed to withstand wave and surge conditions associated with the nominal 100-year frequency hurricane event.
- Impacts from construction of the shore protection features could result from related dredging and land reclamation, as well as the actual installation of the shore protection systems.

Mitigation Measures

- The dredging of berthing pocket at the project site will have a slightly negative impact on the marine habitat and the benthos of the creek; this would adversely affect fisheries reproduction. However, carefully regulated construction program and disposal of spoil at the designated areas would minimize and localize these impacts. Bahria Foundation will ensure the adoption of careful methods to reduce the impact of construction on marine ecology of the site;
- To prevent loss due to erosion, exposed soil materials will be protected by surface treatments such as armoring, pavement and vegetation. No mitigation measures other than those sites above are needed except that the entire operation will be keenly monitored by the proponent and Impendent Monitoring Consultant (IMC);
- Shore protection along the reclaimed site will consist primarily of concrete caissons or equivalent systems. These shore protection systems will be installed in areas that have already been impacted by prior dredging activities. Therefore, no additional impacts are expected due to the installation of the shore protection structures.
- A dredge management plan including controlled disposal at identified points (within dumping area) shall be prepared and followed along with necessary monitoring at dredging sites and in dumping area.
- No marine construction activities to be undertaken including jetty piles during disturbed sea conditions (cyclones, depressions etc.)
- All necessary precautionary measures would be taken so as not to create localized turbulence during marine construction period leading to re-suspension of bottom sediment or apply geo-

textile lining (temporarily) in the vicinity of construction area to prevent entrainment of silty sediment and to minimize turbidity related impacts.

- Use of sophisticated dredgers to avoid or minimize scattering of dredged sediments during transfer to storage hoppers and transport to dump site. There will be no drilling or blasting required as per geotechnical details at proposed dredging area.
- The jetty deck / platform will be supported by circular hollow steel piles with minimal interference to wave movement and the related coastal hydrodynamics in the bay. Appropriate spacing between consecutive jetty deck planks will be maintained to protect the jetty structure in case of unusual rise in sea level.
- The project proponent would ensure that the marine construction activities including dredging shall not affect the daily movement of fishing trawler / boats.
- Demarcation zones for boat will be strictly observed. Monitoring of turbidity and suspended sediment concentration to be undertaken.
- Detailed inventory and mapping of movement of fishermen fishing within 500 m of the FSRU location, or crossing it to access their fishing locations prior to start of construction;
- The marine fisheries department would be updated with a fortnightly plan of the dredging area and planned movement of dredger, to be communicated to the fishing community. Any change in the dredging plan will be further communicated to stakeholders on a regular basis.
- A grievance mechanism shall be in place to respond to ongoing complaints and concerns of the fishermen; and
- Support to the fishing community as part of CSR programme through their cooperative societies in project area.

6.1.4 Laying of Pipeline in the marine environment

The entire submarine pipeline route is located in the coastal area, and the proposed site has characteristics of human frequent activities and the seabed is scoured by wave and current. Because of the installation depth of the pipe (min. 6m below bottom), it is impossible that it could be damaged by anchors, dredging of the river bed or erosion, and buoyancy control with concrete coating is not necessary. The traffic is not disturbed in any way during the installation.

For the onshore section, the minimum trench deep is 1.2m to the top of pipeline. The dredged soil will be backfilled in the trench, when pipes have been in place. The elevation of backfilled layer shall be the same as seabed.

For the offshore section, the minimum trench deep is 6.0m to the top of pipeline. Armour rock or any other equivalent material shall be backfilled in the trench to protect the security of the pipeline, when pipes have been in place. The elevation of backfilled layer shall be the same as seabed.

Environmental impacts of laying the pipeline in the marine environment include the following:

- Physical disturbance of nesting and spawning, destruction of habitats, especially disturbance of spawning habitats, physical removal of benthic faunal communities, physical removal of protected plants disturbance of fish, shrimps and benthic faunal feeding habitats.

- Detrimental effects of suspended sediments, turbidity and sedimentation, especially disturbance of fish spawning and nursery habitats, disturbance of fish and shrimp larval development, effects on the behavior of migrating organisms, effects on feeding of larval, juvenile and adult fishes and crustaceans, burial of benthic fauna communities, disturbance of benthic fauna development, enhancement of photosynthetic oxygen production of planktonic algae, and burial of benthic plants

- Turbidity plumes caused by re-suspension of sediments in the water column in the marine environment may, if suspended at sufficient concentrations for long time, reduce the penetration of sunlight through the water column. Young fish can be damaged if suspended sediments become trapped in their gills and increased fatalities of young fish have been reported in heavily turbid water.

- Release of contaminants during pipeline laying activities in the marine environment: The project activities can potentially cause remobilization of contaminated soil and sediment. However, the results of soil quality analysis indicate that the soil/sediments released are not contaminated to any significant level. Efforts will be made to monitor the quality of sediment released and adverse impacts will be minimized by taking appropriate measures.

- Impacts on Marine Animals during Construction Phase: The bottom sediments to be removed for NG Pipeline laying comprise fine materials predominantly fine silty sands, silty clay and silt. Due to re-suspension of sediments, turbidity plumes are formed in the water column. If the material remains suspended for a long period of time at high concentration, there is a possibility that turbidity will cause clogging of gills and feeding structures of fish and shell fish and filter feeding species including mollusks and worms. Hence, the enhanced turbidity will lead to reduced productivity and may be fatal in extreme cases.

- The excavation of the area for pipeline laying and back filling of desired soil will have negative impact on the benthic habitat along the ROW, which will be adversely affected if proper care is not taken during construction. Since the pipeline laying is a short term activity, the severity of impact is likely to be low. It is anticipated that the turbidity thus caused would not have significant impact.

- The impact of pipeline in the marine environment will have only localized impact on the macro-fauna along the ROW of pipeline.

Mitigation Measures

The following migratory and preventive measures will be adopted to minimize the potential adverse impacts on marine and terrestrial environments during land preparation activities for laying pipeline:

- Unnecessary damage to the ground surface and blockage of natural drainage will be avoided.

- Leakages from the system and rupture of the pipeline will be mitigated through the contingency plan discussed in the detailed EMP at chapter 7.

- Equipment will be maintained properly to minimize oil or fuel leakages from construction machinery. Clean-up will be undertaken in the event of an oil spill larger than half a liter. This will include removal of contaminated soil from the area and disposal at proper location.
- After laying the pipeline, the disturbed surface will be restored as much as possible to its pre-project conditions. The ditch will be backfilled and the ROW graded in a manner that restores the natural contour of the ground and allows natural surface drainage. The backfill will be crowned to a height of not less than 200 mm and not more than 300 mm above and at the adjacent ground surface.
- The backfilled trench will be kept compacted with a low crown of subsoil.
- Excavated material will be placed within the corridor of the pipeline.
- Excavated material from ditching operations will not be placed where there is a chance of impairment of natural drainage system.
- Soil that cannot be used will be considered surplus and will be removed from the pipeline corridor.
- Steep cut and fill will be avoided in all such cases where the risk of slope failure is high.
- The ROW will be cleaned of all remaining debris after the backfilling operation and all holes, ruts, and depressions will be filled in order to leave the ROW in an acceptable condition.
- The contractor will dispose of unusable soil spoils at the location specified by Bahria Foundation. These locations shall be selected to avoid slopes, watercourses, water ponds, or any area where the dumping of waste soil may cause adverse effect on the terrain.
- Removal of debris, cast-off cables, machinery parts, timber, and all other waste from the ROW will be ensured.
- Fuels, oils, and other hazardous substances will be handled and stored according to standard safety practices.
- The fuel tanks will be appropriately marked with regard to their contents.
- Fuels, oils & chemicals will be stored in areas lined by an impervious base and containing dykes.
- The construction contract should include provisions to limit the removal of vegetation to the bare minimum. The bushes and mangrove seedlings may, as far as possible be saved and transferred to the adjacent area. Other plants in the vicinity will need to be protected against damage by appropriate burying operations. The areas beyond the limits of site shall not be disturbed or damaged otherwise.
- Spill prevention and response plan will be prepared by Proponent in consultation with IMC and the same shall be implemented in case of any such incident.
- Soil contaminated with minor, moderate or major oil spills will be removed and suitably disposed of by incineration or bioremediation.

- The acceptable limit of 2,000 mg/l suspended sediment concentration of the World Bank guidelines should be adopted (World Bank Technical Paper 140).
- Careful and regulated excavation, back filling and quality assured construction methods will be adopted by the contractors. The foreign material for filling purposes should be contaminant free.

- No endangered species are reported to exist in the area. The impact of construction activity on the marine ecology will therefore be small, temporary and localized to the microenvironment.
- Photographs of the ROW and other project sites taken prior to commencement of field activity will be used for reference when restoring the site.
- The leakages will have to be keenly monitored
- Existing buried pipelines will be identified in the project area through a detailed topographic survey to set the boundary of ROW.
- Prior approval for right of way will have to be obtained from relevant authorities before the start of pipeline laying activities.
- Damage to existing infrastructure will be avoided as far as possible. Ditch burying along the ROW and horizontal thrust boring under the roads will be employed to avoid damage to the existing infrastructure. Any damage caused to the infrastructure due to construction activities will be promptly repaired.
- Advance notices on upcoming construction activities will be provided to local fishermen, so that they can take measures to deal with possible obstruction of potential fishing areas during construction. Pakistan Fisher folk Forum being the main stakeholder will be kept informed of all activities that could have negative impact on the fisheries operations.
- The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum. The bushes and mangrove seedlings may, as far as possible, be saved and transferred to the adjacent area. Other plants in the vicinity will need to be protected against damage by construction operations. The areas beyond the limits of site shall not be disturbed or otherwise damaged. Trees and shrubs will be planted in consultation with BEPA and monitored by IMC.
- No long-term impacts are likely to occur after completion of construction activity. Given appropriate substrate, sunlight, and temperature, benthic communities will be able to reestablish within the vicinity of the LNG terminal site. There is the potential for long-term impacts due to increased ship traffic, particularly as a result of accumulation of pollutants in the water column and sediment, which is known to adversely affect biological communities. In order to minimize and avoid impacts related to introduction of pollutants and invasive species all bilge discharge procedures will follow standard MARPOL regulations.
- Potential impacts on benthic habitats are likely to be minimized by natural reestablishment of bottom conditions and resettlement of associated fauna. Natural forces of currents and tides should restore the pre-construction distribution of soft bottom sediments that will be recolonized by infaunal organisms.

- Depending on the product being transported in the pipeline, the pipeline may be subjected to corrosion (internal), internal erosion, H_2S induced corrosion. Designing for no corrosion defect may be performed by either material selection or modifying operation procedures (i.e. through use of chemical corrosion inhibitors).

6.1.5 Waste Discharges

Water withdrawals and discharges due to operation of the proposed facility will include the following:

Ballast water withdrawals & Discharges: To maintain operational draft, the FSRU will intake seawater as ballast when it is emptying its LNG cargo by regasification and send off, and will discharge ballast water during LNG loading operations. The quantity to be discharged would be dependent on the actual operation of FSRU. The worst case would be to have full ballast before loading and discharge the ballast during loading. However, ballast water operation would be limited to as much as practicability depending on weather conditions, loading arm envelope, vessel trim etc.

"Since the FSRU will be permanently berthed within the harbor near breakwater, the impacts associated with the regular intake and discharge of ballast water shall be negligible, as it is to taken and discharged at the same location. There will be no chance of transferring alien species and potentially invasive marine species into the project area. Similarly LNG carrier ships will also intake sea water as ballast, while offloading LNG and it will be discharged at LNG cargo loading terminal/port.

It is likely that sodium hypochlorite (Produced from sea water) would be added to the water pumped into the ballast tanks and the cooling water systems, at a dosage of approximately 1.0 ppm (as cl_2), to prevent fouling.

"However the chlorine content in sea water shall be maintained less than 0.2 ppm at the outlet of discharge. It is expected that boiler blow down will have insignificant pollution impact subject to tests showing that this boiler blow down meets MARPOL discharge standards; it is proposed to discharge this to the sea. Any discharges to the Port will be in accordance with MARPOL requirements including compliance with their discharge standards."

Condensate water discharges from submerged condensate vaporizers: Controlled vaporization of the LNG within the FSRU will produce condensate from the ambient air vaporizers. After passing through the treatment system of the FSRU which will comply with MARPOL convention, the water will be discharged back into the sea.

Discharges from ship engine cooling systems: The proposed FSRU will utilize sea water continuously for regasification of LNG / vaporization through open loop process. In this process the heat available in sea water will be utilized to facilitate the heat-transfer to LNG for regasification. The cooler (cold) sea water will be discharged back into the sea.

Apart from the above, potable/ domestic water will be needed for DM water in boiler and for the crew onboard FSRU. The FSRU operation is expected to generate discharges from boiler blow down, domestic sewage, bilge water and ballast water.

"The FSRU shall be equipped with a centrifugal-type bilge oil/water separator that reduces oil in the bilge to 10 ppm. Treated Bilge water will be transferred to barges for transport to onshore for appropriate and approved disposal facilities."

An operational FSRU crew of 35 personnel will generate sullage and sewage at the rate of 250 litres per person per day.

"The FSRU will be equipped with an onboard effluent treatment system. The domestic effluent generated on FSRU shall be treated to meet MARPOL and NEQS effluent discharge standards with the help of onboard STP."

With the appropriate handling of discharges as discussed above, potential adverse impacts resulting from discharge of treated domestic effluent are expected to be of low significance.

It is estimated that 11,000 m^3/hr of seawater will be used for regasification. Using seawater pumps the same quantity will be discharged into the sea. The seawater will be brought in contact with LNG with a shell and tube heat exchanger or open rack vaporizer to vaporize LNG flowing through closed tubes. Sea water will absorb cold energy and vaporize LNG. The cooling water at discharge is 3 degrees Celsius (ºC) cooler (at most) than at intake. According to National Environmental Quality Standards (NEQS) the change in discharge temperature is required to be lower than 3ºC over ambient. The FSRU will be adequately equipped to deal with the temperature differences to respond to the national and international standards. The effects of cooling water discharge are expected to be biologically insignificant in view of the small temperature difference between the discharged cooling water and ambient conditions. However, water temperature and diffusion modeling to be considered in detail design to better evaluate the mixing of cooling water with receiving water.

Discharges from the FSRU would be at approximately the ambient temperature of the Sea. Water discharges for the LNG carriers, primarily associated with cooling on board machinery, would cool to within 1.5°F of ambient temperature within 75 feet of the discharge point. These discharges would not raise the overall temperature of the microenvironment or aggravate conditions that contribute to hypoxia. Temperature-related impacts associated with operation of the FSRU and LNG carriers would be localized and of minor consequence.

"The design of the LNG vaporizers uses a fixed amount of sea water for heating of the LNG and the resulting temperature of the discharge sea water is a function of LNG flow through each vaporizer. The maximum temperature depression of sea water at the maximum LNG flow conditions of the vaporizers is approximately 11ºC at the FSRU overboard. Dispersion studies at numerous FSRU terminals have demonstrated that the resulting temperature differential at the mixing zone boundary 100m from the FSRU is typically less than 1ºC. "

The tidal hydrodynamics at proposed FSRU site are conducive for rapid temperature (heat) dissipation of the sea water discharge from FSRU. It is envisaged that the cumulative sea water temperature will drop <3ºC (Max) at 100m distance around proposed outfall locations thus meeting the NEQS permissible limits. So it can be concluded that the net fall of the temperature in the surrounding waters due to discharges from proposed FSRU would be very nominal and shall not cause any adverse impact on the surrounding sea water.

Oil Contaminated Drain System: Onshore terminal station has considered state of the art oily water treatment system. The oily water treatment plant includes Oily Water Treatment package, underground discharge pipe, and auxiliary facilities. Recovered oil is pumped to a slop tank and the remaining effluent is routed to the evaporation pond. The Oily Water Treatment package consists of API separators, Induced Gas Floater units and subsequent dosing facilities.

To ensure treating oily water of LNG metering station, oily water treatment system can rely on oily water treatment system of onshore terminal.

The oily water system of LNG metering station is only 2.0 m^3/h and intermittent. So it can connect to the oily water treatment system. It isn't also need to build new oily water treatment equipment.

Only collecting pit and pipe for oily water of metering station area and utility area shall be considered connecting to the oily water underground drainage pipe for onshore terminal.

Sanitary Drain System: Onshore terminal has considered excellent sanitary sewer treatment system. The sewage treatment plant of includes Sanitary Sewage tank, Sanitary Sewage transferred pumps, Sanitary Sewage Treatment Package and auxiliary facilities.

Waste water is routed via gravity to underground chambers and transferred to an underground common discharge pipe to a Sanitary Sewage tank. Then domestic/sanitary waste water will be transferred to Sanitary Sewage Treatment Package (rotating disk type biological treatment unit) located inside the Treatment plant. Treated effluent is discharged back to the evaporation pond. The capacity of the Sanitary Sewage Treatment Package is 10 m^3/h.

To ensure treating the sanitary sewer of LNG metering station, sanitary sewer treatment system can rely on sanitary sewer treatment system of onshore terminal.

The sanitary sewer system is only 0.81m^3/h. So it can connect to the sanitary sewage treatment system of onshore terminal. It isn't also need to build new sanitary sewage treatment equipment.

Only collected pit and pipe for sanitary sewer of residential area and utility area shall be considered to connect to the sanitary sewer underground drainage pipe for onshore terminal.

Mitigation Measures

- The proposed operations are not expected to affect either the hydrology or currents of the channel. Discharges of water from the site to the channel are too small to have a measurable effect on hydrology or current patterns that could affect fisheries resources.
- Automatic biocide dosing, quality control and feedback systems will be incorporated into the LNG facility design
- The FSRU operator shall be mandated to use anti-fouling paint on the FSRU hull to minimize biological growth on the surface of the FSRU. Anti-fouling paint would be applied to the proposed FSRU hull by the FSRU provider at their shipyard outside Pakistan and would not be reapplied to the FSRU during the life of the Project. It is learnt that some anti-fouling paints retard biological growth by leaching copper, which prohibits the attachment of organisms. Therefore, use of non-toxic, silicon-based, anti-fouling paint will be ensured. Silicon-based anti-fouling paints prohibit attachment of organisms by creating a surface that is too slippery for organisms to adhere. Use of silicon-based anti-fouling paint would eliminate any impacts to benthic organisms from anti-fouling paint.

- Screens will be installed on the cooling water riser inlets and inlet current speeds will be kept low (estimated at 0.5 m/s) to prevent the ingress of large marine fauna into the cooling water system.

- Heat recovery measures from the FSRU will be considered in the detailed design stage.

- Bahria Foundation has incorporated emergency back-up systems in the event that there is an unexpected failure in the standard processes of the proposed FSRU. These include an emergency central cooling water system and an emergency bilge overboard. The emergency central cooling water system would not discharge during routine operations; and it is not expected that discharge would occur during the life of the Project, based on the safeguards included as part of the glycol/water system. It is anticipated that the emergency bilge overload would not be used at any time for the life of the proposed Project. Therefore, significant impacts from the emergency bilge overload are not anticipated.

6.1.6 Impact on Air Quality

Pakistan's Environmental Protection Agency (EPA) established the National Environmental Quality Standards (NEQS) for criteria pollutants (Ozone, PM_{10}, $PM_{2.5}$, CO, NO, NO_2, SO_2 and lead) to protect the human health. According to the assessment of ambient air quality, the proposed project is located in an area currently designated as in attainment with NEQS for criteria pollutants.

Activities related to civil work for LNG metering station construction and installation of pipeline will be confined to the microenvironment of the LNG Terminal site. Emission of combustion gases from the operating equipment is likely to be rapidly dispersed by the high wind velocity in the marine environment; the severity of impact of emission will accordingly be low, of short term duration, and is not expected to extend beyond the microenvironment. The impact on the microenvironment i.e. the terminal and on the macroenvironment i.e. at the distant locations can be minimized by following standard operating procedures besides adopting the following measures:

- Personal Protective Equipment (PPEs) will be provided to the workers involved in construction activities to safeguard the health of workers.

- Construction materials will be kept covered during transportation.

- Regular maintenance of construction machinery and auxiliary equipment will be the contractor's responsibility.

- All equipment, generators, and vehicles used during the project will be properly tuned and maintained in good working condition, in order to minimize exhaust emission levels.

Project related air quality impacts during construction are expected to include fugitive dust emissions from construction materials at the terminal and onshore facility site, emissions from construction equipment, marine vessel emissions and generators. Construction period will be limited and activities will change during the different phases of construction; the said emissions are therefore likely to be only temporary and may vary throughout this period.

Air emissions from the FSRU are generally generated by burning natural gas to heat the LNG during the vaporization process. Ships may have heavy fuel driven engines which may emit high levels of GHGs including water vapor, CO_2, CO, SOx, NOx, VOCs and particulate matter. In case of Gas turbine driven ships or Gas generators located on shore the potential air emissions would again be the GHGs including water vapor, CO_2, CO, SOx, NOx, VOCs, unburnt NG, and particulate matter. The gaseous emissions being acidic in nature will act to locally acidify the marine environment at micro level, while the water vapor will be addition to the humid marine environment.

The GHGs are all products of oxidative dehydration induced stress, and except water they are themselves oxidants. In the capacity of oxidants they can remove free energy from the micro and nano environment of living bodies where the life processes are governed. Removal of free energy is causative of:

- Disease conditions and aging among plants, animals and humans
- Photochemical smog, acid rain in air shed
- Additional water vapor and
- Warming of the microenvironment

The adverse impact of GHGs on the health of workers will be minimized by providing them the appropriate protective equipment (PPE).

Once liquefied, LNG is stored at atmospheric pressure and at its boiling point temperature of –162°C. With such large difference in temperature of LNG and on the outside, significant efforts are made to insulate the pipes and tanks in which LNG is stored to limit the amount of heat in-leak (absorption) and hence reduce the rate of boil-off of the LNG product. LNG loading lines, when not in use, are maintained at a cryogenic temperature by re-circulating LNG from the LNG storage tanks through the dual line system. This is necessary to avoid repeated thermal expansion and contraction which can damage bellows and pipe supports. The main parameter impacting boil-off gas rates of storage tanks is the extent of heat in-leak through the layers of insulation into the LNG tanks, not tank motions. LNG carriers typically have boil-off rates of their LNG cargo of about 0.15% per day. Newer designs are reducing this to 0.10% per day.

Mitigation Measures

- Construction impacts on air quality will be mitigated through standard operating procedures.
- FSRUs generally have emission monitoring system. However, it is recommended that Bahria Foundation will conduct regular emission monitoring to supplement the data generated offshore.
- Emissions from vehicles and other engine-driven construction equipment will be temporary and cease once the project is completed. Nevertheless, mitigation measures including proper maintenance of construction equipment and controlling unnecessary idling of equipment will be implemented.
- Management of the Proponent will be mandated to comply with air quality standards in vogue and will adhere to the applicable legal requirements during operation of the Project and to continue for the life of the Project. Compliance in this regard will be regularly monitored and the performance evaluated.

Construction activities related to laying of NG pipeline in the environment could entail from emission of dust during trenching, leveling, and backfilling, in addition to operation of vehicular traffic on unpaved roads, emission of combustion gases from construction machinery and equipment.

The emission of pollutants during the construction phase is not likely to be significant due to their rapid dispersion resulting from high wind velocity in the coastal area. As a result the severity of impact of the emission will be low, of short term duration, and can be minimized by appropriate mitigation measures. Furthermore, the activity will be limited to the microenvironment and hence will have insignificant impact on the communities in the distant locations. The dust emissions from traffic on unpaved roads are likely to be a nuisance to residents living close to the ROW of the pipeline.

Emissions from the pipeline or its transmission systems are not likely. The leakages from the pipeline and rupture during the operation phase cannot be ruled out because of the hazards that such incidents can create. The incident would alter the air quality in terms of increase in the concentration of greenhouse gases in the microenvironment, will create fire hazards because of the combustible nature of the NG and the scare that may be created because of the incident.

NG transmission in Pakistan has the track record of safety as observed elsewhere in the world. Incidence of injury due leakages, pipe fracture or any element of operation has not been reported by SSGCL or SNGPL for employees and contractors engaged by the organization. This is because the work practice and the standard operating procedures adopted by SSGCL or SNGPL have been implemented with dedication. As for the world scenario the United States has reported injuries that total at less than 1 injury in the year 2000 and less than 2 in the year 2001 for every 200,000 hours worked (the equivalent of 100 full time workers). This is a low rate of injury but, necessary measures, such as the Worker Health and Safety Plan and Safe Operating Procedures, will have to be employed to reduce risk of occupational hazards.

Because LNG is mostly composed of methane, no criteria air pollutants would be associated with the vaporized LNG if a release were to occur. The dispersion of the methane vapors would cause a temporary change in the ambient air quality. Any wildlife or humans at the water surface near the release in Hazard Zone 1 (500m) could suffer asphyxiation if the natural gas has not dispersed. The duration of exposure to any substantial pollutant concentrations would be short and would not pose a significant health risk to sensitive onshore receptors, given the distance to shore from a potential LNG spill at the FSRU or along the LNG carrier transit route.

Ignition of an LNG release would generate combustion emissions into the atmosphere. Natural gas combustion typically is not complete in spill scenarios. The products of incomplete combustion of natural gas include criteria pollutants, hazardous air pollutants, unburned hydrocarbons, and soot (carbon particulates). These ambient air pollutant concentrations would likely exceed short-term NEQS over the duration of the fire, as well as soot deposition and diminished visibility due to soot transport. The closer the receptors to the release, the higher the pollutant concentrations would be for the short duration of the fire. The types and amounts of emissions from an LNG pool fire would depend on many factors; but the emissions in any localized area would be temporary and would depend on weather, other marine conditions, and response actions.

Any acute exposures to LNG or smoke from LNG-related fires may lead to a range of health problems such as a worsening of asthma conditions; irritation of the eyes, nose, and throat; and difficulty in breathing. The symptoms of exposure may be of greater magnitude to people immediately downwind of the fire at the edge of a safety and security zone, and sensitive populations (children, elderly, or chronically ill persons). This could be a significant impact, being most severe in Hazard Zone 1 (500 m) and decreasing outward through Hazard Zones 2 (1600 m) and 3 (3500 m). However, because of the implementation of safety and security measures during marine transit, the likelihood of an LNG spill would be extremely remote and therefore is highly unlikely to impact air quality.

Establishment of Proposed LNG Project would therefore be an environmentally safe proposition.

The principal Greenhouse Gases (GHG) are methane, carbon dioxide (CO_2) and nitrous oxide (N_2O) and various fluorinated gases which trap heat in the atmosphere and are the primary driver of the increase in global mean temperature, known as global warming. No fluorinated gases would be emitted by the project so the need will be to look at N_2O, methane and CO_2 concentration. There are no Federal regulations at this time limiting the emissions of CO_2; however emissions of N2O are limited through limitations of NOx emissions under National Environmental Quality Standards (NEQS). Methane emissions are limited by valve and pipe leak standards.

Emissions of greenhouse gas are typically estimated as carbon equivalents, or carbon dioxide equivalents. The greenhouse gases are ranked by their Global Warming Potential (GWP). The GWP is a ratio relative to CO_2 which is based on the properties of the greenhouse gases to absorb solar radiation as well as the residence time within the atmosphere (IPCC AR4, 2007). GWP of CO_2 is 1.0, that of Methane is approximately 21 and of N_2O is approximately 310.

Table 6.1 presents the estimates on average CO_2-e emissions per MJ delivered using different ship types.

Table 6.1: Average CO_2-e emissions per MJ delivered using different ship types

Ship size (m^3)	**137,000**	**145,000**	**155,000**	**210,000**	**265,000**
Diesel Consumption (t/day)	35	35	25	30	35
t CO_2-e/t Diesel fuel	3.4064	3.4064	3.4064	3.4064	3.4064
LNG BOG consumption (t/day)	369.53	389.69	416.56	Nil	Nil
t CO_2-e/t LNG BOG	2.4173	2.4173	2.4173	2.4173	2.4173
GHG Index (t CO_2-e/t LNG)	0.028779	0.027896	0.011376	0.010083	0.008859
Average inflow gas quality (Btu/scf)	1092.2	1092.2	1092.2	1092.2	1092.2
Average emissions (g CO_2-e/MJ of LNG delivered)	1.5702	1.5220	0.6207	0.5501	0.4833

Source: Life Cycle Assessment (LCA) of Liquefied Natural Gas (LNG) by Paul Jonathan Barnett

Greenhouse Gas (GHG) emissions from proposed LNG Terminal operation have been estimated at 9,463 tons CO_2 equivalents, which is not considered significant by World Bank standards (significant>100,000 tons CO_2 equivalents).

Mitigation Measures

Adopting the following measures will further reduce the severity if any, of the impacts:

- Dirt road routinely used by a community for accessing the project site, will be sprinkled with water regularly to reduce fugitive dust emissions resulting from heavy vehicular traffic.

- Dust emission while digging close to residential areas, will be suppressed by sprinkling water or else an alternative-digging method will be explored.
- Personal Protective Equipment (PPEs) will be provided to the workers involved in construction activities to safe-guard the health of the workers.
- Transportation of construction materials will be in covered vehicles.
- Regular maintenance of construction machinery and auxiliary equipment will be the contractor's responsibility.
- All equipment, generators, and vehicles used during the project will be properly tuned and maintained in good working condition, in order to minimize exhaust emission levels.
- Pipeline fracture may occur at any point along the ROW. Periodical pipe inspections will be undertaken to identify and register possible pipe fractures.
- Leak detection systems will be installed at strategic locations.
- In the event of a pipe fracture, the fracture location will be isolated according to the ESD (Emergency Shut Down) procedure.
- All emissions from construction and operation must be in compliance with air quality standards prescribed by NEQS. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant and would continue to be so for the life of the Project. Regular monitoring and analysis will be ensured nevertheless.
- Control of NOx and SOx emissions and monitoring of the levels within the microenvironment, also helps protection against the cumulative potential of the gases towards photochemical smog or acid rain generation. Bahria Foundation in collaboration with IMC will continue to maintain an inventory of the level of all primary pollutants on its microenvironment.

6.1.7 Noise

The duration of the construction work is anticipated not to exceed one year. The assessment of noise emissions from project site during the construction phase of the project is based on review of the similar construction activities in offshore / onshore terminals where construction equipment used are very similar to the equipment planned for the construction phase activities, which include diesel engine driven electric generators and earthmoving equipment. Thus, it is reasonable to assume that the expected noise emissions for the construction phase of the project will be of the same order as estimated from the previous noise level assessment. The total noise level that may be expected due to diesel engine driven construction phase operations would be well below both the daytime limit of 75 dB(A) and the nighttime limit of 65 dB(A) required by National Environmental Quality Standards (NEQS) through appropriate mitigation measures.

Noise emissions from the marine vessels would mainly be generated by the operation of the vessel's engines. Underwater noise has the potential to affect marine life, particularly marine mammals and sea turtles, by altering the natural underwater noise environment. The cumulative impact of increased background noise levels in the marine environment is an ongoing and widespread issue of some concern. The secondary and cumulative impacts in this case are considered negligible when compared to operations such as marine seismic surveys and offshore construction or even high intensity fisheries and vessel traffic.

The noise emissions from vessel engines are substantially attenuated by their placement deep within the confines of the vessel. Only one vessel will be using the Terminal at any point of time. The increase in noise emissions from marine vessels using the berth is not expected to result in significant increase in level (< 3dBA). Additionally, sound emissions from marine vessels will occur on an intermittent and infrequent basis.

No mitigation measures are required other than following standard operating procedures which require regular maintenance of equipment and providing PPEs to the workers at stressed sites.

There are no developed residential areas close to the preferred route of pipeline. It is unlikely that noise from the construction phase activity would be noticed audibly at the immediate outside of the operation area. The construction workers who may be exposed to high noise would be provided ear plugs to be worne as protective measures.

- All equipment, generators, and vehicles used during the project will be properly tuned and maintained in good working condition, in order to minimize noise emission levels.
- The company should plan to mitigate the adverse impact of noise on the receptors in general and construction workers in particular. The vehicles and equipment will be regularly monitored for the performance of the noise reducing equipment. Vehicles whose noise levels exceed the minimum required level would be restricted for use in the construction activity area.
- Operators will be instructed keep the noise level at acceptable limits so that the marine fauna is disturbed to the least.
- A speed limit of 25km/hr will be enforced for project vehicles passing through populated areas.

6.1.8 The Influence of LNG Terminal on the Local Vessels Traffic

According to the PIANC standard, the safety zone around the LNG manifold is 200m. So the unloading operation will have no influence on the current port and vessel.

The international practice imposes a safety and security zone around LNG vessels in transit and while berthed.

US (enforced by the US Coast Guard):

- Ahead: 1.5 – 3 km
- Astern: 0.5 – 1.5 km
- Port and starboard: 500 meters

European & Far East Terminals:

- Ahead: - 800 meters
- Astern: - 800 meters

- Port and starboard: typically the channel width.

When the LNG vessel or FSRU vessel is navigating in the channel, an escort tugboat will be used around the vessel to keep the other vessel far from the LNG vessel. The approach channel is about 3.8km. So the LNG vessel will only take about 21 minutes without influence the local vessels traffic.

6.1.9 Manmade Hazards

Spills, leakages, or accidental release of fuels, lubricants, or other hazardous substances during operation of the proposed LNG Terminal could adversely affect water resources. No oil or mixtures containing more than 15 parts of oil per million can be discharged within 50 miles of the shore as per MARPOL 73/78 requirement for operating vessels on the open seas.

The manmade hazards considered for impact assessment include the following:

- Fuel Spills
- Fire and explosion
- Marine Hazard
- Workplace Hazard

Fuel Spills

Spills of fuel oil can have a potential impact on soil, groundwater and particularly surface water during both the construction and operational phases of the project. During construction fuel will be distributed over water to several types of vessels, including the dredge barges, the pipe lay barges, the water treatment barge, the concrete batch plant barge, and the quarters barges or cruise ship. Fueling will be conducted in a manner consistent with the spill prevention and response plan prepared by the construction contractor. In addition to construction barge fueling operations, fuel oil will be transferred from oil delivery barges to tanks. These operations will be managed in a manner consistent with the requirements of the spill plan. Impacts of a very limited nature are anticipated from occasional equipment leaks from fuel and hydraulic systems. The potential area of impact will be minimized by implementing a schedule of mechanical preventative maintenance for equipment and by instructing construction personnel of the importance of controlling the area potentially impacted by a release and providing immediate spill response and cleanup measures.

- The potential for equipment leaks from fuel and hydraulic systems will be avoided and/or reduced by implementing a scheduled mechanical preventive maintenance for equipment.
- Each fuel transfer will be visually monitored for the potential of release. Furthermore, the plan will require fuel tender personnel to be instructed in the means of stopping, minimizing and responding all leaks and spills (if any) using spill containment/cleanup equipment maintained on each vessel. The construction contractor will be required to have active contracts in place with third party emergency response/cleanup companies to provide additional assistance if necessary.
- Given these management controls, the potential impact from a fuel oil spill on water would be restricted to the small area within the deployed booms. Within this area, oil will be removed from

the surface of the water, to the extent possible, using equipment and materials maintained adjacent to the location of fueling operations or supplied by the third party response contractor (depending in the size of the release). In addition to construction barge fueling operations, it is envisaged that fuel oil will be transferred from oil delivery barges to tanks during both the construction and operational phases. These operations will be managed in a manner consistent with the requirements of the spill response plans. As with barge refueling operations, barge to tank transfer procedures will require the barge and onshore crew to visually monitor every fuel transfer to the onshore tanks. Tank volumes, which will be monitored by level sensing devices, will be checked prior to the start of transfer to ensure that there is sufficient volume to receive the delivery. The spill plans will require documentation of volume readings before and after the transfer, as well as other important control measures such as inspections of hoses and mooring lines, verification of communications equipment and signals, and pre-transfer conferences.

- Fuel tanks will be provided with a secondary containment system that will limit the potential impact of releases due to tank failure. The area impacted by a worst case tank failure would be limited to the area of the secondary containment, which will be impervious to the fuel oil and sized to contain the entire contents of the tank. Operators will be provided with spill response materials and training to adequately respond to a pipe leak and minimize the land area potentially impacted by the release. Following transfer, the lines will be blown through to the tanks to minimize potential releases from the piping system between delivery operations.

- The potential impacts from spills of materials other than fuel oil will be minimized and controlled in a similar manner. Portable secondary containment will be used to the degree possible during construction to store drums of chemicals. During the operational phase, chemicals will be stored in a secure warehouse provided with secondary containment arrangements. The warehouse will be supplied with sorbent and other materials appropriate to minimizing the area impacted during a release and clean-up of the spill.

Fire and Explosion

Fire and explosion hazard impacts to surrounding islands most of which have submerged and abandoned, creeks that are fishermen's active areas, workers at the facility and marine resources are not expected during the construction phase due to the limited quantities of flammable and combustible materials to be provided/transported to the site. The availability and use of portable extinguishing systems would limit the impacts of small fires, and personnel will receive training on the proper use and locations of this equipment.

Releases of cryogenic or low temperature liquid (e.g., LNG) due to spills, leaks, or intentional draining can expose facility personnel to several hazards. These hazards include oxygen deficiency, freezing injuries, fire hazards, and explosive air-gas mixtures.

Fire and explosion hazards from the receiving, transfer and regasification of LNG and natural gas are detailed in separate heading as *"Risks"*. The Hazard/Risk Analysis considers the various hazards and potential effects on public safety that could occur in the operation of the LNG Import Terminal with respect to siting and the operating procedures at the terminal.

The Fire Fighting system for LNG Terminal/Metering Station consists of mainly sub-systems as following;

- Fire Water System
- Wheeled Fire Extinguishers
- Portable Fire Extinguishers
- Miscellaneous Fire and Safety Equipment
- Fire Station

Fire Water System

Hydrants will be spaced at regular intervals around the site to provide effective firewater cover from a minimum of two hydrants to any part of the LNG metering station area or residential area. Each hydrant will provide connections for two separate flexible hoses and provide sufficient flowrate and pressure to support both hoses at their maximum application rate.

The firewater tank will be continuously charged to meet this firewater demand at all times. The firewater tank is preliminary sized based on 4 hours fire resistance duration.

Each hydrant has a capacity of (108 m^3/h). Hence the rate for two hydrants is 216 m^3/h. Hose reels will be provided in the buildings to allow all areas to be covered by at least one hose. Therefore the fire water consumption of two hose reel shall be considered as 36 m^3/h. Therefore the total flow rate is 252 m^3/h. By taking 10% design margin then the design flow rate become as 280m^3/h. The maximum fire water demand for the plant has been calculated to be 280m^3/h.

The onshore terminal station has considered excellent fire water storage and distribution system. The fire water supply plant includes raw water/fire water tank, fire water pumps, fire water jockey pumps and fire water main piping network.

Raw water/fire water storing in tank is distributed by fire water pumps to the firefighting water main pipeline in the case of fire and by firewater jockey pumps to the firefighting piping network for maintain the pressure of firefighting piping network. The total raw water/fire water tank capacity is 2500 m^3.

One 100% duty diesel driven and one 100% motor driven firewater pumps will be provided. Two 100% jockey pumps will be provided to maintain the firewater ring main pressure.

The rated capacity of the Main and Auxiliary Fire Water Pumps shall be 340 m^3/h and these pumps shall start at 8 bars and stop manually only. The rated capacity of the Jockey Pumps shall be 36 m^3/h and these pumps shall start at 8.5 bars and stop at 9.0 bar.

To ensure supplying the requirement of fire water for LNG metering station, fire water supply system can rely on fire water supply system of onshore terminal station.

The quantity of fire water for onshore terminal station is 280 m^3/h and the pressure requirement to use point is 6 bar. The designed capacity of fire water system can meet the requirement of LNG metering station. Therefore, LNG metering station does not need to build fire water supply equipment.

A buried fire water piping network has been considered running around the periphery of administrative area and living area of onshore terminal station. To meet the fire water requirement for LNG metering station, only a branch and an isolation valve will be provided to serve fire water consumption for LNG metering station.

HDPE pipe is used for underground fire water piping network.

Wheeled Fire Extinguishers

Wheeled 50 kg dry chemical fire extinguishers shall be installed at strategic locations such as gas metering area. They shall be suitable for Class BC fires and for outdoor installation.

Portable Fire Extinguishers

Portable 4 kg and 9 kg dry chemical fire extinguishers shall be located at strategic points where small Class BC fires may occur in accordance with NFPA 10. The maximum travel distance to reach an extinguisher shall be about 25 m. They shall be suitable for outdoor installation. In addition, buildings shall have two portable fire extinguishers positioned on the outside of the building near each entrance. Portable 5kg CO_2 fire extinguishers shall be located inside the substations, analyzer houses, instrument houses, etc. with a maximum travel distance about 9m to reach an extinguisher.

Miscellaneous Fire and Safety Equipment

The number of self-contained air breathing apparatus and Personal Protection depends upon the number of operators in the LNG metering station and external resources that are available in the local areas.

Fire Station

The Fire Station shall be located in a safe location. It shall accommodate one (1) First Intervention Vehicle, one (1) Command Vehicle and one(1) Pumpers with water tank and foam concentrate tank. Capacity of the water tank shall be 4500 L and capacity of the foam concentrate foam tank shall be 4500 L. In addition, spare fire hoses, portable extinguishers, and tools shall be located in the fire station.

Other measures include:

- As required by NFPA 59A and to minimize impacts to personnel and facilities, Impoundment areas (secondary containment) will be provided.
- LNG carriers will be equipped with a firewater system, with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above deck. In addition, the relief valve capacity of cargo tanks is designed to compensate for over pressure caused by fire. A water spray system will be available for cooling, fire prevention, and crew protection in specific areas.
- Potential impacts due to fire and explosion will be minimized through use of gas detection systems and a fire suppression system consistent with the international guidelines.
- Control Systems and Operational Procedures will be in place to minimize the potential for a fire or explosion and the resultant impacts to the operation, island and personnel.

Marine Hazard

Shipments of LNG received at the Floating Terminal will transit to the project site in the open seas near the Territorial limits. Ships contracted for the movement of the LNG will be equipped with the safety devices and the crews will be trained in safe handling and emergency response procedures. Shipments of LNG will comply with International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), International Maritime Organization 1993.Coordination of ship arrivals and departures will be controlled by the relevant Port Authority. Volume of shipping traffic will increase during the construction phase and would taper-off during the operation of the project.

- LNG Shipment will comply with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), International Maritime Organization 1993. Procedures for inspection and safety checks will be performed on each shipment, prior to the unloading/loading operations and before the vessel is released from the terminal.

- Worldwide there is no record of serious incident of an LNG carrier involved in product transport as envisioned for the Proposed Project. By implementing the management controls and following internationally accepted codes and standards, BAHRIA FOUNDATION expects no marine safety-related impacts due to the shipments of LNG.

Workplace Hazard

During construction, the potential impacts to worker safety include construction related hazards from working at elevation above deep sea water, within confined spaces, and near hydraulic and heavy equipment. The potential impacts to worker safety during operation include extremely low temperature material exposure and oxygen depletion hazards, increased fire hazards, and hazards associated with high-pressure systems.

- A Health and Safety Plan for construction and operations will be implemented and monitored with emphasis on personal protective equipment and inherently safe equipment.

6.1.10 Natural Hazards

Pakistan's Vulnerability to Climate Change Threats

The important climate change threats to Pakistan are:

- Considerable increase in the frequency and intensity of extreme weather events, coupled with erratic monsoon rains causing frequent and intense floods and droughts;

- Projected recession of the Hindu Kush-Karakoram- Himalayan (HKH) glaciers due to global warming and carbon soot deposits from trans-boundary pollution sources, threatening water inflows into the Indus River System (IRS);

- Increased siltation of major dams caused by more frequent and intense floods;

- Rising temperatures resulting in enhanced heat and water-stressed conditions, particularly in arid and semiarid regions, leading to reduced agricultural productivity;

- Further decrease in the already scanty forest cover, from too rapid change in climatic conditions to allow natural migration of adversely affected plant species;
- Increased intrusion of saline water in the Indus delta, adversely affecting coastal agriculture, mangroves and the breeding grounds of fish;

- Threat to coastal areas due to projected sea level rise and increased cyclonic activity due to higher sea surface temperatures;
- Increased stress between upper riparian and lower riparian regions in relation to sharing of water resources;
- Increased health risks and climate change induced migration.

Natural disasters may occur in the vicinity of the project area; these include severe storms and tropical hurricanes, flooding, and earthquakes.

Mitigation Measures:

- When environmental conditions (e.g. wind, wave and current) are under the permissible values (which will determined in the Mooring Study), the FSRU vessel and LNG carrier would be moored at the berth. Furthermore, the tugboats would be used to push the vessels to stay at the berth stably as the extra safety measures. When environmental conditions (e.g. wind, wave and current) exceed the permissible values which will determined in the Mooring Study, the LNG carrier shall leave the terminal and navigate in the fairway to avoid the big storm (may be the typhoon) and the FSRU vessel shall be pulled out the terminal to the temporary anchorage by the tugboats. The temporary anchorage area should be a circle with a radius of 500m and a water depth of 17m where the wind speed is less than 30m/s.
- The Floating Terminal has been designed to withstand a Category 5 hurricane that can protect against high winds, as well as storm surge and wave effects, associated with these relatively infrequent meteorological events. The mitigation strategies proposed to deal with hurricanes and surges of category 5 are considered sufficient to deal with tsunamis of high order.
- A factor of 2.8 m/sec^2 will have to be taken for a maximum credible earthquake (MCE). The design of the LNG terminal should take these values into consideration.

6.1.11 Protected Areas

There are no designated Protected Areas in the immediate vicinity of the project area. Therefore, there will be no impacts from the construction and operation of the facilities; as such, no mitigation will be required.

Historical and cultural sites are not located on the RoW of the pipeline. However the standard form of contract for such projects specifies that any finding of archaeological or historical importance will be immediately brought to the notice of the relevant department.

6.1.12 Operational Risk and Hazards

1. Leakage of LNG

The operational risks associated with LNG projects include those arising from LNGCs, and terminal operations involving transport, storage and transfer of NG.

Of primary concern are those events that could lead to an LNG spill of sufficient magnitude to create an offsite hazard, including events occurring during LNG carrier transit and at the FSRU. It is pertinent to recognize the stringent requirements for the design, construction, operation, and maintenance of the LNG terminals and also that extensive safety systems have to be in place to detect and control potential hazards.

The potential environmental impacts in the incident involving the FSRU or an LNG carrier that released LNG will be on aquatic life. The impact of unignited cryogenic LNG spill would be thermal stress. Any aquatic life coming in direct contact with the liquid gas would experience a sudden cold shock that would be lethal, although it is expected that most motile underwater organisms would detect the temperature change and avoid the area.

Aquatic fauna on the surface near the release could be surrounded by the vapor cloud and suffer asphyxiation. However, because the LNG would quickly vaporize and disperse, the likely duration of such exposure would be short.

Impacts to shoreline habitats and associated fauna could occur in the unlikely event of an unignited vapor cloud of natural gas from an LNG release reached land and ignited onshore. Potential damage could involve the combustion of both vegetation and wildlife as the fire would burn back toward the location of the release.

2. Risk and Hazards Related to LNG

The risks and hazards associated with LNG are directly related to i) cryogenic temperature of -160^{o}C, 2) Flammability and 3) characteristics of vapor dispersion. This implies that LNG will neither burn nor explode.

The positive features of liquid form of natural gas, mainly methane, include: LNG is odorless, colorless, non-flammable, non-corrosive and non-toxic, it will not pollute land or water resources. If it is released on water, it evaporates with no residual trace (although the pool will simultaneously spread and evaporate and is able to sustain a fire if a source of ignition exists). LNG is stored at ambient pressure so that a tank rupture will not cause an explosion. LNG vapors are harder to ignite than other types of flammable liquid fuels. If LNG spills on the ground or on water, it will warm, rise and dissipate into the atmosphere. However, potential hazards include i) fire, in case an ignition source is near LNG vapors and ii) frost bite because of the risk of contact of skin with an extremely cold substance.

Mitigation measures required to minimize the risks and reduce the hazards include the use of double hull features in LNG tankers to obtain a built-in form of secondary containment. According to the Centre for Energy Economics (October 2003.), there has been no off-site property injury or damage over 30 years as a result of the mitigation measures taken (including appropriate and modern equipment, facility design, safety and emergency systems, operational procedures and personnel training). In the EU technical risks that may lead to leaks or other forms of accident can be mitigated by adhering to the approved technical standards such as the BS EN 1473: 1977 on 'Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations' (This European industry standard was prepared by Technical Committee CEN/TC 282 (AFNOR)). This gives functional guidelines for LNG installations and recommends procedures and practices which will result in a safe and environment friendly process.

The design strategy for the LNG transfer system would include the following measures:

- Leak prevention through proper materials selection, minimization of leak paths, and system integrity management;
- An automated emergency shutdown system that includes detection, isolation, shutdown, and depressurization systems;
- Deck curbing, drip pans, and drain systems to direct LNG spills overboard;
- Structural cold protection for important structures, at areas where contact with LNG could occur;
- Emergency response planning and procedures.

Mitigation Measure: Bahria Foundation will ensure that a technical review of its proposed facility design is carried out to:

- Identify all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and
- Demonstrate that these areas are adequately covered by hazard detection devices and indicate how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.

3. LNG Related Incidents and Safety History

The history of LNG shipping has no record of major incidents that may have resulted in significant quantities of cargo being released. LNG has been safely delivered via ocean-going transport for more than 50 years. During that time there have been more than 50,000 LNG ship voyages, covering more than 100 million miles, without any major incidents involving a major release of LNG either in port or on the high seas. LNG ships frequently transit areas of high traffic density. For example, in 2000, one LNG cargo entered Tokyo Bay every 20 hours, on average, and one LNG cargo a week entered Boston harbor. Overall, LNG safety is inherent in the properties of LNG, the technologies and operating practices that have evolved on the basis of understanding these properties, and regulatory requirements.

There appear two exceptions to track record of no accidents:

1) The accident which occurred at the world's first commercial liquefaction plant in Cleveland, Ohio (USA), in 1944. The plant liquefied natural gas and stored the LNG in tanks which was vaporized later for use during heavy demand periods. An LNG storage tank ruptured and spilled the uncontained liquid into storm drains, followed by a large fire, which killed 128 people and injured more than 200. Tanks were subsequently redesigned for the cold temperatures required by LNG and no further tank failure has been reported in the USA ever since. However, the accident was probably

responsible for the dearth of construction of LNG facilities over the next 20 years. It may be noted that the LNG tankers currently used carry five times the amount of LNG stored in the Cleveland plant in only one of their four or five shipboard tanks.

2) An explosion occurred at the Skikda LNG plant in Algeria on 19 January 2003, killing 27 people and injuring 80. This was also an accident involving a liquefaction plant.

However both the above referred accidents occurred at the liquefaction plants. No significant incident has occurred at the receiving terminal anywhere in the world.

Australia has been supplying LNG since 1989 and has an enviable record for safety and reliability. Over 2,200 shipments have been dispatched without incident. (Source: Australian Department of Resources, Energy and Tourism)

However, the possibility of an LNG spill from a ship over the duration of the proposed Project must be considered. If an LNG spill were to occur, the primary hazard to the public would be the impact of radiation from a pool fire. If an LNG release were to occur without ignition, an ignitable gas cloud could form and present a hazard.

Historically, the events most likely to cause some significant release of LNG were a ship casualty such as:

- A grounding sufficiently severe to puncture an LNG cargo tank;
- A vessel colliding with an LNG carrier in transit; or
- A vessel colliding with an LNG carrier while moored at the FSRU.

In order for a spill of LNG to be incident, any or all of the above events would need to occur with sufficient impact to breach the LNG carrier's double hull and cargo tanks. All LNG carriers that will deliver LNG to the proposed FSRU would have double-hull construction, with the inner and outer hulls separated by about 10 feet (2 to 3 meters). Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick.

Mitigation Measure: To a large extent, the overall positive safety record is rooted in the limited risks arising from LNG itself. Because LNG is stored at atmospheric pressure the major hazard is fire, rather than explosion. Hence the need for emergency fire detection and response is a way of combating this risk. Moreover, safety measures, both equipment and training, are planned and designed into these LNG carriers to prevent or control all types of potential incidents.

As required by the IMO conventions and design standards, the vessel's inner hull adjacent to the cargo tanks will be protected against contact from liquid cargo through a combination of proper material selection, adequate insulation, and the use of heating systems. In addition, hold spaces and insulation areas on an LNG carrier will be equipped with gas detection and low-temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. Hazard detection systems will also be provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

4. LNG Related Hazard Zones

Sandia National Labs has defined the outer limits of the three hazard zones discussed in their report: Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water. These criteria are listed in Table 6.2. The criterion used to define the outer limits of Zone 1 and Zone 2 is incident heat flux, i.e., thermal radiation that would be expected from an intense LNG vapor fire. Within Zone 1, the thermal radiation can cause serious injuries or significant damage to structures. Within Zone 2, thermal radiation can cause injuries or some damage to structures. The outer limit of Zone 3 is defined based on the lower flammability limit of LNG vapor, i.e., when the concentrations of natural gas and oxygen does not have enough fuel to burn. Within all three zones, the level of risk is reduced as the distance from the source increases.

Table 6.2: Definition of Hazard Zone Boundaries

Zone	Criteria (10 minute exposure time)	Distance	Basis
Zone 1	37.5 kW/m^2*	500 m	High potential for major injuries or significant damage to structures
Zone 2	5 kW/m^2	1600 m	Potential for injuries and some property damage
Zone 3	Lower flammability limit (5%)	3500 m	Outer limit where LNG vapor can be ignited

Source: Sandia Report

Note: *Kilowatts per square meter

The severity of impacts within Hazard Zones 1 through 3 would depend on the location of the incident relative to a specific area, the scope of the incident, and whether or not the released LNG ignited or dispersed. This could be a significant impact, being most severe in Hazard Zone 1 and decreasing outward through Hazard Zones 2 and 3. However, because of the implementation of safety and security measures during marine transit, the likelihood of marine LNG spill is extremely remote.

5. Terrorism Hazard

LNG facilities and ships require a higher degree of planning, resources, knowledge, and risk to attack than that required for softer targets. Terrorists want to be successful, so they look for ways to execute crimes that will have a desired impact with a high likelihood of success. Lastly, they work with the resources they can acquire to conduct their acts so they are less likely to attack assets requiring sophisticated and complex methods as is evidenced by the vast majority of events. Their strategic objectives are sometimes profound, but their weapons, tactics, and choice of targets tend to be common.

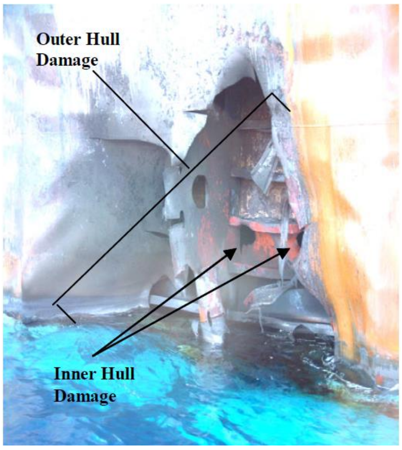


Figure 6.3: FSRU is relatively impervious to terrorism

As a result of the attacks of September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans.

The purpose of the Security code is to: i) prevent and suppress terrorism against ships; ii) improve security aboard ships and ashore; and iii) reduce the risk to vessels, cargoes, and passengers, crew, and port personnel onboard ships and in port areas.

All LNG carriers, as well as other cargo vessels 300 gross tons and larger, and ports servicing those regulated vessels, must adhere to these IMO and SOLAS standards.

Accordingly Bahria Foundation will adhere to the IMO and SOLAS standards stated here:

IMO requirements for the ships:

- Ships must develop security plans and have a Vessel Security Officer (VSO);
- Ships must be provided with a ship security alert system. These alarms transmit ship-to-shore security alerts to a competent authority designated by the Administration, which may include the company, identifying the ship, its location, and indicating that the security of the ship is under threat or has been compromised;
- Ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

Requirement for facilities:

- The facility must have a security plan and a Facility Security Officer (FSO); and
- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and facility security plans must address the following:

- Monitoring and controlling access;
- Monitoring activities of people and cargo;
- Ensuring security communications and that they are readily available; and
- Completion of a Declaration of Security that is signed by the FSO and VSO.

Bahria Foundation has their own contingency plan that will be implemented in letter and spirit. All the relevant safety protocols would be followed by Bahria Foundation; however, "no one can guarantee that a terrorist incident can't happen."

Mitigation Measure: Bahria Foundation and their suppliers shall adhere to the requirements set forth by IMO and other related agencies. Maritime Agency has excellent security record and is committed to maintain the same. No additional mitigation measures will be required.

6. Explosion Hazards

LNG tanks of the LNGCs and FSRUs store natural gas in liquid form at a temperature of about -160°C; they do not require pressure to maintain the liquid state. Sophisticated containment systems prevent ignition sources from coming in contact with the liquid. Since LNG is stored at atmospheric pressure, a crack or puncture of the container will not create an immediate explosion.

Mitigation Measure: The emergency response services integrated into the systems will be in place to rectify the situation. Moreover, since LNG is stored at atmospheric pressure, a crack or puncture of the container will not create an immediate explosion; it may induce an abrupt outflow of the liquid, which the emergency response service will be able to deal with.

7. Exposure to Vapor Clouds

On exposure to ambient heat sources, seawater or soil in the neighborhood, LNG vaporizes at a rapid rate raising vapor cloud in the meantime. As LNG leaves the temperature-controlled container, it begins to warm up, returning the liquid to a vapor and generally produces 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. A large quantity of LNG spilled without ignition would form a vapor cloud that would travel with the prevailing wind until it is either dispersed below the flammable limits or encounters an ignition source. If a large quantity of LNG is spilled in the presence of an ignition source, the resulting pool fire would produce high levels of radiant heat in the area surrounding the LNG pool.

Mitigation Measure: Safety devices and operational procedures will be in place to minimize the probability of release and subsequent vapor cloud formation, which may impact the outside of the facility boundary. It is envisaged that the vapor cloud will be confined to the hazard zone 1, and thus would not cause significant impact on public property. The impact accruing from release of the liquid gas and subsequent cloud formation, if any, will be quantified in detailed QRA study.

8. Freezing Liquid Related Hazards

Direct human contact with the cryogenic LNG, in case of its accidental release, will freeze the point of contact and can damage the tissues.

Mitigation Measure: Appropriate containment systems surrounding an LNG storage tank on ship are designed to contain the tank's contents. Containment systems would also separate the tank from other equipment. Moreover, all facility personnel would be mandated to follow the relevant safety codes and wear the PPEs provided to them as protective measures against freezing liquid in the hazard zone. The potentially hazardous zone being well within the facility boundary is not expected to have significant impact on the macroenvironment or the communities that are at far off distances.

9. Rapid Phase Transition (RPT) Related Hazards

RPTs have been observed during LNG test spills onto water. Being less dense than water LNG floats when released on water and vaporizes. If large volumes of LNG are released on water, it may vaporize too quickly causing a rapid phase transition (RPT). Water temperature and the presence of substances other than methane also affect the likelihood of an RPT. The rapid expansion from liquid to vapor state can cause large overpressures locally. RPT ranges from small pops to blasts large enough to potentially damage light weight structures. Other liquids with widely differing temperatures and boiling points can create similar incidents when they come in contact with each other.

An RPT may not result in dispersion distances that are much longer than what is expected with similar scenarios that do not involve RPTs (Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers, (ABSG) study (FERC 2004b)).

Mitigation Measure:

- Safety devices and operational procedures will be in place to minimize the probability of a release of LNG.
- Impacts due to RPT will be quantified in the detailed QRA study.

10. Flammable Gas Dispersion

Although Liquefied Natural Gas does not burn, the vapors of Natural Gas are flammable in a 5 to 15 percent mixture by volume with air. US Federal regulation: 49CFR193.2059 Flammable vapor-gas dispersion protection provides for protection of the public from flammable gas clouds that may result from an LNG spill. Spilled LNG vaporizes as cold natural gas. Natural gas mixed with air is flammable in concentrations of approximately 5 to 15 percent by volume (LFL and HFL for LNG is 5% to 15% respectively). The concentration of cold and dense natural gas is too rich to burn at sites close to the spill. Additional mixing with air, at warmer sites at farther distances from the spill, produces a flammable cloud of natural gas. The resulting vapor cloud therefore spreads out close to the surface near the spill site. As the cloud moves downwind, mixing with air and heat exchange with the ground warm the vapor cloud. The vapor cloud becomes lighter than air at some distance from the spill site and it is then that it lifts off. Ultimately, mixing with air dilutes the cloud below the flammable range.

The US Federal regulation and NFPA 59A both require that flammable gas dispersion from potential LNG spills should not extend beyond the property line of the LNG facility. More specifically, the regulation calls for an average flammable gas concentration of less than 2.5 percent (one half of the lower flammable limit [LFL] of methane in air) at a receptor height of 0.5 m. Using one half LFL of methane is a safety factor that accounts for the lower LFL's of C2+ hydrocarbons which may be present, as well as the limitations of atmospheric dispersion.

Mitigation Measure: The flammability risk would be taken into consideration during the detailed QRA study and the recommended measures will be adopted.

11. Tanker Collisions Hazards

An offshore terminal is exposed to risk of collision with ship(s), which are unstable due to variable degree of ship movement during unloading. Openness of offshore sites increases the risk of collision during extreme weather conditions. Unberthed LNG carriers with partially filled cargo tanks would be unstable and this may be cause for struggling in rough seas. An offshore facility would be more vulnerable to having the unloading operation interrupted than an onshore terminal.

The following port traffic control scheme is provided at each port to minimize the risk of ship collision: i) segregation of lanes with adequate separation distances and ii) constant monitoring physically or remotely through specific devices, iii) provision of navigational aids to indicate channels, and separation distances, besides marking their positions on the charts, and iv) enforcement of policing to prevent vessels from discharging bilge, tanker washings, oily slop, etc. into the marine waters, as a part of the environmental management strategy.

Collision risks have been given specific consideration by SIGGTO. The risk of a significant collision between the stationary floating LNG facility and a LNG Carrier is according to SIGGTO, sufficient to cause a breach of an LNG tank on either the LNG Facility or the LNG carrier and is extremely low provided:

- Safety zone requirement are followed as per the results of QRA. Detailed risk analysis would be conducted in the QRA study, recommendations of which will be followed in the design of the project.
- LNG import facility is fitted with thrusters to maintain a fixed bearing and position during berthing operations;
- LNG import facility is fitted with very robust fenders to protect both the facility and LNG carriers during berthing. (FSRU and LNG Carriers both have double hulls and, for a spill to occur, both hulls on the FSRU or LNG Carrier as well as the LNG tank linings would need to be breached.)

Mitigation Measure: Since the FSRU will be sited offshore in the open sea the risk of collision between berthed LNG carrier and passing by Vessel is minimized and heavy displacement ships can also pass by in the main channel.

12. Potential Impacts on Assets in Neighborhood

The NFPA59A guidelines and the 49CFR193 Federal regulations of the USA consider proximity of the site to populated areas and to buildings and other industrial facilities to have a direct impact on potential risks. The criteria that must be considered for siting an LNG facility in the USA are to allow for large or greater impact on the surrounding area than from any credible terrorist attack.

Facilities should provide limited access and constant surveillance to keep away the unauthorized persons out of the terminal.

The US regulations on chemical and hydrocarbon processing plant security (6 CFR Part 27, 2007) will apply to LNG regasification terminals and will require each such facility to assess vulnerabilities and to develop adequate Site Security Plans (SSPs). Pakistan will have to frame similar regulations at each LNG facility to assess vulnerabilities and to develop adequate Site Security Plans (SSPs).

Potential risks from a large aircraft being hijacked and used as a weapon to crash into an LNG tank or an LNG ship is not considered realistic, because:

- Increased security measures have been taken at each facility after 9/11, 2001, and
- Most LNG tanks or LNG ships in service generally do not meet the criteria for being an attractive terrorist target.
- Although a small aircraft would be more easily obtained, it would not have the combination of mass and speed necessary to create the impact energy required to cause either a cargo release from a ship or an LNG release from a tank.

Furthermore

- LNG Terminal and LNG ships being assets critical to public safety, have little potential for a significant release in the event of any credible terrorist attack.
- There are several levels of security that would have to be overcome in order for an attack to be successful in circumventing the basic design, emergency shutdown mechanisms, facility security and USCG oversight.
- All of the consequences of a credible terrorist attack produce exclusion zones that fall within the code-required consequence criteria, which are used to permit a facility. These exclusion zones will have to be established and analyzed for Project Site in Sonmiani Bay as part of the siting and permitting process.
- The US Department of Homeland Security sets requirements for facility security measures as regulated per the Marine Transport Security Act (MTSA) and the Chemical Facility Anti-Terrorism Standards (CFATS. Sites will differ in methods of providing security which include CCTV cameras, fencing, intrusion detection and communications to protect the LNG terminal and associated facilities.
- The proposed LNG terminal will obtain ISPS certification and shall comply with the conditions set out in the permission.
- The risk would be taken into consideration during the detailed QRA.

13. Safety & Risk Management of Large LNG Spills Over Water

While standard procedures and techniques exist for the analysis of the potential hazards from an LNG spill over land, no equivalent set of standards currently exists for LNG spills over water. This is due in part to the lack of large-scale data of LNG spills onto water, as well as the much more complicated physical and dispersion phenomena that occur when the very cold and dense liquid such as LNG is spilled onto water. For that reason, the U.S. Department of Energy (DOE) requested that Sandia National Laboratories (Sandia) develop guidance on a risk-based analysis approach to assess and quantify potential threats to an LNG ship, the potential hazards and consequences of a large spill from an LNG ship, and review prevention and mitigation strategies that could be implemented to help reduce the possibility and risks to people and property of an LNG spill over water.

To support this effort, Sandia worked with the main stakeholders including DOE, U.S. Coast Guard, LNG industry and ship management agencies, and collected background information on ship and LNG cargo tank designs, accident and threat scenarios, and standard LNG ship safety and risk management operations. Sandia then developed the report, "Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water", SAND2004-6258, which provides communities and agencies dealing with the marine import of LNG on the general scale of safety, security, and hazard issues of a large spill and how to focus risk prevention and risk management efforts [Hightower 2004].

The information and results presented in the Sandia LNG safety and risk analysis report, intended as it is to be used as guideline for conducting site-specific hazard and risk analyses, need to be considered in the context of siting LNG terminals in Pakistan. The report is a guideline for using performance-based approaches to analyze and responsibly manage risks to the public and property from potential LNG spills over water. The following is an overview of the guidelines to assess and manage site-specific hazards and risks from marine LNG imports:

1. Factors that Influence an LNG Spill

Figure 6.4 is a presentation of the different events that can occur during an LNG spill over water. An LNG cargo tank must first be breached from an accidental event such as a collision/ grounding/ malevolent or intentional event. Quantification of the likelihood and results of such events is important because it influences the size and location of a possible breach, the potential volume of a spill, and the associated hazards. Many site-specific and system-specific variables that must be considered include: LNG vessel size and design type, cargo tank geometry and construction materials, potential ignition sources, site-specific environmental factors such as waves, wind, and terrain, safety and security measures and operations, and emergency response plans and initiatives.

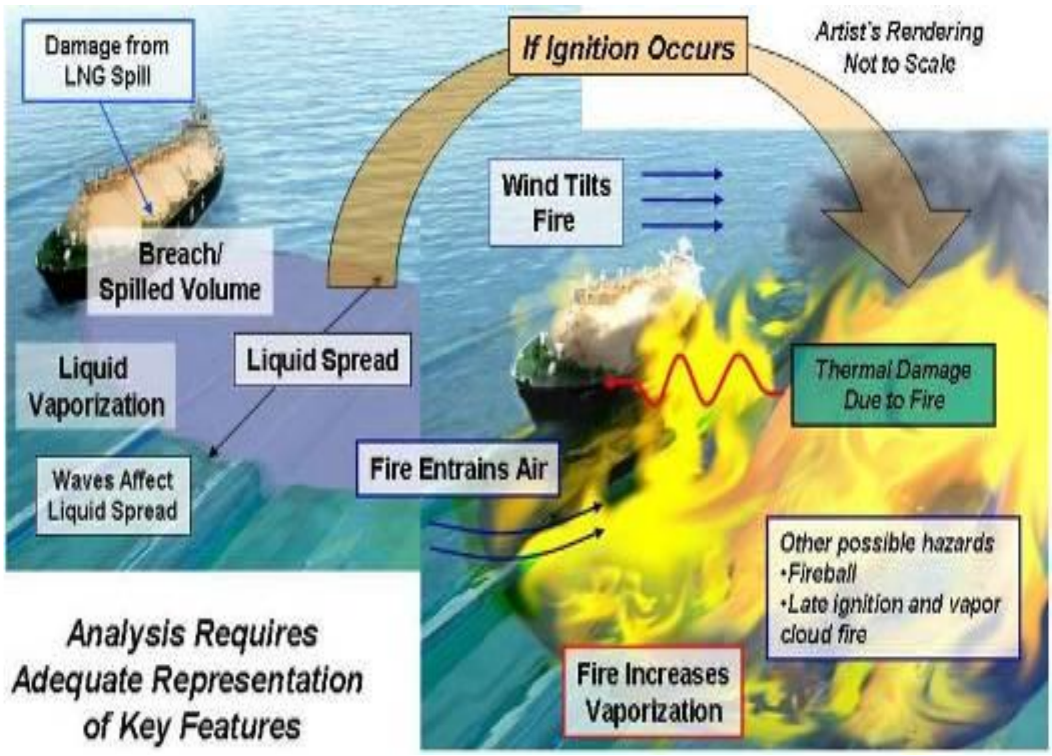


Figure 6.4: Key factors that influence an LNG vessel spill over water.

LNG spill onto or into the LNG ship, and/or flow from the breach onto the water surface will depend on the size and location of the LNG cargo tank breach.

Occurrence of LNG dispersion through volatilization of the LNG from contact with water and transportation as vapor cloud in the air or as a liquid on the water surface will depend on whether there is early or late ignition. The timing of a potential ignition will determine whether the LNG will disperse without a fire, burn as a pool fire, or burn as vapor fire.

These factors can each significantly influence the estimates of the hazard distances and hazard levels for an LNG spill and each should be carefully assessed for each site. For example, an evaluation of several recent LNG spill studies showed significant differences in thermal hazard estimates due to differences in assumptions and modeling approaches used in each analysis [Lehr and Simecek-Beatty 2003][Fay 2003][Quest 2003][Vallejo 2003][Pitblado 2004].

2. Example of Potential Hazards from Large LNG Spills over Water

General scale of potential hazards of a large LNG spill over water, and the existing experimental data were used by Sandia to evaluate and analyze by modeling to assess several potential spill hazards including: asphyxiation, cryogenic burns and cryogenic damage to the ship from the very cold LNG, dispersion, fires, and explosions.

Available accidental and intentional threat information was used to identify possible breaching scenarios.

Based on this review, the most likely hazards to people and property included thermal hazards from an LNG fire. Cryogenic and fire damage to an LNG ship were also identified as concerns that could cause additional damage to LNG cargo tanks following an initial cargo tank breach.

To help the public get a feeling of the expected scale and range of the hazards from a large LNG spill over water, the hazard distances for several possible accidental and intentional breach scenarios of a standard LNG vessel, holding 125,000 – 140,000 m^3 of LNG, for generally stable atmospheric conditions were evaluated by Sandia and are presented in the guidelines.

The results consider spill volumes of one-half the contents of a standard LNG cargo tank, approximately 12,500 m^3, for each LNG cargo tank breached. The range of the results, based on different assumptions and spill parameters, are presented in Table 7.3 for thermal fire hazards. Most intentional events are anticipated to provide an ignition source such that a pool fire occurs and the likelihood of a large unignited release of LNG is unlikely.

Table 6.3 provides information on possible hazard distances for a spill with a significant delay in ignition of the LNG. The 37.5 kW/m^2 and 5 kW/m^2 values shown in Table 6.2are thermal flux values commonly recognized for defining hazard distances for LNG [NFPA 2001]. The 37.5 kW/m^2 level suggests severe structural damage and major injuries if expected for over 10 minutes. The 5 kW/m^2 is a level that suggests second-degree skin burns on exposed skin if anticipated for periods of over about 20 seconds, and is the value suggested as the protection standard for people in open spaces.

The distances shown in Table 6.4 are to the lower flammability limit (LFL) the lowest level at which LNG will burn. The LFL value is commonly used as the maximum hazard distance for a vapor dispersion fire.

Table 7.3: Potential Thermal Hazard Distances for Possible Breaching Events of a Standard LNG Vessel								
Hole Size (m^2)	***Tanks Breach ED***	***Discharge Coefficient***	***Burn Rate (m/s)***	***Surface Emissive Power (kW/m^2)***	***Pool Diameter (m)***	***Burn Time (min)***	***Distance To 37.5 kW/m^2 (m)***	***Distance To 5 kW/m^2 (m)***
Accidental Events								
1	1	.6	$3X10^{-4}$	220	148	40	177	554
2	1	.6	$3X10^{-4}$	220	209	20	250	784
Intentional Events								
5	3	.6	3×10^{-4}	220	572	8.1	630	2118
5*	1	.6	3×10^{-4}	220	330	8.1	391	1305
5	1	.9	3×10^{-4}	220	405	5.4	478	1579
5	1	.6	8×10^{-4}	220	202	8.1	253	810
12	1	.6	3×10^{-4}	220	512	3.4	602	1920

* nominal case considered

Table 7.4: Potential Lower Flammability Limit (LFL) Distances for Possible Vapor				
Hole Size (m^2)	**Tanks Breached**	**Pool Diameter (m)**	**Spill Duration (min)**	**Distance To LFL (m)**
Accidental Events				
1	1	181	40	1536
2	1	256	20	1710
Intentional Events				
5	1	405	8.1	2450
5	3	701	8.1	3614

While these results show the general range of hazards for spills from common LNG vessels, larger vessels are being considered for offshore ports, but that may lead to larger spills. Examples of hazard distances for spills from larger vessels are presented in a Sandia report [Hightower 2006]. The results show the scales of concern, but actual hazard distances will vary based on site-specific environmental conditions, fire dynamics, terrain, ship sizes, and safety and emergency response measures.

3. Mitigation measures/Risk Management for LNG Operations over Water

It is important to assess the possible hazards from a large LNG spill over water, and the risks and hazards from a potential LNG spill that can be reduced in many cases through a combination of safety and risk mitigation approaches, which include:

Reducing the potential for a spill,
Reducing the consequences of a spill, or
Improving LNG transportation safety equipment, security, or operations to prevent or mitigate a spill.

A number of international and U.S. safety and design standards have been developed for LNG ships to prevent or mitigate an accidental LNG spill over water. These standards are designed to prevent groundings, collisions, and steering or propulsion failures. They include traffic control, safety zones around the vessel while in transit within a port, escort by Coast Guard vessels, and coordination with local law enforcement and public safety agencies. These efforts have been exemplary, and in over 40 years of LNG marine transport operations there have been no major accidents or safety problems either in port or on the high seas [Pitblado 2004]. In addition, since September 11, 2001, additional security measures have been introduced to reduce the potential for intentional LNG spills over water. They include earlier notice of a ship's arrival (from 24 hours to 96 hours), investigation of crew backgrounds, at-sea boarding of LNG ships, special security sweeps, and positive control of an LNG ship during port transit.

Risk prevention and mitigation techniques are important tools in reducing both the potential for and the hazards of a spill, especially in zones where the potential impact on public safety and property can be high. The general risk management process recommended is discussed in detail in the Sandia report and a flow chart of the process is presented in Figure 6.5.

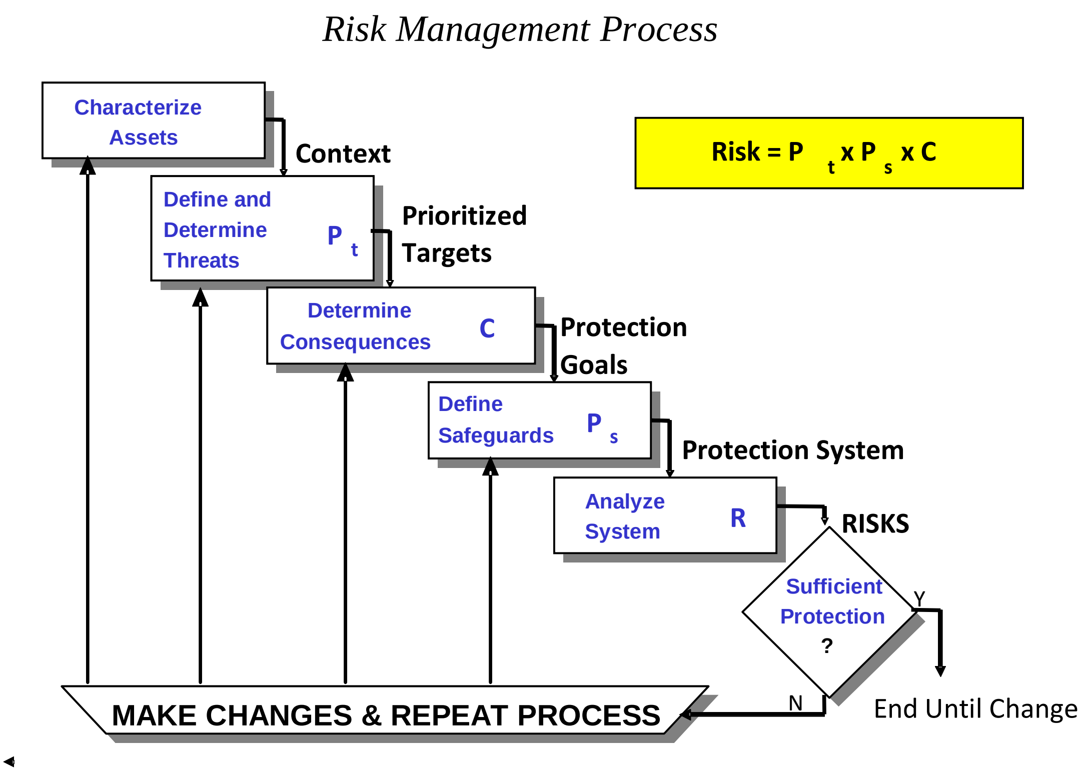


Figure 6.5: Risk Analysis and Risk Management Process Approach

The risk analysis process helps support a program for managing risks to the public of marine LNG imports. The process steps as shown in Figure 6.5 include:

- Evaluating the potential for an event that could cause a breach or loss of LNG from a ship;
- Establishing the potential damage to a cargo tank or other system from these events and the potential spills that could occur;
- Estimating the volume and rate of a potential LNG spill based on the dimensions and location of the breach, properties and characteristics of the LNG, ship construction and design, and environmental conditions (e.g., wind, waves, currents, etc.);
- Estimating the dispersion, volatilization, and potential hazards of a spill based on site-specific physical and environmental conditions; and

- Identifying prevention and mitigation approaches and strategies to meet identified protection goals and risk management goals.

As illustrated in Figure 6.5, if risks, costs, or operational impacts are deemed to be too high such that sufficient protection cannot be provided to meet defined protection goals for the site, the overall process cycles back through the evaluation to identify alternative approaches for improving system performance and protection.

Proactive risk management approaches can help reduce both the potential for and hazards of such events and include:

- Improvements in ship and terminal safety/security systems – including improved surveillance, tank and insulation upgrades, tanker standoff protection systems,
- Modifications and improvements in LNG tanker escorts, extension of vessel movement control zones, and safety operations near ports and terminals,
- Improved surveillance and searches of tugs, ship crews, and vessels,
- Redundant or offshore mooring and offloading systems, and
- Improved emergency response systems to reduce fire and dispersion hazards and improved emergency response coordination and communication.

The risks can be re-evaluated according to the new approaches to determine if they meet the identified protection and risk goals. If not, then the evaluations are repeated with additional provisions or changes until the protection and risk goals are reached. The potential alternatives, changes, and/or upgrades can be compared through the process to identify the most appropriate and cost-effective approaches for improving overall system safety and security. Deciding on the sufficiency of protection measures to meet risk management goals is often aided by a benefit-cost evaluation, with measures matched to risk levels as shown in Table 6.5. For most locations and operations, some level of risk is common and, therefore some "residual" risk often remains.

Table 6.5: Representative Examples of LNG Spill Risk Reduction Options

Impact On Public Safety	*Reduction In Event Potential (Prevention)*	*Improve System Security And Safety (Mitigation)*	*Improved Hazard Analysis (Reduce Analytical Uncertainties)*	*Resultant Risk Reduction*
High and Medium	Early off-shore interdiction Ship inspection Control of ship, tug and other vessel escorts Vessel movement control zones (safety/security zones) One-way traffic LNG offloading system security interlocks	Harbor pilots Ship and terminal safety and security upgrades Expanded emergency response and firefighting to address fires, vapor clouds, and damaged vessels	Use of validated CFD models for LNG spill and thermal consequence analysis for site specific conditions Use of CFD and structural dynamic models for spill/structure interactions	Combination of approaches to reduce risks to acceptable levels

Table 6.5: Representative Examples of LNG Spill Risk Reduction Options

Impact On Public Safety	Reduction In Event Potential (Prevention)	Improve System Security And Safety (Mitigation)	Improved Hazard Analysis (Reduce Analytical Uncertainties)	Resultant Risk Reduction
Low	Use of existing best risk management practices on traffic control, monitoring & safety zones	Use of existing best risk mitigation practices to ensure risks remain low	Use of appropriate models to ensure hazards are low for site-specific conditions	Combination of approaches to ensure risks are maintained at acceptable levels

The risk management approach presented is performance-based and should include identification of site-specific hazards and risks and site-specific public and property protection goals. What might be applicable for effective risk reduction in one location might not be appropriate in another. Therefore, risk management must be balanced between public protection goals, emergency management capabilities and other resources, and overall hazards relative to other local industrial operations and activities. For this reason, risk identification and risk management processes should be conducted in consultation with appropriate stakeholders, including public safety officials and elected public officials. Considerations should include site-specific conditions and needs, available intelligence, threat assessments, safety and security operations, and available resources.

Bahria Foundation will conduct a detailed QRA which would identify mitigation measures for probable risks pertaining to sites being considered for successful commissioning of the LNG facility.

6.1.13 Socioeconomic Impacts

The socioeconomic impacts of an expanding gas sector are undoubtedly positive in terms of employment, competitiveness and sustainable development. However, the gas sector is a relatively modest creator of direct employment, and has contributed mostly as a substitute for coal in power generation. Moreover NG is being used in the transport sector as CNG and also in the domestic sector for cooking and heating. It is the main raw material for fertilizer production. These uses have modest impacts on competitiveness but have clear environmental benefits. In the drive to a low carbon economy, gas is a transitional fuel rather than the ideal fuel of the economy. It nonetheless contributes to policies of sustainable development.

Contribution to sustainable Development: Natural gas is generally considered to make a positive contribution to sustainable development because it helped the European Countries in reducing their reliance on coal in power generation. Natural gas is the cleanest of all hydrocarbon energy sources, by virtue of emission of very low amounts of key pollutants such as Sulphur and nitrogen oxides and emitting less than half of the CO_2 emitted by burning coal but producing an equivalent amount of water which is also a greenhouse gas.

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

The greater Weightage given to climate change mitigation in public policy implies that the CO_2 emissions from methane may discourage the use of natural gas as ‘the fuel of the future’ because it is not a renewable source of energy and its resources will ultimately be exhausted. Its use as a transitional fuel to hydrocarbon based economy is, however, not likely to be in jeopardy, mainly because emission of CO_2 is not as much a problem as water that is produced by oxidative dehydration of fuel oil. It must be realized that carbon dioxide is being recycled and the seas and oceans still have enough capacity to absorb it. The water in its vapor state remains in excess in the atmosphere. Much more water vapor is likely to be lost into the atmosphere since the soil is gradually being desiccated and the groundwater is being excavated at a fast rate. Since the latent heat of vaporization is the same as the latent heat of condensation, an increase in the input of water vapor will, under appropriate conditions, lead to increase in cloud formation, followed by increase in rainfall and snowfall events. This is not all; condensation of water vapor over the snow cover and the glaciers would entail their melting, and more glacial lakes would form and burst.

The link between LNG and sustainability is different in the sense that it is likely to be available until the supplies last and also because technology for its use is well established and is not likely to be abandoned easily. There are some positive connections nevertheless between LNG and the notion of sustainability, such as:

- Providing clean natural gas supplies by Liquefaction technology as an efficient way to monetize stranded gas reserves thus creating benefits for the developing countries that seek to export them
- Providing LNG as a relatively safe and secure fuel with an excellent track record in safety and environmental respects
- Presenting LNG as flexible and scalable solutions: small scale distribution of LNG offers supplies to remote areas while liquefaction technology can capture waste streams from flare gas and landfills

Contribution to Employment Generation: It is estimated that a maximum of 100-120 jobs will be created during the construction phase of the project. Proponent will use good faith efforts to employ qualified Pakistani citizens in the construction and operation of the proposed project.

A training program will be initiated by Bahria Foundation to recruit and train suitable citizens with the skills required during the project’s construction and operational phases. Based on local populations and the potential number of available workers it is expected that up to 50 percent of the construction work force personnel will be hired from Balochistan. The remaining construction and supervisory positions will be filled with experienced workers that will be temporarily relocated to the area. Thus, construction activities will provide new, temporary and permanent, work opportunities for both skilled and unskilled labor, besides contributing significantly to the national economy.

It is estimated that 50-60 permanent full time jobs will result from on-going operations and maintenance of the facility with a permanent annual payroll.

Contribution to Local Economy: The majority of the raw materials to be used during construction are expected to be purchased from the local market since significant amount of cement, aggregate or ready mix concrete, and miscellaneous fabricated material may be sourced from different parts of country. Other required materials may also be purchased locally, and include such items as food, housing materials, ferries and other small marine vessels, household and office supplies, oils, chemicals and cleaning supplies. These purchases are projected to infuse the local economy with additional revenues over the estimated during construction period.

Contribution to National Economy: Natural gas accounts for the largest share of Pakistan’s energy use, amounting to almost 45 percent of total energy consumption. Pakistan currently consumes all of its domestic natural gas production. Limited new gas discoveries and ever increasing demand has resulted in widening the gap between (demand and supply), and (supply and availability).

The cumulative impact on the National economy will be strongly positive. Significant additional resources will be realized by the nation as a result of this project, which is consistent with the government's long-term development plan. The additional licensing income, among other sources of additional income, will add to the government revenues and economic growth resulting from expanded and diversified business development in Pakistan in future.

Table 6.6: Checklist Of Actions Affecting Environment & Significance Of Their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
A. Environmental Problems due to Project Location			**None**	**Small**	**Medium**	**Major**
1. Changes in hydrology affecting existing property values of land on CoI & ROW	1. Damages to land erosion and/or accretion	1. Careful design and planning to minimize /offset problem	X			
2. Changes in drainage pattern	2. Damages due to changes in flooding, accretion, erosion hazards	2. Careful design to minimize/offset problem	X			
2a. Water Obstruction	2a Conflicts with other beneficial water uses	2a. Appropriate sharing of water rights		X		
3. Changes in land uses	3. Possible loss in overall regional welfare	3. Careful planning		X		
4. Encroachment into precious ecological zones	4. Loss of precious ecology	4. Careful planning	X			
5. Displacement of population/Resettlement	5. Social inequities/inadequate compensation	5. Adequate attention to problem	X			
6. Historical / monuments / cultural values	6. Loss of precious values	6. Careful planning to minimize/offset problem	X			
7. Environmental aesthetics	7. Loss of environmental aesthetics	7. Careful planning & Monitoring	X			
B. Environmental Problems due to Inadequate Design						
1. Unrealistic assumptions on available O & M skills	1. Unnecessary damages because O&M requirements too high	1. Realistic O & M assumptions	X			
2. Pollution Control Equipment Selection	2. Assumed pollution removals not realized	2. Appropriate equipment selection	X			

Table 6.6: Checklist Of Actions Affecting Environment & Significance Of Their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
3. Environmental pollution control operations	3. Possible loss in overall regional welfare	3. Careful planning/designing/monitoring and use of appropriate standards		X		
3a. Surface water (Fresh/estuarine)	3a. Impairment of downstream beneficial water uses	3a. Careful planning & monitoring	X			
3b. Groundwater	3b Impairment of beneficial water uses	3b. Careful planning & monitoring	X			
3c. Air	3c. Impairment of air quality	3c. Careful planning & monitoring		X		
3d. Noise	3d. Environmental Degradation & Health hazard	3d. Careful planning & monitoring		X		
4. Impacts on adjacent land economic users including recreation/tourism	4. Impairment of land uses	4. Careful planning/O&M		X		
5. Occupational health & Safety hazards	5. Hazards to workers health & safety	5. Careful planning to offset problem		X		
6. Hazards due to Spills/fires/explosions	6. Hazards to workers health & safety	6. Careful planning & management of pollution control		X		
7. Area sanitation	7.Sanitation/disease hazards	7. Careful planning/design	X			
8. Hauling routes in/out areas	8. Traffic congestion and nuisances along routes	8. Careful planning & Monitoring		X		
C. Environmental Problems During Construction Stage						
1. Problems due to uncontrolled construction practices e.g. scarring	1. Problems of Environmental Degradation	1. Careful Planning and Implementation		X		
a) Dredging /Run off erosion	(a) Problems of Environmental Degradation	a) Careful Planning and Implementation	X			
b) Worker accidents	b) Problems of Environmental Degradation	b) Careful Planning and Implementation		X		
c) Sanitation disease hazards	c) Problems of Environmental Degradation	c) Careful Planning and Implementation		X		

Table 6.6: Checklist Of Actions Affecting Environment & Significance Of Their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
d) Insect vector disease hazards	(d) Problems of Environmental Degradation	d) Careful Planning and Implementation		X		
e) Hazardous material handling	(e) Problems of Environmental Degradation	e) Careful Planning and Implementation		X		
f) Dust/odors/fume	(f) Problems of Environmental Degradation	f) Careful Planning and Implementation		X		
g) Explosion/fire hazards/hazardous materials spills	(g) Problems of Environmental Degradation	g) Careful Planning and Implementation & Monitoring		X		
h) Noise/vibration hazards	(h) Problems of Environmental Degradation	h) Careful Planning and Implementation		X		
i) Trenching/ quarrying/ blasting hazards	(i) Problems of Environmental Degradation & Trapping of Wildlife	i) Careful Planning, Implementation & Monitoring		X		
j) Machinery & Equipment mobilization	(j) Problems of Environmental Degradation	j) Careful Planning and Implementation		X		
k) Water pollution hazards	(k) Problems of Environmental Degradation	k) Careful Planning and Implementation		X		
l) Blockage of animal passageways	(l) Problems of Environmental Degradation	l) Careful Planning and Implementation		X		
2. Uncovered cut & fill trenches/areas	2. Soil erosion, consequent damage to properties & environment, besides trapping of wildlife	2. Careful Planning and Implementation		X		
2. Inadequate construction monitoring	2. Encourages poor construction practices	2. Adequate monitoring during construction		X		
D. Environmental Hazards Relating to Operations (assuming proper design assumptions on O&M)						
1. Inadequate O & M	1. Variety of environmental degradation similar to items B.1 to 8	1. Adequate O&M		X		
2. Inadequate operations	2. Opportunity loss for feedback connections to	2. Adequate monitoring		X		

Table 6.6: Checklist Of Actions Affecting Environment & Significance Of Their Impact

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
phase/environmental monitoring	project design and O&M					
3. Occupational Health & Safety Programmes including accidents	3. Hazards to workers health & safety	3. Careful O&M including readiness for emergency		X		
4. Nuisance from handling & Transportation of fuels on access roads	4. oil drips, spills, dust & noise hazards	4. Careful O&M including safe driving & Monitoring		X		
5. Surface run off from warehouse area	5. leakage of fuel on ground & oil drips	5. Adequate O&M/ monitoring		X		
E. Critical Environmental Review Criteria						
1. Loss of irreplaceable resources	1. Long-term national environmental and economic losses	1. Planning required to be consistent with government policies		X		
2. Accelerated use of resources for short term gain	2. Long-term national environmental and economic losses	2. Planning required to be consistent with polices		X		
3. Endangering of species	3. Long-term environmental losses	3. Planning to be consistent with polices		X		
4. Promoting undesirable rural-urban migration	4. Intensification of urban socioeconomic problems	4. Planning to be consistent with polices		X		
5. Increase in affluence/poor income gap	5. Intensification of national socioeconomic imbalances	5. Planning to be consistent with polices		X		
F. Potential Environmental Problems During Operation						
1. Removal or damage to vegetative growth	1. Problem at preparation of site & during operation	1. Careful implementation of EMP		X		
2. Land Use Changes	2. Problem at preparation of site, construction, commissioning & during operation	2. Careful implementation of EMP		X		
3. Micro level changes in the human settlements	3. Problem at siting & Operation stage	3. Careful implementation of EMP		X		
4. Industrial & Transportation Activities	4. Problem at Operation Stage	4. Careful implementation of EMP including Traffic Management		X		
5. Emergence of Slums & Wayside Commercial Activity	5. Problem at Construction & Operation Stage	5. Careful implementation of EMP	X			

Table 6.6: Checklist Of Actions Affecting Environment & Significance Of Their Impact						
Actions Affecting Environment Resources & Values	**Damage To Environment**	**Recommended Mitigation Measures**	**Significance of Impact**			
G. Impacts from LNG Storage/Transmission facilities						
1 Environmental health hazard due to Leakage	1. Unnecessary exposure of workers to environmental hazards.	1. QRA/Careful planning/ training of workers		**X**		
2. Depreciation of environmental aesthetics	2. Loss of values	2. Careful planning & implementation	**X**			
3. Encroachment on ecosystem	2. Loss of precious ecology	2. Careful planning	**X**			
Overall Rating			**15**	**37**		
Impact related to activities noted at A to G are of low order, low severity and minor significance						

Chapter 7 Environmental Management Plan

7.1 Introduction

For successful environmental practices an essential requirement of the BEPA 2012 is to develop an environmental management plan (EMP) to guide through the procedures to the management and employees of the organization for continual improvement. According, this chapter lays out the Environmental Management Plan (EMP) including a monitoring programme for the activities pertaining to the Design, Construction and the Operation stages of Offshore LNG Terminal Project in Sonmiani Bay, Balochistan by Bahria Foundation.

The Environmental Management Plan is meant to provide an overall approach for managing and monitoring the environmental and social issues and to describe the institutional framework for successful implementation of the EMP.

The rationale of this EMP is to propose environmental protection commitments to protect the environmental values that may be affected by the development of the project and to assist the regulatory bodies to decide the appropriate approval conditions for the project.

The previous sections identified the environmental and social aspects & impacts of different activities during the construction and operation stages of the Offshore LNG Terminal Project and mitigation measures to reduce or compensate for the likely impacts as far as possible.

7.2 Objectives and Scope of EMP

The EMP provides a delivery mechanism to address adverse impacts, to enhance project benefits and to introduce standards of good practice to be adopted for all project works. The primary objectives of the EMP which it is required to achieve are:

- Outlining measures to be taken during the implementation and operation of the Offshore LNG Terminal Project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels.
- Develop a monitoring mechanism & identify parameters that can confirm the implementation of the mitigation measures.
- Taking actions such as defining roles and responsibilities of the project proponent for implementation of EMP and identification of areas where these roles and responsibilities can be shared with other stakeholders.
- Defining the requirements for documentation, training & management and implementation of mitigation measures and giving communication plan with the concerned regulatory agencies.
- Taking actions required for assessing the effectiveness of mitigation measures employing the monitoring mechanism and identifying related parameters to confirm the effective implementation of these measures.
- The scope of the EMP includes the following functional areas in general:
- Planning, design and development: The planning, design and development of the Offshore LNG Terminal and associated infrastructure.

- **Management systems:** Those systems employed in the management of the activities at the terminal. It will include financial systems; engagement and supervision of contractors; purchasing policies, etc.
- **Knowledge systems:** Those processes which build knowledge and capacity on environmental issues, principles and sustainable behaviors. It will include training; communications; campaigns; links with operational departments, etc.
- **Energy management:** The energy related aspects of the planning, design, construction, operation and maintenance of the Offshore LNG Terminal and laying of cryogenic pipeline.
- **Water management:** Aspects of supply, usage and disposal of water pertinent to the planning, design, construction, operation and maintenance of the LNG Terminal and laying of cryogenic pipeline.
- **Materials management:** Those services and activities which support the avoidance, resource recovery (e.g. reuse and recycling) and environmentally responsible disposal of solid and liquid waste materials.
- **Pollution prevention:** Those aspects of planning and management which support minimization of air and water pollution and contamination of land resulting from routine activities.
- **Biodiversity and open space:** Those aspects of management and maintenance which support conservation and enhancement of biodiversity and environmentally sustainable use of open space in the microenvironment.

The proposed scope of the Project subject to the EMP includes all the main components of the Project

- Marine facilities and vessel approach lane out to shipping channel;
- LNG receiving, storage and re-gasification unit facilities;
- Pipeline lateral and directly associated facilities (natural gas and natural gas liquid laterals);
- Supporting facilities and infrastructure

7.3 EMP Process

The EMP consists of the following areas and defines the methods and procedures for its implementation.

- Organizational structure; roles and responsibilities of project personnel;
- Specific requirements of implementation of EMP;
- Mitigation or impact management matrix;
- Monitoring plan with emphasis on specific parameters to monitor.

In the preparation of this plan several aspects concerning the siting, designing, construction and operation of the Offshore LNG terminal & cryogenic pipeline have been taken into consideration. Additionally management related issues have been provided to guide through the procedures.

The Bahria Foundation will establish Environment, Health & Safety (HSE) department which will handle all environment related concerns and issues. The HSE manager will be the Head of HSE department and will be responsible for reporting to Chief Executive Officer. To support HSE management system, an HSE officer will be appointed to coordinate with the contractor during construction process and also monitor the activities at all the sensitive areas during the construction and operations stages of project.

7.4 Project Components

The proposed Offshore LNG Terminal is component of **i) Offshore Facilities** comprising FSRU, jetty, & submarine pipeline, and **ii) Onshore Facilities** comprising metering station and connection pipeline. The LNG from LNG carriers will be received by the FSRU offloading system, stored in tanks, pumped out and regasified into natural gas, delivered to metering station through high-pressure loading arms fixed on the jetty and submarine pipeline. After metering at the Metering station, natural gas will be injected to connection pipeline

The ESIA has recommended mitigation measures to minimize the adverse impacts. These measures include the use of alternative options for siting, management and physical control, besides compensation for acquisition of land, and are based on the understanding of sensitivity and behavior of environmental receptors in the project area, the legislative controls that apply to the project and a review of good management practices while operating in sensitive environments

7.5 Bahria Foundation's Commitment to Environment, Health & Safety

Bahria Foundation is committed to manage and operate its resources in a sustainable manner to protect the environment and health and safety of people besides complying all the Environment Health and Safety (HSE) laws, regulations, guidelines and internal HSE standards, i.e., IFC 2007 and OHSAS 18001.

The execution of the project will be governed by the following expectations and operating philosophy of the HSE Management System. Appropriate procedures, plans and programs will be implemented during the course of the project to ensure that these management expectations are met. The twelve key elements and expectations are:

Policy & Leadership - The leadership will establish policy, provide perspective, set expectations and provide the resources for responsible HSE management.

Risk Management - Appropriate risk management techniques will be employed at all project phases to protect employees, contractors, communities and the environment, and to preserve assets, investor value and the reputation of the Project Operators.

Facilities Design & Construction - Sound standards, procedures and management systems will be utilized for facility design, construction, commissioning and start-up activities to ensure safety and minimize risk to health and the environment.

Information & Documentation - Information on the design, configuration and capabilities of processes and facilities and infrastructure, potential environment, health, and safety hazards and all legal and regulatory requirements will be documented and maintained, and made readily accessible for review to acceptably manage the risks associated with the development.

Personnel & Competence - The success of development operations depends on competent people. Effective selection, placement, ongoing assessment and competence of employees and contractors executing the development will be ensured.

Operations & Maintenance - The development will deliver facilities which have effective operating and maintenance procedures and practices in place with reliable safety and control facilities, and competent personnel who consistently execute these procedures and practices.

Health & Safety - The development activities will be conducted in accordance with health and safety standards and practices that are adopted in the international LNG industry. Key Performance Indicators (KPIs) will be established to monitor performance and where possible to benchmark against the rest of the industry.

Environment Protection - The project will operate in accordance with sound environmental practices and will respect the customary rights, cultural heritage, social values and resource utilization patterns of the local area.

Incident Reporting & Investigation - An incident reporting system will be established to ensure management is notified and that incidents are properly investigated with the goal of preventing recurrence.

Emergency Response - Emergency Response plans will be developed that reflect the reasonably foreseeable scenarios associated with development activities.

Community Relations & Outreach - Open and honest communications will be established with the communities impacted by the development to build trust and confidence in the integrity of the Project Owners and their operations.

Continuous Improvement - A process will be established to measure the performance relative to the expectations established in the management system and to ensure that any lessons are learned and communicated to sustain or improve performance as appropriate.

7.6 Proposed Project Structure

The project will be structured as an unbundled project structure. Under this project structure, LNG will be imported from another country like Qatar by a GOP-designated buyer ("LNG Buyer"), under the LNG SPA (Sale and Purchase Agreement) which could be on a delivered ex-ship basis (CIF) by or collected on a FOB basis from the LNG Seller. The LNG Buyer will enter into an agreement with the REGAS SPV (Special Purpose Vehicle) for the provision of LNG receiving, storage and regasification services at the terminal under tolling-type agreement ("LNG Terminalling Services").

For a FOB purchase, the LNG Buyer will, in addition, enter into an agreement with a shipping company to transport the LNG to the receiving terminal. Within the unbundled project structure, where the LNG is procured by an LNG Buyer, the contract shall be for a minimum period of 20 years, and the price for RLNG will be determined by OGRA based on following criteria:

- LNG purchase prices

- The direct and indirect cost of transportation, storage and regasification incurred by the LNG terminal operator/owner
- Reasonable return on the investment made

The LNG Terminal capacity shall be provided to LNG Buyer under a take or-pay Terminal Usage Agreement with a tolling-type remuneration scheme. Under such an agreement, the LNG Buyer will enter into Tolling Service Agreement (TUA) with the REGAS SPV. The Project Company under the TUA-Agreement will receive, store, regasify and deliver the LNG to Off takers and charge a "tolling fee" to LNG Buyer for performing such services. The tariff to be charged by the REGAS SPV would consist of the regasification charge only. Regas SPV takes no title to the LNG or RLNG.

Using a tolling versus buy/sell-contract structure avoids also any exposure of Regas SPV to market risk. For procurement of LNG, LNG Buyer principally enters into a LNG SPA with an international LNG Seller. The RLNG is then sold to Off-takers under RLNG SPAs, potentially two Sui companies which sell RLNG onwards to IPPs / CNG sector etc. under Gas Sales Agreements (GSA). The supply arrangements could also be entered with IPPs located near the landfall point on Navy land

Initially, a chartered FSRU will be utilized under a Time Charter Agreement (TCA) with a FRSU Provider for the purpose of expediting first RLNG delivery within 18 - 24 months from the Project commencement date.

Allocation of RLNG to the Off-takers will be under Government (MPNR) auspices. This is of particular concern when shortfalls occur due to limited capacity of the FRSU. The MPNR also backs LNG Buyer to procure LNG. As there is more than one Off-taker and most probably more than one supplier (LNG Seller) quality-issues will also play a role in terms of comingling of RLNG.

The interface between Regas SPV and the Off-takers, which is of noncommercial nature only, will be governed by Off-take-and-Custody Transfer Agreements. These Agreements contain acknowledgements of both Regas SPV and the Off-takers of their respective contractual obligations which they entered into with LNG Buyer (RLNG Seller) to ensure that both Regas SPV and Off-takers adhere to their respective custody transfer obligations.

The proposed project structure is shown below.

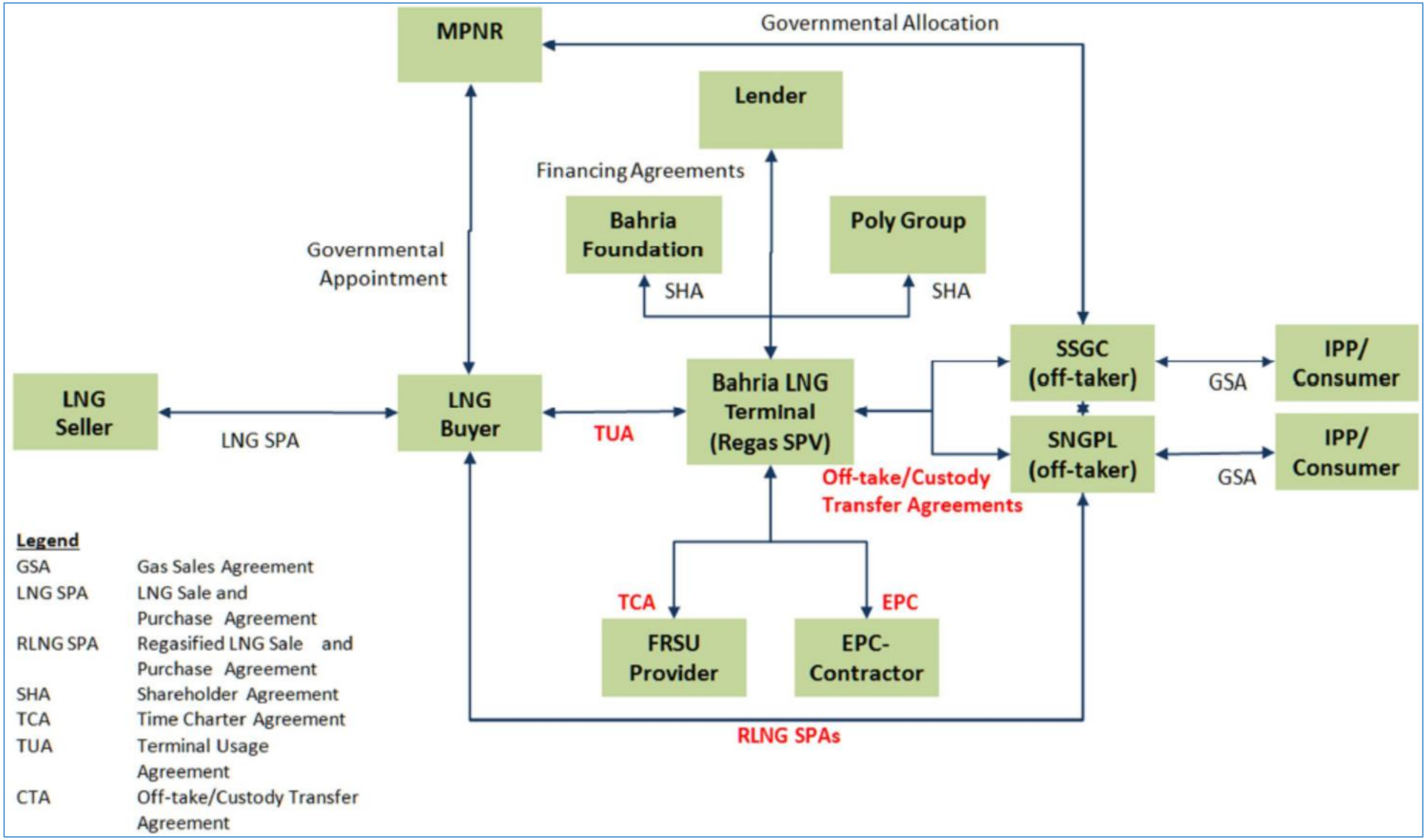


Figure 7.1: Proposed Project Structure

7.7 Management Approach

The environmental management will require specific approach in order to handle the issues effectively. HSE Manager will assign the roles and responsibilities to be performed during the construction and operations stages of the Offshore LNG terminal. It is expected that a certain degree of redundancy is inevitable across all management levels, but should be in the order to ensure that compliance with the environmental management plan can be cross-checked.

Compliance with EMP will be the responsibility of Bahria Foundation's Management at each stage of project. They will ensure that all executive activities during construction stage do not create adverse environmental effects. Contractor and sub-contractor will work in environment friendly manner under the supervision of HSE department. All the regulatory agencies including EPA, stakeholders (both grass-root and secondary) and NGOs/CBOs will be taken on board throughout the project to get advice for environmental management and they will be kept informed of the environmental conditions of the area periodically by project management and their contractors & sub-contractors.

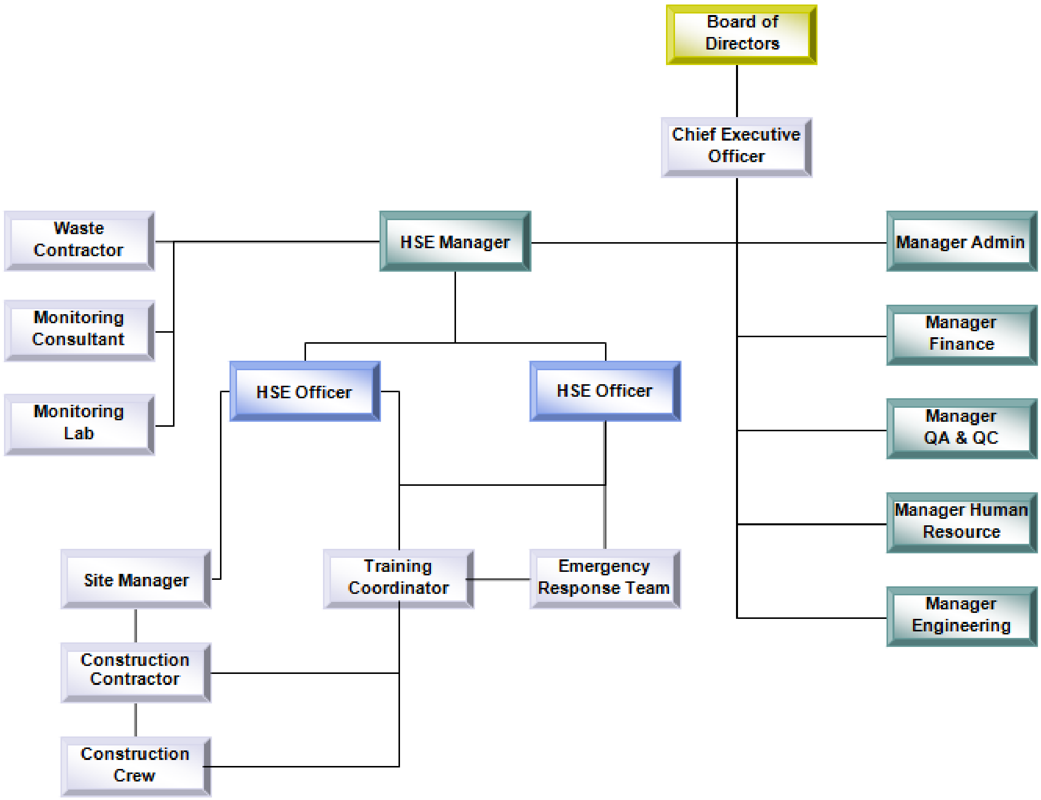


Figure 7.2: Suggested Organogram for Environmental Management

Some of the approaches to be followed during the environmental management practices are given below:

- Complying with the relevant legislation and regulations;
- Regularly reviewing of the impacts on the environment;
- Developing appropriate indicators to monitor core impacts;
- Setting appropriate annual objective, targets and publicly reporting on progress;
- Monitoring supplier's environmental management arrangements;

- Using sustainable materials (e.g. recycled paper and water based inks) for office supplies and environmentally safe raw materials with recycling options where appropriate;
- Communicating openly with internal and external stakeholder on environmental issues.

7.8 Operation and Maintenance

The LNG terminal includes offshore part and onshore part. The offshore includes FSRU and Jetty; the onshore includes metering station and Back-up Control Centre (BCC). The FSRU, Jetty, metering station own individual control system. Different control systems keep communication with each other's. A communication block diagram for the LNG terminal is shown in Figure 7.3.

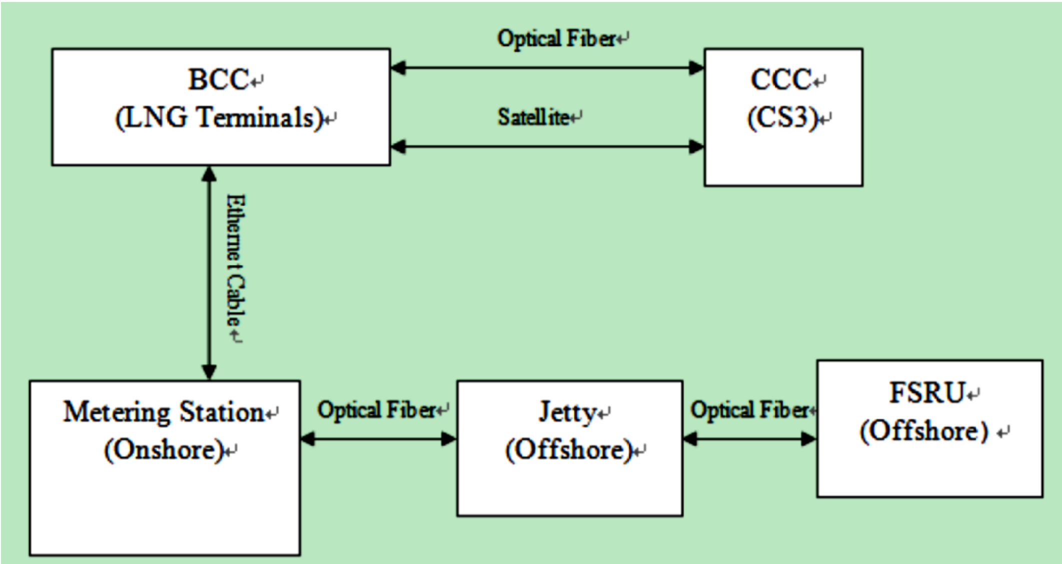


Figure: 8.3 Communication Block Diagram

The FSRU communicates with jetty by fiber optic cable, the jetty communicates with metering station onshore by onshore optical fiber. The metering station communicates with BCC by Ethernet cable.

Pipeline system shall be operated from Central Control Centre (CCC) by the pipeline operators via the pipeline SCADA system. Information between CCC and every station shall be exchanged via fiber optic cable network or satellite communication.

The back-up control center shall take over control automatically in case the main control center fails or on manual request. Through close coordination between both control centers and with the appropriate command authority change over functions, it shall be possible to control the pipeline either from the CCC or from the BCC.

The pipeline also shall have a dedicated fiber optic network for digital communication (voice/data) allowing the exchange of information among compressor stations, block valves, LNG terminals.

The following section summarizes the Operations and Maintenance (O&M) Philosophy for metering station. The part of the metering station includes the following:

- Operation of the metering station and pig receiver in BVS04

- Pipeline safety systems (safety integrity level, redundancy concept, emergency shut-down, depressurizing, corrosion.
- Telecommunication system
- Maintenance philosophy (maintenance centers, warehousing, integrity management maintenance scheduling)
- Firefighting and safety strategy and equipment.

7.9 Overall Technical Management of Operation, Control & Maintenance

- The Executive Department of Company or designated O&M Contractor is in charge of operation, control, maintenance supervision, reporting and decision making.
- The operation and most of the control activities of the metering station shall be executed from the backup Control Centre (BCC) located at the LNG terminal.
- The entire facilities in metering station including Fuel gas System Package, Metering Package used for custody transfer measurement of traded of gas from FSRU, pig launcher and some instrumentation. There also is a set of pig receiver will be built in the BVS04 to receive the pig from metering station.
- The station control system in metering station will finish the control and monitor of metering station. The control and monitor of the pig receiver and relative instruments will rely on the control system in BVS04.
- The control system of metering station will be connected with the SCADA system.
- If maintenance (incl. logistics) will be conducted by operators' own staff or by a contracted Third Party Agency or a combination of both remains open at this stage of the project.

7.10 Operations and Control

It is essential to maintain safe and efficient operations while ensuring a gas mass flow according to pre-established gas supply plans and schedules for the usage of gas of metering station, the Fuel gas System Package will ensuring the requirement of gas pressure for usage of living. The hierarchical structure of system in metering station will meet the pipeline requirements.

7.11 Maintenance

Company's Computerized Maintenance Management System: The maintenance management of metering station will be accepted in the Computerized Maintenance Management System (CMMS).

Third Party Maintenance: Services based on Vendors qualified support for assets management base on long-term service agreements with Company. More explicitly, third party maintenance is considered for the following facilities.

- Fuel gas System Package
- All ESD related systems (e.g. F+G detection, fire suppression, UPS, etc.)
- Metering Package
- pig launcher and receiver

Vital Equipment and systems like turbo-compressors shall be under continuous remote monitoring of performance and machine conditions through the Vendors monitoring system. Professional intervention of Vendors skilled teams is based on just-in-time actions.

Company's Internal Maintenance: Organized on shifts, the Company maintenance crews are trained during the Vendors special training services provided in Vendors factories and in field for the purpose of providing skilled intervention on irregular but manageable maintenance needs (not requiring Vendors supports e.g. changing lube-oil, machine cleaning, purging systems, etc.). During the Vendors interventions on the machines (regular inspections, regular maintenance works listed in the Vendors procedures, accidental maintenance due to failure of some critical machine component) the Company maintenance crew is a qualified workforce support for the Vendors teams.

7.12 Roles & Responsibilities

Environmental management will be the integral part of corporate policy of Bahria Foundation. Therefore, committing to reduce the environmental impacts will reflect the management approach and belief that good governance and performance in this area is synonymous with running a well-managed efficient business.

Overall responsibility for environmental performance rests with the Chief Executive Officer of the company while the daily management will be performed under the direction of Manager HSE. HSE officer and contractor will execute environmental management under the supervision of Manager HSE during construction and operations. A brief make-up of the roles and responsibilities of the system is given below:

7.12.1 Chief Executive Officer

The Chief Executive Officer (CEO) will regulate environmental management plan. Some of the key roles and responsibilities of CEO are given below.

- To consider and react to issues and solutions proposed by the HSE Department;
- To cooperate and consult the relevant environmental agency for better environmental performance;
- To approve any change in decision making and authorities in consultation with Manager HSE, if considered appropriate.

7.12.2 HSE Manager

The success of EMP depends on proper and effective management provided by HSE manager. Following are some of the roles and responsibilities assigned to Manager HSE.

- To appoint an Independent Monitoring Consultant (IMC) who will be responsible to monitor the compliance of the EMP by project team and contractor(s).
- To ensure that the conditions laid down in the Approval issued by EPA are properly communicated among project staff and contractors/sub-contractors;
- To ensure that the points of views of staff, contractors and HSE officers are considered and placed likewise in the EMP;
- To identify issues and propose solutions for inclusion in the EMP review process;
- To improve coordination and exchange of information between top management, employees, and contractors;

- To contribute towards the action to deliver the management plan and ensure its continual development;
- To review EMP every year under the supervision of higher hierarchy, taking steps to change EMP according to the suggested solutions;
- To monitor the progress of development and implementation of the EMP.

7.12.3 HSE Officer(s)

The role of HSE officer(s) will be authorized by HSE Manager. The responsibilities of HSE officer(s) will include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan;
- To maintain balanced approach to the solution of concerned issues in accordance with the legislative requirements;
- To provide professional guidance on questions related to the environmental management and issues raised by the contractors/relevant personnel;
- To improve the EMP process through development of procedure for implementation.

7.12.4 Contractor

On behalf of chief construction contractor, the main responsibilities for all matters pertaining to environment will be looked after by field Construction Contractor and he will be responsible to report directly to HSE Manager.

Major roles to be performed by construction contractor are given below:

- To carry out construction activities in environmentally sound manner;
- To coordinate with the HSE officer to resolve issues arise during construction phase;
- To manage the construction crew and reduce the environmental impacts;
- To appoint a dedicated environment officers that will understand and tackle environmental issues more easily.
- To discuss weekly project report with the HSE Manager & issues concerned with environmental management.

7.12.5 Site (Operational) Manager

Following are the main duties and responsibilities which a Site (Operations) Manager has to perform:

- To establish, implement, and maintain a formal written HSE program that encompasses applicable area of loss prevention and is consistent with cooperative policy;
- To establish controls to assure uniform department performance to the HSE management system. The establishment of controls should include corrective action and follow-up. Develop, by action & example, a positive HSE culture and a clear understanding of specific responsibilities for direct reports;
- To personally investigate facilities, serious Lost Workday cases, environmental incidents or major property losses;
- To review monthly HSE activity report and performance statistics;

- To review Lost Workday Injury/Illness Investigation Reports;
- To review loss-control reports submitted by outside agencies;
- To conduct HSE audits on a regular basis in order to appraise program effectiveness and to correct and reinforce behavior;
- To review program effectiveness annually and make adjustments where necessary;
- To evaluate the functional performance of HSE staff and provide guidance/training where necessary;
- To personally review, sign and approve corrective action planned for Lost Workday cases.

The site manager is accountable and responsible for HSE performance at site.

7.12.6 Personnel Safety Supervisor

- Every supervisor has at least three responsibilities with which he can provide Environmental Safety assistance. These responsibilities are: i) employee training, ii) provision of personal protective equipment (PPE) and iii) accident and injury reporting.
- Employee Training: Supervisors are responsible for ensuring that each new employee, whether temporary or permanent, receives appropriate safety training at the start of service. Supervisors are responsible for ensuring that their employees receive the necessary safety training based on the type of work that their employee performs.
- Personal Protective Equipment: OSHA requires each supervisor to assess the hazards of the work area to determine the type of protective equipment needed and to provide training on its use. This review must be documented. Completing the Hazard Assessment Form meets this documentation requirement. The Personal Protective Equipment Plan includes detailed information to assist in selecting the proper protective equipment.
- Accident and Injury Reporting: It is the supervisor's responsibility to report all accidents or injuries that occur to their employees while at work. Each supervisor must ensure that any employee who is injured while at work completes and signs the Employee's Report of Work-Related Injury Form.
- Additionally the supervisor must receive the employee form, Accident Witness Statement Form (if the accident was witnessed by another person), and fill out a corresponding Supervisor's Report of Work-Related Injury Form.

7.13 Environmental Awareness &Training

All employees will be trained appropriately to work on EMP effectively. Employees training will provide workers with information on minimizing waste generation and other environmental requirements. The HSE Manager will determine the training requirements in consultation with contractor among the staff of construction contractor and supervision consultant.

Trainings identified in EMP are given below:

- Site induction course
- Training for emergency response and preparedness
- Training for familiarization with site environmental controls
- Specific environmental training for relevant employees like daily checks to maintain controls, cleaning up pills, waste minimization/handling of hazardous waste etc.

7.14 Communications

For effective monitoring, management and documentation of the environmental performance during the operation, the Health, Safety and Environmental (HSE) matters will be discussed during weekly meetings held on site.

Environmental concerns raised during the meetings will be mitigated after discussions between the HSE officer and the contractor. Any issues that require attention of higher management of Bahria Foundation will be communicated to them for action. The HSE department and the contractor will also prepare a weekly environmental report. Duplicates of the report will be provided to the higher hierarchy of Bahria Foundation and of the contractor. Communication plays a vital role in good management practices. Following are the types of communication which will be effective in communication and documentation.

- *Kick-off Meeting:* The aim of organizing the kick-off meeting is to define the environmental responsibilities, awareness to EMP to the managing staff and to streamline the work plan according to the EMP. This meeting will be arranged prior to commencement of activities.
- *Quarterly Meetings:* Initially quarterly meetings will be held after kick-off meeting however if situation demands for monthly meetings, it will be rearranged accordingly. Aim of this meeting is to review the progress of activities performed, explore ideas and problems, and discuss about the progress in acquisition and analysis of information. Deadlines are re-evaluated in it and if necessary, the project program is revised in these meetings.
- HSE Manager will arrange departmental meetings regularly on weekly basis throughout the project. The purpose of this meeting is to discuss day-to-day problems arising during the work, steps to be taken to resolve problems, overview of progress of HSE department and contractor with respect to the EMP, overview on monitoring plan and to discuss progress with respect to changes made in operations/documentation/EMP.
  Such changes are elaborated below to make them part of EMP.

a) **Change in Operations:** Any change in the operation of project if required, will be made in relevance to the EMP and all the impacts associated with changed process will be either similar to the existing impacts and if different, will be assessed and included in the mitigation management plan. This has, on the basis of nature of process change, been distributed into three categories.

   First-Order Change is one that leads to a significant removal of any operation from the project described in the chapter on description of project of this report and consequently requires a reassessment of the environmental impacts associated with the changes. In such an instance, reassessed environmental impacts of the proposed change will be sent to EPA for approval.

   Second-Order Change is one that entails project activities not significantly different from those described in the EIA report, and which may result in project impacts whose overall magnitude would be similar to the assessment made in this report. In case of such changes, the environmental impacts of the activity will be reassessed. Additional mitigation measures if required will be identified and documented for being reported to EPA for their record.

Third-Order Change is one that is of little consequence to the EIA findings. This type of change does not result in impact levels exceeding those already assessed in the EIA report; rather these may be made onsite to minimize the impact of an activity. The only action required in this regard will be to record the details of process change in the record register.

b) **Change in Record Register:** A record register will be maintained at project site at the start of construction activity. All the changes to be made will be recorded in this register. This will assist in the step-by-step environmental monitoring and decision-making. Record register will be the responsibility of HSE Manager, and will be used internally.

c) **Change in EMP:** Changes in project design may necessitate changes in the EMP. In this case, the following actions will be taken:

- A meeting will be held between authorized representative(s) of Bahria Foundation and construction contractor, to discuss and agree upon the proposed change to the EMP.
- Based on the discussion during the meeting, a report will be produced collectively, which will include the additional EMP clauses and the reasons for their addition.
- Additional EMP clauses will be added to the original EMP as a second volume which will be distributed among Bahria Foundation and construction contractor. All relevant project personnel will be informed of the addition.
- All the EHS matters will be discussed in detail and if any problem remains unresolved, another meeting will be called to discuss solutions within 2 days' time. Weekly meeting will be attended by Manager EHS, EHS officer and contractor's representative. Such meetings will help in effective monitoring, management and documentation of the environmental performance during construction and operations. Any issues that require attention of higher authorities will be communicated to CEO for necessary action and resolution.
- *Peer Review:* The aim of this review is to predict and modify the conclusions and interpretation of assessment phases in the light of other professional opinions that mainly not involved in the proposed project, but just for the provision of a critical appraisal of the style and expression of documentation produced.
- *Minutes of Meetings:* In the end of quarterly meetings, minutes will be issued which comprises of the discussion made in the meeting, issues discussed and decisions taken with the time frame for their implementation. Main points of minutes for general employees may be incorporated in the record register. These meeting minutes will also be provided to the higher authorities of Bahria Foundation and the contractor for their own record.
- *Monthly Reporting:* Bahria Foundation shall prepare a brief monthly report describing the progress of operations, any changes from the operation for which approval was obtained, the degree to which the recommendations of the EIA were adhered, any damages to the environment along with mitigation measures provided and monitoring information of scientific or environmental interest, if available. The report shall be submitted to the concerned EPA for their review. Comment received from EPA will be discussed in the weekly meetings. The report can make use of the first weekly HSE meeting as well.
- In order to organize and manage occupational hazards and environmental catastrophes such as flooding, cyclonic events, LNG spills/leaks etc., Bahria Foundation management

will develop a contingency plan to deal with emergency situations that may arise during construction and operations as part of EMP. If required, non-conformities arising and remedies taken will be communicated & shared with the regulatory agencies.

- *Management, Co-ordination and Information:* Although Bahria Foundation is keen in environmental management practices and already have plans to adopt preventive measures with environmental considerations, it can be said that any weakness in organizational structure, management, communication, lack of information and coordination may lead to environmental risk. The following are some of the guidelines to handle the risks:
- Management authorities must have access to high quality, up-to-date and relevant data for decision-making.
- Staff associated with implementation of EMP and HSE department must have access to relevant data with regard to provisions of EMP.
- All associated groups, management hierarchy and associated staff must be involved in the EMP process.
- Liaison & co-ordination between contractor & Bahria Foundation management and staff.
- Ensure that HAZOP study has been conducted
- Ensure that all the monitoring details are received by EPA for their review and feedback

Table 7.1: Specific Responsibilities for Management & Coordination

Strategic Objective	*Proposed Implementation Process*	*Suggested In-charge*	*Suggested Priority*
To ensure high level of necessary information exchange.	Make review document available to interested parties.	HSE Manager	High
	Disseminate relevant information held by HSE department among the staff.	HSE Officer	High
	Produce newsletter for publication annually for general awareness in all staff.	HSE Manager	On-going
	Meetings using input from previous reports, advices receive from Stakeholders	HSE Manager	High
To ensure management plan is implemented, monitored and reviewed.	Adopt management structure as proposed.	HSE Manager	High
	Appoint full-time officer(s) with responsibility for long term management and accurate monitoring.	HSE Manager	High
	Examine annual progress report and review with respect to the monitoring progress.	CEO and HSE Manager	On-going
	Conduct self-monitoring regularly.	HSE Manager	High

Table 7.1: Specific Responsibilities for Management & Coordination

Strategic Objective	*Proposed Implementation Process*	*Suggested In-charge*	*Suggested Priority*
To improve decision-making process for management.	Develop an appropriate form of management process, specific to the environmental issues	HSE Officer	High
	Develop a fully comprehensive database of impact and mitigation understandable for the management.	HSE Manager/ HSE officer	High
To ensure co-ordination between contractor and Bahria Foundation	Obtain support for a Memorandum-of-Understanding between management and Contractor for the implementation of EPA Requirements / EMP	HSE Manager	High
	Continue regular liaison between management of Bahria Foundation & contractor.	HSE Officer	On-going
To develop strategic policies for better environmental management.	Develop strong coordination between HSE department and top management.	HSE Manager	High

7.15 Implementation Stages of EMP

Success of EMP will rest with its implementation. For that matter it will be necessary to establish an HSE department and organize a team with direct responsibility for putting the plan into practice. This setup needs to be provided with adequate resources and an office base to execute the EMP in three stages, which include planning and designing; construction and operation.

In the preparation of this plan several aspects concerning the siting, designing, construction and operation of LNG Terminal and laying of cryogenic pipeline have been taken into consideration. Additionally management related issues have been provided to guide through the procedures.

7.15.1 Planning and Design of Offshore Floating LNG Terminal

Implementation of EMP needs to take a start at the inception stage to handle the environmental issues much before they arise. The following are the three main components to consider in an EMP prior to start of construction:

a) **Design Considerations of LNG Terminal:** The EIA has duly considered the microenvironment of project in terms of location, geology, seismicity, magnitude; infrastructure facilities available and their deficiencies; along with the mechanism for doing so. If any design parameter changes at the time of approval, Bahria Foundation will assess the environmental impacts that may arise from such changes. If the impacts are found to be different and in excess of those mentioned in the EIA report, Bahria Foundation will develop effective mitigation measures to address the changes to minimize the residual impacts and seek approval for the required change from EPA.

b) **Approvals:** Bahria Foundation and contractor will, besides obtaining NOC from EPA obtain relevant clearance and necessary approval from the government and other agencies prior to commencing construction and operation. Furthermore, issuance of NOC will require the Bahria Foundation to plan for undertaking continuous monitoring, including self-monitoring and reporting.

The approval from EPA shall not absolve the proponent of the obligation to obtain any other approval or consent that may be required under any law in force.

c) **Contractual Provisions:** The requirements of environmental impact assessment with respect to mitigation measures shall be incorporated in the construction and operations plans and procedures. This will make it mandatory for the contractor to follow procedures and comply with environmental regulations.

7.15.2 Construction and Operation Phase

In order to implement EMP successfully during the construction and operation phase, it is necessary to adopt mitigation measures, monitoring plan and emergency procedures in letter and spirit. Training will be required at each step and phase. Changes in management processes will be documented and made available to the employees.

Mitigation Plan: The environmental impacts and remedial measures, as well as responsible persons designated to ensure adoption of the mitigation measures are given in the Mitigation Matrix Table-7.2, which outlines the mitigation plan. The matrix provides the responsibilities for construction contractor & proponent for adoption of mitigation measures throughout the project.

Table-8.2: Mitigation Matrix

S #	*Affected areas*	*Possible mitigation measures*	*Responsibility*	*Monitoring Frequency*
1	Air Quality	Smoking should be prohibited at all sites	HSE Officer	Continuous Monitoring
2		Water sprinkler should be employed along temporary and dirt roads during construction	Contractor	Continuous up to Construction Completion
3		Proper servicing of vehicles, provision of exhaust mufflers	Contractor	Weekly Monitoring
4		All equipment should be properly tuned	HSE Officer and Contractor	Monthly Monitoring
5		Fire-fighting equipment should be available in all activity areas at all times	HSE Manager	Weekly Monitoring
6		Staff should be provided with personal protective equipment	HSE Manager	Continuous Monitoring

Table-8.2: Mitigation Matrix

S #	Affected areas	Possible mitigation measures	Responsibility	Monitoring Frequency
7	Noise	Safety valves should be provided with silencers	Managers (Engg. & HSE)	Continuous Monitoring
8		Noisy machinery and equipment should be housed in separate enclosures, as far as possible	Managers (Engg. & HSE)	Continuous Monitoring
9		Operators working in noisy environment should be provided with personal protective equipments viz. air mufflers	Manager HSE	Continuous Monitoring
10		Working hours should be adjusted so as not to exceed 8 hours in a single shift	HSE Officer	When it is required
11		Earthmoving equipment should be kept in good condition by proper maintenance and servicing	HSE Officer	Weekly Monitoring
12		Use of horns should be prohibited within the activity area	HSE Officer and Contractor	Continuous Monitoring
13	Soil	Construction activities should not be extended beyond designated buffer zones	HSE Officer and Contractor	Continuous Monitoring
14		Septic tanks and soak pits should be designed and be in place at campsites	Contractor in consultation with HSE Officer	Weekly Monitoring
15		Combustible and explosive material should not be stored in storage area	HSE Manager	Continuous Monitoring
16		Fuel, oil and other hazardous materials if stored on land area, should be provided with impervious lining	HSE Manager	When required
17		Fuel tanks and hazardous material should be marked appropriately	HSE Officer	Continuous Monitoring
18		Fuel storage areas should be checked regularly to identify leakage	HSE Officer	Continuous Monitoring
19		Safety equipments and utensils should be available at site at all times	HSE Manager	Weekly Monitoring
20		Vehicle Maintenance Yard should be developed at a designated location during construction work	HSE Officer and Contractor	Continuous up to Construction Completion
21		Where possible, segregation of solid waste during handling should be followed to manage it effectively	HSE Manager and Officer	Weekly Monitoring
21		Contractor should follow emergency response plan	Contractor	Continuous Monitoring

Table-8.2: Mitigation Matrix

S #	Affected areas	Possible mitigation measures	Responsibility	Monitoring Frequency
22		Fill material from local origin should be considered for use during construction	HSE Manager and Contractor	Continuous Monitoring
23		Machinery movement should be restricted to the construction corridor	Contractor	Continuous Monitoring
24		Restoration of sites after completion of project should be mandatory	Contractor	At completion stage
25		Surplus soil should be removed and disposed of in a borrow area	HSE Manager and Contractor	Continuous up to Construction Completion
26	Water Quality	Sumps for wastewater should be located downstream and above high water mark	Contractor and HSE Officer	Continuous upto Construction Completion
27		Temporary latrines should be located at a suitable distance from water bodies	Contractor	At times of placement of latrines
28		Sewage should be treated appropriately at each unit	HSE Manager	Monthly Monitoring
29		Vehicle cleaning should be prohibited near water bodies	HSE Manager	Continuous Monitoring
30		Wastewater generated during vehicle cleaning should pass through a sand bed to avoid contamination of groundwater	HSE Officer	Weekly Monitoring
31		Construction machinery should be kept off the water resources to the extent possible	HSE Officer	Continuous Monitoring
32		Weekly/monthly water/wastewater/ground water quality monitoring should be conducted throughout construction / operation	HSE Officer	Weekly (Construction) Monthly (Operation)
33		Treated wastewater of acceptable quality, may be reused for processing construction material	HSE Officer and Contractor	Monitoring if required
34		Soil erosion and sediment control should be monitored during construction stage	HSE Officer and Contractor	Continuous Monitoring
38	Solid Waste	Solid waste should be collected and stored in environmental friendly manner	HSE Manager	Weekly Monitoring
39		Certified solid waste contractor should be hired for disposal of waste	HSE Manager	Weekly, if required
40		Solid waste should be kept in closed container	HSE Officer	Weekly Monitoring

Table-8.2: Mitigation Matrix

S #	Affected areas	Possible mitigation measures	Responsibility	Monitoring Frequency
41	Ecology	Bahria Foundation Management shall allocate and build a biodiversity park in the green belt designated within the project area in consultation with Forest Department	CEO/HSE Manager	Monitoring, if required
42		Preserve the natural vegetation and utilize in building the biodiversity park and green belt	HSE Officer	Monitoring, if it is required
43		Utilize treated wastewater for green belt development	HSE Officer	Weekly Monitoring
44		Grow plants of importance to local ecology in biodiversity park in green belt	HSE Officer	Monitoring, if required
45	Archaeological & Social Environment / Traffic	If any historical feature or artefact is identified during earthwork at site the respective authorities will be informed immediately	Managers (Admin. & HSE)	Monitoring, if required
46		Easy and feasible access will be provided from main road for traffic management	Manager Admin.	Monthly Monitoring
47		Traffic (onshore/offshore) management policies will be developed	Manager Admin.	Monitoring, if required
48 49		Jobs will be created for the local people resident in the microenvironment of project area	Managers (Admin. & HR)	Monitor, if it is required

Emergency Response Plan: Emergency may be defined as a sudden event causing or has the potential to cause serious human injury and/or environmental degradation of large magnitude. Prevention and remaining in preparedness are the best options in case of emergency.

A Project-specific Emergency Response Plan will be developed which primarily relates to the different construction and operation activities of the Project. It supports the EMP and addresses actions and required responses of LNG terminal operators/personnel, employees & contractors.

Emergency response management will be provided by a small team of senior managers (the control committee) who in turn will direct all response activities through the Emergency Response Unit, plant security, communications, public relations, safety and environmental affairs and material procurement departments. Each of these departments will have specific responsibilities to perform in the event of an emergency.

Possible Risk

a) Internal Risks arising from operational conditions or human error that could result in personal accidents, spills or fires, such as:

- Uncontrolled gas leak (RLNG and liquefied natural gas) into the atmosphere.
- Fire/explosions.
- Hydrocarbon (gasoline, diesel).

- Chemical product spills, which may or may not be present at site.
- Occupational accidents (serious or fatal), due to product contamination, failure to comply with operating rules and procedures, negligence of the personnel, falls, internal traffic accidents, burns, acts of God, bad use of equipment and personal protection items.
- Environmental Contamination (due to gas leaks into the environment, product spills on land and in the sea).

b) Natural Risks that may affect the facilities and their resulting damage to property and the personnel.

- Strong earthquake
- Tsunamis (flood)
- Typhoon/Cyclone
- Lightening

c) External risks arising from delinquent actions, terrorism or vandalism.

d) Personnel Transportation Risks: All personnel working at site/terminal must be instructed that in the event of automobile/barges/boat accidents, using own or third-party transportation contracted by the company, they must immediately notify the Health, Safety and Environment (HSE) Department so that it will provide the necessary assistance for the injured, and proceed to issue notices not only to the health care centers but also to external support institutions (National Civil Defence, Police, Fire, Fighters, etc.).

Risk management

The management of contingencies at the natural gas regasification LNG import terminal plant is based on:

- Early detection (alarms, detectors, setting off of safety elements);
- Immediate automatic reaction (feed shut-off valves, either of the fluid, electric process or other).
- Confinement of emergency area.
- Application of the adequate response procedure
- Follow-up and monitoring

Evacuation Plan

The following alarm signal(s) will be used to begin evacuation of the facility (check all which applies):

- Bells/Horns/Sirens
- Verbal Public address system
- Other (specify)
- Evacuation map is prominently displayed throughout the facility with assembly point(s), routes and roles and responsibilities for all employees.

Note: A properly completed Site Plan satisfies contingency plan map requirements. This drawing (or any other drawing that shows primary and alternate evacuation routes, emergency exits, and primary and alternate staging areas) must be prominently posted throughout the facility in locations where it will be visible to employees and visitors.

Emergency Contacts	*Phone No.*	*Address*
Fire/Police/Ambulance		
State Office of Emergency Services		
National Response Centre		
Post-Incident Contacts		
Fire Department		
EPA		
Other Contacts (Please insert point of contact)		
Emergency Resources		
Poison Control Centre		
Nearest Hospital		

Emergency Equipment

The Hazardous Materials Storage Ordinance requires that emergency equipment at the facility be listed. Table 7.3 meets this requirement.

Table 7.3: Emergency Equipment Inventory

Equipment Category	*Equipment Type*	*Location*	*Description*
Personal Protective Equipment, Safety, and First Aid Equipment	Cartridge Respirators		
	Chemical Monitoring Equipment (describe)		
	Chemical Protective Aprons/Coats		
	Chemical Protective Boots		
	Chemical Protective Gloves		
	Chemical Protective Suits (describe)		
	Face Shields		
	First Aid Kits/Stations (describe)		
	Hard Hats		
	Plumbed Eye Wash Stations		
	Portable Eye Wash Kits (i.e. bottle type)		
	Respirator Cartridges (describe)		
	Safety Glasses / Splash Goggles		
	Safety Showers		
	Self-Contained Breathing Apparatuses (SCBA)		
	Other (describe)		
Fire Extinguishing Systems	Automatic Fire Sprinkler Systems		
	Fire Alarm Boxes / Stations		
	Fire Extinguisher Systems (describe)		
	Other (describe)		
Spill Control Equipment and Decontamination Equipment	Absorbents (describe)		
	Berms / Dikes (describe)		
	Decontamination (describe)		
	Emergency Tanks (describe)		
	Exhaust Hoods		
	Gas Cylinder Leak Repair Kits (describe)		

Table 7.3: Emergency Equipment Inventory

Equipment Category	Equipment Type	Location	Description
	Neutralizer (describe) Over-pack Drums Sumps (describe) Other (describe		
Communications and Alarm Systems	Chemical Alarms (describe) Intercoms / PA Systems Portable Radios Telephones Underground Tank Leak Detection Monitors Other (describe)		
Additional Equipment (Use Additional Pages if Needed)			

Trainings

a) *Personnel Trainings* General workers will be trained as per following procedures:

- Internal alarm/notification
- Evacuation/ re-entry procedures & assembly point locations
- Emergency incident reporting
- External emergency response organization notification
- Location(s) and contents of Emergency

b) *LNG Handlers* will be annually trained in the following manner:

- LNG Handling Training Procedures
- Safe method for handling and storage of LNG
- Location(s) and proper use of fire and spill control equipment
- Spill procedures/emergency procedures

c) *Emergency Response Team* members are capable of and engaged in the following:

- Personnel rescue procedures
- Shutdown of operations
- Use, maintenance, and replacement of emergency response equipment
- Refresher training which is provided annually
- Emergency response drills which are conducted at least quarterly
- Emergency Response Training

Develop and practice a spill clean-up procedure including where to find emergency equipment and how to use it. Make sure all people on site are aware of emergency telephone numbers to call in the case of a large spill. Spill kit equipment on site should include: booms to contain liquids, material to prevent spills into drains, and material to absorb spills. Keep this absorbent material in a clearly labeled and easily accessible place.

Response Strategy

Upon the occurrence of the emergency, the Plan will be developed under the following conditions:

- First Stage: Notification
- Second Stage: Initial assistance/rescue
- Third Stage: Response operations
- Fourth Stage: Evaluation of the Plan and damages

First Stage: Notification

Internal Communication: Radio communication systems, channels and frequencies will be established for the command post, alternative posts and for the personnel that forms part of the response Brigade.

Furthermore, message forms will be established to record at least the following information: Name of informant, location and place of the emergency, number of people affected and, if possible, an estimate of the type of injuries and/or damages, among others.

External Communication: In the event of spills, leaks or discharges into the sea or the beach, the Harbour Master's Office of the area of influence must be informed through the fastest means: telephone and fax; and also using the forms of the General Harbour Master's and Coast Guard Bureau.

- Local Authorities will be advised by telephone.
- In the case of serious or fatal accidents, the Government Attorney General's Office and the National Police will be notified in coordination with the Legal Counsel.
- The relatives of the injured person, as soon as he is evacuated to a hospital.
- To the extent possible, the press will be notified after the accident has been investigated and by the person designated by Management.
- In the case of an accident that has affected the facilities; the Insurance Company will be notified in Coordination with the Administration and Finance Management.

Second Stage: Initial Assistance/Rescue

A joint evaluation will be made of the status of the event, the conditions of the site, the environmental characteristics that warrant a safe development of rescue actions, first aid and transportation of the injured to a medical unit.

Trained emergency teams must be prepared to act as required, and a reserve team must be available. All personnel who are not essential to fight the emergency must be evacuated to a safe place where there must be communication equipment available to count the number and condition of the personnel. In the event of fire, the execution or fighting phase will be implemented immediately.

Third Stage: Response Operations

Response Operations refer to:

- Firefighting using extinguishers or pressure water network or foam.
- Spill control (of lubricants or fuel using absorbing material) or confinement.
- Dispersion of gas clouds. Access control to affected area.
- Medical assistance and evacuation of injured personnel.
- Evacuation of all personnel if their lives are in danger (in the event of earthquakes, tsunamis or other factors).
- Application of a monitoring program and a mitigation plan.

Fourth Stage: Evaluation Of The Plan And Of Damages

Once response operations have concluded, the development and results of the Plan must be evaluated in order to issue recommendations that allow correcting deficiencies for the purpose of improving response operations. These recommendations will then form part of revision and subsequent annual approval of the Contingency and Risk Prevention Manual. A record of damages will be prepared as part of the final emergency report. The resources used, lost and recovered will be detailed in said register.

Emergency Response Manuals

Including the proponent's commitment to prepare written emergency plans for the pipeline, plant and marine terminal to cover emergency situations that could occur, based on the results of a Quantitative Hazard and Risk Assessment. It was agreed that Emergency Response Manuals will be developed for:

- LNG Terminal Accident Response;
- FSRU/LNGC/Loading Facility Accident Response; and
- Pipeline Rupture Contingency Plan;

a) *Monitoring and Review*

Monitoring of different activities will be required to analyze the impacts of construction and operation on the environment. Self-monitoring and reporting tools will be adopted to carry out monitoring as per EPA rules and regulations.

Monitoring techniques will be identified and the frequency of selected parameters for monitoring will be followed as per the monitoring plan given Table 7.4. HSE Manager will keep a record of all non-conformities observed and report them along with actions to CEO for further action. HSE Manager will also report any impact anticipated along with his recommendations for further action. The contractor shall take note of the recommendations relating to issues arising during monitoring of construction activities.

Review: Environmental assessment of the proposed project has been made on the basis of the project description, site visits, existing environmental conditions and expected changes in environmental parameters due to construction activities as well as during operation of the LNG terminal. Review of activities will take place after conceding changes in project design, record keeping and management plans subsequent to impact assessment study.

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring Component	Parameters	Location	Monitoring frequency	Standard	Responsibility	Supervision
Construction	Benthic Flora and Fauna	Visual checks to assess the situation	All construction areas	Continuous	N.A	HSE Dept.	IMC
	Air Emissions	CO, SOx, NOx, PM10, PM2.5, SPM, VOCs	All construction areas	Before start of construction activity Monthly	WHO/USEPA guidelines, NEQS	HSE Dept.	IMC
	Sea Water Quality	pH, BOD, COD, TDS, TSS, DO, oil and grease	All construction areas	All the sea water quality sampling will be carried out in low and high tide on monthly basis during construction phase.	World Bank guidelines	HSE Dept.	IMC
	Solid Waste	Solid waste quality and quantity and disposal Visual checks to assess the situation.	All construction waste disposal sites	Continuous	N.A	HSE Dept.	IMC
	Wastewater	Primary Pollutants of NEQS	All effluent the discharge points	Monthly	National Environmental Quality Standards (NEQS)	HSE Dept.	IMC
	Noise Levels	Noise Intensity (dBA)	All Construction Areas	Start of construction Monthly during construction	OSHA, NEQS, World Bank Guidelines	HSE Dept.	IMC
	Soil	Soil contamination (Oil & Grease) Soil erosion & sedimentation	All Construction Areas	Continuous	Baseline Criteria	HSE Dept.	IMC
	Health Safety of workers	Accidents PPEs Annoyance Visual checks to assess the situation.	All Construction Areas	Once monthly	Monitoring of the health & safety of workers	HSE Dept.	IMC
End Of Construction	Restoration of sites	Visual analysis Photographic records	All construction sites	End of construction	Previous records	HSE Dept.	IMC

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring Component	Parameters	Location	Monitoring frequency	Standard	Responsibility	Supervision
Operations	Benthic Flora and Fauna	Visual checks and sampling of benthic material to assess the situation.	Sea Water	Once in a year	Comparison with previous records	HSE Dept.	IMC
	Waste water	Waste water minimization Storage and handling Recycling and reuse Treatment before disposal Primary Pollutants of NEQS	All effluent the discharge points	Monthly	NEQS	HSE Dept.	IMC
	Sea Water Quality	pH, BOD, COD, TDS, TSS, DO, Oil and Grease	Vicinity of Project Area	All the sea water quality sampling will be carried out in low and high tide on quarterly basis during operation phase.	World Bank guidelines	HSE Dept.	IMC
	Solid Waste	Solid waste quality and quantity and disposal methods/locations Visual checks to assess the situation.	Project Area	Quarterly	N.A	HSE Dept.	IMC
	Aquatic Ecosystem	Key water quality indicators, Plant and animal species richness & composition, Conductivity, Temperature, BoD, TSS, water level, Heavy metals, Vegetation cover, Heavy metals, Water level, Fish population structure its density & productivity	Project Area	Quarterly	N.A		IMC
	Fire & Safety	Fire Hazards & Safety Protocols	All Operational Areas	Continuous	N.A	HSE Dept.	IMC
	Air Emissions	CO, SOx, NOx, PM_{10}, $PM_{2.5}$, SPM	All operational areas including storage areas	Monthly	WHO/USEPA guidelines, NEQS	HSE Dept.	IMC

Table 8.4- Environmental Monitoring Plan

Stage	Monitoring Component	Parameters	Location	Monitoring frequency	Standard	Responsibility	Supervision
	Noise	Noise intensity measurement	All operational areas	Quarterly	OSHA, NEQS, World Bank Guidelines	HSE Dept.	IMC
	Hazardous spill	Spill on Land, Spill on Water	All operational areas	Continuous	SOPs	HSE Dept.	IMC
	Traffic management	Traffic Management Plan	Terminal approaches and exits	Continuous	Traffic Management Plan	HSE Dept.	IMC
	Health and Safety of workers	Accidents PPEs Annoyance Diseases	Terminal area	On quarterly basis	HSE Manual	HSE Dept.	IMC
	Accidents (Loading & Unloading)	Inspection and record checking.	Port area.	On quarterly basis	HSE Manual	HSE Dept.	IMC
	Compliance monitoring	EIA Commitments Mitigation Measures Conditions of Environmental Approval SOPs	All areas	Monthly	EMMP	IMC	EPA

7.16 Standard Operating Procedures

7.16.1 Wastewater/Storm water management

Purpose of Wastewater/storm water Management: The purpose of the adopted procedure is to provide guidelines and simplify the process of categorizing, quantifying, managing, and disposing of wastewater wherever and whenever arising during the project's construction and operation phase. Wastewater management is a critical component of company's operating policies. Wastewater management includes the proper disposal/recycling and reuse of the wastewater generated during construction and operation phase. The procedure is designed to assist in a company's wide effort to provide protection for the environment and to comply with company's corporate requirement, environmental laws and regulations regarding proper wastewater management.

Scope: Wastewater as part of construction and operational stages shall be managed as per this procedure. An integrated wastewater management system for the Offshore Floating LNG terminal is essential to reduce wastewater; this will be provided as a design input.

Substitute techniques must be investigated, including source reduction, recycling and reuse wherever possible with a view towards maximizing the benefits and minimizing the cost of each method of wastewater management.

Guidelines for proper handling, categorization, recording, minimization, and disposal of all types of wastewater associated with company operations and projects are part of this procedure that need to be documented.

This procedure shall be followed at all construction sites by all company personnel and contractors working for this proposed project.

Definitions

Wastewater: Any water arising after use/consumption shall be including of liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations. In the most general terms, it refers to the municipal wastewater that contains a wider range of pollutants arising due to the mixing of wastewaters from different sources.

Hazardous Wastewater: Plant wastewater comes in the category of hazardous wastewater. If it has one or more of the following properties:

- Oily water
- Toxicity (may cause risk of injury to health of organisms or the environment)
- Concentration of contaminants too high above safe acceptable limits

Non-hazardous Waste: The wastes are categorized as nonhazardous wastes, if they do not possess any of the hazardous contaminant mainly comprising of consumed water arising from washing area and sanitary wastewater.

Procedure: Main concern to manage the wastewater is listed below:

- Eliminate wastewater production wherever possible.
- Minimize wastewater production.
- Recycle or Reuse
- Wastewater disposal in an environmentally safe manner through adequately designed facility

Wastewater Minimization: Generation of wastewater will be minimized through the following steps taken by working personnel at the facility:

- Through efficient use of raw water (minimizing the wastewater).
- Extensive management schemes will be formulated for both phases during construction and operations (water management).
- It is expected that segregated and /or treated wastewater will be made available for subsequent use during operations phase (recycling and reuse).

Storage and Handling: Wastewater shall be stored/retained in lined ponds or storage tanks till proper onsite treatment or remote disposal.

Recycling: Reuse of wastewater is a best way to reduce the quantity of the wastewater that requires subsequent treatment and disposal.

Treatment

- Biological treatment of wastewater through retention in septic tanks prior to disposal
- Sludge produced as a by-product of biological treatment be disposed of properly through burial pits
- Some of the wastewater will be reused for cleaning or washing purpose. The treated water should comply with National Environmental Quality Standards (NEQS).

Disposal: Proper disposal should be done following the treatment through discharge into water bodies or sewerage system where available.

Waste Management Options

- All storm water run-off and pump-out from facility construction-sites will be inspected and directed to sedimentation basins to remove suspended solids (e.g., silt);
- Sewage will be collected and temporarily stored in tank(s) until it is transported to a designated wastewater treatment facility;
- Standard mobile sewage tankers should be engaged to collect and transport sewage from portable latrines and temporary storage tanks
- Oil spills in port waters could result from a variety of sources including on-shore industries; unsupervised bilge pump-outs; collisions and sinking of vessels; illegal discharges from vessels; accidents when transferring waste oil to storage facilities and accidents when refueling vessels.
- To reduce the risk of oil spills occurring from a vessel, Maritime Safety Regulations ensure the safety of navigation, including the provision of navigation aids is maintained.
- Direct discharge will only be considered as a contingency option.
- During preparation of the final EMP, Bahria Foundation will undertake an evaluation of the proposed release of hydro-test water during construction of the storage tanks for LNG and

condensate on-site. This will include an analysis of the additives which will be present, their fate and anticipated environmental effects.

Recording & Reporting: Visually acquired wastewater management-related monitoring data will be recorded in field logbooks. These logbooks will be maintained as part of the Construction Spread Wastewater Management Records at each designated area or facility within a spread, wherever the stated wastewater management activities occur.

These monitoring data will include as applicable.

- Time, date and identify of individual performing the monitoring activity.
- Description of the process or activity being monitored.
- Findings or results of the monitoring activity.
- Description of activities to address deficiencies or problems; and
- Problems/Deficiencies, Remedial Measures.
- It is responsibility of the management to identify and implement appropriate remedial measures based on identified problems/deficiencies and to properly record and verify all EMP compliance initiatives

Table 7.5: Wastewater Data Sheets Guidelines for Wastewater Management

FSRU Wastewater	
Description	General water from washings, etc.
Components	Water Total Dissolved Solids (TDS) and total suspended solids Oil & Grease
Waste Category	Non-hazardous
Analysis	Refer Monitoring procedure for analysis requirements (PRO/ENV/02).
Ownership/Responsibility	HSE Manager/Manager Operations
Accumulation/ Storage	Stored in lined ponds or storage tanks till proper disposal.
Waste Handling	When handling plant wastewater, protect yourself from direct contact by using appropriate personal protective equipment
Waste Reduction	Reduce water use
Disposal Options	Recycle free oil back into the production stream Dispose water into lined evaporation ponds or skim pits Oily water from yards should be treated in oil/water Separator.
Sanitary Wastewater	
Description	Wastewater from camps.
Waste Category	Non-hazardous
Analysis	Refer Monitoring procedure for analysis requirements (PRO/ENV/02).
Ownership/Responsibility	Camp Administrator / PTLs
Waste Handling	When handling sanitary wastewater/ sludge, protect you from direct contact by using appropriate personal protective equipment.

Table 7.5: Wastewater Data Sheets Guidelines for Wastewater Management	
Waste Reduction	Reduce water use.
Disposal Options	Treat wastewater in septic tanks before disposal Sludge removed from septic tank during cleaning should be buried in burial pits.

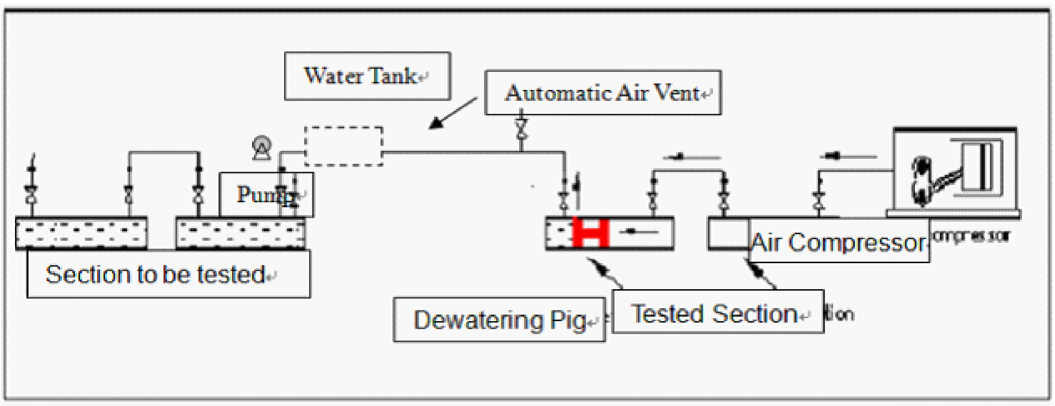
7.16.2 Hydrostatic Testing

Purpose of Hydrostatic Testing: The objective of performing hydrostatic testing of a pipeline is to check and eliminate any defect that might be potential threat for leaks and bursting of pipeline when sustaining maximum operating pressures or sometimes accidental rise in pressure above normal. The key word is pressure which is regulated and when hydrostatic testing is performed through raising the pressure level above the operating pressure to check for any defects in the joining and failure of material due to excessive pressures above the normal operating pressures. If failure occurs then defects are eliminated or in case of no failure a safe margin of pressure above the operating pressure is demonstrated. Defects adversely affect the pressure-carrying capacity because excessive stress in the material leads to failure.

Scope: Primary focus during any pipeline activity, including hydrostatic testing, is public safety and protecting the environment. Also it ensures that the material or substance being transferred from one point to another location is conserved and does not occur as waste from the system.

Definitions: Hydrostatic Leak Testing is used to test components for leaks by pressurizing them inside with a liquid. This testing method can be used on piping, tanks, valves and containers with welded or fitted sections.

Procedure: Hydrostatic testing of pipelines is one method to identify defects or damage in pipelines that could potentially cause a pipeline leak. A hydrostatic test is a routine test to ensure the integrity of pipelines and distribution network. The information below outlined the hydrostatic testing process.



Management Options of Hydrostatic testing: Management of Hydrostatic testing consists of;

- Description of the pipeline to be tested. Include information such as the location, dimensions, and materials of construction, intended use.

- Identify the source of the water to be used for the test. (Should be a good quality water source such as a municipal water supply, drinking water well, irrigation well, clean source of surface water, etc.)
- Note: The use of surface waters may require a temporary water use permit from the Pakistan environmental protection agency.
- Description of any chemicals to be added to the test water, the purpose for using the chemicals, and the concentrations used. Provide product literature and material safety data sheets.
- Estimate total volume of test water to be discharged in gallons and discharge rate.
- Description of how the test water will be settled, filtered, or otherwise treated to prevent erosion and remove suspended solids, oil and grease, and other pollutants.
- A description of how dissolved oxygen will be restored to the test water if it is going to reach any surface water body.
- No hydrostatic test water may be discharged within near drinking water supply intake.
- The operator's representative responsible for ensuring that the hydrostatic test water is disposed of properly.

Reports: The proponent shall make, and retain for the useful life of the pipeline, a record of each test performed. The test records must contain:

- The operators name, the name of the operator’s employee responsible for making the test, and the name of any test company used;
- Test medium used;
- Test pressure;
- Test duration;
- Pressure record charts;
- Elevation variations, whenever significant for the particular test; and
- Leaks and failures noted and their disposition.

7.16.3 Noise and Air Emissions

Purpose: The purpose of this guideline is;

- To monitor contents of polluting substances in the atmospheric air;
- To control observance of approved limiting permissible emissions at manmade sources;
- To monitor natural sources and a number of man-made sources of emission at work sites at the construction phase;
- To monitor noise emissions;
- Sources of noise emissions.

Scope: Scope of work include

- Evaluation of present ambient air quality and noise level at existing area.
- Evaluation of impact of traffic movement at the proposed site and noise level.
- Evaluation of impacts on roads and in the adjacent area due to construction and operation.
- Recommendations for mitigation techniques to redress the expected impacts both for design phase and operational phase.

Definitions: In common use the word noise means unwanted sound or noise pollution. Excessive noise permanently damages hearing, but a continuous low level sound can be dangerous too.

Procedure: Air emissions (continuous or non-continuous) from LNG facilities include combustion sources for power and heat generation (e.g. for dehydration and liquefaction activities at LNG liquefaction terminals, and re-gasification activities at LNG receiving terminals), in addition to the use of compressors, pumps, and reciprocating engines (e.g. boilers, turbines, and other engines).

Emissions resulting from flaring and venting, as well as from fugitive sources, Principal gases from these sources typically include nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), and, in case of sour gases, sulfur dioxide (SO_2). For LNG terminal, air quality impacts should be estimated by the use of baseline air quality assessments and atmospheric dispersion models to establish potential ground level ambient air concentrations during facility design and operations planning. These studies should ensure that no adverse impacts to human health and the environment result.

Emissions of greenhouse gases together with NOx and SOx are expected from power generation units. All reasonable attempts should be made to maximize energy efficiency and design facilities to minimize energy use. The overall objective should be to reduce air emissions and evaluate cost effective options for reducing emissions that are technically feasible.

The main noise emission sources in LNG facilities include pumps, compressors, generators compressor suction/ discharge, recycle piping, air dryers, heaters, air coolers at liquefaction facilities, vaporizers used during re-gasification, and general loading / unloading operations of LNG carriers/vessels.

Atmospheric conditions that may affect noise levels include humidity, wind direction, and wind speed. Vegetation, such as trees, and walls can reduce noise levels. Installation of acoustic insulating barriers can be implemented, where necessary.

Noise and Air Emissions Management Options: Noise and air emissions monitoring includes;

- Strategic environmental planning (e.g., plant sitting and fatal flaw analyses)
- Pollution control device feasibility, troubleshooting, and cost evaluations
- Innovative solutions and flexible permitting.
- Regulatory tracking and rulemaking negotiation on behalf of corporations and trade associations including New Source Review (NSR) Reform, Maximum Available Control Technology (MACT) standard development
- Enforcement assistance, economic evaluations, expert testimony.
- Environmental Management System (EMS) development
- Air permitting such as Prevention of Significant Deterioration (PSD), New Source Review (NSR),and state construction permits
- Air quality modelling and monitoring of air and noise emissions.
- Risk Management Plans
- Emission release inventories (Toxic Release Inventories, Global Warming and Green House Gas Inventories)
- Leak Detection and Repair

- Pollution control technology assessment,
- emission inventory development,
- capture efficiency,
- control equipment performance and equipment specifications and warrantees,
- compliance assessment,
- non-compliance resolution,
- negotiation of commercial terms for air pollution and control equipment and control systems, and
- Development of parametric monitoring, periodic monitoring, & compliance assurance monitoring.

7.16.4 Erosion protection requirements

Purpose Erosion Protection: Erosion control projects protect public and private land value and can help reduce sediment pollution by minimizing the degrading effects of erosion. Erosion control projects utilizing natural materials also conserve plant, fish, and wildlife habitat, as well as wildlife access to the land. Erosion control is necessary at the project sites which are interfacing with land and shore.

Objectives: To manage construction so that erosion is prevented and that sediment laden water does not leave the construction site or contaminate downstream waters. And to manage steep and or instable land so as to prevent or m minimizes erosion

Scope: Soil erosion by water and wind affects the natural environment. Soil loss, and its associated impacts, is one of the most important, yet probably the least well-known, of today's environmental problems. The scope of this activity is to control the erosion through practice of preventing or controlling wind or water erosion.

Definitions: The natural process by which the surface of the land is worn away by the action of water, wind, or chemical action is termed as Erosion. Shore erosion protection works are structures or measures constructed or installed to prevent or minimize erosion of the shoreline in the critical area i.e. is most likely to be the area influenced by the project.

Procedure: The best erosion control methods involve the restoration of natural environments along the shoreline. Replanting bay grasses and shrubs and utilizing biodegradable materials as well as offshore breakwaters can stabilize soil while enhancing habitats at the same time. Structural barriers, such as bulkheads, compact soil, alter the composition of the land, and often undermine natural ecology.

Management Options: Adequate management and/or structural best management practices to minimize accelerated erosion prevent sediment pollution to the waters of the coastal area and maintain the resource base. Generally this will require a conservation plan that meets the soil loss tolerance. Soil loss tolerances denote the maximum level of soil erosion that allows high levels of sustainable economic crop productivity.

- Wherever possible, non-structural erosion control measures, such as marsh creation, should be used to stabilize eroding shoreline.

- Where no significant erosion is occurring, structural shore erosion control measures should not be encouraged.
- Structural erosion control measures should only be used in areas designated for this activity and when non-structural measures are impractical or ineffective.
- A conservation plan includes best management practices to address erosion and sedimentation control and protection of the soil resource. In the absence of a complete conservation plan, an erosion and sedimentation control plan consisting of appropriate numbers and locations of sediment removal best management practices, must be developed, installed and maintained.

7.16.5 Cleanup and re-vegetation

Purpose: This involves removal of excess excavated material (not used as backfill), restoring the site surface to final contours, and stabilization of slopes. After cleanup, disturbed areas are stabilized, smoothed, mulched, reseeded, and fertilized as required. After construction is complete and cleanup is in progress, temporary erosion controls may be removed and permanent landscaping and erosion control measures installed where required as part of final facility reinstatement.

Scope: Topsoil is segregated from sub-soils during this operation. Top soil is stored in temporary topsoil stockpile areas for later use in re-vegetation programs. Regular visual inspection is conducted to monitor the growth of vegetation and to ensure that no erosion occurs on slope areas while the trees and other vegetation get established to protect the slope surfaces. The re-vegetation programs will be continued by the Project.

Procedure: To determine the number of protected species if any in or around the construction zone in order to assess damage inflicted on the natural environment through the loss of these species and the damage to their ecotopes in the course of clearing construction sites;

- To determine number of rare species growing within the determined populations in the clearance zone.
- To determine proximity of the rest of the species population to the pipeline route in order to assess the constructions possible impact on the whole of the population.
- To assess the condition of rare species in the impact zone prior to and in the course of the construction, as well as during commissioning of the facilities.

Management of Cleanup and revegetation

Responsibilities: The site environmental coordinator (SEC) is responsible for verifying that clearing and re-vegetation is performed in compliance with applicable environmental requirements and specifications.

Instructions: The site environmental coordinator (SEC) will verify that the layout at the facility work area and temporary use areas conform to project.

- The SEC will verify that clearing and re-vegetation is performed in accordance with construction Specifications, which include requirements for timber removal, slash disposal, and dust control.

- The SEC will verify that any debris resulting from clearing activities that may block stream flow, contribute to flood damage, or result in streambed scour or erosion is immediately removed from the stream area.
- The SEC will verify that all necessary measures are taken to minimize erosion and transport of sediment and silt from graded and disturbed work areas. Erosion control specifications and site specific erosion control plans will be followed to ensure that disturbed areas are stabilized and erosion is minimized to the greatest extent practicable.
- Environmental inspection will be conducted during clearing and grading activities and in coordination with Construction Superintendent.

Recording & Reporting: The site environmental coordinator (SEC) will document on a Daily Environmental Inspection Reports (DEIR) the progress of clearing and re-vegetation activities and status of compliance.

7.16.6 Waste Management Plan

Purpose of Waste Management: The purpose of this procedure is to provide guidelines and simplify the process of categorizing, quantifying, managing, and disposing of solid wastes. Waste management is a critical component of company's operating policies. Waste management includes the proper handling, collection, storage, manifesting, transportation, and disposal/ recycling of the solid waste generated. The procedure is designed to assist in a company wide effort to provide protection to the environment and to comply with company's corporate requirement, environmental laws and regulations regarding proper waste management.

Objectives of Waste Management: The objective for waste is to priorities the prevention and minimization of waste generation, followed by the effective management of wastes (storage, handling, transport and disposal) in a manner that minimizes impact on the environment while also being cost effective. The Bahria Foundation waste management hierarchy depicted in Figure 8.4, highlights the range of options available to manage the dispose of waste, demonstrating the ranking of the most preferred to least preferred options with regard to waste management. This forms the foundation of the waste management system.

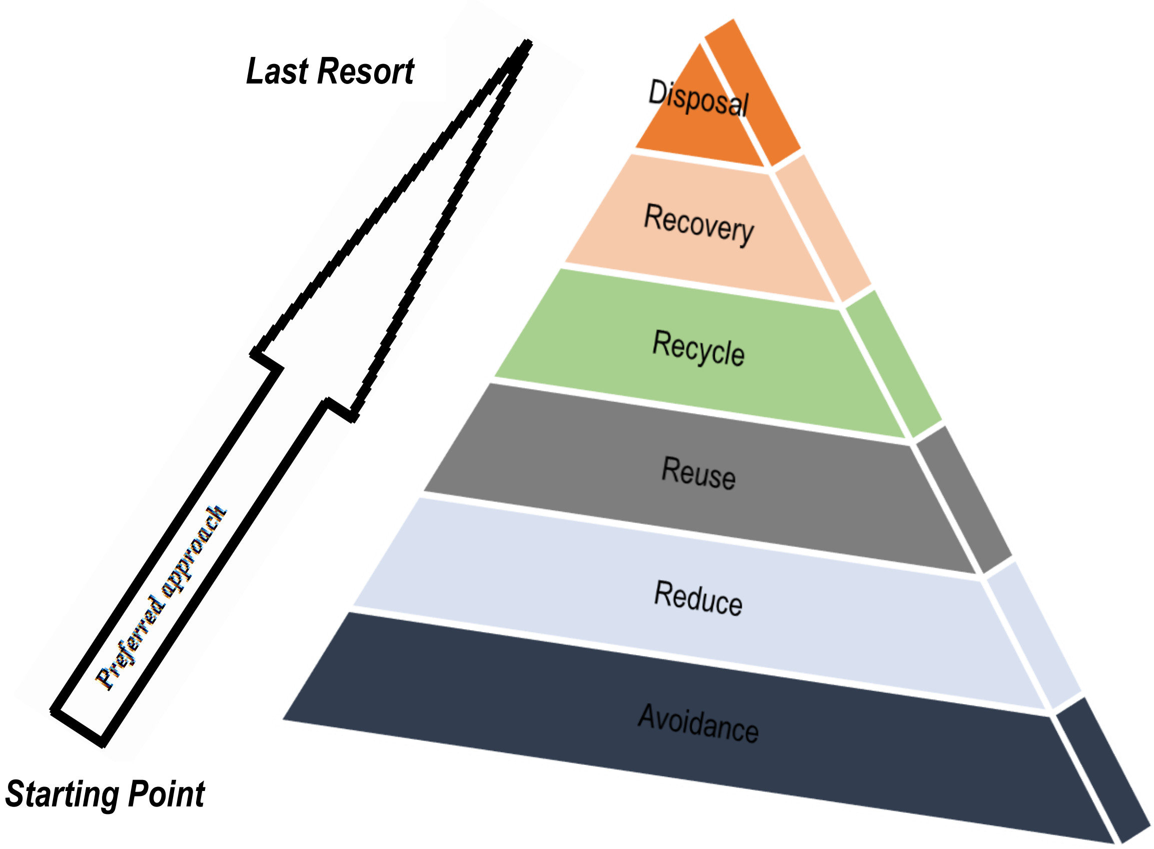


Figure 8.4 Waste Management Hierarchy

Scope: The waste management plan will be developed by the pipeline construction contractors to ensure that the Management of solid waste generated as a result of the construction of the pipeline and associated activities is consistent, efficient, and in conformance with the laws and regulations. With respect to monitoring, the waste management sets out the following objective:

- To monitor and inspect waste management-related facilities and activities directly resulting from executing the scope of the contract in order to ensure compliance with the Waste Management Plan (WMP). Guidelines for proper handling, categorization, recording, minimization, recycling and disposal of all types of waste associated with company operations and projects are part of this procedure.

Definitions

Waste: Any material, for which no further use is intended, is considered a waste. It can be solid, semi-solid or liquid. Additionally, abandoned materials and materials intended to be recycled are considered wastes. It is very important to understand this concept, because even though something is going to be recycled, it must be managed as a waste until it is actually recycled.

Hazardous Waste: Waste is categorized as a hazardous waste if it has one or more of the following properties:

- Ignitability (flash point less than 600°C);
- Corrosivity (pH less than or equal to 2.0, or greater than or equal to 12.5);

- Reactivity (inherently unstable under ordinary conditions or when exposed to water);
- Irritability (when in contact with body causes inflammation)
- Toxicity (may cause risk of injury to health of organisms or the environment.)

Non-hazardous Waste: The wastes are categorized as nonhazardous wastes, if they do not possess any of the hazardous characteristics as defined above. However, non-hazardous waste may still present hazards to employees who handle them. All recommended safety and handling practices must be followed.

Procedure: Priorities to manage the waste are listed below:

- Eliminate waste production whenever and wherever possible. Use the material only for its intended purpose on site
- Minimize waste production
- Reuse
- Recycle waste on site.
- Dispose of waste through properly designed waste disposal facility.

Waste Minimization: To minimize waste, the following steps shall be taken by all personnel working on project sites:

- Only the needed amount of materials shall be ordered. Before purchasing hazardous material, all alternatives for non-hazardous material should be explored.
- Prior consideration shall be given to the sizes of containers available when ordering products that could potentially generate waste. The intent is to avoid unused products and/or their containers from becoming wastes that require special handling.

Waste Categorization: All wastes generated at project facilities shall be categorized in two major categories (i.e. Hazardous wastes and Nonhazardous wastes) as per the definitions in section C. Each category has different types of requirement for handling, storage and disposal.

Labeling

- Name of the waste (e.g., waste oil, solvents).
- Waste category (e.g., toxic, ignitable).
- Facility name and address (disposal site, etc.).
- Date of waste accumulation: (date when waste was placed in drum).
- Wastes are segregated and located in designated areas to optimize control; storage areas.

Segregation: Waste management becomes very complicated if different types of waste are mixed together. A small amount of hazardous waste, mixed with a nonhazardous waste or recyclable material, can make the whole mixture a hazardous waste. Disposal costs and liabilities for hazardous waste are very high, so it is extremely important to identify wastes and keep them segregated.

The scheme of segregation is as follow:

- All hazardous waste shall be segregated from other types of hazardous wastes as well as non-hazardous wastes at the point of generation of waste.
- At all facilities, containers, with color coding for easy identification, shall be kept to collect and segregate common wastes. A proposed scheme is as under:

Coding system for different type of waste	
Waste material	(Color or code)
Glass	(blue);
Metals	(green);
Plastic	(white);
Oily rags	(black);
Used oil	(red);
Rubbish / trash	(yellow)

- Food waste shall be collected in separate containers.
- All containers must be properly and clearly labeled. The label must clearly mention the name or type of waste. Also, if the waste is hazardous, it should be clearly labeled on the container along with its hazardous characteristics (e.g. flammable, toxic, radioactive, etc.). This is important to workers and to emergency response teams, who need to know what they are dealing with. Missing or unreadable labels must be replaced.

Storage and Handling

- Waste that will be sent for recycling or off-site disposal shall be temporarily stored at waste storage facilities available at different sites such as Junkyard, Scrap yard, pits, etc.
- The oily sludge, contaminated soil and other hazardous liquid waste (e.g. rinsate, chemicals, etc.) shall be stored in lined pits with HDPE liner. Liner shall be of sufficient thickness (at least 20mil) and adequate strength to withstand tears and punctures.
- All other wastes awaiting disposal shall be kept in closed containers separately. Care must be taken to prevent wastes giving rise to secondary environmental problems, such as odors or soil and groundwater pollution through rainwater leaching.
- All stored wastes must be clearly labeled with type of waste and warning signs.
- Daily estimates of hazardous and no hazardous waste and volumes generated on site.
- Waste segregation, waste storage containers, general housekeeping and the provision of adequate resources will be monitored.
- All workers handling wastes shall use proper PPE.

Recycling: Recycling and reuse minimizes the quantity of waste requiring disposal. Some of the wastes can be reused within the facilities while others can only be recycled at off-site recycling centers. For example, recycling of used oil is possible in some of the Lube Oil Recycling companies; batteries may be sent back to manufacturer or distributor for recycling. Waste shall not be sold to the unauthorized contractors/companies, who may not have proper recycling facilities, to avoid misuse and to reduce associated liabilities. The possibilities of recycling of each waste are discussed in relevant documents.

Treatment: Some of the wastes, such as wastewater from camps, oily wastewater from process, etc., require proper treatment before disposal. The treated water should comply with National Environmental Quality Standards (NEQS).

Disposal: Disposal becomes the only available alternatives, if reuse and recycling options are exhausted. A material should be classified as a waste for disposal only if no other useful purpose can be identified and if the material cannot be beneficially reused or recycled. The choice of a suitable disposal option for any waste depends on both environmental & economic considerations. The final disposal shall be done through certified waste management contractors.

Recording & Reporting: Bahria Foundation has to record the information about source, composition, quantity, and final disposal of the waste. This information is needed for regulatory compliance, risk assessment and setting reduction targets and objectives as well as corporate statistics.

The Waste Tracking Form, as shown in the following shall be used to record this information by all project teams, while waste is being dispatched outside facility or Bahria Foundation controlled location. It will be made necessary to sign off the Waste Tracking Form, before the waste is dispatched outside.

Table 7.6: Waste Tracking Form

Location of Generation:			
Reporting Team:			
Submitted by (Name):			
Submitted on (Date):			
Waste	*Approx. Quantity*	*Unit*	*Disposal Location*
Aerosol Cans (Empty)			
Asbestos			
Batteries (Dry)			
Batteries (Lead Acid)			
Clinical Waste			
Construction Waste			
Crude Oil or Condensate Waste			
Descaling Acids			
Diethanolamine (DEA)			
Drilling Fluids/Solids			
Drums and Containers (Empty)			
Filters			
Fluorescent Light Tubes			
Food Waste			
Glycols			
Laboratory Wastes			
NORM Containing Waste			
Oil Contaminated Soil			

Table 7.6: Waste Tracking Form

Waste	Approx. Quantity	Unit	Disposal Location
Location of Generation:			
Reporting Team:			
Submitted by (Name):			
Submitted on (Date):			
Oily Rags (Used)			
Paint Waste			
Pigging Wastes			
Plant Wastewater			
Produced Water			
Rinsate			
Sanitary Wastewater			
Scale (Pipe and Equipment)			
Sludge			
Trash			
(i) Glass			
(ii) Metal			
(iii) Plastic			
(iv) General Trash			
Used Engine Oil			
Checked and Signed:			
Dated:			

7.16.7 Environmental Inspection by HSE Department

Purpose: This procedure identifies environmental responsibilities for the project offices and for the construction site HSE Incharge. It also provides procedural guidance for environmental training, inspection, monitoring functions during construction.

Scope: Primary scope of environmental inspector/monitor is to comply with the environmental requirements of the project. Bahria Foundation is also responsible for inspecting, documenting, and ensuring that construction meets environmental responsibilities through an integrated program of personnel orientation and training, and inspection of construction activities. In addition, the company will assist in implementing environmental management plans through its program of construction inspection.

Definitions: Consists of examining construction activities in the field to verify and document those activities are carried out in compliance with construction and environmental Permits, specifications relating to environmental protection, and mitigation plans approved for the LNG project.

Procedure: The Company will establish a plan detailing the procedures and documents required for implementing environmental management plan thereby complying with the environmental legislations and regulations during the construction and operational phase of the project.

Management Options: Functions and responsibilities that will be assigned to company's HSE department include:

- Orientation of LNG project personnel in environmental requirements and procedures particularly in context to the sensitive resource issues at the construction site.
- Environmental training particularly in environmental monitoring is to be imparted to all project personnel.
- Inspection of facilities construction activities for compliance with environmental regulations,
- Specifications, stipulations, drawings, mitigation plans, and procedures.
- Documentation of all training, inspection, and monitoring activities should be exercised.
- Coordinate with the owner's environmental representatives and management personnel on environmental issues.
- Provide technical support to Owner for obtaining environmental permits or other Authorizations as needed or modified during facilities construction.

Recording & Reporting: Environmental compliance records will be completed daily (as applicable) on standard reporting forms. Other records may include daily logbooks, meeting notes, correspondence, or records of telephone conversations. Compliance reports & other appropriate records will be logged into the field HSE office and copies transmitted to the project office.

Forms will be used to document field inspection activities. They become permanent documents when completed by the HSE personnel and reviewed and signed by the appropriate supervisor, as required. Documentation that will be used by field environmental compliance personnel is summarized below.

Daily Environmental Inspection Checklist : The purpose of the checklist (to be prepared by HSE department) is to document the results of the environmental inspection activities conducted during the day with respect to compliance of observed construction activities relative to applicable environmental requirements.

The HSE Manager reviews the report for adequacy and accuracy and identifies potential problem areas. Construction signoff is required only if there is a noncompliance requiring action and/or acknowledgement by Construction. Copies of all checklists are filed in the site HSE files.

Weekly Inspection Report: A weekly inspection report is prepared by the site HSE personnel after completing a general inspection of site and submitted to the field HSE Manager with copies to the Environmental Lead. The report includes:

- Summary of inspection and monitoring efforts on the spread over the past week;
- Identification of any non-compliance and steps taken to correct non-compliance;
- Any other issues or problems encountered in carrying out inspection activities (e.g., schedule delays);

- Government representatives on-site during the week;
- Inspection and monitoring plans and schedules for the upcoming week.
- General site audit and completion of the "Weekly Inspection Checklist".
- The Owner will have a standing invitation to accompany project personnel on this audit. The checklist will be modified over time to reflect pertinent issues related to the phase of construction presently occurring.

7.17 Contingency planning-accidents & malfunctions

7.17.1 Fire Contingency Plan

Because flammable/combustible materials are present at this site, fire is an ever-present hazard.

All personnel and subcontractors are not trained professional fire-fighters. Therefore, if there is any doubt that a fire cannot be quickly contained and extinguished, personnel will notify the Site Superintendent by radio and vacate the area. The Site Superintendent will immediately notify the local Fire Department.

The following procedures will be used to prevent the possibility of fires and resulting injuries:

- Sources of ignition will be kept away from where flammable materials are handled or stored.
- The air will be monitored for exclusivity before and during hot work and periodically where flammable materials are present. Hot work permits will be required for all such work.
- No Smoking" signs will be conspicuously posted in areas where flammable materials are present.
- Fire extinguishers will be placed in all areas where a fire hazard may exist.
- Before workers begin operations in an area, the foreman will give instruction on egress procedures and assembly points. Egress routes will be posted in work areas and exit points clearly marked.
- The following procedures will be implemented in the event of a fire:
- Anyone who sees a fire will notify their supervisor who will then contact the Site Superintendent and the Health and Safety Officer by radio. The Health and Safety Officer will activate the emergency air horns and contact the local Fire Department.
- When the emergency siren sounds, workers will disconnect electrical equipment in use (if possible) and proceed to the nearest fire exit.
- Work crews will be comprised of pairs of workers (buddy system) who join each other immediately after hearing the fire alarm and remain together throughout the emergency. Workers will assemble at a predetermined rally point for a head count. When a small fire has been extinguished by a worker, the Site Superintendent and the Health and Safety Officer will be notified.

Evacuation Procedures: In the event on-site evacuation of remedial action personnel is necessary, the following actions will be taken:

- The emergency signal will be activated (one single long blast on the air horn).

- No further entry of visitors, contractors, or trucks will be permitted. Vehicle traffic within the site will cease in order to allow safe exit of personnel and movement of emergency equipment.
- Shut off all machinery if safe to do so.
- All on-site personnel, visitors, and contractors in the support zone will assemble at the entrance to the site for a head count and await further instruction from the Site Superintendent.
- All persons in the exclusion zone and contamination reduction zone will be accounted for by their immediate crew leaders (e.g., foremen). Crew leaders will determine the safest exits for employees and will choose an alternate exit if the first choice is inaccessible.
- During exit, the crew leader will try to keep the group together. Immediately upon exit, the crew leader will account for all employees in his crew.
- Upon completion of the head count, the crew leader will provide the information to the Site Superintendent.
- Contract personnel and visitors will also be accounted for.
- The names of emergency response team members involved will be reported to the Site Superintendent.
- A final tally of persons will be made by the Site Superintendent or designee. No attempt to find persons not accounted for will involve endangering lives of employees by re-entry into emergency.
- In all questions of accountability, immediate crew leaders will be held responsible for those persons reporting to them. Visitors will be the responsibility of those employees they are seeing. Contractors and truck drivers are the responsibility of the Site Superintendent. The Health and Safety Officer will aid in accounting for visitors, contractors, and truckers by reference to sign-in sheets available from the guard shack.
- Personnel will be assigned by the Site Superintendent to be available at the main gate to direct and brief emergency responders.
- Re-entry into the Site will be made only after clearance is given by the Site Superintendent. At his direction, a signal or other notification will be given for re-entry into the Site.
- Drills will be held periodically to practice all of these procedures and will be treated with the same seriousness as an actual emergency.

7.17.2 Hazardous Spill Contingency Plan

In the event of an emergency involving hazardous material spill or release, the following general procedures will be used for rapid and safe response and control of the situation.

Emergency contacts provide a quick reference guide to follow in the event of a major spill. Hazmat spill responses will be coordinated through the local Emergency Response Centre.

Notification Procedures: If an employee discovers a chemical spill or a vapor or material release, he or she will immediately notify the Site HSE personnel.

The Site HSE personnel will obtain information pertaining to the following:

- The material spilled or released.
- Location of the release.
- An estimate of quantity released and the rate at which it is being released.

- The direction in which the spill, vapor or smoke caused by the release is heading.
- Any injuries involved.
- Fire and/or explosion or possibility of these events.
- The area and materials involved and the intensity of the fire or explosion.

This information will help the Site HSE personnel to assess the magnitude and potential Seriousness of the spill or release.

Procedure for Containing/Collecting Spills: The initial response to any hazardous spill or discharge will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If, for some reason, a chemical spill is not contained within a dike or sump area, an area of isolation will be established around the spill. The size of the area will generally depend on the size of the spill and the materials involved. If the spill is large (greater than 55 gallons) and involves a tank or a pipeline rupture, an initial isolation of at least 100 feet in all directions will be used. Small spills (less than or equal to 55 gallons) or leaks from a tank or pipe will require evacuation of at least 50 feet in all directions to allow cleanup and repair and to prevent exposure. When any spill occurs, only response personnel will be allowed within the designated affected area. If possible, the area will be roped or otherwise blocked off.

If the spill results in the formation and release of a toxic vapor cloud, further evacuation will be enforced. In general, an area at least 500 feet wide and 1,000 feet long will be evacuated downwind if volatile materials are spilled.

If an incident may threaten the health or safety of the surrounding community, settlement, etc., it will be consulted and determine if the public will be informed and possibly evacuated from the area. The Site HSE personnel will inform the proper agencies in the event of its being necessary. All petroleum product spills on the water will be reported to the Environment Protection Agency.

The designated Response personnel will take the following measures:

- Avoid breathing vapors of spilled material.
- If possible and safe to do so, turn off any ignition source or gas emergency shutoff valve.
- Make sure all unnecessary persons are evacuated from the hazard area.
- Put on protective clothing and equipment.
- If a flammable material is involved, remove all ignition sources, and use spark and explosion proof equipment for recovery of material.
- Determine the major components in the waste at the time of the spill and remove all surrounding materials that could be reactive with the spilled material.
- If wastes reach a storm sewer; try to dam the outfall by using sand, earth, sand bags, etc. If this is done, pump this material out into a temporary holding tank or drums as soon as possible.
- If volatile emissions may occur, spray the spill area with foam, if available.
- Apply appropriate spill control media to absorb discharged liquids.

- For large spills, establish dyke around leading edge of spill using booms, soil or other appropriate material. If possible, use a diaphragm pump to transfer discharged liquid to drums or a holding tank.

Emergency spill response cleanup materials and equipment: The supply of appropriate emergency response cleanup and personal protective equipment on hand will be inventoried and visually inspected on a weekly basis.

The materials listed below will be kept onsite for spill control depending on the types of hazardous materials present. The majority of this material will be located in the support zone, in a supply trailer or storage area.

- Activated charcoal (carbon) to adsorb organic solvents (hydrocarbons) and to reduce flammable vapors.
- Appropriate solvents, for decontamination of structures or equipment.

The following equipment will be kept onsite and dedicated for spill cleanup:

- Plastic shovels for recovering corrosive and flammable materials.
- Sausage-shaped absorbent booms for dyke liquid spills, drains, or sewers.
- Sorbent sheets (diapers) for absorbing liquid spills.
- Over pack drums for containerizing leaking drums.
- 55-gallon open-top drums for containerization of waste materials.

Once a hazard has been recognized, take immediate action to prevent the hazard from becoming an emergency. This may be accomplished by the following:

- Daily safety meeting
- Task-specific training prior to commencement of activity
- Lock-out/tag-out
- Personal protective equipment (PPE) selection/use
- Written and approved permits for hot work, confined space
- Air monitoring
- Following all standard operating procedures
- Practice drills for fire, medical emergency and hazardous substances spills.

7.17.3 Housekeeping

In order to reduce the possibility of accidental spills and safety hazards, good housekeeping practices will be followed. They include prompt removal of small spills, regular maintenance of walking areas, regular removal of refuse, and staging of similar materials together.

7.17.4 Security

All rules and regulations set up by landowner will be followed by all personnel on site.

7.17.5 Training

All site personnel are trained to operate the equipment that is present at the site.

7.17.6 Fire Detection and Warning

Portable Fire extinguishers will be used in buildings and as protection during "Hot Work" activities throughout the site. As construction progresses and systems are commissioned within specific buildings, personnel will be informed of the differential of alarm sounds.

- Large office accommodation will be protected by the use of hard-wired smoke detection devices with battery backup.
- A suitable means of raising the alarm in the event of a fire or other emergency at the LNG terminal will be established.

The alarm system will be appropriate to ensure all personnel can be notified immediately of any emergency situation and evacuation, or other actions required. The alarm system will be tested on a regular basis.

7.17.7 Site Accommodation

Site accommodation (all temporary facilities) shall be designed and laid out in such a manner so as to reduce the risk of fire to the minimum.

- Good housekeeping shall be observed at all times throughout buildings with desks cleared at the end of each working day and sensitive documents locked away in flame proof cabinets/ lockers.
- All site accommodation shall have sufficient multipurpose dry powder extinguishers located at the access door with signs indicating their positions.
- Additional CO_2 extinguishers shall be provided to cover other electrical equipment.
- All fire extinguishers are visually checked on a regular basis through weekly area inspections and quarterly in accordance with equipment tagging process.

7.17.8 Fire drills

- The Fire Safety Coordinator shall ensure that monthly drills are carried out that ensure all personnel are familiar with the evacuation procedure and their respective muster points.
- Simulated fires shall be carried out to ensure the readiness and competency of the fire brigade to fight a major fire. During the drill equipment shall be tested and shall adequately work. In the event any piece of equipment should fail it shall be immediately replaced.
- Review of brigade competency shall be determined during the drills. Brigade members shall be retrained if any evidence of in-competency exists.

7.17.9 Materials Storage

- The HSE Officer at site must be informed of all flammable gases and liquids being brought onto site.
- Oxygen and fuel gas cylinders shall not be stored together. Singular oxygen, acetylene carts will be acceptable as long as they are in use together.

- No flammable materials including solids, gases or liquids shall be stored next to any temporary facilities.
- Storage of flammable gases shall be a minimum of 5 meters from any occupied building suitably secured and with a prominent sign stating "*DANGER HIGHLY FLAMMABLE*".
- Storage facilities for flammable gases will be inspected by the Site ES&H Manager prior to being used.
- Material storage within the warehouse facility will maintain an excellent standard of housekeeping at all times. Flammable material packaging shall be removed to a safe location as it becomes redundant. Sprinkler systems shall be investigated in warehousing facilities, and were possible installed.
- Materials shall be stored in compliance with OSHA and EPA regulations.

7.17.10 Firefighting Equipment

The following firefighting equipment shall be maintained in good order at the Project and Equipment will also be suitable for fighting bush fires in and around the LNG Project:

- Fire Extinguishers of adequate size and number
- Fire hose and nozzles
- Bunker gear
- Air packs
- 1 water tank with pumping capabilities
- Fire pumps of sufficient size to fill tank
- Assorted accessories for connecting hoses and fighting fires (wrenches, hose clamps, axes, etc.
- Rescue gear for high level rescue (if this is assigned to this group)
- Equipment shall be maintained and tested to ensure serviceability in the event of a fire.
- Tests shall be conducted monthly.
- A water fill station including a storage tank of adequate size to meet construction fire requirements shall be installed to facilitate the filling of the pumper truck and tanker.
- The plant fire suppression system shall be prioritized and serviceable as soon as practical during construction.

7.17.11 Training

All employees shall receive general firefighting training (i.e. fire extinguisher use). Employees who are members of the fire brigade shall receive at a minimum the following training:

- Use and limitations of the firefighting equipment
- Firefighting strategies and methods
- Use of respiratory equipment and its limitations
- Donning bunker gear and its care
- Care and maintenance of firefighting equipment and hoses
- Confined space entry and firefighting in a confined space
- First aid
- High level rescue (if the site assigns this responsibility to this group)

7.17.12 Communication and Navigation

Communication systems of the terminal include Marine VHF ship to shore communication, CCTV system, DAS (Docking / Berthing Aid System), MLMS (Mooring Line Load Monitoring System), MEMS (Marine Environmental Monitoring System) and SSL (Ship to Shore Communication Link System).

1) The Wire Telephone Communication System

5 sets of telephone will be set at the service terminal and equipment room, which should be connected to the wire telephone communication system at the onshore control center.

2) Marine VHF Ship to Shore Communication System

In order to set up the communication link between ships and LNG terminal, one ship to shore communication system will be constructed. Marine VHF telephone system is set for ship to shore communication. The system at LNG terminal includes two table marine VHF transceivers, antenna, UPS power and several portable sets. The system will cover no less than A1 zone including anchorage area. 5 VHF handsets will be set.

The system will also be used as communication method between LNG terminal and management worker of EMPLOYER on shore. An equal system will also be constructed on shore.

All equipment must meet the requirement of Global Maritime Distress & Safety System (GMDSS).

3) CCTV System

CCTV system will be constructed to cover the terminal area for security, supervision and process monitoring. The CCTV system will be digital network switch system. Camera and monitor are connected to switch system by IP mode. The interface to LAN will be provided to permit the LAN pc to view the CCTV video.

The cameras will be IP cameras fixed with digital PTZ or integrated network dome according to the specific condition. About 8 outdoor cameras are envisaged to be set to monitor the jetty and berth, terminal entrance, and etc. 1 indoor camera is envisaged to be set to monitor the control room.

Data base storage with disk array, network switch LCD monitors and control PCs will provided at the control room. Through the optical fiber, the signal of the jetty control room shall be transferred to the CCTV system in onshore control center.

4) Integrated Assisting Berthing System

The integrated assisting berthing system comprises berthing aid system, marine environmental monitoring system and mooring line monitoring system. DAS (Docking / Berthing Aid System) Two laser detectors will be installed for the berth to measure the berthing angle, distance and approaching speed of carriers. This data shall be transferred to the control center. The control center should be equipped with console, printers and corresponding software to manage and record the data.

One large displayer will be set at the remarkable place of the berth to show the aforesaid data synchronously to instruct the berthing operation for captain of carrier. Meanwhile, the pilot of tugboats should be equipped with pager displayer sets to indicate the same data. MLMS (Mooring Line Load Monitoring System) The System comprises of a number of sub-systems. Sensors of each sub-system shall be located at the jetty. The information from these sensors will be routed and processed at the Data Acquisition Unit (DAU) located in the control room.

The sub-systems are as follows:

- Wind speed and direction sensor
- Air temperature/Humidity sensor
- Air pressure sensor
- Visibility sensor
- Precipitation Gauge
- Sea current meter
- All the data will be shown synchronously on the large displays and pager displayer sets.
- MEMS (Marine Environmental Monitoring System)

With reference to the safe mooring, loading pins of mooring line monitoring system should be set at each quick release hook of each berth. The system includes pressure sensors, signal amplifier and data transfer system. All the real time data will be indicated in the control center.

Once the mooring tension rises to the breaking limits, alarm signals will be launched in the form of voice and flash light.

5) SSL (Ship to Shore Communication Link System)

SSL for ESD will be provided for the terminal.

6) Aids to Navigation

The aids to navigation of this project will include leading marks, light buoys and light beacons.

Leading Marks: One new pairs of leading marks shall be built for the straight approach channels. The structures of towers should be steel structure. Beacon L1 and L2 should be located in the land, the elevation is 30 meters and 40 meters. The elevation should be above mean high water. A single set of high intensity lights and solar powers shall be installed for each mark

Light Buoys: Four light buoys will be set to mark the route of channel and three light buoys will be set to mark the boundary of the turning basis.

Each light buoy assembly will consist of one marine buoy, one marine lantern, solar power generation system and battery, and mooring hardware.

Light Beacon: Two light beacons will be set at both end of the breakwater. Two navigation lights will be set at both end of the terminal (at mooring dolphin).

The structure of the light beacon will be of GRP tower. It is 10m high with diameter of 1.0m. The marine LED lantern will be used for the light beacon.

All the aids to navigation should fit to IALA regulation and recommendation.

Chapter 8 Conclusion

The Environmental & Social Impact Assessment (ESIA) has evaluated the potential environmental, social, economic, cultural, and natural impacts of the proposed Pakistan Floating LNG Terminal Project. This assessment has been carried out to fulfill the regulatory requirements of Baluchistan Environmental Protection Act (BEPA) 2012 and the rules and regulations framed thereunder.

Baseline environmental and socioeconomic information was collected from a variety of sources, including reports of previous studies, published literature, and field surveys. The information collected was used to compose profiles of the natural, socioeconomic, and cultural environments likely to be affected by the project. The impact assessment and proposed mitigation measures are based on the selected site in Sonmiani Bay. The selection of site by the proponent (Bahria Foundation) has been done after a comprehensive qualitative/quantitative risk analysis as part of the techno-economic feasibility.

EMC has carried out analysis on the siting of the LNG terminal. Environmentally the proposed site has been found feasible provided that the mitigations suggested are carried out. It raises minimum social and environmental issues and avoids any adverse environmental impacts; it additionally is economically more viable than the others. Proactive planning and commitment to environmental compliance shall make the project successful.

The specific criteria used for determining the significance of impacts are identified for each resource, and the following assumptions are generally used when evaluating the potential project impacts:

- Bahria Foundation as project proponent shall comply with all applicable laws and regulations;
- The construction phase of the project shall proceed as described in Section 3; and
- Bahria Foundation as proponent shall implement the mitigation measures and Environmental Management Plan in letter and Spirit.

The ESIA study finds that the Offshore LNG Terminal by Bahria Foundation is compatible with the aims and objectives of (a) Sustainable Development in promoting improvement in quality of life, and (b) Energy Sector in making available a sustainable energy source and thus contributing to sustainable economic development in Pakistan.

The cumulative impact of this project on the National economy will be a strongly positive one. Significant additional resources will be realized by the nation as a result of this project, which is consistent with the government's long-term development plan. The additional licensing income, among other sources of additional income, will add to the government revenues and economic growth resulting from expanded and diversified business development in Pakistan.

ANNEXURES

ANNEX – I – Balochistan Environmental Protection Act, 2012

BALOCHISTAN PROVINCIAL ASSEMBLY SECRETARIAT

BALOCHISTAN ENVIRONMENTAL PROTECTION BILL 2012 BILL NO. ___

OF 2012.

A

BILL

Balochistan Environmental Protection Bill 2012.

to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development

Preamble

Whereas, it is expedient to provide for the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution, promotion of sustainable development, and for matters connected therewith and incidental thereto;

Short title, extent and commencement

1. It is enacted as follows:-

(1) *This Act, shall be called the Balochistan Environmental Protection Act, 2012.*

(2) *It extends to the whole Province of Balochistan except Tribal Areas.*

(3) It shall come into force at once.

Definitions

2. In this Act, unless there is anything repugnant in the subject or context,—

(a) adverse environmental effect" means impairment of, or damage to, the environment and includes—

(i) human health and property or biodiversity, coast, beaches and ecosystem;

(ii) pollution; and

(iii) any adverse environmental effect on Land, Air and Water;

(b) "Agricultural waste" means waste from farm and agricultural activities including poultry, cattle farming, animal husbandry residues from the use of fertilizers, pesticides and other farm . chemicals;

(c) "Air pollutant" means any substance that causes pollution of air and includes soot, smoke, dust particles, odour, light, electro-magnetic, radiation, heat, fumes, combustion exhaust, exhaust gases, noxious gases, hazardous substances and radioactive substances;

(d) *"Alien species" means a species that does not occur naturally in Balochistan.*

(e) *"Balochistan coastline or coastal zone" means the territorial jurisdiction of the coastline of the Province of Balochistan.*

(f) *"Best practicable environmental option" means the best method for preventing or minimizing adverse effects on the environment, having regard to, among other things:*

(i) the nature of the discharge and the sensitivity of the receiving environment to adverse effects;

(ii) the financial implications, and the effect on the environment, of that option when compared with other options; and

(iii) the current state of technical knowledge and the likelihood that the option can be successfully applied.

(g) "Biodiversity" or "biological diversity" means the variability among living organisms from all sources, including inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems;

(h) *"Clinical waste" means any waste produced by hospitals, clinics, nursing homes, doctor's offices, medical laboratories, medical research facilities and veterinarians which is infectious or potentially infectious.*

(i) "Council" means the Balochistan Environmental Protection Council established under section 3;

(j) "Discharge" includes spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping;

(k) "Ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non- living environment interacting as a functional unit;

(l) "Effluent" means any material in solid, liquid or gaseous form or combination thereof being discharged from industrial activity or any other source and includes a slurry, suspension or vapor;

(m) "Electronic waste" means discarded computers, office electronic equipment, entertainment device electronics, mobile phones, television sets, Cathode ray tubes (CRT) and refrigerator, VCRs, stereos, copiers, and fax machines. It also includes used electronics which are destined for reuse, resale, salvage, recycling, or disposal and electronic products nearing the end of their "useful life."

(n) "Emission standards" means the permissible standards established by the Provincial Agency for emission of air pollutants and noise and for discharge of effluent and waste;

(o) "Endemic and indigenous species" means a species which occurs naturally in the wild only in Balochistan, or a species which only breeds in the wild in Balochistan.

(p) "Environment" means—

(i) air, water and land;

(ii) all layers of the atmosphere;

(iii) all organic and inorganic matter and living organisms;

(iv) the ecosystem and ecological relationships;

(v) buildings, structures, roads, facilities and works;

(vi) all social and economic conditions affecting community life; and

(vii) the inter-relationships between any of the factors specified in sub-clauses (i) to (vi);

(q) "Environmental impact assessment" means an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigation and compensatory measures, formulation of environmental management and training plans and monitoring arrangements, and framing of recommendations and such other components as may be prescribed;

(r) "Environmental Magistrate" means the Magistrate of the First Class appointed under Section 32 ;

(s) "Environmental Tribunal" means the Balochistan Environmental Protection Tribunal constituted under section 28;

(t) "Exclusive Economic Zone" shall have the same meaning as in the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(u) "Factory" means any premises in which industrial activity is being undertaken;

(v) "Genetic Resource" means any material of plant, animal, microbial or other origin containing functional units of heredity of actual or potential value.

(w)"Government" means the Government of Balochistan.

(x) "Government Agency" includes—

(i) a department, attached department, bureau, section, commission, board, office or unit of the Provincial Government;

(ii) a developmental or a local authority, company or corporation established or controlled by the Provincial Government; and

(iii) the Balochistan Environmental Protection Agency. ; and

(iv) any other body defined and listed in the Rules of Business of the Provincial Government.

(y) "Handling", in relation to any substance, means the manufacture, processing, treatment, package, storage, transportation, collection, destruction, conversion, offering for sale, transfer or the like of such substance;

(z) "Hazardous substance" means—

(i) a substance or mixture of substances, other than a pesticide as defined in the Agricultural Pesticides Ordinance, 1971 (II of 1971), which, by reason of its chemical activity or toxic, explosive, flammable, corrosive, radioactive or other characteristics, causes, or is likely to cause, directly or in combination with other matters an adverse environmental effect; and

(ii) any substance which may be prescribed as a hazardous substance;

(aa) "Hazardous waste" means waste which is or which contains a hazardous substance or which may be prescribed as hazardous waste and includes hospital waste and nuclear waste;

(bb) "Historic waters" means such limits of the waters adjacent to the land territory of Pakistan as may be specified by notification under section 7 of the Territorial Waters and Maritime Zones Act, 1976 (LXXXII of 1976);

(cc) "Hospital waste" includes waste medical supplies and materials of all kinds, and waste blood, tissue, organs and other parts of the human and animal bodies, from hospitals, clinics and laboratories;

(dd) "Industrial activity" means any operation or process for manufacturing, making, formulating, synthesizing, altering, repairing, ornamenting, finishing, packing or otherwise treating any article or substance with a view to its use, sale, transport, delivery or disposal, or for mining, for oil and gas exploration and development, or for pumping water or sewage, or for generating, transforming or transmitting power or for any other industrial or commercial purpose;

(ee) "Industrial waste" means waste resulting from an industrial activity;

(ff) "Initial Environmental Examination" means a preliminary environmental review of the reasonably foreseeable qualitative and quantitative impacts on the environment of a proposed project to determine whether it is likely to cause an adverse environmental effect for requiring preparation of an environmental impact assessment;

(gg) “Integrated pollution control” means the holistic system aimed at pollution prevention and minimization at source, managing the impact of pollution and waste on the receiving environment and remediation of damaged and polluted environments.

(hh) “Living modified organism” means any living organism that possesses a novel combination of genetic material obtained through the use of modern technology.

(ii) "local authority" means regional or district set up of EPA or any Agency designated by the Provincial Government, by notification in the official Gazette, to be a local authority for the purposes of this Act;

(jj) "Local council" means a local council constituted or established under a law relating to local Government;

(kk) "Motor vehicle" means any mechanically propelled vehicle adapted for use upon land whether its power of propulsion is transmitted thereto from an external or internal source, and includes a chassis to which a body has not been attached, and a trailer, but does not include a vehicle running upon fixed rails;

(ll) "Municipal waste" includes sewage, refuse, garbage, waste from abattoirs, sludge and human excreta and the like;

(mm) "Environmental Quality Standards" means standards established by the Federal/Provincial Agencies under clause (e) of sub-section (1) of section 6 and approved by the Council under clause (c) of sub - section (1) of section 4;

(nn) "Noise" means the intensity, duration and character of sounds from all sources, and includes vibration;

(oo) "Nuclear waste" means waste from any nuclear reactor or nuclear plant or other nuclear energy system, whether or not such waste is radioactive;

(pp) "Person" means any natural person or legal entity and includes an individual, firm, association, partnership, society, group, company, corporation, co-operative society, Government Agency, non-governmental organization, community-based organization, village organization, local council or local authority and, in the case of a vessel, the master or other person having for the time being the charge or control of the vessel;

(qq) "Pollution" means the contamination of air, land or water by the discharge or emission of effluent or wastes or air pollutants or noise or other matter which either directly or indirectly or in combination with other discharges or substances alters unfavorably the chemical, physical, biological, radiation, thermal or radiological or aesthetic properties of the air, land or water or which may, or is likely to make the air, land or water unclean, noxious or impure or injurious, disagreeable or detrimental to the health, safety, welfare or property of persons or harmful to biodiversity;

(rr) "Prescribed" means prescribed by rules made under this Act;

(ss) "Project" means any activity, plan, scheme, proposal or undertaking involving any change in the environment and includes—

(i) construction or use of buildings or other works;

(ii) construction or use of roads or other transport systems;

(iii) construction or operation of factories or other installations;

(iv) mineral prospecting, mining, quarrying, stone-crushing, drilling and the like;

(v) any change of land use or water use; and

(vi) alteration, expansion, repair, decommissioning or abandonment of existing buildings or other works, roads or other transport systems, factories or other installations;

(tt) "Protection of environment" means the qualitative and quantitative improvement of the different components of the environment and prevention of the deterioration of qualitative and quantitative standards;

(uu) "Proponent" means the person who proposes or intends to undertake a project;

(vv)"Provincial Agency" means the Balochistan Environmental Protection Agency established under section 5, or any Government Agency, local council or local authority exercising the powers and functions of the Provincial Agency;

(ww) "Rules &Regulations" means rules and regulation made under this Act;

(xx) "Sewage" means liquid or semi-solid wastes and sludge from sanitary conveniences, kitchens, laundries, washing and similar activities and from any sewerage system or sewage disposal works;

(yy) "Ship breaking" means breaking up of various types of ship for recycling.

(zz) "Standards" means qualitative and quantitative standards for discharge of effluent and wastes and for emission of air pollutants and noise either for general applicability or for a particular area, or from a particular production process, or for a particular product, and includes the Environmental Quality Standards, emission standards and other standards established under this Act and the rules and regulations;

(aaa) "Strategic Environmental Assessment" Strategic environmental assessment (SEA) is a system of incorporating environmental considerations into policies, plans, programmes and strategies. It is sometimes referred to as strategic environmental impact assessment.

(bbb) "Sustainable Development" means development that meets the needs of the present generation without compromising the ability of future generations to meet their needs;

(ccc) "Sustainable Management" means management of the use of natural resources to provide for the health, safety and social, cultural and economic well-being of people and communities taking into account the following:

(i) safeguarding the life-supporting capacity of natural resources and ecosystems;

(ii) ensuring the maintenance of the life-supporting capacity and quality of natural resources and ecosystems to meet the reasonably foreseeable

needs of future generations;
(iii) avoiding the creation of adverse effects and, where adverse effects cannot be avoided, mitigates and remedies adverse effects.

(ddd) "*Territorial waters" shall have the same meaning as in the Territorial Waters and Maritime Zones Act, l 976 (LXXXII of 1976);*

(eee) "Vessel" includes anything made for the conveyance by water of human beings or of goods; and

(fff) "Waste" means any substance or object which has been, is being or is intended to be, discarded or disposed of, and includes liquid waste, solid waste, waste gases, suspended waste, industrial waste, agricultural waste, nuclear waste, municipal waste, hospital waste, used polyethylene bags and residues from the incineration of all types of waste.

(ggg) "Water resource" includes surface water, an aquifer or ground water , a river or spring, a natural channel in which water flows regularly or intermittently, and a wetland, lake or dam into which, or from which, water flows.

Establishment of the Balochistan Environmental Protection Council.—

3. (1) The Provincial Government shall, by notification in the official Gazette, establish a Council to be known as the Balochistan Environmental Protection Council consisting of—

(a) Chief Minister or such other person as the Chief Minister may nominate in this behalf.	Chairperson
(b) Minister for Environment	Vice chairperson
(c) Chief Secretary Balochistan	Member
(d) Secretary Environment	Member/Secretary
(e) Secretary Finance	Member
(f) Secretary Industries	Member
(g) Secretary Agriculture	Member
(h) Secretary Forest	Member
(i) Secretary P&D	Member
(j) Secretary S&GAD	Member
(k) Director General EPA	Member

(l) Such other persons not exceeding six (6) as the Provincial Government may appoint, with the following representation:

One from the Balochistan Chamber of Commerce & Industries and one from the Balochistan Chamber of Agriculture, Two Environment experts/Scientist, One Educationist and One from Non Governmental Organization.

(2) The Members of the Council, other than ex-officio members, shall be appointed in accordance with the prescribed procedure and shall hold office for a term of two years.

(3) The Council may constitute committees of its members and entrust them with such functions as it may deem fit, and the recommendations of the

committees shall be submitted to the Council for approval. The council or any of such committee may seek assistance from any Government Department or expert in the relevant environmental field in performance of its functions.

Functions and powers of the Council.—

4. (1) The Council shall:-

(a) co-ordinate and supervise enforcement of the provisions of this Act; and

(b) approve comprehensive environmental policies and ensure their implementation within the framework of a National /Balochistan conservation strategy as may be approved by the Federal/Provincial Government from time to time;

(c) approve the Environmental Quality Standards;

(d) provide guidelines for the protection and conservation of species, habitats, and biodiversity in general, and for the conservation of renewable and non-renewable resources.

(e) co-ordinate integration of the principles and concerns of sustainable development into development plans and policies;

(f) The Council shall frame its own rules of procedure.

(g) The Council shall hold meetings, as and when necessary, but not less than two meetings, shall be held in a year.

(2) The Council may direct the Provincial Agency or any Government Agency to prepare, submit or implement projects for the protection, conservation, rehabilitation and improvement of the environment and the sustainable development of resources or to undertake research in any aspect of environment.

Establishment of the Balochistan Environmental Protection Agency.

5. (1) The Government of Balochistan shall by a notification in the official Gazette established Balochistan Environmental Protection Agency to exercise the powers and perform the functions assigned to it under this Act and the rules and regulations made there under.

(2) The Balochistan Environmental Protection Agency shall be headed by a Director-General who shall be appointed by the Government of Balochistan on such terms and conditions as it may determine.

(3) The Balochistan Environmental Protection Agency shall have such administrative, technical and legal staff, as the Government of Balochistan may specify, to be appointed in accordance with Balochistan Civil Servant Act 1974.

(4) The powers and functions of the Balochistan Environmental Protection Agency shall be exercised and performed by the Director-General.

(5) The Director-General may, by general or special order, delegate any of the powers and functions to staff appointed under sub-section (3).

(6) For assisting the Balochistan Environmental Protection Agency in the discharge of its functions the Government of Balochistan shall establish Advisory Committees for various sectors and appoint as members thereof representatives of the relevant sector, educational institutions and non- governmental organizations.

Functions of the Balochistan Environmental Protection Agency

6. (1) The Balochistan Environmental Protection Agency shall—

(a) administer and implement this Act and the rules and regulations made;

thereunder;

(b) prepare, in co-ordination with the relevant Government Agency and in consultation with the concerned sectors Advisory Committees, environmental policies for approval by the Council;

(c) take all necessary measures for the implementation of the national environmental policies approved by the Council;

(d) prepare and publish an Annual Environment Report on the state of the environment;

(e) establish standards for the quality of the ambient air, water and land, by notification in the official Gazette in consultation with the other relevant Government Departments/ Agencies.

(f) Revise the Environmental Quality Standards with approval of the Council:

Provided that

(i) before seeking approval of the Council, the Balochistan Environmental Protection Agency shall publish the proposed Environmental Quality Standards for public opinion in accordance with the prescribed procedure; and

(ii) different standards for discharge or emission from different sources and for different areas and conditions may be specified; where standards are less stringent than the Environmental Quality Standards prior approval of the Council shall be obtained;

(iii) certain areas, with the approval of the Council, may exclude from carrying out specific activities, projects from the application of such standards;

(g) co-ordinate environmental policies and programmes;

(h) establish systems and procedures for surveys, monitoring, measurement, examination, investigation, research, inspection and audit to prevent and control pollution, and to estimate the costs of cleaning up pollution and rehabilitating the environment in various sectors;

(i) take measures to promote research and the development of science and technology which may contribute to the protection of the environment, and sustainable development;

(j) certify one or more laboratories as approved laboratories for conducting tests and analysis and one or more research institutes as environmental research institutes for conducting research and investigation for the purposes of this Act.

(k) initiate legislation in various sectors of the environment;

(l) render advice and assistance in environmental matters including such information and data available with it as may be required for carrying out the purposes of this Act:

Provided that the disclosure of such information shall be subject to the restrictions contained in the proviso to sub-section (3) of section 15;

(m) assist the local councils, local authorities, Government Agencies and other persons to implement schemes for the proper disposal of wastes so as to ensure compliance with the standards established by it;

(n) provide information and guidance to the public on environmental matters;

(o) recommend environmental courses, topics, literature and books for incorporation in the curricula and syllabi of educational institutions;

(p) promote public education and awareness of environmental issues through mass media and other means including seminars and workshops;

(q) specify safeguards for the prevention of accidents and disasters which may cause pollution, collaborate with the concerned person in the preparation of contingency plans for control of such accidents and disasters, and co-ordinate implementation of such plans;

(r) encourage the formation and working of non-governmental organizations, community organizations and village organizations to prevent and control pollution and promote sustainable development;

(s) perform any function which the Council may assign to it.

(2) The Balochistan Environmental Protection Agency may—

(a) undertake inquiries or investigation into environmental issues, either of its own accord or upon complaint from any person or organization;

(b) request any person to furnish any information or data relevant to its functions;

(c) initiate with the approval of the ***Provincial/Federal Government,*** requests for foreign assistance in support of the purposes of this Act and enter into arrangements with foreign agencies or organizations for the exchange of material or information and participate in international seminars or meetings;

(d) recommend to the Government of Balochistan the adoption of financial and fiscal programmes, schemes or measures for achieving environmental objectives and goals and the purposes of this Act, including—

(i) incentives, prizes awards, subsidies, tax exemptions, rebates and depreciation allowances; and

(ii) taxes, duties and other levies;

(e) establish and maintain laboratories to help in the performance of its functions under this Act and to conduct research in various aspects of the environment and provide or arrange necessary assistance for establishment of similar laboratories in the private sector;

(f) provide or arrange, in accordance with such procedure as may be prescribed, financial assistance for projects designed to facilitate the discharge of its functions.

Powers of the Balochistan Environmental Protection Agency

7. Subject to the provisions of this Act*, the Balochistan Environmental Protection Agency may*

(a) lease, purchase, acquire property both moveable and immovable;

(b) fix and realize fees, rates and charges for rendering any service or providing any facility, information or data under this Act or the rules and regulations;

(c) enter into contracts, execute instruments subject to approval of the Provincial Government, necessary for proper management and conduct of its business made thereunder;

(d) subject to approval of the Provincial Government appoint in accordance with prescribed procedures such experts and consultants as it considers necessary for the efficient performance of its functions on appropriate terms and conditions;

(e) summon and enforce the attendance of any person and require him to supply any information or document needed for the conduct of any enquiry or investigation into any environmental issue;

(f) The Director General Balochistan EPA or any other Regional officer specifically authorized in this behalf by the Director General shall have the power to impose fine/administrative penalty up to rupees one hundred thousand from case to case basis.

(i) the fine/administrative penalty shall be recovered as per land revenue act.

(ii) the fine/administrative penalty initially or for an interim period shall be placed with the Balochistan EPA till the decision of the Environmental Tribunal or Magistrate; and

(iii) the fine/administrative penalty after the final decision shall be deposited in the public exchequer.

(g) enter and inspect and under the authority of a search warrant issued by the Environmental Court or Environmental Magistrate, search at any reasonable time, any land, building, premises, vehicle or vessel or other place where or in which. there are reasonable grounds to believe that an offence under this Act has been, or is being, committed;

(i) Subject to the provisions of this Act, any person generally or specifically authorized in this behalf by the Director General shall be entitled to enter, at all reasonable times, with such assistance as he considers necessary, any building or place for the following purposes, namely:-

a) to perform duties conferred on him under this Act or rules;

b) to inspect any activity in such building or place in accordance with this Act, the rules or any notice, order or direction issued thereunder;

c) to examine or test any equipment, industrial plant, record, register or any other important matter relating thereto;

d) to conduct a search of any building or place which the said person has reason to believe to have been the place of occurrence of any offence in contravention of any notice, order or direction issued under this Act or the rules;

e) to seize/close any equipment, industrial plant, record, register, document or other matter which may serve as evidence of the commission of any offence punishable under this Act or the rules.

(ii) The provisions of the Code of Criminal Procedure shall be applicable in respect of any search or seizure under this Act.

(a) take samples of any materials, products, articles or substances or of the effluent, wastes or air pollutants being discharged or emitted or of air, water or land in the vicinity of the discharge or emission;

(b) arrange for test and analysis of the samples at a certified laboratory;

(i) Every person authorized in this behalf by the Director General may, in such manner as may be prescribed by rules, collect from any factory, premises or place samples of air, water, soil or of any other substance for the purpose of analysis.

(ii) The results of the analysis of samples collected under clause (i) shall not be admissible in evidence in any legal proceeding unless the provisions of the clauses (iii) and (iv) have been complied with.

(iii) Subject to the provisions of sub-section (4), the officer collecting a sample under clause (i) shall-

(a) serve notice on the owner or proponent or agent of the said place, in such manner as may be prescribed by rules, of his intention to collect such sample;

(b) collect the sample in the presence of the said occupier or agent;

(c) put the sample into a container and affix on it a seal bearing the signatures of himself and of the occupier or agent;

(d) prepare a report of the sample collected and sign it himself and take the signature of the occupier or agent;

(e) send without any delay, the said container to the laboratory specified by the Director General EPA.

(iv) Where a sample is collected under clause (i) and a notice is served by the collecting officer under sub clause a) of clause (iii), the collecting officer shall, if the occupier or agent willfully absents himself at the time of the collection of the sample or, though being present, refuses to sign the sample or report, in the presence of two witnesses, give his signature and attest and seal it and shall send it without any delay to the laboratory specified by the Director General, mentioning that the occupier or agent had not been present or, as the case may be, refused to give his signature.

(i) confiscate any article used in the commission of the offence where the offender is not known or cannot be found within a reasonable time:

Provided that the power under clauses (f), (h), (I) and (j) shall be exercised in accordance with the provisions of the Code of Criminal Procedure, 1898 (Act V of 1898). or the rules made under this Act and under the direction of the Environmental

Tribunal or Environmental Magistrate; and

(j) establish an Environmental Co-ordination Committee comprising the Director-General as its chairman and the heads of relevant Government Agencies and such other persons as the Government of Balochistan may appoint as its members to exercise such powers and perform such functions as may be delegated or assigned to it by the Government of Balochistan for carrying out the purposes of this Act and for ensuring inter departmental co-ordination in environmental policies.

Establishment, powers and functions of the Regional or District Environmental Protection Agencies.—

8. (1) Government of Balochistan shall, by notification in the official Gazette, establish the Regional or District Environmental Protection Agency, to exercise such powers and perform such functions as may be delegated to it by the Government of Balochistan under sub-section (2) of section 34.

(2) The Regional or District Environmental Protection Agency shall be headed by an officer at least of the rank of regional Director or Deputy Director who shall be appointed by the Provincial Government on such terms and conditions as prescribed in the Balochistan Civil Servant Act 1974.

(3) The Regional or District Environmental Protection Agency shall have such administrative, technical and legal staff as the Government of Balochistan may specify, to be appointed in accordance with the Balochistan Civil Servants Appointment, Promotion and Transfers Rules 2009 such procedure as may be prescribed.

(4) The powers and functions of the Regional or District Environmental Protection Agency shall be exercised and performed by an Officer of the rank of regional Director or Deputy Director appointed as head.

(5) The Director General may, by general or special order, delegate any of the powers and functions to staff appointed under sub-section (3).

Establishment of the Balochistan Sustainable Development Funds.—

9. (1) There shall be established in the Province a Balochistan Sustainable Development Fund.

(2) The Balochistan Sustainable Development Fund shall be derived from the following sources, namely:—

(a) grants made or loans advanced by the Federal Government or the Provincial Government;

(b) aid and assistance, grants, advances, donations and other non-obligatory funds received from foreign governments, national or international agencies, and non-governmental organizations; and

(c) contributions from private organizations and other persons.

(3) The Balochistan Sustainable Development Fund shall be utilized in accordance with such procedure as may be prescribed for—

(a) providing financial assistance to the projects in the public/private sector designed for the protection, conservation, rehabilitation and improvement of the environment, the prevention and control of pollution, the sustainable development of resources and for research in any aspect of environment; and

(b) any other purpose which in the opinion of the Board shall help to achieve environmental objectives and the purposes of this Act.

Management of the Balochistan Sustainable Development Fund.—

10. (1) The Balochistan Sustainable Development Fund shall be managed by a Board known as the Sustainable Development Fund Board consisting of:-

(i) Secretary Environment Department Chairperson

(ii) Secretary Industries Department Member

(iii) Secretary Social welfare Department Member

(iv) Secretary Finance Department Member

(v) Secretary Forest Department Member

(vi) Secretary Agriculture Department Member

(vii) such non-official persons not exceeding six (6) as the Members Government of Balochistan may appoint including two (2)representatives of the Balochistan Chamber of Commerce and Industry, two (2) representatives of the Balochistan Chamber of Agriculture and two (2) representative of leading non-governmental organizations/donors.

(viii) Director General, Balochistan Environmental Protection Agency Member/Secretary

(2) the Board shall have the power to—

(a) sanction financial assistance for eligible projects; as specified in section 9(3) of this Act

(b) invest moneys held in the Balochistan Sustainable Development Fund in such profit - bearing Government bonds, savings schemes and securities as it may deem suitable; and

(3) The Board shall constitute committees of its members to undertake regular monitoring of projects financed from the Balochistan Sustainable Development Fund and to submit progress reports to the Board which shall publish an Annual Report incorporating its annual audited accounts and performance evaluation based on the progress reports.

(4) Audit of the fund shall be conducted on annual basis.

Inter-Provincial Environmental issues:-

11. (1) The project falling within the geographical jurisdiction of two or more Provinces, the IEE or EIA may be submitted by the proponent to each Provincial Environmental Agencies for review and approval.

(2) In case of any dispute or concerns the matter shall be settled through mutual consultation of the Provinces to avoid any inconveniences or future litigation.

(3) The concerned Provinces may constitute a joint technical or review committee including a representative of the concerned Federal Ministry dealing with Environment and coordination.

Multilateral Environmental Agreements:-

12. (1) The obligation of the International Conventions, Treaties and Protocols shall be observed as before devolution of the subject of Environment to the Province on Environment or climate change. In case of any international/ bilateral cooperation, the matter shall be proceeded with consultation with the concerned Federal Ministries.

(2) The Government of Balochistan/ Environmental Protection Agency shall extend support to those obligation of the International Conventions, Treaties and Protocols where adequate assistance provided by the Federal Government.

Strategic Environment Assessment (SEA):-

13. (1) This section regulates the conditions, methods and procedure according to which the assessment of impact of certain plans and programmes on the environment (hereinafter referred to as: strategic assessment) shall be carried out in order to provide for the environmental protection and improvement of sustainable development through integration of basic principles of environmental protection into the procedure of preparation and adoption of plans and programmes.

(2) The Government at all levels of administration and in every sector shall incorporate environmental considerations into policies, plans, programmes and strategies.

Prohibition of certain discharges or emissions and potential harmful items or materials .—

14. (1) Subject to the provisions of this Act and the rules and regulations no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level or is likely to cause, a significant adverse effect on the environment or human health which is in excess of the Environmental Quality Standards or, where applicable, the standards established under sub -clause (ii) of clause (f) of section 6.

(2) The Government of Balochistan shall not allow any imported or locally made commodities or items or materials or equipment or instruments or automobile or pesticides etc, into its provincial jurisdiction which may have any potential of causing Environmental problems.

(3) No person or company related to public and private sector shall introduce any of the imported or locally made items or materials or equipment or instruments or automobile or pesticides etc as per subsection (2) for any purpose unless it has filed an application to the Balochistan Environmental Protection Agency, as the case may be, and has obtained approval from the Government Agency in respect thereof.

(4) The Government of Balochistan may levy a pollution charge on any person who contravenes or fails to comply with the provisions of sub-section (1), to be calculated at such rate, and collected in accordance with such procedure as may be prescribed.

(5) Any person who pays the pollution charge levied under sub-section (2) shall not be charged with an offence with respect to that contravention or failure.

(6) The approved license in terms of section 15 of this Act does not affect the applicant's duty to obtain any other authorization required in order to undertake the activity or implement the project concerned, whether in terms of this Act or any other legislation

(7) A person /firm causing discharge of pollutants shall take all reasonable measures to ensure that the best practicable environmental option is adopted in relation to the discharge of emission and conservation of the environment.

Initial Environmental Examination and Environmental Impact Assessment.—

15. (1) No proponent of a project of public and private sector shall commence construction or operation unless he has filed an Initial Environmental Examination with the Government Agency designated by Balochistan Environmental Protection Agency, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof.

(2) The Government Agency shall subject to standards fixed by the Balochistan

Environmental Protection Agency—

(a) review the initial environmental examination and accord its approval, or require submission of an environmental impact assessment by the proponent; or

(b) review the environmental impact assessment and accord its approval subje to such conditions as it may deem fit to impose, require that the environmental impact assessment be re-submitted after such modifications as may be stipulated c reject the project as being contrary to environmental objectives.

(3) Every review of an environmental impact assessment shall be carried out with public participation and no information will be disclosed during the course of such public participation which relates to—

(i) trade, manufacturing or business activities, processes or techniques of a proprietary nature, or financial, commercial, scientific or technical matters which the proponent has requested should remain confidential, unless for reasons to be recorded in writing, the Director General of the Balochistan Environmental Protection Agency is of the opinion that the request for confidentiality is not well- founded or the public interest in the disclosure outweighs the possible prejudice to the competitive position of the project or its proponent; or

(ii) international relations, national security or maintenance of law and order, except with the consent of the Government of Balochistan; or

(iii) matters covered by legal professional privilege.

(4) The Government Agency shall communicate its approval or otherwise within a period of four months from the date the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

(5) Subject to sub-section (4) the appropriate Government may in a particular case extend the aforementioned period of four months if the nature of the project so warrants.

(6) The provisions of sub-sections (1), (2), (3), (4) and (5) shall apply to such categories of projects and in such manner as may be prescribed.

(7) The Government Agency shall maintain separate registers for initial environmental examination and environmental impact assessment projects, which shall contain brief particulars of each project and a summary of decisions taken thereon, and which shall be open to inspection by the public at all reasonable hours and the disclosure of information in such registers shall be subject to the restrictions specified in sub-section (3).

(8) No concession areas for any developmental activities shall be awarded to any International/National groups or firms without consultation and concurrence of the Government of Balochistan/Environmental Protection Agency.

(9) The prospect licenses for mining, quarrying, crushing etc. shall only be awarded/ granted in compliance with the sub section (1), (2), (3), (4) and (5) .

(10) The cellular companies shall obtain environmental approval from the Balochistan EPA before installing Base Transceivers Station (BTS).

(11) BTS Stations should be required to undergo routine evaluation for Compliance. Whenever an application is submitted to the Balochistan EPA for construction or modification of a transmitting facility. EPA shall have the authority to take action if a cellular base station antenna does not comply with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines and recommendations of the report titled `Environmental and Health Related Effects of the Cellular Base Station Antennas' carried out by IT and Telecom Division, Ministry of Information Technology.

(12) No person or company related to public and private sector shall commence construction or operation unless the concerned building authority accord approval under the provisions of the in vogue Building Code.

(13) after fulfilling the sub section (12) an action plan shall be submitted to the concerned municipal/town/union council to carry out the activities for a specific time period as to provide the general public or road users an alternative corridor.

(14) the waste generated during the construction or maintenance or repair of any building shall be appropriately disposed of or transported or collected to a designated place allocated for the purpose like any land fill site to avoid public nuisance.

(15) the construction or repair activities especially in the main city area shall be carried out in a manner to minimize the road congestion or blockage.

(16) the proponent of the project shall remit fifty thousand rupees as review fee of an Initial Environmental Examination (IEE) and one hundred thousand as review fee for Environmental Impact Assessment (EIA).

(17) the person or company in public or private sector intend to commence any scheme or project do not falling under schedule I and II of this Act shall remit twenty five thousand rupees as an Environmental approval fee to the Balochistan Environmental Protection Agency.

Prohibition of import of hazardous waste.—

16. No person shall import hazardous waste into Balochistan and its jurisdiction limits.

Handling of hazardous substances and License:-

17. (1) Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except—

(a) under a license issued by the Government of Balochistan and in such manner as may be prescribed; or

(b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.

(2) Every owner or proponent of any land or premises on which hazardous waste is kept, treated or disposed of shall make a written application to the Balochistan Environmental Protection Agency for a hazardous waste management license, which shall at least include details of:

a) the chemical composition, nature and volume of the waste which is being, or will be, produced;

b) the industrial process, trade or activity giving rise to the waste;

c) the way in which the applicant proposes to keep, treat or dispose of the hazardous waste, including storage and handling procedures;

d) the precautions which will be taken to avoid any adverse effects on the environment being caused by the hazardous waste.

(3). the Balochistan Environmental Protection Agency shall evaluate each application for a license under this Article in the following manner:

a) grant a hazardous waste management license, with or without conditions, if satisfied that the proposed method of keeping, treating and disposing of the hazardous waste will not cause any adverse effects; or

b) refuse to grant a license giving reasons for the refusal in writing to the applicant.

(4). the Balochistan Environmental Protection Agency would take a decision in regard to subsection 2 within thirty (30) days of the date of lodging of the application for a license.

(5) The license shall be granted for a reasonable period not exceeding five years. On expiry of the license for renewal same procedure shall be followed.

Electronic Wastes:-

18. (1) Every producer, distributer, collection centre, refurbisher, dismantler or recyclers shall store the electronic waste for a period not exceeding six months and shall maintain a record of collection, sale, transfer, storage and segregation of wastes and make these records available for inspection:

Provided that the Balochistan Environmental Protection Agency may extend the said period in following cases, namely:

(a) Dismantlers and Recyclers up to six months of their annual storage capacity of the owner; or

(b) Collection centers who do not have access to any registered dismantling or recycling facility; or

(c). the waste which needs to be specifically stored for development of a process for its recycling, reuse.

(2) Every producer, distributer, collection centre, refurbisher, dismantler or recyclers shall make arrangements for the environmentally sound management and disposal of electronic waste.

(3) the 'environmentally sound management of electronic waste' as "taking all steps required to ensure that electronic waste are managed in a manner which shall protect health and environment against any adverse effects, which may result from hazardous substance contained in such wastes."

(4) the provisions of this section shall apply to every producer, consumer and bulk consumer involved in manufacture, sale, purchase and processing of electronic equipment or components.

(5) information dissemination on electronic waste and the environmentally sound management of electronic waste is also mandated from producers.

(6) to regulate the provisions of this section all the relevant international conventions, protocols and treaties collectively called as multilateral environmental agreements (MEAs) shall be applicable where Pakistan is signatory or ratified the MEAs.

(7) any person or company or unit who contravenes or fails to comply with the provisions of the above subsections shall be imposed penalty under section 25 of this act.

General Prohibition in relation to Solid and Hospital Waste management and Waste Management License:-

19. (1) No person may collect, transport, sort, recover, store, dispose of or otherwise manage waste in a manner that results in a significant adverse effect.

(2) Every person who imports, produces, collects, recovers, transports, keeps, treats or disposes of waste shall take all reasonable measures to prevent a significant adverse effect on the environment from occurring.

(3) The owner or proponent of every premises upon which solid and hazardous hospital waste is produced shall ensure that all hazardous waste whether solid or hospital waste is separated from other waste, and is stored in separate containers pending disposal, in accordance with the requirements of the Balochistan Environmental Protection Agency as set out in regulations, published guidelines or license conditions.

(4) A person shall not dispose of solid and hazardous hospital waste in such a manner that it becomes litter or is likely to become litter.

(5) Unless in possession of a valid waste management license issued by the Balochistan Environmental Protection Agency, no person may construct, own or operate a landfill site, incinerator or other facility at which waste is permanently disposed of or is stored indefinitely.

(6). The Balochistan Environmental Protection Agency shall evaluate each application for a license and shall do the following:

a) grant a license if the Balochistan Environmental Protection Agency is satisfied that the applicant has sufficient expertise to undertake the activity in question in accordance with the law and in a manner that will not have significant adverse effects; or

b) refuse to grant a license giving reasons for the refusal in writing to the applicant.

(7). The Balochistan Environmental Protection Agency shall reach a decision in regard to subsection 2 within thirty (30) days of the date of lodging of the application for a license with the Balochistan Environmental Protection Agency.

(8). If there are reasonable grounds to grant license, and those grounds are communicated to the license holder in writing, the Balochistan Environmental Protection Agency may amend, revoke or impose new conditions in an existing waste management license.

(9). The license granted under subsection (6) shall be subject to review if condition of license granted are not fulfilled.

Management of Water Resources:-

20. (1) All persons, for the purpose of protection, conservation, development, use, control and management of water resources, would take into account the following measures:

a) protecting aquatic and associated ecosystems and their biological diversity;

b) reducing and preventing pollution and degradation of water resources.

(2) When preparing water resource management plans, Departments and other relevant institutions shall at least take the following into account:

a) provisions for integrated watershed management;

b) regulation of sustainable abstraction of groundwater;

c) regulation of the use of ground or surface water for agricultural, industrial, mining, and urban purposes;

d) measures to protect human health and ecosystems;

e) measures to protect wetlands and their associated ecosystems;

f) any other provision necessary for the sustainable use and management of water resources.

(3) An owner of land or a person who uses the land on which any activity or process is performed or undertaken which causes or is likely to cause significant pollution of a water resource must take measures to prevent any such pollution.

Regulation of motor vehicles.

21. (1) Subject to the provisions of this Act, and the rules and regulations, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Environmental Quality Standards, or where applicable the standards established under clause (e) of section 6 (1).

(2) For ensuring compliance with the standards mentioned in sub-section (1), the Balochistan Environmental Protection Agency may direct that any motor vehicle or class of vehicles shall install such pollution control devices or other equipment or use such fuels or undergo such maintenance or testing as may be prescribed.

(3) Where a direction has been issued by the Government Agency under subsection (2) in respect of any motor vehicles or class of motor vehicles, no person shall operate any such vehicle till such direction has been complied with.

(4) To regulate the provision of this Act a green squad comprising of representative of Traffic Police, Motor Vehicle Examiner, Excise & Taxation and EPA Balochistan shall be in place to monitor and inspect the automobiles running on the road as per the Environment Quality Standard.

(5) The inspection or monitoring shall be carried out at least once in a month wherein a mechanism be chalked out for issuance of warning tickets (red: Highly polluted, Blue: less polluted) on a prominent on the vehicle, as the case may be for specific period of time not exceeding 30 days to maintain the vehicle in order .

(6) Whoever contravenes or fails to comply with the provision of subsection (5) such vehicle should be made off road or punishable with fine at least twenty thousand rupees which may be extended to one hundred thousand rupees. In the case of continuing contravention or failure the vehicle shall be impounded.

Alien Species and Living Modified Organisms:-

22. (1) The import into Balochistan of alien species and of living modified organisms is prohibited without a permit issued by the relevant authority under any law enforce in Balochistan. The Balochistan Environmental Protection Agency in consultation with the Departments of Agriculture, Livestock and Animal Husbandry and Food shall monitor the matter.

(2) No permit for the introduction of an alien species or of a living modified organism shall be issued unless the environmental impact indicates that there is a reasonable certainty that no harm to indigenous natural resources or human health will result from the proposed introduction.

(3) Subsection 1 and 2 of this Section shall apply equally to introductions of alien species and living modified organisms into the Province of Balochistan and to introductions from one ecosystem to another within the province.

(4) The introduction of alien species and living modified organisms into protected areas shall not be allowed.

Coastal Zone:-

23. (1) Subject to the provisions of this Act the activities or concentration or level of discharges of the following units established on onshore and offshore shall be monitored strictly to prevent the pollution and environmental degradation caused by the following multi-magnitude and multidisciplinary units.

a) Ports and shipping
b) Fisheries
c) Ship dismantling
d) Shipping Traffic (Oil Tankers & Vessels) & dredging.
e) Oil and gas mineral exploration.
f) Coastal power plants and Energy sector.
g) Oil refineries and Industries

(2) The ship breaking at Gaddani or anywhere else in the coastal belt/zone of this province shall be subject to fulfilling all the relevant obligations under the Basel Convention “on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal”, Rotterdam Convention “on the prior Informed Consent(PIC) Procedure for certain Hazardous Chemicals and Pesticides in International Trade” and other relevant Treaties/Protocols and provisions of this Act.

(3) During the process of ship breaking/dismantling the waste, hazardous waste or sludge or Polychlorinated biphenyls or asbestos etc, shall be disposed of in a manner to ensure Protection of Terrestrial and Marine environment.

(4) The activities of ship breaking/dismantling activities on shore or offshore within territorial limit of Balochistan shall be monitored at least biannually to ensure environmental protection and prevent degradation and pollution.

(5) The disposal of untreated sewage and domestic wastes and untreated disposal of industrial effluents into the sea is an offence any person or company or unit who contravenes or fails to comply with the provisions of this Act shall face to penalty under section 25.

Environmental protection order.

24. (1) Where the Balochistan Environmental Protection Agency is satisfied that the discharge or emission of any effluent, waste, air pollutant or noise, or the disposal of waste, or the handling of hazardous substances, or any other act or omission is likely to occur, or is occurring, or has occurred, in violation of the provisions of this Act, rules or regulations or of the conditions of a license, and is likely to cause, or is causing or has caused an adverse environmental effect, the Balochistan Environmental Protection Agency may, after giving the person responsible for such discharge, emission, disposal, handling, act or omission an opportunity of being heard, by order direct such person to take such measures that the Balochistan Environmental Protection Agency may consider necessary within such period as may be specified in the order.

(2) In particular and without prejudice to the generality of the foregoing power, such measures may include—

(a) immediate stoppage, preventing, lessening or controlling the discharge, emission, disposal, handling, act or omission, or to minimize or remedy the adverse environmental effect;

(b) installation, replacement or alteration of any equipment or thing to eliminate, control or abate on a permanent or temporary basis, such discharge, emission, disposal, handling, act or omission;

(c) action to remove or otherwise dispose of the effluent, waste, air pollutant, noise, or hazardous substances; and

(d) action to restore the environment to the condition existing prior to such discharge, disposal, handling, act or omission, or as close to such condition as may be reasonable in the circumstances, to the satisfaction of the Balochistan Environmental Protection Agency.

(3) Where the person, to whom directions under sub-section (1) are given, does not comply therewith, the Balochistan Environmental Protection Agency may, in addition to the proceedings initiated against him under this Act, the rules and regulations, itself take or cause to be taken such measures specified in the order as it may deem necessary and may recover the reasonable costs of taking such measures from such person as arrears of land revenue.

Penalties

25. (1) Whoever contravenes or fails to comply with the provisions of sections 14, 15, 16, 18 or section 24 or any order issued there-under shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues:

Provided that if contravention of the provisions of section 14 also constitutes contravention of the provisions of section 21, such contravention shall be punishable under sub-section (2) only.

(2) Whoever contravenes or fails to comply with the provisions of section 17, 19, 21, 22 or 23 or any rule or regulation or conditions of any license, any order or direction, issued by the Council or the Balochistan Environmental Protection Agency, shall be punishable with fine which may extend to one hundred thousand rupees, and in case of continuing contravention or failure

with an additional fine which extend to one thousand rupees for every day during which such contravention continues.

(3) Where an accused has been convicted of an offence under sub-sections (1) and (2), the Environmental Court and Environmental Magistrate, as the case may be, shall, in passing sentence, take into account the extent and duration of the contravention or failure constituting the offence and the attendant circumstances.

(4) Where an accused has been convicted of an offence under sub-section (1) and the Environmental Court is satisfied that as a result of the commission of the offence monetary benefits have accrued to the offender, the Environmental Court may order the offender to pay, in addition to the fines under sub-section (1), further additional fine commensurate with the amount of the monetary benefits.

(5) Where a person convicted under sub-sections (1) or sub-section (2) had been previously convicted for any contravention under this Act, the Environmental Court or, as the case may be, Environmental Magistrate may, in addition to the punishment awarded thereunder—

(a) endorse a copy of the order of conviction to the concerned trade or industrial association, if any, or the concerned Provincial Chamber of Commerce and Industry or the Federation of Pakistan Chambers of Commerce and Industry;

(b) sentence him to imprisonment for a term which may extend to two years;

(c) order the closure of the factory;

(d) order confiscation of the factory, machinery, and equipment, vehicle, material or substance, record or document or other object used or involved in contravention of the provisions of the Act:

Provided that for a period of three years from the date of commencement of this Act the sentence of imprisonment shall be passed only in respect of persons who have been previously convicted for more than once for any contravention of sections 14, 16, 17, 18,19 or 24 involving hazardous waste;

(e) order such person to restore the environment at his own cost, to the conditions existing prior to such contravention or as close to such conditions as may be reasonable in the circumstances to the satisfaction of the Balochistan Environmental Protection Agency; and

(f) order that such sum be paid to any person as compensation for any loss, bodily injury, damage to his health or property suffered by such contravention.

(6) The Director-General of the Balochistan Environmental Protection Agency or an officer generally or specially authorized by him in this behalf may, on the application of the accused compound an offence under this Act with the permission of the Environmental Tribunals or Environmental Magistrate in accordance with such procedure as may be prescribed.

(7) Where the Director-General of the Balochistan Environmental Protection Agency is of the opinion that a person has contravened any provision of Act he may, subject to the rules, by notice in writing to that person require him to pay to the Balochistan Environmental Protection Agency an

administrative penalty in the amount set out in the notice for each day the contravention continues; and a person who pays an administrative penalty for a contravention shall not be charged under this Act with an offence in respect of such contravention.

(8) The provisions of sub-sections (6) and (7) shall not apply to a person who has been previously convicted of offence or who has compounded an offence under this Act who has paid an administrative penalty for a contravention of any provision of this Act.

Offences by bodies corporate

26. Where any contravention of this Act has been committed by a body corporate, and it is proved that such offence has been committed with the consent or connivance of, or is attributed to any negligence on the part of, any director, partner, manager, secretary or other Officer of the body corporate, such director, partner, manager, secretary or other officer of the body corporate, shall be deemed guilty of such contravention along with the body corporate and shall be punished accordingly:

Provided that in the case of a company as defined under the Companies Ordinance, 1984 (XLVII of 1984), only the Chief Executive as defined in the said Ordinance shall be liable under this section.

Explanation.— For the purposes of this section, "body corporate" includes a firm, association of persons and a society registered under the Societies Registration Act, 1860 (XXI of 1860), or under the Co-operative Societies Act, 1925 (VII of 1925).

Offences by Government Agencies, local authorities or local councils.

27. Where any contravention of this Act has been committed by any Government Agency, local authority or local council, and it is proved that such contravention has been committed with the consent or connivance of, or is attributable to any negligence on the part of, the Head or any other officer of the Government Agency, local authority or local council, such Head or other officer shall also be deemed guilty of such contravention along with the Government Agency, local authority or local council and shall be liable to be proceeded against and punished accordingly.

Balochistan Environmental Tribunals.—

28. (1) The Government of Balochistan may, by notification in the official gazette establish Balochistan Environmental Protection Tribunals which shall exercise jurisdiction under this Act.

(2) The Balochistan Environmental Protection Tribunal shall consist of a Chairperson who is, or has been, or is qualified for appointment as, a judge of the High Court to be appointed after consultation with the Chief Justice of the High Court and two members to be appointed by the Government of Balochistan which at least one shall be a technical member with suitable professional qualifications and experience; in the environmental field as may be prescribed. For every sitting of the Balochistan Environmental Protection Tribunal the presence of the Chairperson and not less than one Member shall be necessary.

(3) A decision of Balochistan Environmental Protection Tribunal shall be expressed in terms of the opinion of the majority or if the case has been decided by the Chairperson and only one of the members and a there is a difference of opinion between them, the ;decision of the Balochistan Environmental Protection Tribunal shall be expressed in terms of the opinion of the Chairperson.

(4) Balochistan Environmental Protection Tribunal shall not, merely by reason of a change in its composition, or the absence of any member from any sitting, be bound to recall and rehear any witness who has given evidence, and

may act on the evidence already ;recorded by, or produced, before it.

(5) Balochistan Environmental Protection Tribunal may hold its sittings at such places within its territorial jurisdiction as the Chairperson may decide.

(6) No act or proceeding of Balochistan Environmental Protection Tribunal shall be invalid by reason only of the existence of a vacancy in, or defect in the constitution, of, the Balochistan Environmental Protection Tribunal.

(7) The terms and conditions of service of the Chairperson and members of the Balochistan Environmental Protection Tribunal shall be such as may be prescribed.

Jurisdiction and powers of Balochistan Environmental Tribunals.

29. (1) Balochistan Environmental Protection Tribunal shall exercise such powers and perform such functions as are, or may be, conferred upon or assigned to it by or under this Act or the rules and regulations made there under.

(2) All contravention punishable under sub-section (1) of section 25 shall exclusively be triable by Balochistan Environmental Protection Tribunal.

(3) Balochistan Environmental Protection Tribunal shall not take cognizance of any offence triable under sub-section (2) except on a complaint in writing by- -

(a) the Government Agency or local council; and

(b) any aggrieved person, who has given notice of not less than thirty days to the Provincial Agency concerned, of the alleged contravention and of his intention to make a complaint to the Environment Tribunal.

(4) In exercise of its criminal jurisdiction, the Balochistan Environmental Protection Tribunal shall have the same powers as are vested in Court of Session under the Code of Criminal Procedure, 1898 (Act V of 1898).

(5) In exercise of the appellate jurisdiction under section 22 the Balochistan Environmental Protection Tribunal shall have the same powers and shall follow the same procedure as an appellate court in the Code of Civil Procedure, 1908 (Act V of 1908).

(6) In all matters with respect to which no procedure has been provided for in this Act, the Balochistan Environmental Protection Tribunal shall follow the procedure laid down in the Code of Civil Procedure, 1908 (Act V of 1908).

(7) Balochistan Environmental Protection Tribunal may, on application filed by any officer duly authorized in this behalf by the Director-General of the Balochistan Environmental Protection Agency, issue bail able warrant for the arrest of any person against whom reasonable suspicion exist, of his having been involved in contravention punishable under sub-section (1) of Section 25:

Provided that such warrant shall be applied for, issued, and executed in accordance with the provisions of the Code of Criminal Procedure, 1898 (Act V of 1898):

Provided further that if the person arrested executes a bond with sufficient sureties in accordance with the endorsement on the warrant he shall be released from custody, failing which he shall be taken or sent without delay to the officer in-charge of the nearest police station.

(8) All proceedings before the Balochistan Environmental Protection Tribunal shall be deemed to be judicial proceedings within the meaning of section 193 and 228 of the Pakistan Penal Code (Act XLV of 1860), and the Balochistan Environmental Protection Tribunal shall be deemed to be a court for the purpose of section 480 and 482 of the Code of Criminal Procedure, 1898 (Act V of 1898).

(9) No court other than Balochistan Environmental Protection Tribunal shall have or exercise any jurisdiction with respect to any matter to which the jurisdiction of Balochistan Environmental Protection Tribunal extends under this Act, the rules and regulations made thereunder.

(10) Where the Balochistan Environmental Protection Tribunal is satisfied that a complaint made to it under sub-section (3) is false and vexatious to the knowledge of the complainant, it may, by an order, direct the complainant to pay to the person complained against such compensatory costs which may extend to five hundred thousand rupees.

Appeals to the Environmental Tribunal.—

30. (1) Any person aggrieved by any order or direction of the Balochistan Environmental Protection Agency under any provision of this Act, and rules or regulations may prefer an appeal with the Balochistan Environmental Protection Tribunal within thirty days of the date of communication of the impugned order or direction to such person.

(2) An appeal to the Balochistan Environmental Protection Tribunal shall be in such form, contain such particulars and be accompanied by such fees as may be prescribed.

Appeals from orders of the Environmental Tribunal

31. (1) Any person aggrieved by any final order or by any sentence of the Balochistan Environmental Protection Tribunal passed under this Act may, within thirty days of communication of such order or sentence, prefer an appeal to the High Court.

(2) An appeal under sub-section (l) shall be heard by a Bench of not less than two Judges.

Jurisdiction of Environmental Magistrates.

32. (1) Notwithstanding anything contained in the Code of Criminal Procedure, 1898 (Act V of 1898), or any other law for the time being in force, but subject to the provisions of this Act, all contravention punishable under sub-section (2) of section 25 shall exclusively be trial-able by Environmental Magistrate especially empowered in this behalf under section 14 of the Code of Criminal Procedure, 185(Act No. V of 1898).

(2) An Environmental Magistrate shall be competent to impose any punishment specified in sub-sections (2) and (4) of section 25.

(3) An Environmental Magistrate shall not take cognizance of an offence trial able under sub-section (I) except on a complaint in writing by—

(a) the Balochistan Environmental Protection Agency, or Government Agency or a local council; and

(b) any aggrieved person.

Appeals from orders of Environmental Magistrates.

33. Any person convicted of any contravention of this Act or the rules or regulations by an Environmental Magistrate may, within thirty days from the date of his conviction, appeal to the Court of Sessions whose decision thereon shall be final.

Power to delegate.

34. *(1)* The Government of Balochistan may, by notification in the official Gazette, delegate any of its or of the Balochistan Environmental Protection Agency powers and functions under this Act and the rules and regulations to any Government Agency, local council or local authority.

(2) The Balochistan Environmental Protection Agency may also by notification in the official Gazette, delegate any of its powers or functions under this Act and the rules and regulations to EPA Regional or sub-offices. In case of nonexistence of its Regional/Sub-offices may delegate its powers or functions to any local council or local authority in the Province.

Power to give directions.

35. In the performance of its functions the Provincial Agency shall be bound by the direction given to it in writing by the Government.

Indemnity.

36. No suit, prosecution or other legal proceedings shall lie against the Government , the Council, the Balochistan Environmental Protection Agency, the Director-Generals of the Balochistan Environmental Protection Agency, members, officers, employees, experts, advisers, committees or consultants of the Balochistan Environmental Protection Agency or the Environmental Tribunal or Environmental Magistrates or any other person for anything which is in good faith done or intended to be done under this Act or the rules or regulations made thereunder.

Dues recoverable as arrears of land revenue.

37. Any dues recoverable by the Balochistan Environmental Protection Agency under this Act, or the rules or regulations shall be recoverable as arrears of land revenue.

Act to override other laws.

38. The provisions of this Act shall have effect notwithstanding anything inconsistent therewith contained in any other law for the time being in force.

Power to make rules.

39. The Government of Balochistan may, by notification in the official Gazette, make rules for carrying out the purposes of this Act including rules for implementing the provisions of the international environmental Agreements, specified in the Schedule to this Act.

Power to amend the Schedule

40. The Government of Balochistan may, by notification in the official Gazette, amend the Schedule so as to add any entry thereato or modify or omit any entry therein.

Power to make regulations.

41. (1) For carrying out the purposes of this Act, the Balochistan Environmental Protection Agency may, by notification in the official Gazette and with the approval of the Government of Balochistan, make regulations not inconsistent with the provisions of this Act or the rules made thereunder.

(2) In particular and without prejudice to the generality of the foregoing power, such regulations may provide for

(a) submission of periodical reports, data or information by any Government agency, local authority or local council in respect of environmental matters;

(b) preparation of emergency contingency plans for coping with environmental hazards and pollution caused by accidents, natural disasters and calamities;

(c) appointment of officers, advisers, experts, consultants and employees;

(d) levy of fees, rates and charges in respect of services rendered, actions taken and schemes implemented;

(e) monitoring and measurement of discharges and emissions;

(f) categorization of projects to which, and the manner in which, section 15 applies;

(g) laying down of guidelines for preparation of initial environmental examination and environmental impact assessment and Development of procedures for their filing, review and approval;

(h) providing procedures for handling hazardous substances; and

(i) installation of devices in, use of fuels by, and maintenance and testing of motor vehicles for control of air and noise pollution.

Repeal, savings and succession.

42. (1) The provision of Pakistan Environmental Protection Act 1997 (Act No.XXXIV of 1997) applicable to the Province of Balochistan are hereby repealed.

(2) Notwithstanding the repeal of the Pakistan Environmental Protection Act 1997 hereinafter called the repealed Act, any rules or regulations or appointments made, orders passed, notifications issued, powers delegated, contracts entered into, proceedings commenced, rights acquired liabilities incurred, penalties, rates, fees or charges levied, things done or action taken under any provisions of the repealed Act shall, so far as they are not inconsistent with the provisions of this Act be deemed to have been made, passed, issued, delegated, entered into, commenced, acquired, incurred, levied, done or taken under this Act, until they are repealed, rescind, withdrawn, cancelled, replaced or modified in accordance with the provisions of this Act.

(3) On the establishment of the Balochistan Environmental Protection Agency under this Act, all properties, assets and liabilities pertaining to the Balochistan Environmental Protection Agency established under repealed Act shall vest in and be the properties, assets and liabilities, as the case may be, of the Balochistan Environmental Protection Agency established under this Act.

(4) The Balochistan Environmental Protection Agency constituted under the repealed Act and existing immediately before the commencement of this Act shall be deemed to have been constituted under section 5 and the Director General and other officers and employees appointed in the said Agency shall be deemed to be Director General, officers and employees appointed under the Balochistan Civil Servant Act 1974.

(5) Notwithstanding the repeal of the Pakistan Environmental Protection Act 1997(Act No.XXXIV of 1997), all proceeding pending immediately before commencement of this Act, against any person under the repealed Act and rules, regulation or order made thereunder, or any other Law or rules shall continue under that Law and rules, in the manner proceeded thereunder.

SCHEDULE
(See section 39)

1. International Plant Protection Convention, Rome, 1951.

2. Plant Protection Agreement for the South-East Asia and Pacific Region (as amended), Rome, 1956.

3. Agreement for the Establishment of a Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in South-West Asia (as amended), Rome, 1963.

4. Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 and its amending Protocol, Paris, 1982.

5. London Convention on Ocean Dumping 1972.

6. Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972.

7. MARPOL Convention on Prevention of Pollution from Ship, 1973/78

8. Convention on International Trade in Endangered Species of Wild Funa and Flora (CITES), Washington, 1973.

9. Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979.

10. Convention on the Law of the Sea, Montego Bay, 1982.

11. Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985.

12. Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987 and amendments thereto.

13. Agreement on the Network of Agriculture Centres in Asia and the Pacific, Bangkok, 1988.

14. Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, Basel, 1989.

15. Convention on Biological Diversity, Rio de Janeiro, 1992.

16. United Nations Framework Convention on Climate Change, Rio De Janeiro, 1992.

17. Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 17 March 1992.

18. The Rio Declaration on Environment and Development, 13 June 1992

19. London Amendment to Montreal Protocol on Substances that deplete the ozone layer, 10 Aug 1992

20. United Nations Convention on the Law of the Sea, 16 Nov 1994

21. Washington Declaration on Land Based Marine Pollution 1995.

22. UN Convention on Non-Navigational Uses of International Watercourses, 1995

23. Ban Amendment to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 22 Sept 1995.

24. The Kyoto Protocol, 11 Dec 1997

25. The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 11 Sept 1998.

26. The Beijing Amendment to the Montreal Protocol on Substances that deplete the ozone layer, 1 Jan 2000

27. The Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 29 Jan 2000.

28. Stockholm Convention on Persistent Organic Pollutants (POPs), 23 May 2001.

29. International Treaty on Plant Genetic Resources for Food and Agriculture, 3 Nov 2001.

30. Hong Kong International Convention For The Safe And Environmentally Sound Recycling Of Ships, 2009

STATEMENT OF OBJECTS AND REASONS.

After the 18th Constitutional amendments the subject of environment vide Notification No.4-9/2011-Min dated 29th June, 2011 stand devolved to the provinces with effect from 1st July, 2011. Even after the deletion of the subject of environment from the concurrent list the Pakistan Environmental Protection Act 1997 remained intact as per Article 270-AA, Sub-Article(6). However, there is provision that the province through an appropriate legislature/competent authority may alter, repeal and amend the laws related to the subject.

To regulate and effectively address the peculiar environmental issues of the province of Balochistan this act namely “Balochistan Environmental Protection Act 2012” is submitted as per provisions of the Article 270-AA, Sub-Article(6) of 18th Constitutional amendments.

(Mir Asghar Rind)

Minister for Environment Department

SECRETARY

Balochistan Provincial Assembly

Dated _______ November, 2012.

ANNEX – II – Pakistan Environmental Protection Agency (Review of IEE / EIA) Regulations 2000

PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (REVIEW OF IEE AND EIA) REGULATIONS, 2000

S.R.O. 339 (1)/2001. - In exercise of the powers referred by section 33 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), Pakistan Environmental Protection Agency, with the approval of the Federal Government is pleased to make the following Rules, namely : -

1. Short title and commencement

(1) These regulations may be called the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000.

(2) They shall come into force at once.

2. Definitions

(1) In these regulations, unless there is anything repugnant in the subject or context –

(a) "Act" means the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997);

(b) "Director-General" means the Director-General of the Federal Agency;

(c) "EIA" means an environmental impact assessment as defined in section 2(xi);

(d) "IEE" means an initial environmental examination as defined in section 2(xxiv); and

(e) "section" means a section of the Act.

(2) All other words and expressions used in these regulations but not defined shall have the same meanings as are assigned to them in the Act.

3. Projects requiring an IEE

A proponent of a project falling in any category listed in Schedule I shall file an IEE with the Federal Agency, and the provisions of section 12 shall apply to such project.

4. Projects requiring an EIA

A proponent of a project falling in any category listed in Schedule II shall file an EIA with the Federal Agency, and the provisions of section 12 shall apply to such project.

5. Projects not requiring an IEE or EIA

(1) A proponent of a project not falling in any category listed in Schedules I and II shall not be required to file an IEE or EIA:

Provided that the proponent shall file –

(a) an EIA, if the project is likely to cause an adverse environmental effect;

(b) for projects not listed in Schedules I and II in respect of which the Federal Agency has issued guidelines for construction and operation, an application for approval accompanied by an undertaking and an affidavit that the aforesaid guidelines shall be fully complied with.

(2) Notwithstanding anything contained in sub-regulation (1), the Federal Agency may direct the proponent of a project, whether or not listed in Schedule I or II, to file an IEE or EIA, for reasons to be recorded in such direction:

Provided that no such direction shall be issued without the recommendation in writing of the Environmental Assessment Advisory Committee constituted under Regulation 23.

(3) The provisions of section 12 shall apply to a project in respect of which an IEE or EIA is filed under sub-regulation (1) or (2).

6. Preparation of IEE and EIA

(1) The Federal Agency may issue guidelines for preparation of an IEE or an EIA, including guidelines of general applicability, and sectoral guidelines indicating specific assessment requirements for planning, construction and operation of projects relating to particular sector.

(2) Where guidelines have been issued under sub-regulation (1), an IEE or EIA shall be prepared, to the extent practicable, in accordance therewith and the proponent shall justify in the IEE or EIA any departure therefrom.

7. Review Fees

The proponent shall pay, at the time of submission of an IEE or EIA, a non-refundable Review Fee to the Federal Agency, as per rates shown in Schedule III.

8. Filing of IEE and EIA

(1) Ten paper copies and two electronic copies of an IEE or EIA shall be filed with the Federal Agency.

(2) Every IEE and EIA shall be accompanied by –

(a) an application, in the form prescribed in Schedule IV; and

(b) copy of receipt showing payment of the Review Fee.

9. Preliminary scrutiny

(1) Within 10 working days of filing of the IEE or EIA, the Federal Agency shall –

(a) confirm that the IEE or EIA is complete for purposes of initiation of the review process; or

(b) require the proponent to submit such additional information as may be specified; or

(c) return the IEE or EIA to the proponent for revision, clearly listing the points requiring further study and discussion.

(2) Nothing in sub-regulation (1) shall prohibit the Federal Agency from requiring the proponent to submit additional information at any stage during the review process.

10. Public participation

(1) In the case of an EIA, the Federal Agency shall, simultaneously with issue of confirmation of completeness under clause (a) of sub-regulation (1) of Regulation 9, cause to be published in any English or Urdu national newspaper and in a local newspaper of general circulation in the area affected by the project, a public notice mentioning the type of project, its exact location, the name and address of the proponent and the places at which the EIA of the project can, subject to the restrictions in sub-section (3) of section 12, be accessed.

(2) The notice issued under sub-regulation (1) shall fix a date, time and place for public hearing of any comments on the project or its EIA.

(3) The date fixed under sub-regulation (2) shall not be earlier than 30 days from the date of publication of the notice.

(4) The Federal Agency shall also ensure the circulation of the EIA to the concerned Government Agencies and solicit their comments thereon.

(5) All comments received by the Federal Agency from the public or any Government Agency shall be collated, tabulated and duly considered by it before decision on the EIA.

(6) The Federal Agency may issue guidelines indicating the basic techniques and measures to be adopted to ensure effective public consultation, involvement and participation in EIA assessment.

11. Review

(1) The Federal Agency shall make every effort to carry out its review of the IEE within 45 days, and of the EIA within 90 days, of issue of confirmation of completeness under Regulation 9.

(2) In reviewing the IEE or EIA, the Federal Agency shall consult such Committee of Experts as may be constituted for the purpose by the Director-General, and may also solicit views of the sectoral Advisory Committee, if any, constituted by the Federal Government under sub-section (6) of section 5.

(3) The Director-General may, where he considers it necessary, constitute a committee to inspect the site of the project and submit its report on such matters as may be specified.

(4) The review of the IEE or EIA by the Federal Agency shall be based on quantitative and qualitative assessment of the documents and data furnished by the proponent, comments from the public and Government Agencies received under Regulation 10, and views of the committees mentioned in sub-regulations (2) and (3) above.

12. Decision

On completion of the review, the decision of the Federal Agency shall be communicated to the proponent in the form prescribed in Schedule V in the case of an IEE, and in the form prescribed in Schedule VI in the case of an EIA.

13. Conditions of approval

(1) Every approval of an IEE or EIA shall, in addition to such conditions as may be imposed by the Federal Agency, be subject to the condition that the project shall be designed and constructed, and mitigatory and other measures adopted, strictly in accordance with the IEE/EIA, unless any variation thereto have been specified in the approval by the Federal Agency.

(2) Where the Federal Agency accords its approval subject to certain conditions, the proponent shall –

(a) before commencing construction of the project, acknowledge acceptance of the stipulated conditions by executing an undertaking in the form prescribed in Schedule VII;

(b) before commencing operation of the project, obtain from the Federal Agency written confirmation that the conditions of approval, and the requirements in the IEE/EIA relating to design and construction, adoption of mitigatory and other measures and other relevant matters, have been duly complied with.

14. Confirmation of compliance

(1) The request for confirmation of compliance under clause (b) of sub-regulation (2) of Regulation 13 shall be accompanied by an Environmental Management Plan indicating the measures and procedures proposed to be taken to manage or mitigate the environmental impacts for the life of the project, including provisions for monitoring, reporting and auditing.

(2) Where a request for confirmation of compliance is received from a proponent, the Federal Agency may carry out such inspection of the site and plant and machinery and seek such additional information from the proponent as it may deem fit:

Provided that every effort shall be made by the Federal Agency to provide the requisite confirmation or otherwise within 15 days of receipt of the request, with complete information, from the proponent.

(3) The Federal Agency may, while issuing the requisite confirmation of compliance, impose such other conditions as the Environmental Management Plan, and the operation, maintenance and monitoring of the project as it may deem fit, and such conditions shall be deemed to be included in the conditions to which approval of the project is subject.

15. Deemed approval

The four-month period for communication of decision stipulated in sub-section (4) of section 12 shall commence from the date of filing of an IEE or EIA in respect of which confirmation of completeness is issued by the Federal Agency under clause (a) of sub-regulation (1) of Regulation 9.

16. Extension in review period

Where the Federal Government in a particular case extends the four-month period for communication of approval prescribed in sub-section (5) of section 12, it shall, in consultation with the Federal Agency, indicate the various steps of the review process to be taken during the extended period, and the estimated time required for each step.

17. Validity period of approval

(1) The approval accorded by a Federal Agency under section 12 read with Regulation 12 shall be valid, for commencement of construction, for a period of three years from the date of issue.

(2) If construction is commenced during the initial three year validity period, the validity of the approval shall stand extended for a further period of three years from the date of issue.

(3) After issue of confirmation of compliance, the approval shall be valid for a period of three years from the date thereof.

(4) The proponent may apply to the Federal Agency for extension in the validity periods mentioned in sub-regulations (1), (2) and (3), which may be granted by the Federal Agency in its discretion for such period not exceeding three years at a time, if the conditions of the approval do not require significant change:

Provided that the Federal Agency may require the proponent to submit a fresh IEE or EIA, if in its opinion changes in location, design, construction and operation of the project so warrant.

18. Entry and inspection

(1) For purposes of verification of any matter relating to the review or to the conditions of approval of an IEE or EIA prior to, during or after commencement of construction or operation of a project, duly authorized staff of the Federal Agency shall be entitled to enter and inspect the project site, factory building and plant and equipment installed therein.

(2) The proponent shall ensure full cooperation of the project staff at site to facilitate the inspection, and shall provide such information as may be required by the Federal Agency for this purpose and pursuant thereto.

19. Monitoring

(1) After issue of approval, the proponent shall submit a report to the Federal Agency on completion of construction of the project.

(2) After issue of confirmation of compliance, the proponent shall submit an annual report summarizing operational performance of the project, with reference to the conditions of approval and maintenance and mitigatory measures adopted by the project.

(3) To enable the Federal Agency to effectively monitor compliance with the conditions of approval, the proponent shall furnish such additional information as the Federal Agency may require.

20. Cancellation of approval

(1) Notwithstanding anything contained in these Regulations, if, at any time, on the basis of information or report received or inspection carried out, the Federal Agency is of the opinion that the conditions of an approval have not been complied with, or that the information supplied by a proponent in the approved IEE or EIA is incorrect, it

shall issue notice to the proponent to show cause, within two weeks of receipt thereof, why the approval should not be cancelled.

(2) If no reply is received or if the reply is considered unsatisfactory, the Federal Agency may, after giving the proponent an opportunity of being heard:

(i) require the proponent to take such measures and to comply with such conditions within such period as it may specify, failing which the approval shall stand cancelled; or

(ii) cancel the approval.

(3) On cancellation of the approval, the proponent shall cease construction or operation of the project forthwith.

(4) Action taken under this Regulation shall be without prejudice to any other action that may be taken against the proponent under the Act or rules or regulations or any other law for the time being in force.

21. Registers of IEE and EIA projects

Separate Registers to be maintained by the Federal Agency for IEE and EIA projects under sub-section (7) of section 12 shall be in the form prescribed in Schedule VIII.

22. Environmentally sensitive areas

(1) The Federal Agency may, by notification in the official Gazette, designate an area to be an environmentally sensitive area.

(2) Notwithstanding anything contained in Regulations 3, 4 and 5, the proponent of a project situated in an environmentally sensitive area shall be required to file an EIA with the Federal Agency.

(3) The Federal Agency may from time to time issue guidelines to assist proponents and other persons involved in the environmental assessment process to plan and prepare projects located in environmentally sensitive areas.

(4) Where guidelines have been issued under sub-regulation (3), the projects shall be planned and prepared, to the extent practicable, in accordance therewith and any departure therefrom justified in the EIA pertaining to the project.

23. Environmental Assessment Advisory Committee

For purposes of rendering advice on all aspects of environmental assessment, including guidelines, procedures and categorization of projects, the Director-General shall constitute an Environmental Assessment Advisory Committee comprising –

(a) Director EIA, Federal Agency … Chairman

(b)	One representative each of the Provincial Agencies	…	Members
(c)	One representative each of the Federal Planning Commission and the Provincial Planning and Development Departments	…	Members
(d)	Representatives of industry and non-Governmental organizations, and legal and other experts	…	Members

24. Other approvals

Issue of an approval under section 12 read with Regulation 12 shall not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law for the time being in force.

SCHEDULE I
(*See* Regulation 3)

List of projects requiring an IEE

A. Agriculture, Livestock and Fisheries

1. Poultry, livestock, stud and fish farms with total cost more than Rs.10 million
2. Projects involving repacking, formulation or warehousing of agricultural products

B. Energy

1. Hydroelectric power generation less than 50 MW
2. Thermal power generation less than 200 KW
3. Transmission lines less than 11 KV, and large distribution projects
4. Oil and gas transmission systems
5. Oil and gas extraction projects including exploration, production, gathering systems, separation and storage
6. Waste-to-energy generation projects

C. Manufacturing and processing

1. Ceramics and glass units with total cost more than Rs.50 million
2. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost less than Rs.100 million
3. Man-made fibers and resin projects with total cost less than Rs.100 million
4. Manufacturing of apparel, including dyeing and printing, with total cost more than Rs.25 million
5. Wood products with total cost more than Rs.25 million

D. Mining and mineral processing

1. Commercial extraction of sand, gravel, limestone, clay, sulphur and other minerals not included in Schedule II with total cost less than Rs.100 million
2. Crushing, grinding and separation processes

3. Smelting plants with total cost less than Rs.50 million

E. Transport

1. Federal or Provincial highways (except maintenance, rebuilding or reconstruction of existing metalled roads) with total cost less than Rs.50 million

2. Ports and harbor development for ships less than 500 gross tons

F. Water management, dams, irrigation and flood protection

1. Dams and reservoirs with storage volume less than 50 million cubic meters of surface area less than 8 square kilometers

2. Irrigation and drainage projects serving less than 15,000 hectares

3. Small-scale irrigation systems with total cost less than Rs.50 million

G. Water supply and treatment

Water supply schemes and treatment plants with total cost less than Rs.25 million

H. Waste disposal

Waste disposal facility for domestic or industrial wastes, with annual capacity less than 10,000 cubic meters

I. Urban development and tourism

1. Housing schemes

2. Public facilities with significant off-site impacts (e.g. hospital wastes)

3. Urban development projects

J. Other projects

Any other project for which filing of an IEE is required by the Federal Agency under sub-regulation (2) of Regulation 5

SCHEDULE II
(*See* Regulation 4)

List of projects requiring an EIA

A. Energy

1. Hydroelectric power generation over 50 MW
2. Thermal power generation over 200 MW
3. Transmission lines (11 KV and above) and grid stations
4. Nuclear power plans
5. Petroleum refineries

B. Manufacturing and processing

1. Cement plants
2. Chemicals projects
3. Fertilizer plants
4. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost of Rs.100 million and above
5. Industrial estates (including export processing zones)
6. Man-made fibers and resin projects with total cost of Rs.100 M and above
7. Pesticides (manufacture or formulation)
8. Petrochemicals complex
9. Synthetic resins, plastics and man-made fibers, paper and paperboard, paper pulping, plastic products, textiles (except apparel),printing and publishing, paints and dyes, oils and fats and vegetable ghee projects, with total cost more than Rs.10 million
10. Tanning and leather finishing projects

C. Mining and mineral processing

1. Mining and processing of coal, gold, copper, sulphur and precious stones
2. Mining and processing of major non-ferrous metals, iron and steel rolling
3. Smelting plants with total cost of Rs.50 million and above

D. Transport

1. Airports
2. Federal or Provincial highways or major roads (except maintenance, rebuilding or reconstruction of existing roads) with total cost of Rs.50 million and above
3. Ports and harbor development for ships of 500 gross tons and above
4. Railway works

E. Water management, dams, irrigation and flood protection

1. Dams and reservoirs with storage volume of 50 million cubic meters and above or surface area of 8 square kilometers and above
2. Irrigation and drainage projects serving 15,000 hectares and above

F. Water supply and treatment

Water supply schemes and treatment plants with total cost of Rs.25 million and above

G. Waste Disposal

1. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)
2. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters

H. Urban development and tourism

1. Land use studies and urban plans (large cities)
2. Large-scale tourism development projects with total cost more than Rs.50 million

I. Environmentally Sensitive Areas

All projects situated in environmentally sensitive areas

J. Other projects

1. Any other project for which filing of an EIA is required by the Federal Agency under sub-regulation (2) of Regulation 5.
2. Any other project likely to cause an adverse environmental effect

SCHEDULE III
(See Regulation 7)

IEE/EIA Review Fees

Total Project Cost	IEE	EIA
Upto Rs.5,000,000	NIL	NIL
Rs.5,000,001 to 10,000,000	Rs.10,000	Rs.15,000
Greater than Rs.10,000,000	Rs.15,000	Rs.30,000

SCHEDULE IV
[*See* Regulation 8(2)(a)]

Application Form

1.	Name and address of proponent		Phone: Fax: Telex:	
2.	Description of project			
3.	Location of project			
4.	Objectives of project			
5.	IEE/EIA attached?	IEE/EIA :	Yes/No	
6.	Have alternative sites been considered and reported in IEE/EIA?		Yes/No	
7.	Existing land use		Land requirement	
8.	Is basic site data available, or has it been measured?	(only tick yes if the data is reported in the IEE/EIA)	Available	Measured
		Meterology (including rainfall)	Yes/No	Yes/No
		Ambient air quality	Yes/No	Yes/No
		Ambient water quality	Yes/No	Yes/No
		Ground water quality	Yes/No	Yes/No
9.	Have estimates of the following been reported?		Estimated	Reported
		Water balance	Yes/No	Yes/No
		Solid waste disposal	Yes/No	Yes/No
		Liquid waste treatment	Yes/No	Yes/No
10.	Source of power		Power requirement	
11.	Labour force (number)	Construction: Operation:		

Verification. I do solemnly affirm and declare that the information given above and contained in the attached IEE/EIA is true and correct to the best of my knowledge and belief.

Date _______

Signature, name and ______
designation of proponent
(with official stamp/seal)

SCHEDULE V
[*See* Regulation 12]

Decision on IEE

1. Name and address of proponent ______________________________

   ____

2. Description of project ______________________________

3. Location of project ______________________________

4. Date of filing of IEE ______________________________

5. After careful review of the IEE, the Federation Agency has decided –

   (a) to accord its approval, subject to the following conditions:

   ____

   ____

   or (b) that the proponent should submit an EIA of the project, for the following reasons –

   ____

   ____

   [Delete (a) or (b), whichever is inapplicable]

Dated ________

Tracking no.___

Director-General
Federal Agency
(with official stamp/seal)

SCHEDULE VI
[*See* Regulation 12]

Decision on EIA

1. Name and address of proponent ______________________________
____

2. Description of project ______________________________

3. Location of project ______________________________

4. Date of filing of EIA ______________________________

5. After careful review of the EIA, and all comments thereon, the Federation Agency has decided –

(a) to accord its approval, subject to the following conditions:

____
____

or (b) that the proponent should submit an EIA with the following modifications-

____
____

or (c) to reject the project, being contrary to environmental objectives, for the following reasons:

____
____

[Delete (a)/(b)/(c), whichever is inapplicable]

Dated ________

Tracking no.___

Director-General
Federal Agency
(with official stamp/seal)

SCHEDULE VII
[*See* Regulation 13(2)]

Undertaking

I, (full name and address) as proponent for (name, description and location of project) do hereby solemnly affirm and declare that I fully understand and accept the conditions contained in the approval accorded by the Federal Agency bearing tracking no._____ dated ________, and undertake to design, construct and operate the project strictly in accordance with the said conditions and the IEE/EIA.

Date _______

Signature, name and ______
designation of proponent
(with official stamp/seal)

Witnesses
(full names and addresses)

(1) ______________

(2) ______________

SCHEDULE VIII
(*See* Regulation 21)
Form of Registers for IEE and EIA projects

S. No.	Description	Relevant Provisions
1	2	3
1.	Tracking number	
2.	Category type (as per Schedules I and II)	
3.	Name of proponent	
4.	Name and designation of contact person	
5.	Name of consultant	
6.	Description of project	
7.	Location of project	
8.	Project capital cost	
9.	Date of receipt of IEE/EIA	
10.	Date of confirmation of completeness	
11.	Approval granted (Yes/No)	
12.	Date of approval granted or refused	
13.	Conditions of approval/reasons for refusal	
14.	Date of Undertaking	
15.	Date of extension of approval validity	
16.	Period of extension	
17.	Date of commencement of construction	
18.	Date of issue of confirmation of compliance	
19.	Date of commencement of operations	
20.	Dates of filing of monitoring reports	
21.	Date of cancellation, if applicable	

ANNEX – III – National Environmental Quality Standards, NEQS

REGISTERED No. M-302
L. 7646

The Gazette of Pakistan

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABD, THURSDAY, AUGUST 10, 2000

PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND
RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2._____

(1289)

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

(1) for Annex, I the following shall be substituted, namely:_____

Annex-I

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Existing Standards	Revised Standards Into Inland Waters	Into Sewage Treatment (5)	Into Sea ( )
1	**2**	**3**	**4**	**5**	**6**
1.	Temperature or Temperature Increase *	40^0C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C (1)	80	80	250	80**
4.	Chemical Oxygen Demand (COD) (1)	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) (2)	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides (3)	0.15	0.15	0.15	0.15

PART-II] THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 1291

1	2	3	4	5	6
17.	Cadmium (4)	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent (4).. ..	1.0	1.0	1.0	1.0
19.	Cooper (4)	1.0	1.0	1.0	1.0
20.	Lead (4)	0.5	0.5	0.5	0.5
21.	Mercury (4)	0.01	0.01	0.01	0.01
22.	Selenium (4)	0.5	0.5	0.5	0.5
23.	Nickel (4)	1.0	1.0	1.0	1.0
24.	Silver (4)	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic (4)	1.0	1.0	1.0	1.0
28.	Barium (4)	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron (4)	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/I is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3^{0}C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/I

*** Discharge concentration at or below sea concentration (SC).

Note:______ 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits" and

(2) for Annex-II the following shall be substituted, namely:____

Annex-II

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm^3, UNLESS OTHERWISE DEFINED)."

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
1.	Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
2.	Particulate malter	(a) Boilers and Furnaces		
	(1)	(i) Oil fired	300	300
		(ii) Coal fired	500	500
		(iii) Cement Kilns	200	300
		(b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas.	500	500
3.	Hydrogen Chloride	Any	400	400

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1	2	3	4	5
4.	Chlorine	Any	150	150
5.	Hydrogen Fluoride	Any	150	150
6.	Hydrogen Sulphide	Any	10	10
7.	Sulphur Oxides [(2) (3)]	Sulfuric acid/Sulphonic acid plants		
		Other Plants except power Plants operating on oil and coal	400	1700
8.	Carbon Monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen	Nitric acid manufacturing unit.	400	3000
	(3)	Other plants except power plants operating on oil or coal:		
		Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanations:-

1. Based on the assumption that the size of the particulate is 10 micron or more.

2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.

3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

A. **Sulphur Dioxide**

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m^3) Standards.

Background Air Quality (SO_2 Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max. SO_2 Emission (Tons per Day Per Plant)	Criterion II Max. Allowable ground level increment to ambient (ug/m^3) (One year Average)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NO_x should not be exceed the following:-

Annual Arithmetic Mean	100ug/m^3 (0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram (10^0-gram) per joule of heat input:

Liquid fossil fuel	..	..	..	130
Solid fossil fuel ..	..	..		300
Lignite fossil fuel	..	..	..	260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULAH AWAN
DEPUTY SECRETARY (ADMN)

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PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT

NOTIFICATIONS

Islamabad, the 18th October, 2010

S. R. O. 1062(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (I) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Ambient Air.

National Environmental Quality Standards for Ambient Air

Pollutants	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Effective from 1st July, 2010	Effective from 1st January 2013	
Sulphur Dioxide (SO_2)	Annual Average* 24 hours**	80 $\mu g/m^3$ 120 $\mu g/m^3$	80 $\mu g/m^3$ 120 $\mu g/m^3$	-Ultraviolet Fluorescence method
Oxides of Nitrogen as (NO)	Annual Average* 24 hours**	40 $\mu g/m^3$ 40 $\mu g/m^3$	40 $\mu g/m^3$ 40 $\mu g/m^3$	- Gas Phase Chemiluminescence

(3205)

[2944(2010)/Ex. Gaz.] *Price: Rs. 5.00*

Pollutants	Time-weighted average	Concentration in Ambient Air: Effective from 1st July, 2010	Concentration in Ambient Air: Effective from 1st January 2013	Method of measurement
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m³	40 µg/m³	- Gas Phase Chemiluminescence
	24 hours**	80 µg/m³	80 µg/m³	
O³	1 hour	180 µg/m³	130 µg/m³	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400 µg/m³	360 µg/m³	- High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	550 µg/m³	500 µg/m³	
Respirable Particulate Matter. PM_{10}	Annual Average*	200 µg/m³	120 µg/m³	-β Ray absorption method
	24 hours**	250 µg/m³	150 µg/m³	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	25 µg/m³	15 µg/m³	-β Ray absorption method
	24 hours**	40 µg/m³	35 µg/m³	
	1 hour	25 µg/m³	15 µg/m³	
Lead Pb	Annual Average*	1.5 µg/m³	1 µg/m³	- ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2 µg/m³	1.5 µg/m³	
Carbon Monoxide (CO)	8 hours**	5 mg/m³	5 mg/m³	- Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m³	10 mg/m³	

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

S. R. O. 1063(I)/2010.— In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Standards for Drinking Water Quality.

National Standards for Drinking Water Quality

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12 month period.	Most Asian countries also follow WHO standards
Physical			
Colour	≤ 15 TCU	≤ 15 TCU	
Taste	Non objectionable/Acceptable	Non objectionable/Acceptable	
Odour	Non objectionable/Acceptable	Non objectionable/Acceptable	
Turbidity	< 5 NTU	< 5 NTU	
Total hardness as $CaCO_3$	< 500 mg/l	----	
TDS	< 1000	< 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	*mg/Litre*	*mg/Litre*	
Aluminium (Al) mg/l	≤ 0.2	0.2	

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Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Antimony (Sb)	≤ 0.005 (P)	0.02	
Arsenic (As)	≤ 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	< 250	250	
Chromium (Cr)	≤ 0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	***mg/Litre***	***mg/Litre***	
Cyanide (CN)	≤ 0.05	0.07	Standard for Pakistan similar to Asian developing countries
Fluoride (F)*	≤ 1.5	1.5	
Lead (Pb)	≤ 0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	≤ 0.5	0.5	
Mercury (Hg)	≤ 0.001	0.001	
Nickel (Ni)	≤ 0.02	0.02	
Nitrate (NO_3)*	≤ 50	50	
Nitrite (NO_2)*	≤ 3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source	—	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries

* indicates priority health related inorganic constituents which need regular monitoring.

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		≤ 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

Proviso:

The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The Arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, Lead was completely phased out from petroleum products to cut down Lead entering into environment. These steps will enable to achieve WHO guidelines for Arsenic, Lead, Cadmium and Zinc. However, for bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

S. R. O. 1064(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Noise.

National Environmental Quality Standards for Noise

S. No.	Category of Area / Zone	Effective from 1st July, 2010		Effective from 1st July, 2012	
		Limit in dB(A) Leq *			
		Day Time	Night Time	Day Time	Night Time
1.	Residential area (A)	65	50	55	45
2.	Commercial area (B)	70	60	65	55
3.	Industrial area (C)	80	75	75	65
4.	Silence Zone (D)	55	45	50	45

Note: 1. Day time hours: 6.00 a. m to 10.00 p. m.

2. Night time hours: 10.00 p. m. to 6.00 a.m.

3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.

4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

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

[No. F. I(12)/2010-11-General.]

MUHAMMAD KHALIL AWAN,
Section Officer (PEPC).

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