Draft Environmental Impact Assessment
Volume 2

Project Number: 48307-001
July 2014

PAK: Engro Fast Track LNG Regasification Project

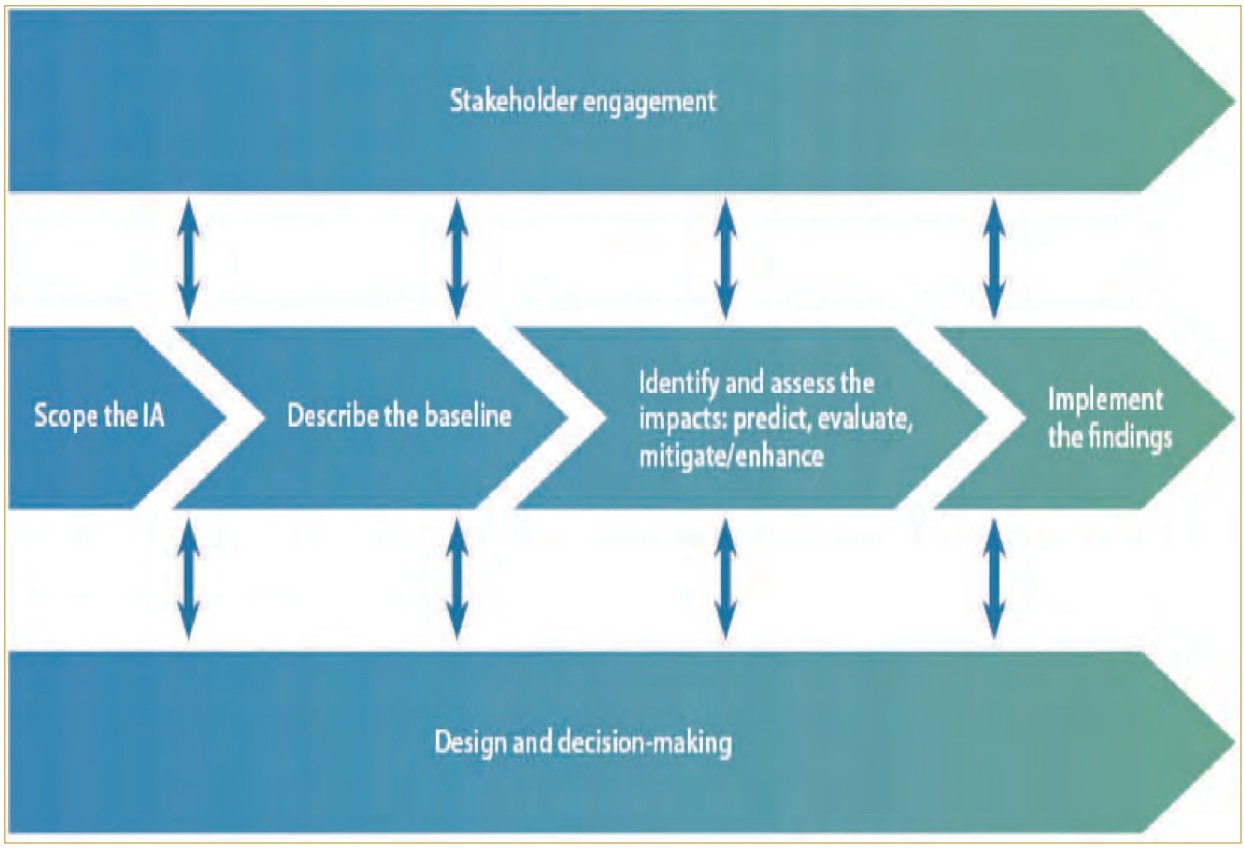
Prepared by Environmental Management Consultants (EMC) for Engro Elengy Terminal Private Limited

07 PUBLIC / STAKEHOLDERS CONSULTATION & INFORMATION DISCLOSURE

7.1 PUBLIC CONSULTATION & PARTICIPATION

Public Consultation and Public Participation are two effective tools of social interaction. Public Consultation is an important tool to build up confidence between the stakeholders and the project formulators to minimize the risk of delay of project implementation. It also counters erroneous information, if any, about the project. It helps the project proponent (Elengy Terminal Pakistan Limited; ETPL) make informed assessments of public opinion about the project, and the nature and extent of opposition likely to occur during the implementation stage.

Public Participation, on the other hand, helps project implementation to a great extent. The purpose of involving the public in general and project affected persons, in the decision making process is to have a fair interaction with all community groups and ensuring them that every attempt would be made to minimize negative impacts of the project, and that adequate mitigation measures would be taken to compensate the loss of the affected persons, if any. Thus, it ensures partnering between the community and the project proponent leading to timely completion of the project with least social cost and disruption. Moreover, experience indicates that unexpected project effects on the local community generally give rise to significant issues and concerns among Project Affected Persons (PAPs). These problems get reduced when people are properly informed and consulted about the project and given the opportunity of being heard. Similarly, Non Governmental Organizations (NGOs) will frequently come forward to



advocate on behalf of the stakeholders, including PAPs. By making NGO's party to the decision making process, future litigation at later stages can be avoided.

7.2 ETPL'S POLICY OF PUBLIC CONSULTATION & DISCLOSURE PLAN

Since ETPL's proposed LNG Terminal project is a significant development in Port Qasim, it has special consultation responsibilities. Effective project planning has required regular consultation with a wide range of project stakeholders. Based on an extensive public outreach program, including public meetings, public hearings, and individual and group consultations, the local community is well informed of the project objectives, likely impacts and essential provisions of compensation policy through the Project's conduct of the following activities:

1) Information dissemination campaigns using media, notice of meetings or information leaflets;

2) Holding Public/Stakeholder Consultation Meetings and Focus Group Discussions (FGDs);

3) Arranging interviews with the communities and their stakeholder groups;

4) Formation of focus groups involving key stakeholders, like local/community leaders, women, the poor, and other groups;

5) Setting up various committees for planning, implementation and monitoring of construction and operations; and

6) Involvements of the PAPs in a formal grievance redress process.

To discuss and seek opinion/suggestion from the communities & other stakeholders, their representatives were invited to participate in various meetings regarding project related issues involving impact mitigation and compensation procedures in light of ADB & IFC guidelines.

Guiding Principles: ADB requires public consultation in the environmental assessment process. For category A and B projects, the borrower must consult with groups affected by the proposed project and local non-government organizations (NGOs). The consultation needs to be carried out as early as possible in the project cycle so that views of affected groups are taken into account in the design of the project and its environment mitigation measures. Such consultation will also take place during project implementation to identify and help address environmental issues that arise. For category A projects, ADB ensures that the borrower carries out public consultation at least twice: (i) once during the early stages of EIA field work; and (ii) once when the draft EIA report is available, and prior to loan appraisal by ADB. ***ADB's Environmental Assesment Guidelines*** describe the best practices for consulting stakeholders and providing acces to information.

The project has also followed International Finance Corporation (IFC) Performance Standard 1: Social and Environmental Assessment and Management Systems, in developing the public participation program for the LNG project. A relevant objective adhered to in designing the public involvement program for the project is:

- To ensure that affected communities are appropriately engaged on issues that could potentially affect them.

Requirement 19 of this Performance Standard states "When local communities may be affected by risks or adverse impacts from a project, the engagement process will include consultation with them. …Community engagement will be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information."

Requirement 23 of this Performance Standard states "The client will respond to communities' concerns related to the

project. If the client anticipates ongoing risks to or adverse impacts on affected communities, the client will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The client will inform the affected communities about the mechanism in the course of its community engagement process."

IFC Performance Standard 4: Community Health, Safety and Security and a relevant objective is to:

- To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances.

IFC Performance Standard 7: Indigenous Peoples and relevant objectives are to:

- To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project; and
- To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples.

International standards that are followed by ETPL relevant to community engagement include:

- International Finance Corporation, 'Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets' (IFC, 2007); and
- The Core Values of the International Association for Public Participation (IAP2).

The project has striven to rely on the following IFC principles:

- Early engagement: Commencing engagement early is critical in building trust, mutual respect and in establishing relationships with communities. ETPL will ensure that consultation activities are proactive, planned and delivered in a timely way.
- Long-term view: Establishing and maintaining relationships is a long-term investment. To enhance the value of community relationships, ETPL will take a long-term view to engagement.
- Tailored at each phase of project: The outreach and engagement program will be tailored to each phase of the project. In developing the project, activities, issues and stakeholders associated with the phase will be considered and built into the engagement activities for that phase.
- Proactive, not reactive: ETPL will set a proactive path for consultation and will consult in a strategic manner, as opposed to being reactive and responding to grievances as they arise. A proactive approach to consultation will build credibility and relationships with the community.
- Managed as a business priority: ETPL will ensure that engagement activities are planned and delivered through a systematic and consistent approach and that management responsibilities are assigned to each consultation activity.

The major objectives of ETPL's public consultation program are to:

- Create awareness among local people about the project in general and its potential impacts (both positive and negative) on the community, and involve them in the decision making process from the very inception of the project with a view to build trust.

- Identify significant public concerns with a view to reduction of public resistance during implementation of the project. Make them feel that they are not ignored. Take them in confidence by providing them a role in the decision making process.
- Educate potentially affected communities/persons about the project.
- Solicit the views of affected communities on socio-economic aspects of the project. This process serves as an important tool for collection of information on both natural and human environment, which would not be possible through traditional approach of data collection.
- Produce a suitable plan for meaningful and responsive public involvement by incorporating the felt needs and preferences of communities as evolved through community interactions.

7.3 IDENTIFICATION OF STAKEHOLDERS

Stakeholders are people, groups, or institutions that may be affected by, can significantly influence, or are important to the achievement of the stated purpose of a proposed intervention.

The Primary and secondary stakeholders were identified based on standard following definitions:

1. Primary Stakeholders are people, groups or institutions affected positively (beneficiaries) or negatively by the project;

2. Secondary Stakeholders are people, groups, or institutions that are important intermediaries in the project delivery process (e.g., the institutions, research organizations, government line agencies, or NGOs etc).

For the purpose of this project, the primary stakeholders are the fishing communities living in the macroenvironment of project area. However, it is pertinent to mention that the living population/ community settlements are located more than 5 km away from the proposed site designated by PQA for LNG Terminal.

Group discussions and consultation meeting were conducted with stakeholders particularly with the Korangi Fishing Harbor Administration, notables of fisheries community, etc. For this purpose semi structured questionnaires were used for data collection. These

Table 7.1: People and Organizations Consulted

Organization Consulted	Organization Type	Person Consulted
Environmental Protection Agency (EPA)	Governmental	Mr. Naeem Ahmed Mughal Director General, Sindh EPA
Port Qasim Authority	Governmental	Vice Admiral Muhammad Shafi Chairman, PQA
World Conservation Union(IUCN)	Non-governmental	Mr. Tahir Qureshi Senior Expert on Ecology
Shehri-CBE	Non-governmental organization	Mr. Roland Desouza & Mrs. Amber Ali Bhai
National Institute of Oceanography	Governmental	Dr. Shaukat Hayat Khan Director General
Pakistan Fisher folk Forum (PFF)	Non-governmental organization	Muhammad Ali Shah Chairman
Pakistan Gasport Limited	Private	Mr. Anees Ahmed Ansari Director

questionnaires were consisted of open and close ended questions.

The consultation team consisted of Environment & Social issues specialists and enumerators. In most cases, the team was accompanied by a local representative. The local representatives were instrumental in the selection of venues and timings for the meetings and focus group discussions. Local CBOs played a vital role to mobilize the community to attend public consultation meetings.

The comments expressed by the participants at public consultation and focus group discussions were noted (an outline of issues and concerns expressed by individuals, the community, NGOs and public agencies is detailed in the following table and elsewhere in this section). Similarly, the comments made by stakeholders at scoping meeting were noted.

These comments have been analyzed as socio-economically viable statements of the participants and have been reflected in the detailed engineering design as much as possible.

Since these consultation meetings/FGDs were an open forum for all, there was a representation from all groups by language, gender, age and income levels. This is a continuous process and will be continued until the issues pertaining to preconstruction, construction & operational phases of project are settled to the reasonable satisfaction of stakeholders, especially the affected local communities if any.

The result of the consultation was a clear identification of the issues perceived to be important by the community and stakeholders and the need to respond to those issues in the ESIA. Mitigation of potential environmental effects of concern to the community and other stakeholders has been incorporated into the project planning and will occur throughout the construction and operational phases of the project.

7.4 CONSULTATION AT EIA PREPARATION STAGE

According to the survey conducted by a team of independent experts it has come to know that there are no settlements or sensitive areas including archaeological sites or protected areas in the neighborhood beyond 5 km radius. However, it is predicted that the project will not affect the livelihood of the communities residing in the macroenvironment who are mainly fisherman by occupation or are directly or indirectly related to fishing industry to earn their livelihood followed by unskilled labor, self-employed and service providers. Concerns expressed by the stakeholders are presented in Table 7.2. All stake holders expressed serious concerns on the alternative site Option 2 on account of LNG safety and security risks. The same are out of scope of this report and have been separately addressed by ETPL as part of their risk assessment studies.

The stakeholder engagement process is intended to seek the views, concerns and needs of stakeholders and engage with them in a constructive two-way dialogue throughout the project.

Initiating the stakeholder consultation process at an early stage in the project cycle ensures that feedback from communities and other stakeholders directly or indirectly affected by the project can be used to adjust and improve project design, planning, and implementation from an environmental and social perspective.

The stakeholder consultation was conducted with respect to the ETPL's LNG import terminal project. The Scoping process identified data gaps relating to the quality of the marine environment baseline ambient air quality, baseline noise levels, Health & Safety issues, information about other planned developments in the area, Hazards and Risks associated with the constructed and operation activities of the FSRU, and jetty.

Table 7.2: Stakeholder Concerns and Mitigation Measures

Organization Discussion and Concerns	Organization Discussion and Concerns
Environmental Protection Agency (EPA)	The proposed LNG import terminal should not be sited in the main navigational channel (Siting Option 2) due to the safety and security risks associated with this type of project. All relevant legal requirements must be fulfilled at the planning stage of project and those should be referred in detailed EIA study. The impact of dredging and reclamation should be thoroughly studied and measures to be evaluated so that the activities have least impacts on mangroves and benthic communities.
Port Qasim Authority	Initially Port Qasim Authority proposed its consent to ETPL for carrying out studies on three possible sites considered for LNG import terminal. Those included Alternative Site Option 1 & Option 2 (green field) and Option 3 (brown field) near the existing EVTL terminal. Provisional NOC has been issued to ETPL for option 1, 2 & 3 by PQA. PQA will provide NOC if all the studies prove technical viability of the site. Dredging spoil would be off-loaded at Bundal Island which is faced with serious erosion and has lost considerable area to the sea. This activity will reclaim some of the lost land at the island and protect the channel by suitable design. The benthic community loss would be rehabilitated at a suitable place, may be at Bundal Island where a Biodiversity Park proposed by EMC could be establishment in collaboration with the stakeholders including the Fisher folk forum.
World Conservation Union(IUCN)	The proponent should consider the site which is less exposed to open sea (option 1 or 3) instead of placing it in the main navigational channel critically exposed to open sea (option 2) because option 2 would be prone to natural hazards which include cyclones, hurricanes and tsunamis. Placing the LNG terminal in the main navigation channel would face erosion and sedimentation problems and as a result more dredging would be required that will affect the marine ecology. Therefore, Brown Field site seems to be preferred as compare to option 2. It should be ensured that the activity will minimize the impact on mangroves and benthic communities through the adoption of mitigation measures. Strict monitoring of contractor's activities must be carried out during the different stages of project. Any loss to mangroves should be compensated by planting 4-7-10 mangroves for loss of one depending on the canopy.
Shehri-CBE	The LNG terminal should not be sited in the main channel (option 2) and also it must be away far from communities. Detailed hydraulic study should be conducted for this project. SIGTTO siting standards should be considered in evaluating the optimum and safe location for the LNG terminal. Land based LNG terminals like nuclear plants and other infrastructure are vulnerable to natural disasters (earthquakes, tsunamis) and sabotage/terrorist action. Careful planning and mitigation measures need to be considered for the project.
National Institute of Oceanography	The LNG terminal should not be sited on option 2 (green field) which is located along main navigational channel and is therefore most prone to natural hazards including cyclones, storm surges and tsunamis. More dredging would be required for option 2 because of the increased erosion and sedimentation in this area. Option 1 or 3 (Brown Field site) may be considered as the preferred alternative. However, a detailed hydraulic study should be done.
Pakistan Fisher folk Forum (PFF)	LNG terminal is the requirement of the Country due to the short fall of natural gas in the country. PFF would support the project if it does not hinder the commercial fishing activities in the area. Mitigation measures should be adopted to minimize the impacts on communities and fisherman. PFF should be a part of monitoring team for all phases of the project.
Pakistan Gasport Limited	The safety records of LNG terminals are very good and satisfactory worldwide; therefore, the proposed ETPL's LNG terminal would successfully operate if all the mitigation measures are in place. However; the criticality of siting of LNG terminal near the entrance to main channel (option 2) is questionable because this option shall not find favor according to the international guidelines

7.5 PUBLIC HEARING BY SINDH ENVIRONMENTAL PROTECTION AGENCY

The Sindh Environmental Protection Agency (SEPA) had invited all the stakeholders including general public, local communities, academia, NGOs, and experts for "Public Hearing" on EIA that was held on April 09, 2011 at a Local Hotel in Karachi.The meeting was chaired by Director General of Sindh EPA.

Following questions were raised by the participants and responded by ETPL and EMC:

Question by: Mr. Arsalan, representative of Pakistan Fisherman Folk Forum (PFFF): EVTL must conduct a detailed QRA study to identify the impacts on the living population in case of any mishap. He suggested that EVTL should take PFFF onboard during the planning, construction and operation stages of project. He also said that EVTL should also include CSR plans for the betterment of the area especially fishermen. He further enquired if any independent review has been conducted for project.

Response by: Mr. Naeem Ahmed Mughal, Director General Sindh EPA: Public hearing itself is a part of an independent review process and after this hearing; experts committee will be formed who will further review the findings of EIA.

Response by: Mr. Sheikh Imranul Haq, CEO, ETPL: ETPL is conducting QRA study through a reputable international consultant. ETPL shall share the QRA with EPA. He assured the PFFF and fishermen that ETPL shall take all the stakeholders onboard throughout the project. Separate funds will be allocated to initiate programs such as training centers for fishing communities. Local people shall be preferred for all the semi-skilled and un-skilled jobs during the construction and operation of Project.

Question by Prof. Dr. Akhlaq Ahmed from Institute of Business Management (IOBM): He acknowledged the efforts made by EMC for preparing a very comprehensive EIA report. His raised a question that availability of portable water during project activities is not included in executive summary of EIA report. He also asked that why Pakistan Steel is not invited in the Public Hearing.

Response by Mr. Saquib Ejaz from EMC: Portable water requirements for project staff is given in EIA report section 03. Pakistan Steel was also invited by Sindh EPA in Public Hearing.

Question by Miss. Anila Ashfaz (Lawyer): Why IEE is not conducted of the project? She also enquired about the incident history at regasification terminals worldwide.

Response by Mr. Syed Nadeem Arif, EMC: IEE is a basic study and conducted for projects under schedule-I of PEPA (Review of IEE and EIA) Regulations, 2000. However this project is listed in Schedule-II of PEPA (Review of IEE and EIA) Regulations, 2000. Therefore we conducted EIA study.

Response by Mr. Naeem Ahmed Mughal, Director General Sindh EPA: Projects having less impacts do require an IEE whereas projects having significant environmental impacts project requires EIA.

Response by Mr. Saquib Ejaz from EMC: There are about 54 reported incidents on LNG but none of it happened with LNG regasification unit. All such incidents have taken place at LNG liquefaction plants worldwide. History of LNG Regasification & Import terminal in this context is very safe and is without incidents.

Question by Mr. Saeed Baloch from Pakistan Fisherman Folk Forum: Who is responsible for Mangrove compensation and its monitoring? He also asked about effluent quality which may effects marine life.

Answer by Dr. Shahid Amjad from EMC: Mangroves loss will compensated by 1:5 ratios which mean that 5 mangroves will be planted against one loss of 1 mangrove and it will be monitored by IUCN. He also said that effluent quality shall comply with National Environmental Quality Standards (NEQS) of Pakistan.

Question by Mr. Gulzar Memon from IEP: What will be the source of Energy during construction and operation?

Response by Mr. Sheikh Imran Ul Haq (CEO EVTL): Diesel Generators will be used for energy requirement during construction and FRSU will have its own power generation unit.

Question by Mr. Akbar Mushtaq (HSE Manager, PRL): Is there any contingency plan in case of disaster?

Response by Mr. Sheikh Imran Ul Haq (CEO EVTL): Contingency Plan will be in place for disaster management.

Question by Mr. Imran Sabir from EPA: What will be the Impacts on marine life due to temperature shock? What will be the impact of noise on marine mammals?

Response by Mr. Saquib Ejaz Hussain from EMC: Any aquatic life directly contacting the LNG may experience a sudden cold shock. Marine life near/under 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 and no adverse impact is envisaged as shown in video.

7.6 EXPERTS COMMITTEE MEETING

The Sindh Environmental Protection Agency (SEPA) had notified a committee of experts to evaluate the ESIA report of ETPL LNG Terminal Project and to assist and guide EPA Sindh for decision making. The meeting was held on May 26, 2011 and was chaired by Director General of Sindh EPA.

Following questions were raised by the experts and responded by ETPL and EMC:

Question

Dr. Moinuddin, IoBM: It is suggested that the proponent obtain certification against ISO 20858 Standard - Ships and marine technology - Maritime port facility security assessments and security plan development

Answer

Mr. Imran ul Haq, CEO Engro Vopak: The Engro Vopak terminal is in operation from 1997 without any LTI and environmental damage and it is the first terminal in Asia to receive the Gold Award for best records in safety, health and environment. The company is ISO certified and follows the ISPS Standard. There is a robust HSE Policy in place at Engro.

Engro shall comply with all National and International Codes and Standards for this Project.

Question

Mr. Rafiulhaq, IUCN: Dredging of Phitti creek by PQA had affected mangroves in the past. Mangroves are the natural sequesters factory for carbon. The mangroves in the region are more than 2-3 metres in height. ETPL must take into consideration the importance of mangrove and formulate a plan in consultation with IUCN for its replantation.

Answer

Saquib Ejaz Hussain, EMC: The EIA report suggests a plan for mangroves. It has been suggested that ETPL shall take IUCN onboard for replantation of mangroves. ETPL is required to plant atleast 10 magroves for loss of one. Mr. Tahir Qureshi of IUCN has agreed to provide his expertise in this regard.

Question

Dr. Samiuzzaman, Chairman GEL: 1) Is there any arrangement for treatment of effluent generated by project personnel on board?

2. What are the provisions for dealing with the hot water generated?

What are the sources of LNG?

Answer:

Syed Nadeem Arif, EMC: Liquid waste will be treated to

comply NEQS.

Mr. Imran ul Haq, CEO ETPL: 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 11°C 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 1°C.

Mr. Imran ul Haq, CEO Engro Vopak: Our most probable source shall be Qatar due to the advantage of less shipping time and cost and we have a signed a 10 year contract with them. Second source would be Australia. Other sources include Egypt, Libya, Oman & Abu Dhabi

Question

Dr.Yasmin Nergis, Bahria University: What are the economic benefits of the proposed project?

Answer

Mr. Imran ul Haq, CEO Engro Vopak: There is shortage of gas to the tune of 25-30% in the country. Gas costs are high in other countries – Cost of gas is $4 in Pakistan vs. $12 internationally. Hence increase in price of gas is expected.

The benefit will be in power generation even though the electricity shortfall will not be met. In order to overcome these shortfalls, demand for LNG will increase and we shall be requiring more than 3 to 4 LNG terminals in future.

Question

Naeem Ahmed Mughal, DG EPA: What will be the impact on marine benthic fauna from dredging activities?

Saquib Ejaz Hussain, EMC: 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 microenvironment. Most of the area to be dredged consists of soft bottom or soft bottom/rubble with little or no observed epifaunal communities.

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.

Conclusion

Mr. Naeem Mughal, DG EPA emphasized that each and every issue raised by the stakeholders must be given due consideration by ETPL. The location of the proposed terminal must be selected very carefully considering all aspect. He added that brown field site is far from communities and therefore will not interfere with fishermen activities. However, ETPL must take all stakeholders on board throughout the project. This will ensure project sustainability in long term. ETPL must also appint an Inpendent Monitoring Consultant (IMC) for implementation of EMP. IUCN should be on board for mangrove replantation.

DG EPA assured that EIA approval shall be issued soon since the Project is of National Importance.

The meeting was concluded with vote of Thanks.

Progressing towards Environmental Prosperity

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GOVERNMENT OF SINDH

PUBLIC NOTICE

The Environmental Protection Agency, Sindh hereby notifies that M/s Engro Vopak Terminal Limited has submitted Environmental & Social Impact Assessment (ESIA) report for construction and operation of a Liquefied Natural Gas (LNG) terminal in Port Qasim, inclusive of ship berthing and import facilities, floating storage tanks and regasification equipments. The project intends to provide facilities for receiving supplies of LNG via a conventional LNG carrier, for offloading, transfer and loading into a floating storage and regasification arrangement (FSRA). The ESIA report identifies potential environmental impacts and provides mitigation measures to minimize the impacts.

The general public, stakeholders, experts can pursue/consult the ESIA report in the office of the Director General, Environmental Protection Agency Sindh, located at Plot No. ST-2/1, SECTOR-23, KORANGI INDUSTRIAL AREA, KARACHI. The report is also available on the websites: **www.emc.com.pk** and **www.engrovopak.com**

A public hearing will be conducted by the EPA Sindh at **10:00 a.m** on **09th April, 2011 at Hotel Avari Towers Khorshed Mahal Hall, Karachi** in which the proponents will make a presentation about the project. The general public, concerned citizens, civil society organizations and all other stakeholders are requested to attend this public hearing. All others who are interested to offer their comments in writing may communicate the same to Director General, EPA, Sindh on the above mentioned address or through e-mail at epasindh@gmail.com (within 30 days of the publication of this notice).

Director General

ماحولیاتی خوشحالی کی طرف بڑھتے قدم

ENVIRONMENT & ALTERNATIVE ENERGY DEPARTMENT
GOVERNMENT OF SINDH

پبلک نوٹس

ایجنسی برائے ماحولیاتی تحفظ (EPA)، سندھ نے اعلان کیا ہے کہ میسرز اینگرو ووپاک ٹرمینل لمیٹڈ نے پورٹ قاسم پر LNG ٹرمینل کی تعمیر اور آپریشن بشمول شپ برتھنگ، درآمدی سہولیات، فلوٹنگ اسٹوریج ٹینک اور ری گیسیفیکیشن آلات کے سلسلے میں ماحولیاتی تجزیاتی (ESIA) رپورٹ جمع کروادی ہے۔

پروجیکٹ کا مقصد روایتی LNG کیریئرز کے ذریعے LNG گیس کے حصول، LNG کی آف لوڈنگ، ٹرانسفر اور فلوٹنگ اسٹوریج ٹینک میں منتقلی کی سہولت فراہم کرنا ہے۔ ماحولیاتی تجزیاتی (ESIA) رپورٹ میں چند ماحولیاتی اثرات کی نشاندہی کی گئی ہے اور ساتھ ہی ان اثرات کو کم کرنے کے لئے احتیاطی تدابیر بھی تجویز کی گئی ہیں۔ عوام الناس، شراکت دار اور ماہرین متذکرہ ماحولیاتی تجزیاتی (ESIA) رپورٹ، ڈائریکٹر جنرل، ایجنسی برائے ماحولیاتی تحفظ (EPA)، سندھ کے دفتر بمقام پلاٹ نمبر ST-2/1، سیکٹر 23، کورنگی انڈسٹریل ایریا، کراچی پر ملاحظہ کی جاسکتی ہے۔ یہ رپورٹ ایجنسی کی ویب سائٹس www.emc.com.pk اور www.engrovopak.com پر بھی دستیاب ہے۔

اس ضمن میں ایک سماعت عام بمقام ہوٹل آواری ٹاورز خورشید محل ہال، کراچی بتاریخ 9 اپریل 2011 بوقت 10 بجے صبح، ایجنسی برائے ماحولیاتی تحفظ (EPA)، سندھ کی جانب سے منعقد کی جائے گی۔ عوام الناس، متعلقہ شہری، سول سوسائٹی کی تنظیمیں اور دیگر تمام شراکت داروں سے اس سماعت عام میں شرکت کی درخواست ہے۔ وہ تمام لوگ، جو اس ضمن میں اپنے تاثرات تحریری طور پر دینا چاہیں اوپر دیئے ہوئے پتے پر ڈائریکٹر جنرل ایجنسی برائے ماحولیاتی تحفظ (EPA)، سندھ سے اس نوٹس کی اشاعت کے 30 دن کے اندر بذریعہ ای میل epasindh@gmail.com پر رابطہ کرسکتے ہیں۔

ڈائریکٹر جنرل

ماحوليياتي خوشحالي
ڈانهن وڌندڙ قدم

ENVIRONMENT & ALTERNATIVE
ENERGY DEPARTMENT
GOVERNMENT OF SINDH

پبلڪ نوٽيس

ايجنسي براءِ ماحولياتي تحفظ (EPA) سنڌ اعلان ڪيو آهي تہ ميسرز اينگرو ويوپاڪ ٽرمينل لميٽڊ پورٽ قاسم تي LNG ٽرمينل جي تعمير ۽ آپريشن شامل شپ برٿنگ، درآمدي سهولتون، فلوٽنگ اسٽوريج ٽينڪ ۽ ريگيسيفڪيشن اوزارن جي سلسلي ۾ ماحولياتي تجزياتي (ESIA) رپورٽ جمع ڪرائي چڪي آهي.

پروجيڪٽ جو مقصد روايتي LNG ڪيريئر ذريعي LNG گئس جي حصول، LNG جي آف لوڊنگ، ٽرانسفر ۽ فلوٽنگ اسٽوريج ٽينڪ ۾ منتقلي جي سهولت فراهم ڪرڻ آهي. ماحولياتي تجزياتي (ESIA) رپورٽ ۾ جنڊ ماحولياتي اثرن جي نشاندهي ڪئي آهي ۽ گڏ ڪ انهن اثرن کي گهٽ ڪرڻ لاءِ احتياطي تدبيرون به تجويز ڪيون ويون آهن عوام الناس، شرڪتدارءِ ماهرن ذڪر ڪيل ماحولياتي تجزياتي (ESIA) رپورٽ ، ڈائريڪٽر جنرل، ايجنسي براءِ ماحولياتي تحفظ (EPA)، سنڌ جي آفيس هنڊ پلاٽ نمبر ST_2/1 ، سيڪٽر 23، ڪورنگي انڊسٽريل ايريا ، ڪراچي تي ڏسي سگهجي ٿي. هي رپورٽ ايجنسي جي ويب سائيٽ www.emc.com.pk ۽ www.engrovopak.com تي به دستياب آهي.

ان سلسلي ۾ هڪ عام بڌڻي هنڊ هوٽل آواري تاون خورشيد محل هال، ڪراچي تاريخ 09 اپريل 2011 وقت 10:00 وڳي صبح، ايجنسي براءِ ماحولياتي تحفظ (EPA) سنڌ طرفان منعقد ڪئي وئي آهي عوام الناس ، لاڳاپيل شهري، سول سوسائٽي جي تنظيمن ۽ بين شرڪتدارن کي هن عام بڌڻي ۾ شرڪت جي درخواست آهي. اهي سموزا ماڻهو جيڪي هن سلسلي ۾ پنهنجا تاثرات تحريري طور تي ڏيڻ چاهين ٿا اهي مٿي ڄاڻايل ايڈريس تي ڈائريڪٽر جنرل ايجنسي براءِ ماحولياتي تحفظ (EPA) ، سنڌ کي هن نوٽيس جي اشاعت جي 30 ڏينهن اندر اي ميل epasindh@gmail.com ذريعي رابطو ڪري سگهن ٿا.

ڈائريڪٽر جنرل

Reference No: EPA/2011/2/21/EIA/58

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH
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Dated: 18th May, 2011

NOTIFICATION

SUBJECT:- **FORMULATION OF A COMMITTEE OF EXPERTS FOR EVALUTION OF EIA REPORT OF CONSTRUCTION AND OPERATION A LIQUIFIED NATURAL GAS PROJECT.**

The EPA Sindh under Rule 11(2) of the Pakistan Environmental Protection Agency (Review of EIA/IEE Regulations, 2000 has constituted a Committee of Experts to assist and guide EPA Sindh in reviewing the EIA report for the subject project.
The Committee shall comprise of following members:-

1. Dr. Y. Nargis, Incharge, Environmental Research Centre, Bahria University, Karachi.
2. Professor Dr. Fasihullah Khan, Expert Oil & Gas, Department of Chemical Engineering, University of Karachi.
3. Dr. Sami-uz-Zaman, Chairman, Global Environmental Management Systems, Godam Chowrangi/ Brooks Chowrangi, Near KTI Office 1st Floor, Karachi.
4. Mr. Tahir Qureshi, Expert Marine Ecosystem, IUCN, D-66, Block-9, Clifton, Karachi.
5. Mr. Shams-ul-Haq Memon, Expert Marine Ecosystem, Sindh Coastal Development Authority, 2nd Floor, PIDC House, Karachi.
6. Mr. Muhammad Ali Shah, Chairman, Fish Folk Forum Office, Ibrahim Hyderi, Korangi Creek, Karachi
7. Dr. S. M. Makhdoomi, Dean, Sir Syed University of Engineering & Technology.
8. Mr. Muhammad Moinuddin Ali Khan, Senior Fellow & Coordinator Environment & Energy Management Institute of Business Management, Karachi
9. Dr.Moazam Ali Khan, Director, Institute of Environmental Studies, University of Karachi.
10. Mr. Raziuddin, Independent Consultant, House #-478-B, Street 10, Sector F-10/2, Islamabad
11. Mr. Intisar Haqqi, Director, Power & Energy, Lucky Cement.
12. Mr. Khawaja Bilal, Director Private Power & Investment Management, KESC House, 2nd Floor, 39-B, Sunset Boulevard, Phase II, DHA Karachi.
13. Mr. Noor-ud-din, Pakistan Institute of Engineering.
14. Mr. Kishan Chand, Director, Department of Energy & Management, Quaid-e-Awam University, Shaheed Benazirabad.
15. Dr. Adnan Hassan, Assistant Professor, Institute of Environmental Studies, University of Karachi.

Always Remember--- Reuse, Reduce & Recycle

PHOTOGRAPHS OF CONSULTATION MEETINGS

Meeting with SHEHRI-CBE (NGO)

Meeting with National Institute of Oceanography

Meeting with IUCN Pakistan

Meeting with Chairman PFFF

Meeting with PFFF

PHOTOGRAPHS OF EXPERTS COMMITTEE MEETING

7.7 ONGOING COMMUNITY ENGAGEMENT PLAN FOR CONSTRUCTION & OPERATION PHASES

Elengy Terminal Pakistan Limited (ETPL) will implement the following Community Engagement Management Plan as part of its Environmental (and Social) Management Plan (EMP) outlining a range of mitigation measures designed to avoid or reduce undesired community impacts during construction and operation phases of project.

This plan also establishes a basis and template for use by the project's Contractor(s) to develop their own plans outlining not only mitigation measures but to also incorporate the roles and responsibilities of the EMP.

The objectives of the Community Engagement Management Plan are:

- Establish and maintain positive community relations through effective communication and consultation.
- Effectively manage community grievances and comply with the project's Community Grievance Procedure (a detailed discussion of the CGP is included below).

The project recognizes the potential for creation of adverse impacts on the environment and within the local community, and the potential to make significant positive contributions if impacts are properly addressed. To achieve these goals, the project has developed an ongoing policy framework for mitigation and management of socio-economic impacts, and making long-term investments in the local community. ETPL is committed to human development and protection of biodiversity in the project area by:

- Understanding the social, economic and environmental context of the project area;
- Working with stakeholders and engaging and maintaining dialogue with them to build relationships based on trust and mutual respect;
- Enhancing positive effects of our project while minimizing adverse impacts;
- Providing compensation commensurate with loss where impacts cannot be adequately remedied;
- Preserving a natural environment for future generations;
- Promoting human development in local communities;
- Providing employment and economic opportunity to local communities;
- Monitoring the success of environmental and social programs against reasonable benchmarks;
- Following recognized standards in our social and environmental activities as defined by IFC Guidelines and local requirements.

Interviews and public outreach programs with local communities and stakeholders consultation identified the following major social and economic issues of concern:

- Pollution discharges affecting human health and decreases in fish populations
- Loss of use of near shore boat mooring facilities
- Provision of basic quality of life amenities (jobs, services, resettlements and compensation for lost opportunity or livelihood);

Most of the issues described in meetings with the local community have been addressed in other segments of this report. While few direct impacts have been identified affecting the local community, ETPL's on-going process will effectively monitor its activities and impacts both upon the environment and the socio-economic setting of the project. ETPL will pro-actively address negative impacts that may develop over the course of construction and operation, and develop appropriate mitigation measures to provide satisfactory redress of project-related issues.

PHOTOGRAPHS OF MEETING WITH FISHERMEN

7.8 COMMUNITY ENGAGEMENT RESPONSIBILITIES

ETPL is committed as well as required under its environmental approvals from the Sindh Environmental Improvement Agency to:

- create "no threat to livelihood of local fishermen and communities"
- repair or compensate any damages to boats or equipment caused by project components
- employ an Independent Environmental Monitoring Consultant for the life of the project who will submit quarterly reports on ETPL activities.

In addition, ETPL's Environmental Management Plan identifies a Site Environmental Coordinator charged with monitoring and evaluating permit compliance and environmental impacts associated with constructing and operating the project.

ETPL has also designated a Community Liaison Officer (CLO), reporting to the project's General Manager, who is tasked to help manage and facilitate communications with the local community, including people making their living from fishing. The CLO's duties include providing the main point of contact with the local community, and transmitting concerns and complaints to the projects' management structure. The CLO is responsible for actively identifying and communicating with local community leaders, NGOs active in the area, such as Pakistan Fisher Folk Forum and loosely affiliated common-interest groups. The CLO is available to address questions about and concerns with project activities, and to provide information about jobs (especially during construction), opportunities to provide goods and services to the project, and opportunities for the project to pro-actively engage in promoting the health, welfare and quality of life for the local community. The CLO is charged with creating a positive relationship between the project, its contractors and the local community, managing and planning future public consultations, disclosure meetings and events, maintaining records, and leading dispute resolution proceedings. The CLO is responsible for implementation of the Community Grievance Procedure outlined below.

As outlined above, the major concerns expressed by the local community to date are described below:

Fishing Community: Impacts on fishing are potentially the most significant in terms of economically disadvantaged local persons who earn a subsistence living by fishing. While the local fishery is not significant for most, dredging and other construction related activities may temporarily affect fishing in the area of the project. The project if developed at Khiprianwala (Option 1) site may affect fishermen activities during the construction stage, therefore ETPL should prefer Brown Field (Option 3) site near existing EVTL Terminal which is the best option in terms of safety, security as well as environmental & social considerations. The proposed brown field site shall not affect fishermen activities at all.

The CLO is responsible for communicating job and economic opportunities to the local community. His duties include establishing good relations with the local community and to act as a 'clearing house' for questions about how to apply for jobs, how to become qualified for bidding on provision of goods and services to the project, and similar economic opportunities. The CLO and GM will together develop a list of economic opportunities targeted toward the local community to help create goodwill towards the project.

The following compensation plan has been adopted by ETPL in response to project concerns expressed during the initial consultation process:

- Separate funds allocated to initiate programs such as training centers for fishing communities.
- ETPL shall initiate community welfare programs under their CSR policy. ETPL shall collaborate with local NGOs including WWF Pakistan, The Citizens Foundation (TCF) to implement these programs.

- For all unskilled jobs, the project will attempt to fill those positions from local applicants.
- Local community leaders and first responders will be informed and updated regularly on project activities.
- The project's Community Grievance Procedures will be easy to participate in and free of cost.

In addition to project activities, the Project Contractor shall:

- be responsible for community affairs as it relates to industrial relations, human resources, procurement, and sub-contracting associated with the Contractor's Work;
- establish community affairs office(s) as appropriate to support the Contractor's community affairs activities. Such offices shall be located at sites that facilitate effective management of community affairs, industrial relations, recruitment and hiring without disrupting the Work;
- work with appropriate community leaders to reduce the adverse effects of their activities on the community, and to facilitate resolution of community unrest and disruptions resulting from Contractor's performance of the Work;
- confirm that its personnel and the personnel of its sub-contractors are appropriately qualified and trained to be aware of and manage local cultural issues to the extent required to minimize and manage local community disruptions arising as a result of Contractor's performance of its Work. ETPL shall provide induction materials for new workers and necessary briefings for workers and Contractor(s) as required;
- comply with the Community Grievance Procedures detailed below.
- gain the prior approval from ETPL before making any direct agreements with local communities.

7.9 TRAINING ON COMMUNITY RELATIONS

The CLO is responsible for ensuring that ETPL's and the Contractor(s) workers and subcontractors receive adequate training in project-specific community relations, so as to be aware of health, safety and security issues as well as the standard of conduct expected when engaging with the community. Induction training for all new workers shall be provided and will cover at a minimum:

- General liaison and interaction with communities;
- Cultural sensitivities;
- Awareness-raising on health, safety and security considerations;
- Project Code of Conduct.

Additional training on community relations will be delivered through:

- Tool Box Meetings;
- Safety, Security, Health and Environment Safety Committee Meetings;
- In-House Training / Seminars;
- Notice Boards; and
- Newsletters.

7.10 GRIEVANCE MANAGEMENT

ETPL has adopted the Community Grievance Procedure outlined below, which requires interaction, consultation, targeted information and timely resolution of legitimate grievances. This approach is aimed at building a reputation of responsiveness, concern and responsibility among the community, with a view to building and sustaining acceptance and support for the construction and operation of the project.

ETPL and its Contractor(s) shall foster a sense of working with the local community and demonstrate that the Project takes a proactive stance to grievances.

ETPL's grievance management system and database will comply with and has the flexibility to feed information into the Community Grievance Procedure. ETPL will also provide all Contractor(s) teams with training in Community Grievance Procedures.

In implementing ETPL's Community Grievance Procedure, the Contractor(s) shall:

- Record all grievances using the template Grievance Form given at the end of this section;
- Assess and advise the resolution of the grievance in the time frame required by the assessment.

All grievances will be investigated and a response (outlining a resolution) provided by ETPL/Contractor(s) as soon as possible and not more than 30 days after receiving the grievance. If more time is required for resolution, the person raising the grievance and ETPL shall be kept informed.

While the Contractor(s) is not prevented from initiating the grievance resolution, any corrective action taken must be in coordination with ETPL.

ETPL, through the CLO, will ensure that the details of the Community Grievance Procedure are publicized at community meetings and via posters and other means to all communities in the vicinity of the project.

In addition, ETPL and its Contractor(s) shall ensure that the local populations working/residing in the macroenvironment of the project area receive necessary information for contacting and initiating a grievance through meetings, pamphlets and similar community outreach programs under the direction of the CLO.

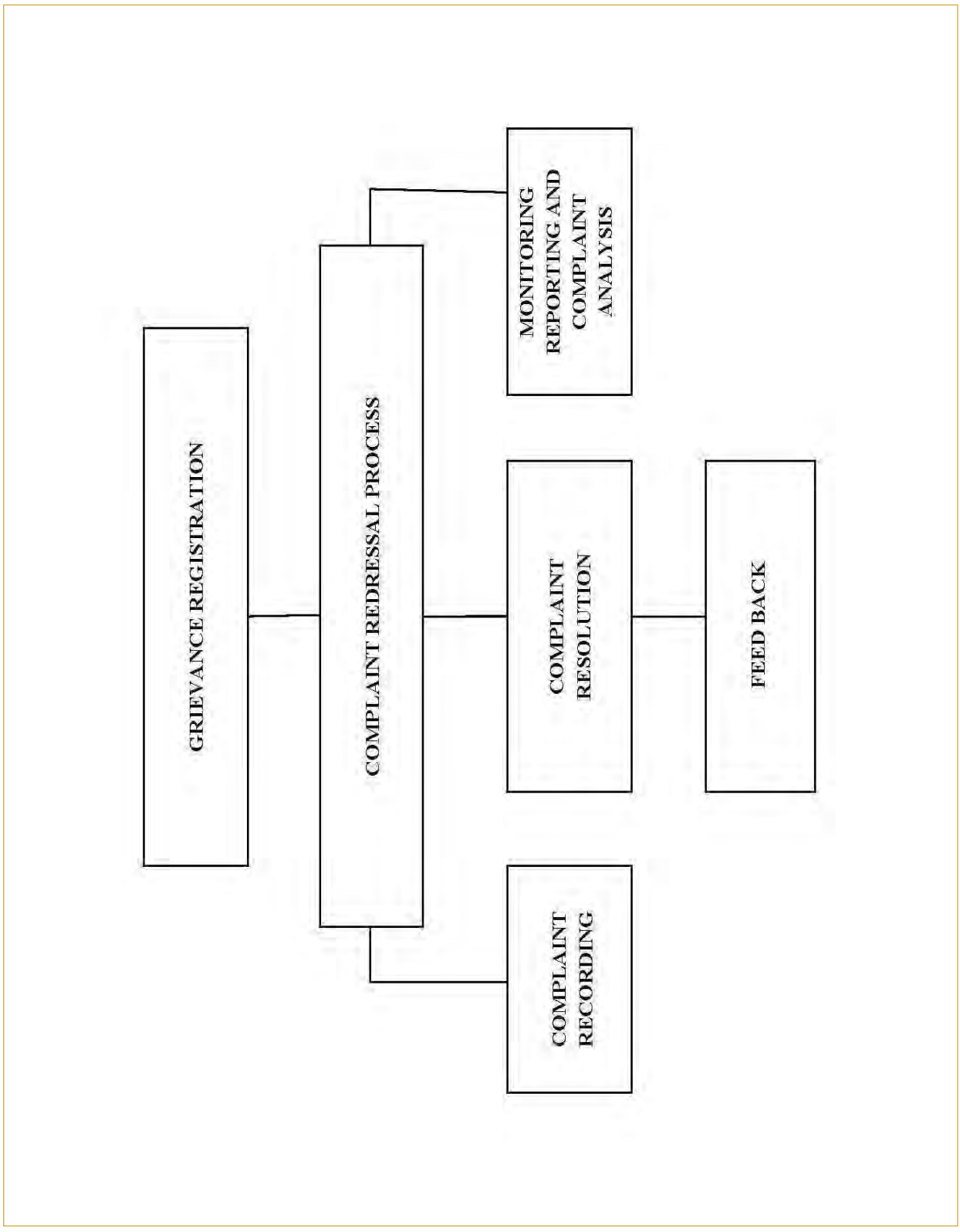
ETPL and its Contractor(s) shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of this Plan. The Contractor Plan shall describe the resources allocated to and responsibility for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities are communicated to relevant personnel.

7.11 PERFORMANCE INDICATORS

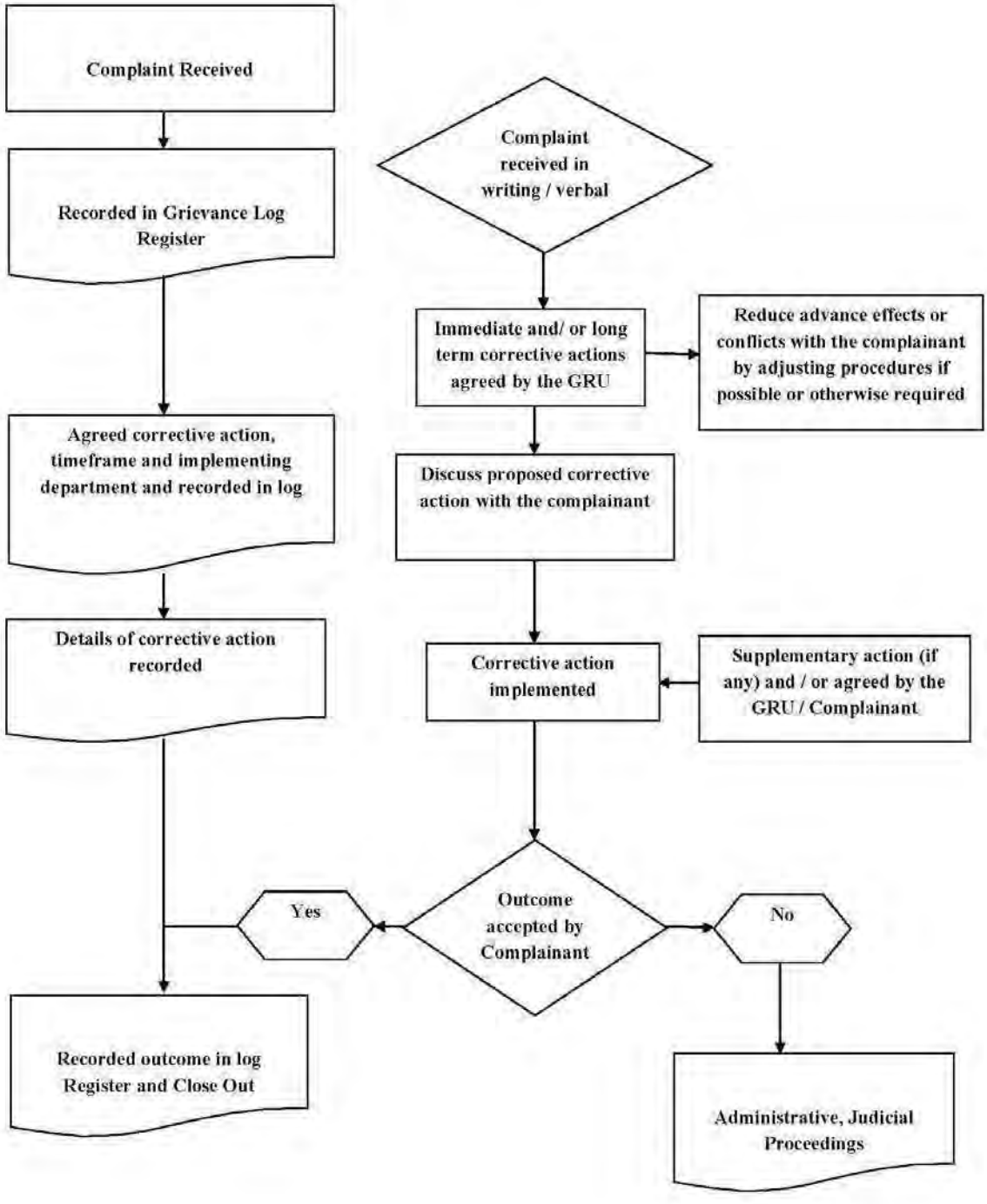
Table 7.5 outlines the indicators used for measuring and verifying performance in relation to community engagement. However ETPL may modify or add to these indicators to enhance the Plan based on learning from the performance indicators.

Table 7.5: Performance Indicators

ID No.	Performance Indicator	Measurement	Internal Assessment Frequency
1	Maximize use of the Project Community Grievance Procedure.	100% of grievances (except those related to worker issues) channeled through the Community Grievance Procedure.	Monthly
2	Resolution of Community Grievances.	75% of grievances resolved (from the Project perspective) within 30 days, categorized according to cause of grievance.	Monthly
3	Disruptions to work.	Number of hours lost due to community disruption categorized according to cause of disruption (to be coordinated with Security departments to ensure consistent reports).	Monthly
4	Compensation payments.	Amount of compensation paid as a result of Project impacts	Monthly


GRIEVANCE REGISTRATION
COMPLAINT REDRESSAL PROCESS
MONITORING REPORTING AND COMPLAINT ANALYSIS
COMPLAINT RESOLUTION
FEED BACK
COMPLAINT RECORDING

GRIEVANCE REDRESSEL PLAN



08 POTENTIAL ENVIRONMENTAL IMPACTS OF PROPOSED DEVELOPMENT AND RECOMMENDED MITIGATION MEASURES

8.1 METHODOLOGY FOR IMPACT ASSESSMENT

The environmental and social consequences of construction and operation of proposed project facilities are analyzed in this section. The impacts on environmental resources from the proposed project will vary in duration and significance. Three types of impact duration were considered as part of the evaluation, including short term, long term, and permanent impacts. Short-term impacts are temporary in nature and occur during the construction phase of the project. Short-term impacts diminish to cessation as soon as the construction phase of the project is completed; long-term impacts are those impacts that will be chronic in nature due to ongoing activities in the project area, while permanent impacts are those resulting in a permanent and irreversible change to existing environmental resources and their quality in the vicinity of the project. Impacts may be positive or negative, and are generally identified as such. 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:

- ETPL as project proponent will comply with all applicable laws and regulations;
- The construction phase of the project will proceed as described in Section 3; and
- ETPL as proponent will implement the mitigation measures and Environmental Management Plan in letter and Spirit.

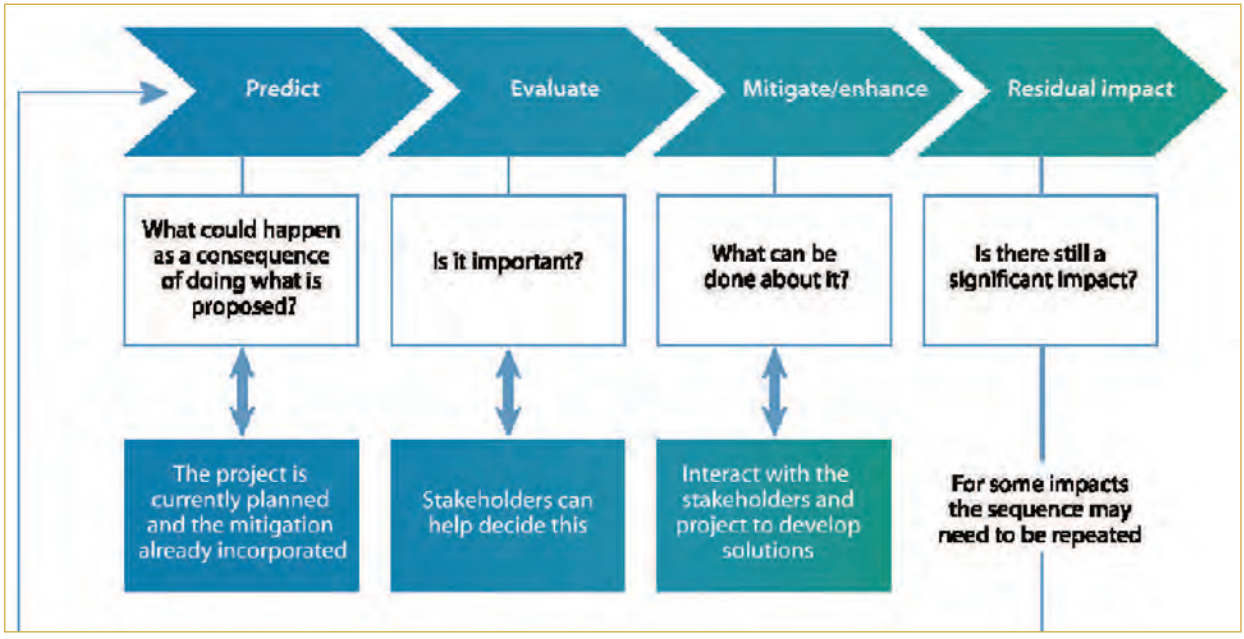


Figure 8.1: Schematic of the Impact Assessment Process

8.2 Screening of Potential Impacts

Screening of potential impacts due to construction and operation stages of proposed LNG import terminal at Port Qasim are related to:

- Site Preparation
- LNG Terminal installation
- Waste Discharges
- Air Quality;
- Noise Level;
- Man Made Hazards;
- Natural Hazards;
- Sensitivity
- Operational Risks and management of Hazards
- Socioeconomic impacts

8.3 Impact Assessment & Proposed Mitigation Measures

The impact assessment and proposed mitigation measures are based on the location of brown field site in the side bay adjacent to ETPL's exiting terminal referred as Option 3.

8.3.1 Site Preparation

8.3.1.1 Dredging and Reclamation Activities

The technology to be adopted for dredging would depend on the geology of the site which will be determined at the detailed design stage. It is estimated that up to 1.6 million cubic meters of material will be dredged at the proposed brown field site. According to the analysis on data of the previous works done in the same area, the main materials to be dredged are clay and sand, which are easily dredgeable. The dredging process has been found to result in loss of the biota located within the dredge area which is a short time activity localized to the environment.

Most of the area to be dredged consists of barren sand/soft bottom or soft bottom/rubble with little or no observed epifaunal communities. 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 *(Dr. Shahid Amjad,NIO, 2004).*

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 (3280 ft) (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 ETPL-LNG 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.

Most dredged material will be transported and deposited directly to reclamation and to the proposed dumping site designated by PQA or temporary at areas on project site. 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.

No blasting will be involved during the entire site preparation and development phase as rocks are not envisaged in the area to be dredged.

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.

An additional issue related to the dredging operation is the fueling of dredge barges and associated vessels. It is envisaged that a fuel barge will be used to transport fuel to the dredger. A Spill Control Plan shall be prepared in consultation with Independent Monitoring Consultant (IMC) and 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.

If Land reclamation is conducted, it will occur by placing dredge spoils from the berthing basin and turning basin expansion directly into designated fill and stockpile areas. Placing most dredged material directly into planned reclaim areas avoids the need to rehandle the material, thus minimizing the potential sedimentation impacts from storm water run-off and re-deposition of material. Some sedimentation could potentially occur due to transport of fine material into marine habitats during dewatering of dredged material. It will be minimized using dikes equipped with control weirs or some such technique that will appropriately contain the sediment movement, as discussed earlier.

Dredged spoils not directly placed in areas to be reclaimed will be pumped into PQA-designated site and sediment particles will be allowed to settle prior to discharge of effluent water. Once drained, dredge spoils will be placed using conventional fill placement techniques. Turbidity control booms will be placed as required around any fill areas not permanently contained. As with the dredging operation, it is expected that these control procedures will minimize adverse impacts on marine resources due to short-term sedimentation and turbidity effects.

8.3.1.2 Maintenance Dredging:

Maintenance dredging is an essential part of operation of all port activities particularly the LNG terminals. PQA need to conduct hydrodynamic and sediment transport modeling to predict frequency of maintenance dredging or the bathymetric surveys being conducted to indicate

about the prevailing depths by PQA.

During operation of the proposed Terminal, periodic bathymetric surveys will be conducted by PQA and Terminal Operators within the berthing and turning basin to measure changes in bottom elevation and locate areas of sediment accumulation. As discussed above relative to construction dredging, the primary concerns for dredging are increases in turbidity and suspended sediments, and the loss of benthic organisms in particular. Turbidity will be monitored during each maintenance dredging event to ensure compliance with relevant international standards. If the turbidity standard is exceeded, dredging will be shut down temporarily until modifications can be made to the dredging technique to bring the operation back into compliance.

8.3.1.3 Compaction of Reclaimed Soil

Appropriate compacting technique will be used for improvement of the reclaimed soils. Because many of the near-shore habitats around project site will be undergoing modification due to island expansion and construction of shoreline protection, and because new habitats may still not have established themselves along the shoreline, the impact of compacting process on existing and new habitats will be minimal. The compacting activity would need to be completed prior to the reestablishment of new near shore habitats around project area. When proposed works are complete, no anticipated adverse long-term operational impacts from site filling and soils compacting are expected.

8.3.1.4 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. Of the habitats that will be impacted by shore protection system construction, the mangrove habitat is the most sensitive; however, the mangrove habitat on brown field site in the vicinity of ETPL is relatively small. Due to its isolation and small size the overall impact due to loss of the mangroves is minimal.

Mitigation Measures

1) 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. The extensive dredging and disposal of spoils carried out for Port Qasim over the last decade or so, has greatly reduced the benthic habitat. ETPL will ensure the adoption of careful methods to reduce the impact of construction on marine ecology of the site;

2) 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 IMC;

3) Any loss of mangrove habitat will be compensated by plantation/replantation of mangrove of as many mangrove trees as the canopy of the removed trees would require. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC;

4) 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.

5) Monitoring of all activities related to removal of plantation and the replantation.

8.3.2 LNG Terminal Installations

Impacts related to LNG Terminal are those associated with the construction as well as operational activities at LNG import terminal.

Activities associated with the installation of Jetty for the FSRA/LNGC will involve construction of loading platforms, breasting dolphins, mooring points, access trestles, and walkways. Construction of the loading platforms and breasting dolphins will require installation of drilled steel piles. Pilings will be installed in previously dredged areas, no benthic habitats will be present at the time of borehole installation; and hence no direct impact from pile installation is expected to benthic habitats. Potential impacts during pile installation will be further reduced a) by the use of non-toxic, clay free, biodegradable drilling fluid, b) Mooring points, access trestles and walkways will be installed above the water surface thus reducing direct impacts to marine communities as a result of these construction activities.

Construction activities and vessel traffic have the potential to interfere with local fishing activity by temporarily obstructing access of fishermen to their fishing grounds.

The entire Kadiro-Phitti-Gharo Creek ecosystem is only sparsely vegetated with a few plant species, which are otherwise prevalent in the Karachi region. Construction of the proposed LNG Terminal and associated activities will not result in significant damage to this sparsely vegetated system. It is estimated that on shore ecology will not be much affected. No unique habitat has been identified and it will be ensured that any unique habitat if identified will not be lost. Similarly, during operation phase terrestrial ecology will remain unaffected. No rare or endangered species of plants or animals are reported in the area. Removal of the scrub may have some negative impact on the birds and aquatic animals which would migrate to the more dense adjacent bushes.

There will be no anticipated impacts to marine mammals once the facility is operational; therefore, mitigation measures will not be required. With the exception of marine mammals, no other at-risk marine species are known to occur or to utilize the habitats within the project area; mitigation measures will therefore not be necessary.

The operation of the LNG terminals has an excellent safety record world-wide and is not likely to affect the terrestrial ecology of the area. LNG after its re-gasification will be NG and its fugitive emissions or spillage will not need special remedial measures other than proper ventilation and diffusion in the atmosphere which is an integral part of the project design. Hazards of any accidental release of LNG are discussed in subsequent section on Risk Assessment (QRA study is also being conducted by the proponent). No impacts on the terrestrial ecology are likely from the normal operation of the LNG Terminal.

The tie in to the gas distribution system would be provided with the consent of SSGC through PQA approved ROW. ***For the construction of sub-sea delivery pipeline, "No" mangrove plants will need removal along the alignment of the pipeline.*** The proposed design ensures that no major damage to this important asset is caused.

Mitigation Measures

1) Advance notices on upcoming construction activities will be provided to local fishermen, in order to mitigate possible obstruction of potential fishing areas during construction. Pakistan Fisherfolk Form being the main stakeholder will be kept informed of all activities that could have negative impact on the fisheries operations.

2) The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the land area identified by PQA. 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 PQA and monitored by IMC.

3) Once construction activities are completed, there are no anticipated long-term impacts that will occur as a direct result of installation of berthing facilities. 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.

4) Mitigation of potential impacts to benthic habitats is anticipated to occur through natural reestablishment of bottom conditions and resettlement of associated faunas. Natural forces of currents and tides should restore the pre-construction distribution of soft bottom sediments that will be recolonized by infaunal organisms.

5) Any loss of mangrove habitat will be compensated by plantation/replantation of mangrove of as many mangrove trees as the canopy of the removed trees would require. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC.

IUCN (International Union for Conservation of Nature) has been engaged by ETPL to manage replantation of mangroves over an area of about 250 hectares. IUCN shall replant 10 plants for every mangrove removed. This activity shall be completed in 18 months. Indicative replantation area is shown in figure below highlighted in red.

8.3.3 WASTE DISCHARGES

Figure 8.2: Mangrove Plantation Sites shown with red boundary

Water withdrawals and discharges due to operation of the proposed Terminal will include the following:

- Ballast water withdrawals

During the offloading of LNG, the LNGCs take on ballast water to offset the tonnage of LNG. The ballast water is used to correct for trim, list, and structural items. In addition to taking on ballast water, the LNGCs will utilize sea water for cooling while at dock. The amount of cooling water required varies, depending on several

factors such as ship size, propulsion system.

- Ballast water discharge

The proposed Project will increase ship traffic into the PQA channel by around one ship per week in the first phase. However, LNGC ships will enter the channel with a full load and will not need to discharge ballast water into the channel. Therefore, there are no anticipated impacts from ballast water discharge into the main channel.

- Condensate water discharges from submerged condensate vaporizers

Controlled vaporization of the LNG within the FSRA will produce condensate from the ambient air vaporizers if considered (decision on the open/closed loop system would be taken at the time of FEED). After passing through the treatment system of the FSRA which will comply with MARPOL convention, the water will be discharged back into the sea.

- Discharges from ship engine cooling systems

The cooling water at discharge is 3 degrees Celsius (°C) warmer (at most) than at intake. According to National Environmental Quality Standards (NEQS) the change in discharge temperature is required to be lower than 3°C over ambient. The FSRA 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.

Discharges from the FSRA would be at approximately the ambient temperature of the Sea. Water discharges for the LNG carriers, primarily associated with cooling onboard 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 FSRA and LNG carriers would be localized and minor.

"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 11°C 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 1°C."

- Storm water discharges from developed shore-side facilities

The designing stage will take care of the appropriate site for storm water discharges from the facility. Care would be taken that the storm water is not mixed with other effluents.

- Sewage Discharge

The crew will generate grey water (from showers, sinks laundry, etc.) at the rate of approximately 150 liters per person per day and sewage (from toilets) at the rate of 50 liters per person per day. This will generate 2000 cubic meters per year of grey water and about 650 cubic meters per year of sewage, which will be treated before discharge and expected to be catered for during the design stage.

MITIGATION MEASURES

1) 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 fishery resources.

2) Automatic biocide dosing, quality control and feedback systems will be incorporated into the FLNG facility design.

3) Screens will be installed on the cooling water riser inlets and inlet current speeds will be low (estimated at 0.5 m/s) to prevent the ingress of large marine fauna into the cooling water system.

4) Heat recovery measures from the FSRA will be

considered in the detailed design stage.

8.3.4 Air Quality

Project related air quality impacts during construction are expected to include fugitive dust emissions at the project site from ground excavation, fill operations, and removal of debris, as well as construction vehicle emissions, marine vessel emissions and portable generators. Typical practice for fugitive dust control is to treat land disturbed during construction and grading, if necessary, in a way that minimizes visible airborne particulates. Because the construction period is limited and activities change during the construction phases, these emissions are only temporary and vary throughout this period.

Potential emissions of fugitive dust will depend on such factors as soil properties (i.e., moisture content, volume of spoils, and soil silt content), meteorological variables (wind speed and precipitation), and construction practices employed.

Air emissions from the FSRA 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 SOx and NOx. In case of Gas turbine driven ships or Gas generators located on shore the levels would be lower. The potential air emissions would mainly be NOx. Oxides of nitrogen emissions can be of concern for three reasons:

- Human health effects, including those associated with photochemical smog;
- Generation of photochemical smog or acid rain in air sheds with high levels of nitrogen oxides; and
- Nitrous oxide (N_2O), an oxide of nitrogen, is a greenhouse gas with a very high GHG warming potential of about 300 times that of CO_2.

Once liquefied, LNG is stored at atmospheric pressure and at its boiling point temperature of -161°C. With such a huge difference in the temperature of LNG compared to the outside ambient temperature, 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 recirculating 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 0.1% per day.

The air dispersion models have been prepared for LNG vapor emissions considering two scenarios viz. Normal and Emergency. The detailed report of Air Dispersion Modelling has been provided as Annex-I to this ESIA report. Detailed QRA studies will further evaluate the risks associated with LNG transfer, regasification, handling and storage.

Mitigation Measures

1) Construction impacts on air quality will be mitigated through construction management practices, including the use of appropriate dust suppression measures. Air quality impacts from operation of the project's power production system will be minimized by appropriate technology to reduce the impact of emissions to confirm to World Bank standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions.

2) FSRUs generally have emission monitoring system. However, it is recommended that ETPL would conduct regular emission monitoring to supplement the data generated offshore.

3) Fugitive dust emissions will be minimized through the use of dredged fill material, which will be pumped in a slurry form through pipeline into dewatering basins located near the final reclamation areas. Construction equipment used for final grading will handle fill material

with high moisture contents and minimal potential to generate fugitive dust. To further minimize emissions of airborne particulates, fugitive dust will be mitigated using the following measures, as necessary:

- The use of water on areas of exposed soils, if necessary; and
- Final grading and landscaping of exposed areas as soon as possible.

4) 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.

5) It is envisaged that Selective Catalytic Reduction or any other alternative systems would be incorporated on board the ships to reduce NOx emissions.

6) All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended.

7) The lack of other cumulative sources of NOx emissions within the region also protects against the potential for photochemical smog or acid rain generation.

7.3.5 Noise

LNG terminal construction and associated activities may raise the ambient noise levels in the microenvironment. In particular, works such as pile driving, dredging, drilling, earthworks, etc. as well as site plant such as compressors, would contribute to noise pollution. 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 PQA where construction equipments 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 valid to extrapolate the expected noise emissions for the construction phase of the project from the previously calculated baseline noise assessment.

The diesel engine driven equipment will comprise most of the construction tools needed for this project. These include the dredging barges and pumps, winches for cranes and pipe shore pulling, power for dredged spoil compaction system and pile driving, concrete batching, sand pumping, jetting equipment, pipe compression test equipment, welding generators, power for the temporary fuel, water and sewer systems, and the engines for the tugs, launches and ferries. 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 55 dB(A) and the nighttime limit of 45 dB(A) required by World Bank Guidelines through appropriate mitigation measures.

Wind speed and direction data reveal that winds blow from the southwest. Offshore winds are also generated by convection changes as the land warms during the day. It is considered likely that there would be regular occasions when the prevailing wind would direct the acoustic waves towards the land. The acoustic effect at the creeks would be to echo the noise especially during low tides. This may be more pronounced in case of sharp burst of noise such as during pile driving. However, the open land would dissipate the acoustic waves from noise emission activities and the impact of noise emission would be only feebly reaching the shore line. There are no noteworthy structures, buildings or topographic features in the proximity of Project site and thus there would be no necessity for further shielding or damping of the noise.

There are no developed residential areas close to the proposed LNG terminal site. There is no school, hospital or library, however some human settlements mostly comprising earthen dwellings are scattered. It is unlikely that noise from the construction phase activity would be noticed audibly at the microenvironment of the project area. Based on the review of data for similar activities performed for other projects of similar nature the

expected noise levels would be well below both the daytime limit of 55 dB(A) and the nighttime limit of 45 dB(A) required by World Bank Guidelines. If the noise emitted from construction operations reaches levels which exceed the World Bank Guidelines then modest noise control measures can be employed that will reduce the noise by 5 to 10 dB. The construction workers who may be exposed to high noise would be provided ear plugs to be worne as protective measures.

There are several factors that would affect the potential impact of noise emission from the LNG terminal operation. Such factors include the distance between the terminal and the residential areas, local acoustic barriers, and the limits of tolerance of the local population. The operation of LNG cargo unloading, storage and re-gasification etc. are low impact activities. Noise emissions during project operation is expected to be much lower and generally derived from facility operations such as pumps, engines, other on-site machinery, and from LNG Carriers unloading LNG at the jetties.

LNG Terminal and storage facilities are not particularly noisy. Noise level immediately outside these facilities is generally reduced to acceptable level of 70 dB(A) required by World Bank guidelines for noise emissions .There are no continuously noisy systems around the facility, while the noisy standby power generator would be housed in its own building, and its occasional use inside an adequately sealed structure would reduce the emission level from almost 90 to 105 dB(A) to less than 70 dB(A) at the boundary wall of the facility.

Noise emissions from the marine vessels would mainly be generated by the operation of the vessel's engines. 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 berth 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.

Cumulative Impact: Including the proposed LNG import terminal, there are number of industrial facilities that are proposed to be established in the vicinity of the project site. There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. The cumulative effect of the noise emission from LNG facility and any other proposed industrial developments (including any other proposed LNG facilities) is assessed not to exceed the recommended ambient noise levels, on the basis that any other proposed industrial development would be required to achieve the same noise criteria which are acceptable for the proposed Engro-LNG project. In some circumstances, the existing ambient noise level may already be above the recommended noise levels. In such cases, noise generated by the LNG facility will be maintained below the existing ambient noise levels. This should ensure that ambient cumulative noise impacts of the project will be negligible. Also other proposed industrial developments (including potential LNG facilities) are likely to include some or all of the proposed mitigation measures outlined within, thereby minimizing cumulative impact on the receiving environment.

Mitigation Measures

No additional 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.

8.3.6 Manmade Hazards

The manmade hazards that may potentially occur during the construction and operation of the LNG import terminal project will be minimized to the extent practically possible through the use of automated systems and controls, environmental management system plans for spill and fire response, as well as worker health and safety, and designated work practices required during construction and operation. The manmade hazards considered for impact include the following:

1) Fuel Spills

2) Fire and explosion

3) Marine Hazard

4) Workplace Hazard

8.3.6.1 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.

MITIGATION MEASURES

1) 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.

2) 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.

3) 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.

4) 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.

5) 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.

8.3.6.2 Fire and explosion:

Fire and explosion hazard impacts to surrounding islands, inhabitants, workers, 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 at LNG Terminal 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 in Port Qasim with respect to siting and the operating procedures at the terminal.

Mitigation Measures

1) 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.

2) 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.

3) A detailed risk assessment is being conducted to determine if a LNG facility of a specific design and layout can be located on a site without causing an unacceptable impact to the safety of the public who live or work near the site. In this study the requirements of NFPA 59A (2009) for LNG Facilities shall be followed. It is expected that hazard zones would lie within the property of the LNG terminal site or over adjacent water, these requirements are met.

4) As required by NFPA 59A and to minimize impacts to personnel and facilities, Impoundment areas (secondary containment) will be provided.

8.3.6.3 Marine Hazard:

Shipments of LNG received at the LNG facility/terminal will transit to the project site through the PQA navigational channel. Volume of shipping traffic will increase during the construction phase and would taper-off during the operation of the project. 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 Port Qasim Authority.

Mitigation Measures

1) 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.

2) Worldwide there is no record of serious incident of an LNG carrier involved in product transport as envisioned for the ETPL-LNG project. By implementing the management controls and following internationally accepted codes and standards, ETPL expects no marine safety-related impacts due to the shipments of LNG.

8.3.6.4 WORKPLACE HAZARD:

There are potential impacts to worker safety during the construction and operation phase due to the increased activities on the island and over water, the higher risk associated with handling LNG and the higher population of workers. 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.

MITIGATION MEASURES

A Health and Safety Plan for construction and operations will be implemented and monitored with emphasis on personal protective equipment and inherently safe equipment.

8.3.7 NATURAL HAZARDS

Pakistan's Vulnerability to Climate Change Threats

The important climate change threats to Pakistan are:

1. Considerable increase in the frequency and intensity of extreme weather events, coupled with erratic monsoon rains causing frequent and intense floods and droughts;

2. 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);

3. Increased siltation of major dams caused by more frequent and intense floods;

4. Rising temperatures resulting in enhanced heat and water-stressed conditions, particularly in arid and semi-arid regions, leading to reduced agricultural productivity;

5. Further decrease in the already scanty forest cover, from too rapid change in climatic conditions to allow natural migration of adversely affected plant species;

6. Increased intrusion of saline water in the Indus delta, adversely affecting coastal agriculture, mangroves and the breeding grounds of fish;

7. Threat to coastal areas due to projected sea level rise and increased cyclonic activity due to higher sea surface temperatures;

8. Increased stress between upper riparian and lower riparian regions in relation to sharing of water resources;

9. 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***. The impacts are expected to be much severe in case of siting the LNG terminal in the main channel critically exposed to open sea as compared with its location away from the navigation channel (proposed Brown Field site).

MITIGATION MEASURES

The mitigation strategies for each of the aforementioned natural hazards are discussed below.

1) Natural hazards associated with storm events include those arising from storm waves/surges, high winds, and torrential rainfall. For protection against wave run-up and over topping, shore protection features will be constructed to protect the proposed island footprint. The LNG facility will be designed to withstand a Category 5 hurricane and the remaining components of the facility will be designed for a Category 4 hurricane. These design parameters will protect against high winds, as well as

storm surge and wave effects, associated with these relatively infrequent meteorological events.

2) Shore protection structures will be designed to withstand the impacts from a 100-year storm. Based on design evaluations, shore protection features will be incorporated to further stabilize the island and its operational features.

3) The Geological Survey of Pakistan has, however, defined the area of Port Qasim, where the site under study is located, to fall in a ***Seismic Zone 2B*** region. This suggests the possibility of moderate to major seismic hazard i.e. probability of earthquakes of intensity VI to VIII MM scale and 5.6 to 6.6 on Richter scale. From the charts published (such as Figure 8.2), the peak ground level acceleration (PGA) for this zone is 28%. The seismic risk factor of 0.3 is advisable and will need to be incorporated in the design for constructions and installations in the coastal zone, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-VI to VIII). The seismicity in the Karachi and at Project site is considered to be low. According to the published data the Project area lies in zone of low seismic activity, with acceleration ranging from 1.6 to 2.8 m/sec^2. A factor of 2.8 m/sec^2 will, on the other hand, have to be taken for a maximum credible earthquake (MCE). The design of the LNG terminal should take these values into consideration.

4) Major damages done by ***Tsunamis***, the impulsively generated seawater waves that are a result of underwater earthquakes, have not been recorded for the coastal area south of Karachi. There are, however, evidences of a 1.2 m tsunami generated by an offshore earthquake of intensity 8 M in 1945, which caused only minor damages in Port Qasim area. This event was followed by another Tidal wave that was recorded in 1953. The Tsunami of December 26, 2004 had no impact on the macroenvironment of the Port Qasim area.

5) ***Tsunamis are not expected to occur in the vicinity of the project area***; yet, the mitigation strategies proposed to deal with hurricanes and surges of category 5 are considered sufficient to deal with tsunamis of high order.

ETPL shall also adopt the following measures to respond to the ***Climate Change Policy of Pakistan.***

- Restoring & establishing the blue carbon sequestration capacity of mangroves: ETPL has signed an MoU with IUCN Pakistan for replantation of mangroves over 250 acres of degraded creek areas. This will ensure building of natural barriers; plantation and regeneration of mangroves, to control erosion and to minimize the disastrous impacts of cyclones and tsunamis;
- Encourage involvement of local communities in conservation and sustainable use of biodiversity;
- ETPL shall assist local authorities through funding programs on sensitization, education and training health personnel and the public about climate change related health issues;
- ETPL shall support/initiate R&D project in association with EPA approved R&D organization to assess potential climate change threats to the fishing sector and develop appropriate adaptation measures including the promotion of aquaculture;
- ETPL shall allocate adequate budget to support the PQA for implementation of "National Disaster Risk Management Framework" formulated by NDMA;
- Strengthen community level climate change adaptation measures to prepare communities for enhanced & efficient natural resources management;
- Improve energy efficiency through maximum use of natural light, better insulation and use of energy efficient lights, boilers, appliances & pumping units;
- Promote and gradually make it mandatory to specify the energy efficiency/ fuel consumption rates of energy using equipment and devices of common use.

- Measure and monitor GHG emissions

8.3.8 PROTECTED AREAS & HERITAGE SITES

There are no designated Protected Areas in the vicinity of the project area. Similarly, this ESIA study has not found any antiquity artifact in the microenvironment of area concerned. No sites of cultural heritage are known to exist at or in the immediate vicinity of the LNG Project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. Therefore, there will be no impacts from the construction and operation of the facilities; as such, no mitigation will be required.

8.3.9 OPERATIONAL RISK AND HAZARDS

The risks unique to LNG projects include operational risks arising from gas tanker and terminal operations involving transport, storage and the transfer of LNG. In particular, many gas terminals are located within the environs of established ports. So their operations and those of the tankers serving them share a common operational environment with other port users. The management of gas shipping operations within ports is therefore a matter of some importance, and needs to be taken into account by those who administer ports and provide essential services in port areas (This is well-known within the LNG industry: see for example the manual, 'LNG Operations in Port Areas: Recommendations for the Management of Operational Risk Attaching to Liquefied Gas Tanker and Terminal Operations in Port Areas', written by SIGTTO, the Society of International Gas Tanker and Terminal Operators (Witherbys Publishing, 2003, first edition). SIGTTO has a membership of over 100 companies who own or operate over 95% of the world's LNG tankers and terminals and over 55% of the world's LPG tankers and terminals.). As a protective device, the industry body, SIGTTO, has argued for the elimination of major risk elements by locating gas operations in places where they are unlikely to be vulnerable to uncontrolled threats from outside their own operating environments. (SIGTTO Information Paper 14: Site Selection and Design for LNG Ports and Jetties, 1997.)

There is also a dynamic factor affecting risk in LNG operating environments. Ports tend to be competitive and seek to grow their businesses. Over time the promise of new business or the demands of other users will have an impact, and therefore the prospects of a changing risk profile should be anticipated from the outset. As a result, the cooperation of port authorities with the gas businesses becomes important if the required degree of safety is to be achieved. This is particularly true of risks arising from the movement of gas tankers in port areas and from other activities carried out in the vicinity of gas tankers and terminals.

There has never been a catastrophic failure of an LNG tanker's hull and containment system so it is not possible to draw on data that would permit the construction of scenarios following the release of large quantities of LNG into the atmosphere. Controlled releases of LNG however show that a cloud will develop and travel horizontally from the spill point under prevailing winds. The flammable volumes of gas will eventually disperse in the atmosphere. However, the SIGTTO manual notes that in spite of an exemplary safety record:

"The risk profile of LNG tankers presents a very serious residual hazard in port areas if the vital structure of the tanker is penetrated… Thus the paramount objective in managing LNG shipping operations in port areas is the elimination of any credible risk of a tanker's containment system being breached" (11 SIGTTO, LNG Operations in Port Areas, section 1, at 3.).

It also notes that:

"If very large quantities of LNG were released into the atmosphere the resulting gas cloud could extend beyond the terminal area, or the immediate vicinity of a tanker in transit through to a port, to affect adjacent port areas up to several hundred meters from the source of the escape". (SIGTTO, at 5. It recommends the use of a Quantitative Risk Assessment study as a decision tool to satisfy company safety policy and the authorities that the risk is acceptable.)

Further, there is a lack of data on the consequences of a large-scale and sudden confluence of LNG and sea water, although it appears likely that it too would generate a gas cloud in the atmosphere similar to that described above. There have been incidents recorded of LNG escaping during

cargo transfer at loading and receiving terminals. However, the volumes have been very small and the effects confined to the immediate environment of the terminals involved.

The likelihood of the above events is customarily minimized by stringent application of rigorous standards in the design and operation of the terminal. In the event of their occurrence the adverse consequences are minimized through appropriate siting of facilities, and institutionalizing standard emergency response plan (ERP) and disaster management plan (DMP). The ships that transport LNG are specially designed and constructed to carry LNG for long distances. Construction of LNG ships is highly regulated and comprises a combination of conventional ship design and equipment, with specialized materials and system designed to safely contain liquids stored at temperatures of -260ºF.

We addressed potential environmental impacts in the unlikely event that an incident involving the FSRA or an LNG carrier released LNG. Because LNG is a cryogenic liquid, the greatest threat to aquatic life from an unignited LNG spill would be thermal stress. Any aquatic life directly contacting the LNG would experience a sudden cold shock that could 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 burned back toward the location of the release.

8.3.9.1 LEAKAGE OF LNG

The available literature on LNG emphasizes a number of positive features of this form of gas. Since 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 (Liquefied Natural Gas) vapors (primarily methane) 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

Table 8.1: Estimated Impact of International LNG Breaches, Spills on Public Safety and Property

Event	Problem ship damage, spill	Potential Hazard	Potential Impact on public spill safety [1]		
			-500m	500-1,600 m >	1,600 m
Insider threat or hijacking	International, 2-7 sq m breach and medium-to-large spill	Large fire Damage to ship Fireball.	High High Medium	Medium Medium Low	Low Low Very low
Attack on ship	International, large release of LNG	Large fire Damage to ship Vapor cloud fire	High High High	Medium Medium High-	Low Low Medium
	International, 2-12 sq m breach and medium-to-large spill	Large fire Damage to ship fireball	High High Medium	medium Medium Medium Low	Low Low Very low

[1] *Distance to spill origin, varies according to site*
Source: Sandia Report, p, 54

hazards include fire, in case if an ignition source is near LNG vapors and frost bite because of the risk of contact with an extremely cold substance such as any direct exposure of skin or equipment.

Mitigation Measures include the use of double hull features in LNG tankers to provide 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 environmentally

8.3.9.2 ACCIDENTS ONLY AT LIQUEFACTION PLANTS

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 resulted since in the USA. 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)

As of February 2009, the global LNG industry comprises 27 export (liquefaction) facilities, 64 receiving (regasification) terminals, and 298 ships, altogether handling more than 175 million metric tons of LNG every year. LNG has been safely delivered via ocean-going transport for more than 50 years. During that time there have been more than 46,000 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 high traffic density areas. 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.

MITIGATION MEASURES:

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.

8.3.9.3 TERRORISM

Independently of the typical industry-generated risks, there are increased risks from terrorist attacks, which may

also have important and highly damaging environmental consequences. Prior to September 11, 2001, the major security issue concerning LNG infrastructure was accidental leakage from LNG storage and processing facilities. Residents of densely populated areas where LNG plants were planned tended to express their concerns that gas might escape, congeal and possibly ignite. Discussions on risk and the likelihood of accidents in LNG transport have focused on how to deal with human errors. The current context is very different. One study has stated that the international gas transport infrastructure seems to be "increasingly susceptible to risks of accidents or even attacks of transport bottlenecks or other supply interruptions" (C Jepma and N Nakicenovic, Sustainable Development and the Role of Gas, May 2006 (Energy Delta Institute Report for the European Gas Union Congress 2006)).

In 2002 there was a suicide boat attack on a tanker off the coast of Yemen. Such events have contributed to public concerns about safety post 9/11. Facilities that handle large amounts of hazardous materials like LNG terminals and ships have been thought to be attractive targets for terrorists. The ships themselves could be perceived as potentially 'floating bombs'. The fear has been a scenario involving a terrorist using an explosive charge like a rocket or flying an airplane to breach and probably detonate one or more storage tanks on an LNG ship at or near a populated port area. A similar scenario is envisaged when LNG storage facilities are considered.

In January 2008 a US Government Accountability Office study concluded that "the threat of seaboard terrorist attacks on maritime energy tankers and infrastructure is likely to persist" (GAO, Maritime Security, December 2007). It may be noted that LNG is flammable but not explodable. Therefore, the greatest risk to the public from a suicide attack on a tanker ship carrying LNG was deemed to be from fire, not an explosion. The ferocity of such a fire could, according to some US Government studies, cause burns to persons standing more than one kilometer away from the ship. LNG in its liquid form does not burn and is inherently less volatile than many petrochemical products. The US report did however note that plans for responding to a spill and to a terrorist threat are generally separate from each other; ports have rarely tested these plans simultaneously to see if they work effectively with each other. This particular risk factor can be expected to be reviewed from time to time and to vary in the weight attached to it.

LNG facilities and ships require a higher degree of planning, resources, knowledge, and risk to attack than 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.

Existing ETPL terminal at PQA is ISPS certified and regular drills are carried out. ETPL have their own contingency plan which will be supplemented with the comprehensive contingency plan being proposed for all port terminals at PQA. All the relevant safety protocols would be followed by ETPL; however, "no one can guarantee that a terrorist incident can't happen."

Mitigation Measures:

Maritime Agency and PQA have an enviable security record and are committed to maintain the same. No additional mitigation measures are required.

8.3.9.4 Explosion

LNG tanks store natural gas in liquid form at a temperature of about -160°C, which does not require pressure to maintain its 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 Measures

No mitigation measures are required because LNG is stored at atmospheric pressure, a crack or puncture of the container will not create an immediate explosion.

8.3.9.5 Vapor Clouds

As LNG leaves a temperature-controlled container, it begins to warm up, returning the liquid to a vapor. Initially, the liquefying gas is colder and heavier than the surrounding air. In the liquid/liquefying stage it creates a fog which is a vapor cloud above the released liquid. As the gas warms up, it mixes with the surrounding air and begins to disperse. The vapor cloud will only ignite if it encounters an ignition source while concentrated within its flammability range.

Mitigation Measures

Safety devices and operational procedures are intended to minimize the probability of a release and subsequent vapor cloud having an effect outside the facility boundary.

8.3.9.6 Freezing Liquid

If LNG is released, direct human contact with the cryogenic liquid will freeze the point of contact and can damage the tissues.

Mitigation Measures

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 must wear gloves, face masks and other protective clothing as a protection from the freezing liquid when entering potentially hazardous areas. This potential hazard is restricted within the facility boundaries and does not affect neighboring communities.

8.3.9.7 Rapid Phase Transition

When released on water, LNG floats being less dense than 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. An RPT can only occur if there is mixing between the LNG and water. 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.

Mitigation Measures

Safety devices and operational procedures are intended to minimize the probability of a release of LNG.

8.3.9.8 Flammable Gas Dispersion

US Federal regulation 49CFR193.2059, Flammable vapor-gas dispersion protection, provides for protection of the public from flammable gas clouds that could result from an LNG spill. When spilled, LNG vaporizes, releasing cold natural gas. Natural gas mixed with air is flammable in concentrations of approximately 5-15% by volume (LFL and HFL for LNG is 5% to 15% respectively). Very close to a spill, the natural gas concentration is too rich to burn, but further away from the spill, additional mixing with air produces a flammable cloud of natural gas. Natural gas formed by vaporization of LNG is initially very cold and thus much denser than the surrounding air. The resulting vapor cloud therefore spreads out close to the surface near the spill. As the cloud moves downwind, mixing with air and heat transfer with the ground warm the vapor cloud. At some distance from the spill, the cloud becomes lighter than air and 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 not extend beyond the property line of the LNG facility.

More specifically, the regulation calls for an average flammable gas concentration of no greater than 2.5% (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 Measures

The flammability risk would be taken into consideration during the detailed QRA. The recommendations of QRA shall be implemented as mitigation measures for flammability risk.

8.3.9.9 Likelihood of Tanker Collisions

An offshore terminal has the added risks of ship collision, varying degrees of movement during unloading, and less protected areas during extreme weather. Aside from safe docking, an onshore terminal has no ship movement to worry about. Many ship designs are not able to sail with a partial cargo. An unberthed LNG carrier with partially filled cargo tanks might be unstable and might flounder in rough seas. An offshore facility would be more vulnerable to having the unloading operation interrupted than an onshore terminal.

A traffic control scheme, such as segregation of lanes with adequate separation distances and constant monitoring physically or through remotely operated devices, is evolved to minimize the risk of tanker encounters. Further, adequate navigational aids are installed to indicate channels, as well as separation distances. Their positions are marked clearly on the charts. Proper policing is enforced 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 also been considered by SIGGTO.

Mitigation Measures

The risk of a significant collision between the stationary ETPL-LNG facility and a LNG Carrier, sufficient to cause a breach of an LNG tank on either the LNG Facility or the LNG carrier is extremely low given that:

- Safety zone requirement would be followed as per the results of the 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;
- FSRA and LNG Carriers both have double hulls and, for a spill to occur, both hulls on either the FSRA or LNG Carrier as well as the LNG tank linings would need to be breached;
- ETPL intends to place the LNG carrier inside a berthing pocket, dimensions of which will be confirmed in the FEED, so that 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. Moreover; the Jetty arrangement would be designed to minimize/sustain the surge loads due to large ships passing by LNG ships.

Such an eventuality would have a lesser probability at the proposed Brown Field site.

8.3.9.10 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 have as large or greater impact on the surrounding area than any credible terrorist attack.

Facilities should provide limited access and constant surveillance to keep away the people who have no business near 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. This is because of:

- Increased security measures being taken after September 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 PQA 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 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), and Port Qasim Authority will act in similar manner. 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 ETPL-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.

8.3.9.11 Safety and 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 a very cold 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 DOE, the U.S. Coast Guard, LNG industry and ship management agencies, LNG shipping consultants, and government intelligence agencies to collect background information on ship and LNG cargo tank designs, accident and threat scenarios, and standard LNG ship safety and risk management operations. Sandia developed a report, "Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water", SAND2004-6258, that 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 are intended to be used as guidance for conducting site-specific hazard and risk analyses. The results of the Sandia report are not a prescription but need to be considered in the context of siting LNG terminals in Pakistan. Furthermore, the report has been recommended as 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 guidance to assess and manage site-specific hazards and risks from marine LNG imports.

I Factors that Influence an LNG Spill

Figure 8.3 presents a pictorial view of the various factors or events that can occur during an LNG spill over water. First, an LNG cargo tank must be breached, either from an accidental event such as a collision or grounding or possibly from a malevolent or intentional event. Quantifying the likelihood and results of such events are very important because they influence 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 must be considered including; the 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.

Depending on the size and location of an LNG cargo tank breach, LNG could spill onto or into the LNG ship, flow from the breach onto the water surface, or both. Depending on whether there is early or late ignition, LNG dispersion will occur through volatilization of the LNG from contact with water and be transported as a vapor cloud in the air or as a liquid on the water surface. The timing of a potential ignition will determine whether the LNG will disperse without a fire, burn as a pool fire, or burn as a 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].

II Example of Potential Hazards from Large LNG Spills over Water

Sandia used the general scale of the potential hazards of a large LNG spill over water, and used the existing experimental data 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.

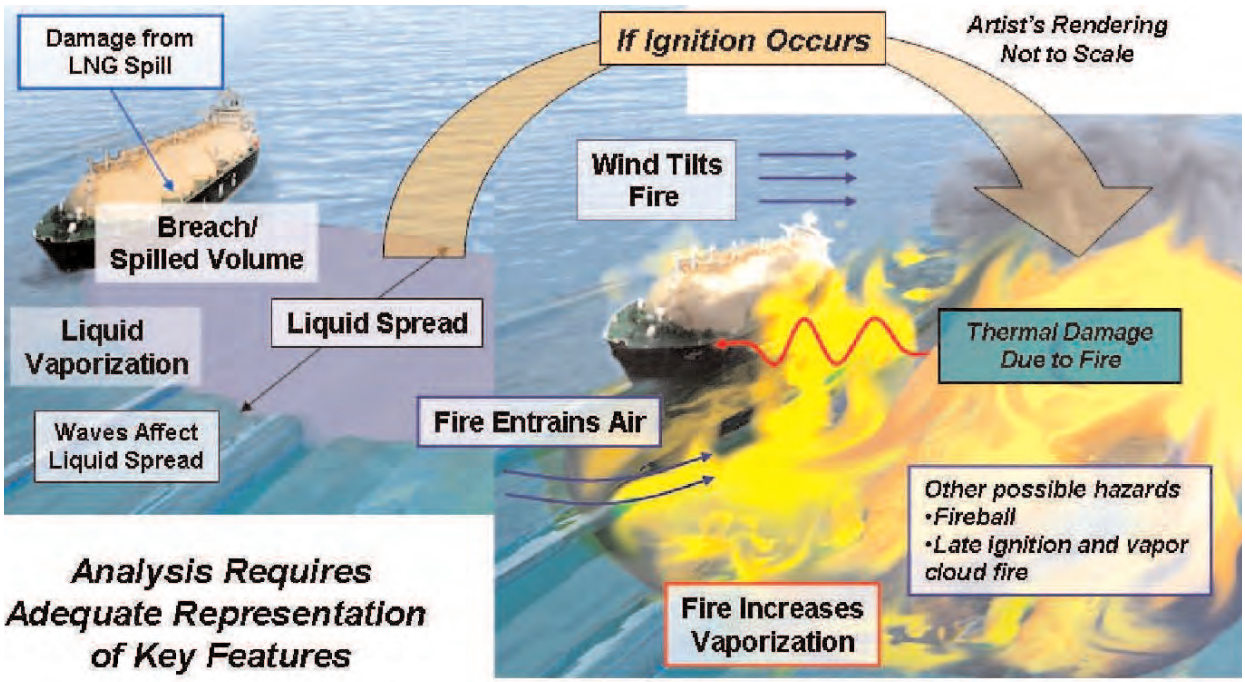


Figure 8.3: Key factors that influence an LNG vessel spill over water

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 guidance report. 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 various spill parameters, are presented in Table 8.2 for thermal fire hazards. Most intentional events are expected to provide an ignition source such that a pool fire occurs and the likelihood of a large unignited release of LNG is unlikely. The 37.5 kW/m^2 and 5 kW/m^2 values shown in Table 8.2 are thermal flux values commonly recognized for defining hazard distances for LNG [NFPA 2001]. The 37.5 kW/m^2 is a level suggesting severe structural damage and major injuries if expected for over 10 minutes. The 5 kW/m^2 is a level suggesting second-degree skin burns on exposed skin if expected for periods of over about 20 seconds, and is the value suggested as the protection standard for people in open spaces.

While these results show the general range of hazards for spills from common LNG vessels, larger vessels are being considered for offshore ports, and larger spills could occur. Examples of hazard distances for spills from larger vessels are presented in a Sandia report [Hightower 2006]. The results show the scale of the concerns, but actual hazard distances will vary based on site-specific environmental conditions, fire dynamics, terrain, ship sizes, and safety and emergency response measures in place.

III MITIGATION MEASUES/RISK MANAGEMENT FOR LNG OPERATIONS OVER WATER

While it is important to assess the possible hazards from a large LNG spill over water, it should be noted that the risks and hazards from a potential LNG spill can be reduced in many cases through a combination of safety and risk mitigation approaches, including:

1) Reducing the potential for a spill,

2) Reducing the consequences of a spill, or

3) Improving LNG transportation safety equipment,

Table 8.2: Potential Thermal Hazard Distances for Possible Breaching Events of a Standard LNG Vessel

HOLE SIZE(m^2)	TANKS BREACHED	DISCHARGE COEFFICIENT	BURN RATE(m/s)	SURFACE EMISSIVE POWER (kW/m2)	POOL DIAMETER(m)	BURN TIME(min)	DISTANCE TO 37.5 kW/m2(m)	DISTANCE TO 5 kW/m2(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 x 10-4	220	572	8.1	630	2118
5*	1	.6	3 x 10-4	220	330	8.1	391	1305
5	1	.9	3 x 10-4	220	405	5.4	478	1579
5	1	.6	8 x 10-4	220	202	8.1	253	810
12	1	.6	3 x 10-4	220	512	3.4	602	1920

** nominal case considered*

security, or operations to prevent or mitigate a spill.

For example, 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 implemented 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 boardings of LNG ships, special security sweeps, and positive control of an LNG ship during port transit.

It is also to be noted that Milford Haven in UK has successfully operated at criteria much more stringent than those indicated here.

Milford Haven Port Authority notifies two zones for safe navigation of vessels within the port jurisdiction as follows:

- Controlled Zones

Controlled Zone is extending 1 mile ahead and astern of the specified vessel and within the main channel. No commercial vessel of 20 meters or more may navigate within the controlled zone except astern of the specified vessel where such navigation is away from it and provided that prior permission has been sought from and granted by Port control.

- Exclusion Zones

Exclusion zone is extending ahead to the limit of the line of sight from the bridge of the specified vessel within the confines of the channel; no vessel is permitted to navigate within this zone at any time. Such limit will be determined by a patrol vessel stationed ahead. The zone astern will extend to the stern of an escort tug, when provided, or 100 meters where it is not.

By specifying these controlled zones the ports is able to handle LNG ships without any issues. The idea is again based on a risk based regime.

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 8.4.

The risk analysis process helps support a program for

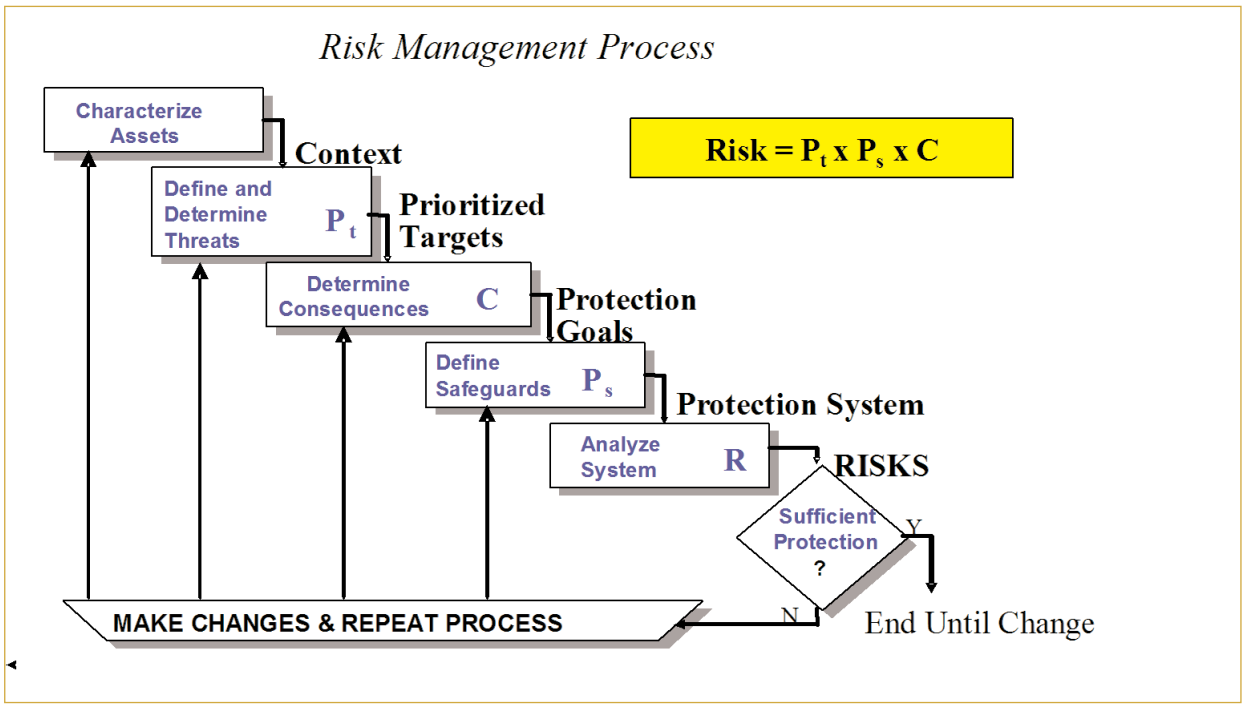


Figure 8.4: Risk Analysis and Risk Management Process Approach

managing risks to the public of marine LNG imports. The process steps as shown in Figure 8.4 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 8.4, 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

Table 8.3: Potential Lower Flammability Limit (LFL) Distances for Possible Vapor

IMPACT ON PUBLIC SAFETY	REDUCTION IN EVENT POTENTIAL (Prevention)	IMPROVE SYSTEM SECURITY AND SAFETY(Mitigation)	IMPROVED HAZARD ANALYSIS(Reduce Analytical	RESULTANT RISK REDUCTION Uncertainties)
High and Medium Low	■ 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 fire fighting 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
	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

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 8.3. For most locations and operations, some level of risk is common and, therefore, a "residual" risk often remains.

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 cooperation 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.

ETPL has also carried out a detailed Consequence Analysis and QRA studies which highlights mitigation measures to the probable risks pertaining to the site being considered for successful commissioning of project. The studies are annexed to the ESIA.

"The consequence analysis has shown that only 3 release cases out of the 40 have the potential to give rise to thermal radiation or flammable gas concentration zones that extend beyond the terminal's berthing pocket.

It should be noted that the presence of consequence zones beyond the berthing pocket does not necessarily indicate an unacceptable Risk to personnel in these locations. The consequence analysis is a deterministic assessment which considers the consequences of accident scenarios, but does not explicitly consider their likelihood (or frequency). Some of the large accident scenarios modelled will have a consequence zone impact outside the berthing pocket which is common on most LNG regasification terminals in port estuaries. When a low likelihood of occurrence (associated with these large events) is included in the full QRA model, the resulting Risk to personnel outside the berthing pocket is expected to be within acceptable

individual risk levels. Based on the above the operational Permanent Exclusion Zone (PEZ) for the project is determined not to extend beyond the berthing pocket of the Elengy Terminal."

Please refer Annex - X I for details on Consequence Analysis.

8.3.10 INSTALLATION OF PIPELINE

The installation of the pipeline underground will involve alteration of land surface. Environmental issues may arise during land preparation, improper backfilling, dumping of excess soil and surface erosion. Environmental issues emanating from project activities will be as follows:

- The right of way (RoW) of the proposed route for pipeline will run in the terrestrial environment along existing roads which are fairly level and covered with loamy saline soils. The land area along the existing roads has already been utilized for industrial development and for providing infrastructure facilities. Since no significant land use change is envisaged no mitigation measure would be necessary.
- Around 4 km long portion of the RoW is privately owned. SSGC has acquired the land from the land owners as per the procedures laid down in Land Acqusition Act (LAA), 1894. The aquired land is a barren land and there are no community structures, houses, businesses on this land. Hence there will be no relocation or resettlement involved in the Project. ***There are "no" sensitive receptors along the RoW of pipeline.***
- The high pressure 600mm-pipeline would be buried under ground by conventional burying method. A trench of about 1.2 m depth will be excavated to bury the pipeline. After laying of pipeline the trench will be backfilled and compacted and the RoW will be restored to its original condition.
- The RoW will be restored to its original condition after commissioning of the pipeline. The operation phase of the project will therefore not contribute to soil erosion.
- The RoW, campsites and other construction sites will be restored to the original conditions to the extent possible. The photographs taken prior to commencement of construction will be used for this purpose. The land will be re-contoured, debris and excess construction material will be removed, surplus soil will be disposed of, damaged/blocked drainage will be restored, ditches and pits will be backfilled, all concrete structures will be dismantled, and re-vegetation measures will be implemented, wherever required.

The following mitigatory 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 6.
- 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 PQA & SSGCL. 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, and 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 bushes and mangrove to the bare minimum and restricted to the area identified by PQA. 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. Mangrove trees will be planted at 1:10 in consultation with an Independent Monitoring Consultant (IMC) and IUCN Pakistan.
- Spill prevention and response plan will be prepared by ETPL 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

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 green house 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.

8.3.10.1 Impact on Air Quality

Construction activities related to laying of NG pipeline in the terrestrial 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 NG 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 green house 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.

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 Equipments (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.

8.3.10.2 Noise Emissions

Pipeline laying activities may raise the ambient noise emission level particularly in the residential and commercial areas. The duration of the pipeline laying activity is anticipated not to exceed 15 months. 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 Port Qasim where construction equipments used are very similar to the equipment planned for the construction phase activities of NG pipeline, which include diesel engine driven electric generators and earthmoving equipment. Thus, it would be appropriate to assume that the expected noise emission level during the construction activity period will be of low intensity besides being contained in the microenvironment.

The construction equipment will be diesel engine driven and will include the barges and pumps, winches for cranes and pipe shore pulling, soil compaction systems and pile driving, concrete batching and pumping, jetting, pipe compression testing, welding generators, temporary fuel, water and sewer systems, and the engines for the tugs, launches and ferries. The total ambient noise level that may be expected due to diesel engine driven construction phase operations would be well below both the daytime limit of 70dB(A) and the nighttime limit of 60 dB(A) required by National Environmental Quality Standards (NEQS).

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.

MITIGATION 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 equipments. Vehicles whose noise levels exceed the minimum required level would be restricted for use in the construction activity area.
- All work will be carried out during day time.
- 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.

8.3.10.3 IMPACT ON WATER RESOURCES

The activities related to NG Pipeline laying may affect the water resources and lead to groundwater pollution, seawater contamination, and soil erosion. The pipeline will be laid at a depth of 1.2-2m in the terrestrial environment and up to 2 to 3m at sub-sea level. The risk from exposure to sea water will be high at the coastline, the creeks and the mangrove area. The coastal and the creek area are both under high stress due to indiscriminate discharge of untreated wastewater from cattle colony, residential areas in Bin Qasim town and the industrial areas of Korangi and Landhi besides the industrial zones of Port Qasim.

Construction activities along the coastline, especially excavation, trenching, and backfilling, pose the greatest threat to the marine ecosystem.

MITIGATION MEASURES

To reduce the risk to the quality of marine ecosystem, special attention will be paid to reduce the impact that may be by introducing the following mitigation measures:

- Freshwater will be used for hydro-testing, after which oil-contaminated water will be properly disposed of. Appropriate size of mesh will be used to filter out debris including metallic residues. Efforts

will be made to reuse this filtered water as far as possible.

- Sewage generated from construction camps will be appropriately treated before being discharged into the existing sewerage system.
- Heavy construction machinery will be kept off the waterfront to the extent possible.
- The RoW including the coastline will be regularly inspected to monitor erosion and spills.
- Erosion- and sediment-control measures will be employed and maintained where necessary.
- All the disturbed areas including the pipeline trench, the storage and work place will be restored to the original contour as far as possible.
- The backfill will be stabilized and consolidated into layers not exceeding a depth of 25 cm.
- Washing vehicles near the working area and any other natural water source will be prohibited.
- Equipment will be maintained properly to minimize oil or fuel leakages from construction machinery.

8.3.10.4 WILDLIFE

Under the existing environmental setting of the study area, no significant impact on wildlife is expected, nor is any serious wildlife issue anticipated. There is no protected, endangered, or endemic species in the project area. There are 1) No threatened species inhabiting the area, 2)No animal dens and burrows along the pipeline route, 3) Foxes and jackals, the common nocturnal carnivores in the study area, are not likely to be impacted during the construction period which will be of short duration and will be confined to day time activity, 4) Birds being mobile species are not likely to be easily impacted since they have the capacity to avoid area under disturbance, 5) No endemic species are reported in the study area.

MITIGATION MEASURES

The following measures will further minimize any impact on the wildlife during the construction of the proposed project:

- A No Hunting, No Trapping and No Capturing policy will be enforced by the contractor and monitored by supervision consultant.
- Project personnel will be prohibited from buying wild animals or birds.
- Waste of any kind will not be discharged into the sea, and leftover food will be disposed of appropriately.
- Night time construction and vehicular traffic will be avoided as much as possible.

8.10.3.5 DAMAGE TO EXISTING INFRASTRUCTURE

The total length of proposed pipeline right of way is 23 km. The construction activities may accidentally damage buried utility lines and all such systems will have to be identified before start of excavation for laying the pipeline.

MITIGATION MEASURES

- 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.

8.3.10.6 DISRUPTION TO TRAFFIC AND ACCESS

The proposed pipeline parallels major roads for a significant proportion of its length. Most construction

traffic will follow the access road along the RoW and is not expected to cause significant disruption on the public highway. Line pipe will be transported on normal size trailers and no heavy equipment will be required for construction. There may be some traffic disruption associated with construction traffic using the existing roads.

MITIGATION MEASURES

Crossings of major highways and busy roads shall be performed with thrust boring which would not involve any disruption or diversion of normal traffic.

IMPACT RATING

Overall Impact Rating	Impact Priority
≤ 3	Catastrophic
4 ~ 6	High Significance
7 ~ 9	Medium Significance
10 ~ 16	Low Significance
> 16	Insignificance

Consequence / Severity	Likelihood/Frequency: Very High (1)	High (2)	Medium (3)	Low (4)	Very Low (7)
Very High (1)	VH X VH (1)	H X VH (2)	M X VH (3)	L X VH (4)	VL X VH (7)
High (2)	VH X H (2)	H X H (4)	M X H (6)	L X H (8)	VL X H (14)
Medium (3)	VH X M (3)	H X M (6)	M X M (9)	L X M (12)	VL X M (21)
Low (4)	VH X L (4)	H X L (8)	M X L (12)	L X L (16)	VL X L (28)
Very Low (7)	VH X VL (7)	H X VL (14)	M X VL (21)	L X VL (28)	VL X VL (49)

	Very High	High	Medium	Low	Very Low
Likelihood / Probability	• The occurrence during abnormal / unplanned event on monthly basis; or • during normal activity, the aspect occurs continuously as a normal operating condition	• The occurrence during abnormal / unplanned event is once per quarter; or • during normal activity, the aspect occurs twice a month	• The probability of occurrence during abnormal / unplanned event events, is once in six months, or • during normal activity, the aspect occurs once in a month	• The occurrence of aspect is during abnormal or unplanned event with the probability of occurrence once per year or • during normal activity, the aspect occurs once in six months	• The occurrence of aspect is only during abnormal or unplanned event with the probability of occurrence less than once per year.

Severity	Very High	High	Medium	Low	Very Low
Environment	• Extensive and long term impacts causing irreversible damage to all components of environment including land, water and air as a result of hazardous releases. Examples include: Leakage of large quantity of LNG, Emissions of air pollutant responsible for global impacts (e.g. CFC, GHG) in large quantities, long-term impacts to water bodies from wastewater discharges, extensive areas of ground damage, or large spills affecting waterway ecosystem. • Large uncontrolled release of hazardous material / NG e.g. >100,000 m3, 10,000 m3 in sensitive area • Impact far beyond the Terminal boundary • Long term damage affecting extensive area off site and prolonged clean-up.	• Severe impacts to habitat or extensive impact to wildlife or fisheries or agricultural lands or potential for regional or global environmental impacts. Examples include: Emissions of air pollutant responsible for global impacts (e.g. CFC, GHG) in significant quantities, long-term impacts to water bodies from wastewater discharges, extensive areas of ground damage, or large spills affecting waterway ecosystem. • Uncontrolled release of reportable quantity e.g. >1000 m3. • Impact on immediate neighborhood beyond facility boundary. • Long term damage affecting limited area off site and prolonged clean-up.	• Local environmental impacts with degradation of sensitive habitat or potential impact to wildlife or fisheries or agricultural lands. Examples include: Emission of air pollutants in moderate quantity altering air quality in the immediate surrounding, discharges of concentrated contaminants to water, localized areas of ground damage, or medium size spills of hydrocarbon (>= one bbl and < 100 bbl) in less sensitive areas. • Uncontained release of minimum reportable quantity. • No long term impact beyond facility boundary. • Prolonged damage on site.	• Local environmental impacts with degradation of habitat or low impact to wildlife or fisheries or agricultural lands. Examples include: Emission of air pollutants in low quantity which may effect air quality in the immediate surrounding, discharges of concentrated contaminants to water, localized areas of ground damage, or medium size spills of hydrocarbon (less than one bbl) in less sensitive areas, or physical impacts to ground directly adjacent to a facility or low consumption of natural resources. • Release contained to site. • No prolonged damage.	• Environmental impacts are not existent, are transitory, or are limited to a relatively small area where there is no impact on flora of fauna or for very small duration. Examples include: well-dispersed atmospheric emissions (below NEOS), dilute aqueous discharges to water, small spills of hydrocarbon (negligible amount) • Contained releases of hazardous material. No off site impact. • Minor damage/ quick clean-up.
Occupational Health	• Multiple deaths or multiple persons on-site with onset of severe or life-threatening health effects alleged to be due to exposure arising from ETPL's activities. • Death or onset of severe or life-threatening health effects to single person off-site alleged to be due to exposure arising from ETPL's activities. • Multiple persons off-site with onset of irreversible health effects alleged to be due to exposure arising from ETPL's activities.	• Death or onset of severe or life-threatening health effect to single person on-site alleged to be due to exposure arising from ETPL's activities. • Multiple persons on-site with onset of irreversible health effects alleged to be due to exposure arising from ETPL's activities. • Single person off-site with onset of irreversible health effect alleged to be due to exposure arising from ETPL's activities. • Multiple persons off-site with mild to moderate reversible short term health effects alleged to be due to exposure arising from ETPL's activities.	• Single person on-site with onset of irreversible health effect alleged to be due to exposure arising from ETPL's activities. • Multiple persons on-site with mild to moderate short term reversible health effects resulting in DAFWC and alleged to be due to ETPL's activities. • Single person off-site, with mild to moderate reversible short term health effects alleged to be due to ETPL's activities.	• Single person on-site, with moderate short term reversible health effect resulting in DAFWC and alleged to be due to ETPL's activities. • Over exposure to multiple persons on-site but no reported health effects. • Off-site exposure likely, but no effects identified	• Over-exposure to single person on site, but no reported ill-health effect e.g. monitoring result shows occupational exposure limit has been exceeded, or one-off event such as failure of local controls or PPE

PROPOSED LNG IMPORT TERMINAL PROJECT

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase				Potential Impact Description	Management from the ETPL	Inherent Risk Ranking			Proposed Mitigation and Follow-up Actions	Residual Risk Ranking		
			Pre-construction	Construction	Operation	Post Operation			Likelihood	Severity	Risk Ranking		Likelihood	Impact	Risk Ranking
SITE Preparation															
Loss of the biota	Most of the area to be dredged consists of barren sand/soft bottom or soft bottom/rubble with little or no observed epifaunal communities. The benthic population is restricted to the top 10 cm of the substrate.	Dredging and Reclamation Activities		x			loss of the biota located within the dredge area which is a short time activity localized to the environment. 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	HSE Dept. to monitor vegetation, benthic community on continous basis.	Low	Medium	Low Significance (12)	1) 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. The extensive dredging and disposal of spoils carried out for Port Qasim over the last decade or so, has greatly reduced the benthic habitat. ETPL will ensure the adoption of careful methods to reduce the impact of construction on marine ecology of the site; 2) 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 IMC; 3) Any loss of mangrove habitat will be compensated by plantation/replantation of mangrove of as many mangrove trees as the canopy of the removed trees would require. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC; 4) 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. 5) Monitoring of all activities related to removal of plantation and the replantation. 6) The construction contract should include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the land area identified by PQA. 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 PQA and monitored by IMC. 7) Once construction activities are completed, there are no anticipated long-term impacts that will occur as a direct result of installation of berthing facilities. 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. 8)Mitigation of potential impacts to benthic habitats is anticipated to occur through natural reestablishment of bottom conditions and resettlement of associated faunas. Natural forces of currents and tides should restore the pre-construction distribution of soft bottom sediments that will be recolonized by infaunal organisms. 9) Any loss of mangrove habitat will be compensated by plantation/replantation of mangrove of as many mangrove trees as the canopy of the removed trees would require. The number of trees to be planted against the number removed will be determined in consultation with IUCN and IMC.	Very Low	Low	Insignificance (28)
Creek Bed	The suspended matter in the creek areas has an annual range of 25-170 ppm. The higher values were observed during the southwest monsoon period (usually May-August). The average suspended load during June-July was between 80-115 ppm.	Maintenance Dredging			x		Increases in turbidity and suspended sediments, and the loss of benthic organisms in particular.	PQA need to conduct hydrodynamic and sediment transport modeling to predict frequency of maintenance dredging or the bathymetric surveys being conducted to indicate about the prevailing depths by PQA. Turbidity will be monitored during each maintenance dredging event to ensure compliance with relevant international standards.	High	Low	Medium Significance (8)		Low	Very Low	Insignificance (28)
Near-shore habitats	the Phitti Creek has faunal community characteristic of very fine sediments from muddy to clayey. The animal communities are not very abundant except mudskipper fish, fiddler crabs and the snail Cerithidea cingulata a pollution indicator species.	Compaction of Reclaimed Soil		x			Because many of the near-shore habitats around project site will be undergoing modification due to island expansion and construction of shoreline protection, and because new habitats may still not have established themselves along the shoreline, the impact of compacting process on existing and new habitats will be minimal.	The compacting activity would need to be completed prior to the reestablishment of new near shore habitats around project area.	Low	Low	Low Significance (16)		Very Low	Very Low	Insignificance (40)
Mangroves	The density of mangrove trees is between 50-60 / 100 m2. The height of the individual tree within the established Avicenna marina habitats were between 2-3 m. However, the mangrove habitat on green field project site option 1 (75 to 100 acres land on Khiprianwala Island) or on brown field site Option 3 in the vicinity of ETPL is relatively small.	Shore Protection resulting in Land reclaimation		x			Of the habitats that will be impacted by shore protection system construction, the mangrove habitat is the most sensitive: however, the mangrove habitat on green field project site option 1 (75 to 100 acres land on Khiprianwala Island) or on brown field site Option 3 in the vicinity of ETPL is relatively small. Due to its isolation and small size the overall impact due to loss of the mangroves is medium.	HSE Dept. to monitor Mangrooves disburbance / replantation on continous basis.	Medium	Medium	Medium Significance (9)		Low	Low	Low Significance (16)
Local fishing activity	Residents of Ibrahim Haidery and Rehri were traditional fishermen involved in fishing business since the last few centuries.	LNG Terminal Installations Impacts related to LNG Terminal are those associated with the construction as well as operational activities at LNG import terminal.		x			Construction activities and vessel traffic have the potential to interfere with local fishing activity by temporarily obstructing access of fishermen to their fishing grounds.	Advance Notices to be issued for every activity to local fisherman	High	Low	Medium Significance (8)	1) Advance notices on upcoming construction activities will be provided to local fishermen, in order to mitigate possible obstruction of potential fishing areas during construction. Pakistan Fisherfolk Form being the main stakeholder will be kept informed of all activities that could have negative impact on the fisheries operations.	Low	Very Low	Insignificance (28)

PROPOSED LNG IMPORT TERMINAL PROJECT

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase: Pre-construction	Construction	Operation	Post Operation	Potential Impact Description	Management from the ETPL	Inherent Risk Ranking: Likelihood	Severity	Risk Ranking	Proposed Mitigation and Follow-up Actions	Residual Risk Ranking: Likelihood	Impact	Risk Ranking
Sea water temperature	Sea water temperature mesured were 22.7°C.	Waste Discharges			x		The cooling water at discharge is 3 degrees Celsius (°C) warmer (at most) than at intake. Ship crew will generate 2000 cubic meters per year of grey water and about 650 cubic meters per year of sewage, which will be treated before discharge and expected to be catered for during the design stage.	Monthly monitoring	High	Low	Medium Significance (8)	1) 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 fishery resources. 2) Automatic biocide dosing, quality control and feedback systems will be incorporated into the FLNG facility design 3) Screens will be installed on the cooling water riser inlets and inlet current speeds will be low (estimated at 0.5 m/s) to prevent the ingress of large marine fauna into the cooling water system 4) Heat recovery measures from the FSRA will be considered in the detailed design stage	Low	Very Low	Insignificance (28)
Air Quality	The measured mean concentrations of gaseous pollutants were, 93.3 µg/m3 for PM10, 0.9 ppm for CO, 8.1 ppb for SO2, 11.9 ppb for NOx and 300.8 ppm CO2. All these levels of gaseous pollutants were well within limits of USEPA	Fugitive dust emissions.		x			Air quality impacts during construction are expected to include fugitive dust emissions at the project site from ground excavation, fill operations, and removal of debris, as well as construction vehicle emissions, marine vessel emissions and portable generators	Monthly monitoring during construction	High	Very Low	Low Significance (14)	1) Construction impacts on air quality will be mitigated through construction management practices, including the use of appropriate dust suppression measures. Air quality impacts from operation of the project's power production system will be minimized by appropriate technology to reduce the impact of emissions to confirm to World Bank standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions. 2) Fugitive dust emissions will be minimized through the use of dredged fill material, which will be pumped in a slurry form through pipeline into dewatering basins located near the final reclamation areas. Construction equipment used for final grading will handle fill material with high moisture contents and minimal potential to generate fugitive dust. To further minimize emissions of airborne particulates, fugitive dust will be mitigated using the following measures, as necessary: • The use of water on areas of exposed soils, if necessary; and • Final grading and landscaping of exposed areas as soon as possible. 3) 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. 4) It is envisaged that Selective Catalytic Reduction or any other alternative systems would be incorporated on board the ships to reduce NOx emissions. 5) All emissions from construction and operation must be in compliance with air quality standards in vogue. With adherence to the applicable legal requirements, impacts to regional air quality during operation of the Project would be insignificant but would continue for the life of the Project. Regular monitoring and evaluation is recommended. 6) The lack of other cumulative sources of NOx emissions within the region also protects against the potential for photochemical smog or acid rain generation.	Low	Very Low	Insignificance (28)
Air Quality	The measured mean concentrations of gaseous pollutants were, 93.3 µg/m3 for PM10, 0.9 ppm for CO, 8.1 ppb for SO2, 11.9 ppb for NOx and 300.8 ppm CO2. All these levels of gaseous pollutants were well within limits of USEPA	LNG Vapour Emissions			x		LNG carriers typically have boil-off rates of their LNG cargo of about 0.15% per day.	Monthly monitoring	High	Very Low	Low Significance (14)	FSRUs generally have emission monitoring system. However, it is recommended that ETPL would conduct regular emission monitoring to supplement the data generated offshore.	Low	Very Low	Insignificance (28)
Noise	The mean noise level at the site was 54 dB(A)	Construction and associated activities		x			LNG terminal construction may raise the ambient noise levels in the microenvironment. In particular, works such as pile driving, dredging, drilling, earthworks would contribute to noise pollution.	Monthly monitoring	Medium	Low	Low Significance (12)	No additional 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	Very Low	Very Low	Insignificance (48)
Manmade Hazards															

PROPOSED LNG IMPORT TERMINAL PROJECT

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Sea water contamination	Concentration of Oil & grease in marine sediments in Phitti Korangi Creek is 16.25 mg/kg.	Fuel Spills		x	x		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. Impacts of a very limited nature are anticipated from occasional equipment leaks from fuel and hydraulic systems.	Sea water quality to be recorded weekly to observe any change due to construction activity.	Medium	Very Low	Insignificance (21)	1) 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. 2) 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. 3) 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. 4) 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. 5) 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.	Very Low	Very Low	Insignificance (48)
Effect on human health	Public Safety	Fire and Explosion			x		Impacts include oxygen deficiency, freezing injuries, fire hazards, and explosive air-gas mixtures.	Detailed Fire contingency Plan to be developed.	Low	Very High	High Significance (4)	1) 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. 2) 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. 3) A detailed risk assessment is being conducted to determine if a LNG facility of a specific design and layout can be located on a site without causing an unacceptable impact to the safety of the public who live or work near the site. In this study the requirements of NFPA 59A (2009) for LNG Facilities shall be followed. It is expected that hazard zones would lie within the property of the LNG terminal site or over adjacent water, these requirements are met. 4) As required by NFPA 59A and to minimize impacts to personnel and facilities, Impoundment areas (secondary containment) will be provided.	Very Low	Medium	Low Significance (14)
Marine Hazard	The maximum frequency of ship arrival with a FSRA of 150,000 m3 storage and an LNG carrier of 135,000 m3 considering per day consumption of NG at 500 MMSCFD would be after approximately 4 to 5 days.	Volume of Shipping Traffic		x	x		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.		High	Very Low	Low Significance (14)	1) 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. 2) Worldwide there is no record of serious incident of an LNG carrier involved in product transport as envisioned for the ETPL-LNG project. By implementing the management controls and following internationally accepted codes and standards, ETPL expects no marine safety-related impacts due to the shipments of LNG.	Low	Very Low	Insignificance (28)
Workplace Hazard		Overall construction and operation activities		x	x		There are potential impacts to worker safety during the construction and operation phase due to the increased activities on the island and over water, the higher risk associated with handling LNG and the higher population of workers.	Workplace hazards will be managed by strong OH&S management system.	Medium	Low	Low Significance (12)	A Health and Safety Plan for construction and operations will be implemented and monitored with emphasis on personal protective equipment and inherently safe equipment	Very Low	Very Low	Insignificance (48)

PROPOSED LNG IMPORT TERMINAL PROJECT

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Natural Hazards	Tsunamis have not been recorded for the coastal area south of Karachi. Tropical cyclones that come near the proximity of Karachi are generally weakened, the coastal topography being gentle and flat, even a surge of 2.0 feet during spring tide can create flooding. In Sindh Coastal belt, frequency of the storm striking the coast is low (for over a 75 year period only four storms struck the coast between 18 and 19o N and only three of these struck between 19 and 20o N).	Extreme weather conditions		x	x		The impacts are expected to be much severe in case of siting the LNG terminal in the main channel (Option 2) as compared with its location away from the navigation channel (Option 1 & Option 3).	Natural hazards will be managed by strong Emergency preparedness and response.	Very Low	Very High	Medium Significance (7)	1) Natural hazards associated with storm events include those arising from storm waves/surges, high winds, and torrential rainfall. For protection against wave run-up and over topping, shore protection features will be constructed to protect the proposed island footprint. The LNG facility will be designed to withstand a Category 5 hurricane and the remaining components of the facility will be designed for a Category 4 hurricane. These design parameters will protect against high winds, as well as storm surge and wave effects, associated with these relatively infrequent meteorological events. 2) Shore protection structures will be designed to withstand the impacts from a 100-year storm. Based on design evaluations, shore protection features will be incorporated to further stabilize the island and its operational features. 3) The Geological Survey of Pakistan has, however, defined the area of Port Qasim, where the site under study is located, to fall in a Seismic Zone 2B region. This suggests the possibility of moderate to major seismic hazard i.e. probability of earthquakes of intensity VI to VIII MM scale and 5.6 to 6.6 on Richter scale. From the charts published, the peak ground level acceleration (PGA) for this zone is 28%. The seismic risk factor of 0.3 is advisable and will need to be incorporated in the design for constructions and installations in the coastal zone, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-VI to VIII). The seismicity in the Karachi and at Project site is considered to be low. According to the published data the Project area lies in zone of low seismic activity, with acceleration ranging from 1.6 to 2.8 m/sec2. A factor of 2.8 m/sec2 will, on the other hand, have to be taken for a maximum credible earthquake (MCE). The design of the LNG terminal should take these values into consideration. 4) Major damages done by Tsunamis, the impulsively generated seawater waves that are a result of underwater earthquakes, have not been recorded for the coastal area south of Karachi. There are, however, evidences of a 1.2 m tsunami generated by an offshore earthquake of intensity 8 M in 1945, which caused only minor damages in Port Qasim area. This event was followed by another Tidal wave that was recorded in 1953. The Tsunami of December 26, 2004 had no impact on the macroenvironment of the Port Qasim area. 5) Tsunamis are not expected to occur in the vicinity of the project area; yet, the mitigation strategies proposed to deal with hurricanes and surges of category 5 are considered sufficient to deal with tsunamis of high order.	Very Low	Low	Insignificance (20)
Protected Areas	There are no designated Protected Areas in the vicinity of the project area. Similarly, this ESIA study has not found any antiquity artifact in the microenvironment of area concerned. No sites of cultural heritage are known to exist at or in the immediate vicinity of the LNG Project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites.	Construction and associated activities	x	x			There will be no impacts from the construction and operation of the facilities; as such, no mitigation will be required.	N/A	N/A	N/A	N/A		N/A	N/A	N/A
Operational Risk and Hazards															
Fire hazard		Leakage of LNG			x		potential hazards include fire, in case if an ignition source is near LNG vapors and frost bite because of the risk of contact with an extremely cold substance such as any direct exposure of skin or equipment.	Detailed Fire contingency Plan to be developed.	Very Low	Very High	Medium Significance (7)	Mitigation measures include the use of double hull features in LNG tankers to provide 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 environmentally	Very Low	Medium	Insignificance (21)
Public Safety	The accident which occurred at the world's first commercial liquefaction plant in Cleveland, Ohio (USA), in 1944. An explosion occurred at the Skikda LNG plant in Algeria on 19 January 2003, killing 27 people and injuring 80.	Liquefaction Plants			x		storage tank can rupture and spill the uncontained liquid into storm drains, followed by a large fire	Detailed Spill contingency Plan to be developed.	Very Low	Very High	Medium Significance (7)	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	Very Low	Medium	Insignificance (21)
Terrorism	In 2002 there was a suicide boat attack on a tanker off the coast of Yemen.	Unavailability of security			x		Facilities that handle large amounts of hazardous materials like LNG terminals and ships have been thought to be attractive targets for terrorists.	Detailed Security Plan to be developed.	Very Low	Very High	Medium Significance (7)	Maritime Agency and PQA have an enviable security record and are committed to maintain the same. No additional mitigation measures are required	Very Low	Low	Insignificance (20)

PROPOSED LNG IMPORT TERMINAL PROJECT

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Vapor Clouds	As LNG leaves a temperature controlled container, it begins to warm up, returning the liquid to a vapor. Initially, the liquefying gas is colder and heavier than the surrounding air. In the liquid/liquefying stage it creates a fog which is a vapor cloud above the released liquid.	Release of LNG			x		As the gas warms up, it mixes with the surrounding air and begins to disperse. The vapor cloud will only ignite if it encounters an ignition source while concentrated within its flammability range.	Detailed Spill contingency Plan to be developed.	Low	High	Medium Significance (8)	Safety devices and operational procedures are intended to minimize the probability of a release and subsequent vapor cloud having an effect outside the facility boundary	Very Low	Low	Insignificance (28)
Freezing Liquid		Release of LNG			x		If LNG is released, direct human contact with the cryogenic liquid will freeze the point of contact and can damage the tissues.	Detailed Spill contingency Plan to be developed.	Low	High	Medium Significance (8)	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 must wear gloves, face masks and other protective clothing as a protection from the freezing liquid when entering potentially hazardous areas. This potential hazard is restricted within the facility boundaries and does not affect neighboring communities	Very Low	Very Low	Insignificance (48)
Rapid Phase Transition	If large volumes of LNG are released on water, it may vaporize too quickly causing a rapid phase transition (RPT).	Release of LNG			x		RPT ranges from small pops to blasts large enough to potentially damage light weight structures.	Detailed Spill contingency Plan to be developed.	Low	High	Medium Significance (8)	Safety devices and operational procedures are intended to minimize the probability of a release of LNG.	Very Low	Low	Insignificance (28)
Flammable Gas Dispersion	US Federal regulation 49CFR193.2059, Flammable vapor-gas dispersion protection, provides for protection of the public from flammable gas clouds that could result from an LNG spill.	Flammable Gas Dispersion			x		Very close to a spill, the natural gas concentration is too rich to burn, but further away from the spill, additional mixing with air produces a flammable cloud of natural gas.	Detailed Spill contingency Plan to be developed.	Low	High	Medium Significance (8)	The flammability risk would be taken into consideration during the detailed QRA shall be implemented as mitigation measures for flammability risk	Low	Very Low	Insignificance (28)
Likelihood of Tanker Collisions	The maximum frequency of ship arrival with a FSRA of 150,000 m3 storage and an LNG carrier of 135,000 m3 considering per day consumption of NG at 500 MMSCFD would be after approximately 4 to 5 days.	Likelihood of Tanker Collisions			x		An offshore terminal has the added risks of ship collision, varying degrees of movement during unloading, and less protected areas during extreme weather.	QRA to identify safety zones.	Medium	Very High	Catastrophic (3)	• Safety zone requirement would be followed as per the results of the 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; •FSRA and LNG Carriers both have double hulls and, for a spill to occur, both hulls on either the FSRA or LNG Carrier as well as the LNG tank linings would need to be breached; • ETPL intends to place the LNG carrier inside a berthing pocket, dimensions of which will be confirmed in the FEED, so that 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. Moreover, the Jetty arrangement would be designed to minimize/sustain the surge loads due to large ships passing by LNG ships.	Very Low	High	Low Significance (14)
Soil	Sand formation is brown in color and the grain size ranges from fine to medium. Normally sand thrown by sea waves on the coast are carried inwards, work-up into dunes by wind action. Beach and sea bottom material in the vicinity of Phitti mouth is predominantly composed of Micaceous, very well sorted fine sand.	Construction and associated activities		x			Contamination of Soil	Monthly Monitoring	Low	Very Low	Low Significance (8)	• Construction activities should not be extended beyond designated buffer zones • Natural and existing clearings should be used to the extent possible • Fuel, oil and other hazardous materials if stored on land area, should be provided with impervious lining • Combustible and explosive material should not be stored in storage area • Fuel tanks and hazardous material should be marked appropriately Fuel storage areas should be checked regularly to identify leakage • Safety equipments and utensils should be available at site at all times Vehicle Maintenance Yard should be developed at a designated location during construction work • Where possible, segregation of solid waste during handling should be followed to manage it effectively • Contractor should follow ETPL 's emergency response plan •Machinery movement should be restricted to the construction corridor Restoration of sites after completion of project should be mandatory	Low	Low	Low Significance (16)
Water Quality	The coastline of Karachi is highly polluted with a variety of hazardous substances of industrial, municipal and agriculture origin.	Construction and associated activities		x			Contamination of water followed by effect on marine biota	Monthly Monitoring	Low	Very Low	Insignificance (20)	• Temporary latrines should be located at a suitable distance from water bodies • Sewage should be treated appropriately at each unit • Vehicle cleaning should be prohibited near water bodies • Construction machinery should be kept off the water resources to the extent possible • Weekly/monthly water/wastewater/groundwater quality monitoring should be conducted throughout construction/operation • Treated wastewater of acceptable quality, may be reused for processing construction material	Very Low	Very Low	Insignificance (48)
Solid Waste		Construction and associated activities		x			Contamination of Soil, surface and ground water	Segregation and proper disposal being part of waste management plan.	Low	Very Low	Insignificance (20)	• Solid waste should be collected and stored in environmental friendly manner • Certified solid waste contractor should be hired for disposal of waste •Solid waste should be kept in closed container	Very Low	Very Low	Insignificance (48)

HIGH PRESSURE TRANSMISSION PIPELINE & NITROGEN BLENDING FACILITY

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase: Pre-construction	Project Phase: Construction	Project Phase: Operation	Project Phase: Post Operation	Impact Description within Pipeline & Nitrogen Blending Facility	Management from the RKL/RPL	Inherent Risk Ranking: Likelihood	Inherent Risk Ranking: Impact	Inherent Risk Ranking: Risk Ranking	Proposed Mitigation and Follow-up Actions	Residual Risk Ranking: Likelihood	Residual Risk Ranking: Impact	Residual Risk Ranking: Risk Ranking
Ground Disturbance	The right of way (RoW) of the preferred alternative route for pipeline will run in the terrestrial environment along existing roads which are fairly level and covered with loamy saline soils.	Laying of Pipeline		x			The impact is expected to be confined to the microenvironment for short term as the loose soil will be re-used for backfilling.	Contractor to ensure the restoration of ROW of pipeline to its original contours.	Very High	Very Low	Medium Significance (7)	Ensure that unnecessary damage to the ground surface and blockage of natural drainage is avoided. Ensure that after laying the NG pipeline, the disturbed surface is 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. Ensure that steep cut and fill is avoided in all such cases where the risk of slope failure is high. Ensure that unusable soil spoils are disposed of at the location specified by PQA & SSGCL. 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. Ensure that a spill prevention and response plan is prepared and implemented in case of any such incident. Ensure that photographs of the RoW and other project sites are taken prior to commencement of field activity to be used for reference when restoring the site.	Medium	Very Low	Insignificance (21)
Fire Hazard / Air pollution		Laying of Pipeline			x		potential hazards include fire, in case if an ignition source is near LNG vapors and frost bite because of the risk of contact with an extremely cold substance such as any direct exposure of skin or equipment.	Hydrostatic testing will be performed.	Low	Very High	Medium Significance (8)	Ensure that a contingency plan is in place to mitigate leakages from the system and rupture of the pipeline before entering the Linde facility and/or after delivery into the downstream pipeline. Ensure that the leakages are keenly monitored.	Very Low	Medium	Insignificance (21)
Water and ground pollution		Fuel spills / leakages					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. Impacts of a very limited nature are anticipated from occasional equipment leaks from fuel and hydraulic systems.	Monthly Monitoring	Low	Low	Low Significance (16)	Ensure that fuels, oils, and other hazardous substances are handled and stored according to standard safety practices.Ensure proper and timely maintenance of equipment 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.	Very Low	Very Low	Insignificance (49)
Mangrooves	Pipeline route will not disturb any mangroves	Laying of Pipeline					Construction activities will not require clearing of mangroves trees in the marine ecosystem	HSE Dept. to monitor laying process	Very High	Low	Insignificance (49)	Ensure that the construction contract include provisions to limit the removal of bushes and mangrove to the bare minimum and restricted to the area identified by PQA. 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. Mangrove trees will be planted at 1:5 in consultation with an Independent Monitoring Consultant (IMC) at an area identified by PQA.	Very Low	Low	Insignificance (49)
Historical / monuments / cultural values	Historical and cultural sites are not located on the RoW of the project.	Laying of Pipeline		x			Loss of precious values	Continous monitoring during construction phase	Very low	High	Low Significance (14)	Careful planning to minimize/offset problem. Any finding of archaeological or historical importance will be immediately brought to the notice of the relevant department.	Very Low	Low	Insignificance (28)
Health and Safety	Linde Pakistan will implement Standard Operating Procedures (SOPs) for the production of Liquid Nitrogen and its blending with NG in pipeline followed by metering and conveying the gas to the downstream NG pipeline.	Nitrogen Blending Facility			x		Health and Safety hazards will exist during operation of Nitrogen blending facility.	OH&S hazards will be managed by strong OH&S management system.	High	Low	Medium Significance (8)	Linde currently has nitrogen production facilities and operating standards, albeit at a smaller magnitude, therefore possesses experience and expertise to built and operate the mentioned blending facility.	Very Low	Low	Insignificance (28)

HIGH PRESSURE TRANSMISSION PIPELINE & NITROGEN BLENDING FACILITY

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase				Impact Description within Pipeline & Nitrogen Blending Facility	Management from the RKL/RPL	Inherent Risk Ranking			Proposed Mitigation and Follow-up Actions	Residual Risk Ranking		
			Pre-construction	Construction	Operation	Post Operation			Likelihood	Impact	Risk Ranking		Likelihood	Impact	Risk Ranking
Natural drainage streams	The pipeline RoW crosses a few narrow channels and dry stream beds. The Sindh Irrigation Act 1879 under section 61 also prohibits the damaging, altering, enlarging or obstructing the canals without proper authority.	laying of Pipeline		x			Construction activities within the natural drainage streams may cause their blockage, especially if RoW is not properly restored to its original contours.	Contractor to ensure the restoration of ROW	High	Low	Medium Significance (8)	The RoW will be restored to its original condition after commissioning of the pipeline. The operation phase of the project will therefore not contribute to soil erosion.	Low	Very Low	Insignificance (2I)
Air Quality	The general air quality data for the region pollutants was carried out by EMC and the values were; 238 µg/m3 for PM10, 3.0 ppm for CO, 14 ppb for SO2, 20 ppb for NOx and 321 ppm CO2	Laying of NG pipeline		x			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.	Monthly Monitoring	High	Very Low	Low Significance (1d)	• Ensure that the dirt road routinely used by a community for accessing the project site, is sprinkled with water regularly to reduce fugitive dust emissions resulting from heavy vehicular traffic. •Ensure that Personal Protective Equipments (PPEs) are provided to the workers involved in construction activities to safe-guard the health of the workers. •Ensure that construction materials are transported in covered vehicles. •Ensure that all equipment, generators, and vehicles used during the project are properly tuned and maintained in good working condition, in order to minimize exhaust emission levels. •Ensure that periodical pipe inspections are undertaken to identify and register possible pipe fractures. •Ensure that leak detection systems are installed at strategic locations.	Very Low	Very Low	Insignificance (2I)
Noise	There are no developed residential areas close to the preferred route of pipeline.	Laying of NG pipeline		x			Increased ambient noise emission level particularly in the residential and commercial areas.	Monthly Monitoring	Medium	Low	Low Significance (1J)	• Ensure that all equipment, generators, and vehicles used during the project are properly tuned and maintained in good working condition, in order to minimize noise emission levels. •Ensure that the vehicles and equipment are regularly monitored for the performance of the noise reducing equipments. Vehicles whose noise levels exceed the minimum required level must be restricted for use in the construction activity area. •Ensure that all work is carried out during day time. •Ensure that operators are instructed to keep the noise level at acceptable limits so that the marine fauna is disturbed to the least. •Ensure that a speed limit of 25km/hr is enforced for project vehicles passing through populated areas.	Very Low	Very Low	Insignificance (4I)
Water Resources	The coastal and the creek area are both under high stress due to unsustainable discharge of untreated sewage from cattle colony, residential areas in Bin Qasim town and the industrial areas of Korangi and Landhi besides the industrial zones of Port Qasim.	Laying of NG pipeline		x			groundwater pollution, seawater contamination, and soil erosion.	Monthly Monitoring	Medium	Very Low	Insignificance (2I)	• Ensure that the oil-contaminated water (after hydro-testing) is properly disposed of. Appropriate size of mesh will be used to filter out debris including metallic residues. Efforts will be made to reuse this filtered water as far as possible. •Ensure that sewage generated from construction camps is appropriately treated before being discharged into the existing sewerage system. •Ensure that heavy construction machinery is kept off the waterfront to the extent possible. •Ensure that the RoW including the coastline is regularly inspected to monitor erosion and spills. •Ensure that erosion and sediment-control measures are employed where necessary. •Ensure that all the disturbed areas including the pipeline trench, the storage and work place are restored to the original contour as far as possible.	Very Low	Very Low	Insignificance (4I)
Wildlife	There are no threatened species inhabiting the area	Laying of NG pipeline		x	x		No significant impact on wildlife is expected, nor is any serious wildlife issue anticipated.	Monthly Monitoring	Very Low	Very Low	Insignificance (4I)	Ensure that a 'No Hunting, No Trapping and No Capturing policy is enforced by the contractor and monitored by supervision consultant.	Very Low	Very Low	Insignificance (4I)
Existing Infrastructure	The right of way runs along existing roads and crosses number of physical structures including, major roads, Highway N-5, Pakistan Railway Mainline and the steel mill drainage system. Furthermore the pipeline RoW would pass through buried utility lines.	Laying of NG pipeline	x				The construction activities may accidentally damage these lines and all such systems will have to be identified before start of excavation for laying the pipeline.	Identification of Existing facilities and their plans during preconstruction stage.	Medium	Medium	Medium Significance (9)	• Ensure that existing buried pipelines are identified in the project area through a detailed topographic survey to set the boundary of RoW. • Ensure that prior approval for right of way is obtained from relevant authorities before the start of pipeline laying activities. •Ensure that damage to existing infrastructure is avoided as far as possible and any damage caused to the infrastructure due to construction activities is promptly repaired.	Low	Very Low	Insignificance (2I)

HIGH PRESSURE TRANSMISSION PIPELINE & NITROGEN BLENDING FACILITY

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase				Impact Description within Pipeline & Nitrogen Blending Facility	Management from the RKL/RPL	Inherent Risk Ranking			Proposed Mitigation and Follow-up Actions	Residual Risk Ranking		
			Pre-construction	Construction	Operation	Post Operation			Likelihood	Impact	Risk Ranking		Likelihood	Impact	Risk Ranking
Socioeconomic Impacts		Laying of NG pipeline		x			project related traffic and operation of the construction machinery can be hazardous to the population when the work is being conducted in the vicinity of settlements. Open trench can also be a potential source of accidents.	Continous monitoring	High	Low	Medium Significance (B)	•Ensure that the RoW is aligned to avoid residential areas, settlements, houses and buildings. • Ensure that the land ownership is, if necessary, determined with extreme care. • Ensure that written agreements are made for any temporary or permanent land acquisition. • Ensure that compensation is paid according to the written agreements. • Ensure that the acquired land is clearly marked and the actual land take is limited to the agreed limits. • Ensure that continuous liaison is maintained with the affected community and their concerns are addressed appropriately, if necessary. • Ensure that noise from campsites and construction sites is minimized using appropriate means (silencers, barriers, etc.) as required and noise levels is checked regularly at the campsite and construction sites. • Ensure that the camps are constructed at least 500 m from any settlement. • Ensure that no construction works is carried out during the night. • Ensure that the construction activities should not block the existing roads and tracks. If unavoidable, alternate routes will be provided in consultation with the affected people and concerned department. • Ensure that the liaison with local community is maintained by project proponent and contractor and the communities are informed of the construction activities well in advance. • Ensure that the construction area is cordoned off, and no irrelevant personnel are allowed inside. • Ensure that road driving practice is enforced for the project vehicles. A speed limit of 25 km/hr will be enforced for the project vehicles near settlements. • Ensure that all supplies (water, fuel, construction materials, camp supplies, etc.) are sourced in a manner not adversely affecting the local population. The capacity and existing demand on the sources will be estimated, and these will be used (for the project needs only when surplus capacity is available. •Ensure that the construction crew undergoes medical screening before being deployed in the field. • Ensure that all sites of archaeological, historical, cultural and religious significance are avoided and if any artifacts are discovered during the excavation, the relevant authorities (Department of Archaeology and Museums, Government of Pakistan, Karachi) will be contacted.	Low	Very Low	Insignificance (Ø)

HIGH PRESSURE TRANSMISSION PIPELINE & NITROGEN BLENDING FACILITY - IEE REPORT

ESH Aspect/Issue	Summary of Relevant Data	Impact Source	Project Phase				Impact Description within Pipeline & Nitrogen Blending Facility	Management from the RKL/RPL	Inherent Risk Ranking			Proposed Mitigation and Follow-up Actions	Residual Risk Ranking		
			Pre-construction	Construction	Operation	Post Operation			Likelihood	Impact	Risk Ranking		Likelihood	Impact	Risk Ranking
Socioeconomic Impacts		Laying of NG pipeline		x			project related traffic and operation of the construction machinery can be hazardous to the population when the work is being conducted in the vicinity of settlements. Open trench can also be a potential source of accidents.	Continous monitoring	High	Low	Medium Significance (8)	•Ensure that the RoW is aligned to avoid residential areas, settlements, houses and buildings. • Ensure that the land ownership is, if necessary, determined with concerned land. • Ensure that written agreements are made for any temporary or permanent land acquisition. • Ensure that compensation is paid according to the written agreements. • Ensure that the acquired land is clearly marked and the actual land take is limited to the agreed limits. • Ensure that continuous liaison is maintained with the affected community and their concerns are addressed appropriately, if necessary. • Ensure that noise from campsites and construction sites is minimized using appropriate means (silencers, barriers, etc.) as required and noise levels is checked regularly at the campsite and construction sites. • Ensure that the camps are constructed at least 500 m from any settlement. • Ensure that no construction works is carried out during the night. • Ensure that the construction activities should not block the existing roads and tracks. If unavoidable, diversions routes will be provided in consultation with the affected people and concerned department. • Ensure that the liaison with local community is maintained by project proponent and contractor and the communities are informed of the construction activities well in advance. • Ensure that the construction area is sanitized off and no irrelevant personnel are allowed inside. • Ensure that safe driving practice is enforced for the project vehicles. A speed limit of 25 km/hr will be enforced for the project vehicles passing through settlements. • Ensure that all supplies (water, fuel, construction materials, camp supplies, etc.) are sourced in a manner not adversely affecting the local population. The capacity and existing demand on the sources will be estimated, and these will be used for the project needs only when surplus capacity is available. •Ensure that the construction crew undergoes medical screening before being deployed in the field. • Ensure that all sites of archaeological, historical, cultural and religious significance are avoided and if any artifacts are discovered during the excavation, the relevant authorities (Department of Archeology and Museums, Government of Pakistan, Karachi) will be contacted.	Low	Very Low	Insignificance (28)

09 POTENTIAL SOCIAL IMPACTS OF PROPOSED DEVELOPMENT AND RECOMMENDED MITIGATION MEASURES

9.1 SOCIOECONOMIC IMPACTS

There are undoubted positive impacts of an expanding gas sector on employment, competitiveness and sustainable development. However, the gas sector is a relatively modest creator of employment, and has contributed mostly as a substitute for coal in power generation. However NG is being used in the transport sector as CNG and also 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 low-carbon economy. It nonetheless contributes to policies of sustainable development.

Natural gas is generally considered to make a positive contribution to sustainable development because it has been responsible for a declining reliance on coal in power generation, at least in the European context. Natural gas is the cleanest of all hydrocarbon energy sources, but virtue of emitting very low amounts of key pollutants such as sulphur and nitrogen oxide and emitting less than half of the CO_2 emitted by burning coal. However, the greater weight given to climate change mitigation in public policy means that the CH_4 emissions from methane take the shine off natural gas as 'the fuel of the future' or even as a transitional fuel to a low carbon economy.

The link between LNG and sustainability is rather different. There are at least four positive connections between LNG and the notion of sustainability. These are:

- It provides clean natural gas supplies;
- Liquefaction technology is an efficient way to monetise stranded gas reserves and create benefits for the developing countries that seek to export them;
- LNG is a relatively safe and secure fuel with an excellent track record in safety and environmental respects, and
- LNG solutions are flexible and scalable: small scale distributed LNG offers supplies to remote areas while liquefaction technology can capture waste streams from flare gas and landfills;

It is estimated that a maximum of 200 to 300 full time construction jobs will be created during the construction phase of the project. EVTL will use good faith efforts to employ qualified Pakistani citizens in the construction and operation of the proposed project. A training program will also be established by EVTL 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 Sindh. The remainder of the construction and supervisory positions will be filled with experienced workers that will temporarily relocate to the area. Thus, construction activities will provide numerous new, temporary and permanent, work opportunities for both skilled and unskilled labor, as well as contribute significantly to the national economy. Because of the available labor pool, particularly of unskilled workers, and the diminishing needs of other large construction projects currently underway in the Sindh, the demand for labor for this project is not expected to compete with or impede other ongoing development projects in the area.

In addition to creating construction jobs for an extended period (estimated at 2 years), job training will be made available to provide the appropriate personnel for civil, mechanical and other positions required by the

construction. This action is consistent with the national goals of advancing both training and employment of its citizens in the high technology sector, and is particularly important to the young population of the Country as they emerge from school into the workforce.

It is estimated that 100 to 150 permanent full time jobs will result from on-going operations and maintenance of the facility with a permanent annual payroll.

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 2-year construction period.

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 projected demand/supply/availability analysis had indicated a shortfall of 3.0 MTOE in 2010 and the gap is expected to reach 19.9 MTOE in 2015 and 85.3 MTOE in 2030. Pakistan is exploring all possible avenues for cheap, abundant and environment-friendly sources of gas in order to continue with sustained economic growth in the coming years.

The gap between supply and demand of natural gas (NG) emerged in 2007- 08 and was projected to build up to 2,100 MMCFD by 2015, as the current gas fields gradually go off plateau. The demand and supply projections had indicated a widening gap of approximately 500 million cubic feet per day (MMFCD) by the year 2010. Winter of 2010-11has actually shown higher shortage then envisaged.

The existing demand of NG in the country is 5190.5 MMCFD, out of which 3895.5MMCFD is met by internal sources. As of June 30, 2010 the NG reserves were 28.90 trillion cubic feet. With no external source of NG available, Pakistan meets the demand from internal sources only. The increasing demand of NG has created a shortfall of 1,295 MMCFD and is expected to increase further. Gas load shedding has become a phenomenon with industry being forced to shut down for five days in a week in Punjab and fertilizer industry for 30-45 days. KESC and other IPPs had their gas allocations curtailed significantly resulting in gas load shedding of over 6-8 hours in the country. Industry running boilers to generate steam is being forced to use coal, furnace oil or diesel and diesel for power generation, with households utilizing charcoal and firewood, thus inducing rapid deforestation and warming of their microenvironment

The present requirement of oil in the country is around 19 million tons per annum, out of which about three million tons (15%) is met from internal sources. The oil reserves being only 314.39 million barrels, the balance demand is met through imports of crude oil and other petroleum products.

Oil imports cost $ 32.26 billion for 58.64 million tons oil during last four years (2006-2009). In order to attract local and multi-national companies for investment in oil and gas sectors and in aggressive exploration, the government has given incentives in new Petroleum Policy 2009.

Since inception, exploration and production companies made 223 oil and gas discoveries in the country and that so far cumulative production from these discoveries is 543 million barrels oil and 24.433 trillion cubic feet of gas having worth of about Rs 27000 billion and Rs. 4930 billion respectively at an average international market price of oil and average wellhead value of gas for 2009.

In order to explore more oil and gas reserves the government granted 115 exploration licenses. Presently, 16 foreign companies are operating in 44 blocks in Pakistan for the purpose.

To fill the growing energy supply deficit, GOP is in earnest implementing a multi-pronged strategy which includes: (i) increasing domestic oil & gas exploration and production, (ii) fast track utilization of hydro power potential, (iii) expediting the development of vast local coal reserves, (iv) importing piped natural gas from neighboring countries, (v) importing LNG, (vi) setting-up new nuclear power plants, and (vii) exploiting affordable alternate energy resources.

Any commitment of additional gas supplies to industries, power and fertilizer production on a long term basis have not been possible, without confirmation of additional sources of gas supply. This may, however, have been possible through:

1) Gas pipeline import which at the earliest could come on-stream by 2017 as per the Gap Coverage Strategy from Iran or Turkmenistan,

2) A major on-shore/off-shore gas field discovery in the current year (the gas to market period being five years), or

3) LNG import which by current assessment could provide gas by the year 2012-13. It was supposed to have started by 2010-11 under the Mashaal Project.

The GOP had mandated SSGC to develop a project for the import of LNG. The first supply of LNG of 3.5 million tons per annum (equivalent to 500MMCFD of gas) was targeted for the year 2011; followed by another for supply of 2.0mtpa by the year 2013. The projects stand delayed, while the shortage keeps multiplying.

ETPL intends to follow a fast track approach towards developing the LNG import terminal in order to bridge the gap between supply and demand of energy. The Project is primarily based on developing the required infrastructure so that LNG can be brought into the Natural Gas (NG) market, which has witnessed phenomenal growth in the energy sector in Pakistan. In the first stage, the focus is on the fastest method to facilitate LNG flow into the NG pipeline network in Pakistan.

The proponent is best placed in the energy sector, particularly in handling about 70% of LPG imports into Pakistan and cryogenic product ethylene. EVTL operates a state of the art LPG and chemical terminal in south western zone of Port Qasim. The terminal consists of a jetty, suitable for handling ships up to 75,000 DWT and houses storage tanks with a storage capacity of 10,100 cubic meters of LPG and balance for chemicals for a total storage capacity of EVTL 84,000 cbm.

The proposed site at Port Qasim is a dedicated area for Oil and Gas development and is promoting local energy supply system. FOTCO is utilized for oil imports and PRO-GAS for LPG in addition to EVTL.

In short, the cumulative impact 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 in future.

The proposed development will also not cause any displacement of population in the microenvironment of any of the site(s) under consideration.

9.2 Interaction with Local population

Construction activities are frequently conducted with a minimum level of interaction with the local population at the construction site. This will be a short term activity that will shift from site to site and hence it is more than likely that the interaction with the community will be of short term duration. However relationship with the local communities will be established prior to and during the construction work to ensure that their natural concern about possible socio-economic impacts is taken into account.

9.3 Employment Opportunities

The project will provide unskilled and semiskilled employment opportunities, although temporary, during the construction phase. Preference will be given to those who are resident near the corridor of impact and are likely

to be directly affected by construction activities.

9.4 Safety Hazards for Local Population

The project related traffic and operation of the construction machinery can be hazardous to the population when the work is being conducted in the vicinity of settlements. Open trench can also be a potential source of accidents.

9.5 Resource Utilization

The sourcing of supplies such as water, fuel, camp supplies, etc., required during the construction phase can adversely affect the available resources. The demands induced by the needs of the project will be fulfilled by the proponent who area already located in the industrial zone of Port Qasim.

9.6 Impacts on Historical and Cultural Sites

Historical and cultural s ites are not located on the RoW of the project. 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.

9.7 Impacts on Fishing Activities

The proposed project at Port Qasim shall not hinder fishing activities during construction or operation stage. The project site is designated for industrial / port development under PQA masterplan and fishermen are not alowed to do any fishing within PQA's jurisdiction. Pakistan Fishermen Folk Forum and fishing communities have been informed of the project and they will receive benefits in terms of sustainable CSR activities planned / proposed by ETPL.

Mitigation measures

The following mitigation measures will be implemented during construction phase of the pipeline project to minimize the impacts.

- The RoW will be aligned to avoid residential areas, settlements, houses and buildings. There will be no displacement of population and no loss of business. Hence no mitigation measure required.
- Land ownership will, if necessary, be determined with extreme care.
- Written agreements will be made for any temporary or permanent land acquisition.
- Compensation will be paid according to the written agreements.
- The acquired land will be clearly marked and the actual land take will be limited to the agreed limits.
- Continuous liaison will be maintained with the affected community and their concerns addressed appropriately, if necessary.
- Noise from campsites and construction sites will be minimized using appropriate means (silencers, barriers, etc.) as required. Noise levels will be checked regularly at the campsite and construction sites.
- Camps will be constructed at least 500 m from any settlement.
- No construction works will be carried out during the night.
- The construction activities will not block the existing roads and tracks. If unavoidable, alternate routes will be provided in consultation with the affected people and concerned department.
- Construction crew's interaction with local population will be minimized. Liaison with local community will be maintained by project proponent and contractor. The communities will be informed of the construction activities well in advance.
- The construction area will be cordoned off, and no irrelevant personnel will be allowed inside. The construction machinery will not be left un-attended. The trench will not be left open for extended period,

appropriate crossover passages will be provided in consultation with the local population.

- Safe driving practice will be enforced for the project vehicles. A speed limit of 25 km/hr will be enforced for the project vehicles passing through settlements.
- It will be ensured that the supplies (water, fuel, construction materials, camp supplies, etc.) are sourced in a manner not adversely affecting the local population. The capacity and existing demand on the sources will be estimated, and these will be used for the project needs only when surplus capacity is available.
- The construction crew will undergo medical screening before being deployed in the field.
- All sites of archaeological, historical, cultural and religious significance will be avoided. If any artifacts are discovered during the excavation, the relevant authorities (Department of Archaeology and Museums, Government of Pakistan, Karachi) will be contacted.

10 PRELIMINARY CUMULATIVE IMPACT ASSESSMENT

The section presents the assessment of Cumulative Impacts of proposed ETPL LNG Terminal Project on the microenvironment and macroenvironment during the construction and operation stages. It may be stated that the microenvironment comprises the onshore installations including the Terminals and the handling of cargo at Port Qasim. The following terminals form the main components of the microenvironment:

1. PIBT – Pakistan International Bulk Terminal (handling Coal, Cement & Clinker) (under construction)

2. FOTCO LNG Terminal – Handling LNG (proposed)

3. Progas – Handling LPG (Operational)

4. FOTCO Oil terminal – Handling Oil (Operational)

5. IOCB (PSM) – Pakistan Steel Mill Iron Ore and Coal Berth (Operational)

6. FAP – Fauji Akber Portia Grain Terminal – Handling grains (Operational)

7. QICT – Qasim International Container Terminal (handling cargo) (Operational)

The macroenvironment on the other hand comprises the Industrial and Urban area on the coastline that forms the hinterland of Port Qasim. Relevant IFC guidelines have been followed for the assessment of each environmental aspect. Figure 10.1 shows the location of different installations in the microenvironment and macroenvironment.

Figure 10.1 Location Map of Terminals in PQA

10.1 Assessment Scenario (I): Cumulative Impacts from ETPL in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction

10.1.1 Impacts on Air Quality

The ambient air quality in the project area was found to be within allowable limits. The operation of the LNG terminal projects will emit exhaust and potentially leak Boil-off gas. The significant components of combustion emissions are NOx, SO_2, CO and fine particulate matter less than 10 microns (PM10).

A general air dispersion study was carried out for the ETPL LNG terminal Project and indicated there is a potential for significant air quality impacts if stack emissions from the FSU/Power Generation Unit during operation are not maintained within NEQS. However, some of the predicted discharges exceed international (WHO) standards for emission. Modelling of emissions from the operation of ETPL LNG Terminal suggested the highest 24-hour average concentrations of NOx would be 19.13 mg/m^3, SO_2 would be 94.83 mg/m^3 and PM10 would be 3.55 mg/m^3. The highest annual mean for ground level NOx was 4.72 mg/m^3, 23.41 mg/m^3 for SO_2, and 0.627 mg/m^3 for PM10.Predicted emissions and the relevant NEQS and WHO guidelines for ambient air quality are summarized in Table 10.1 below.

Table 10.1 Predicted Emissions for Operation of ETPL LNG and Ambient Air Quality Standards and Guidelines

Emission	Predicted Stack Emission Levels	NEQS (Ambient)	NEQS (Stack Emissions)	WHO Ambient Air Standard
NOx (Max. 24-hour concentration)	19.13 mg/m^3	--	NOx=400mg/Nm^3	--
SO2 (Max. 24-hour concentration)	94.83 mg/m^3	50 µg/m^3	SOx=400mg/Nm^3	20 µg/m^3
PM10 (Max. 24-hourconcentration)	3.55 mg/m^3	--		50 µg/
NOx (Max. annual mean)	4.72 mg/m^3	100 µg/m^3		40 µg/m^3 (NO_2)
SO2 (Max. annual mean)	23.41 mg/m^3	200 µg/m^3		--
PM10 (Max. annual mean)	0.627 mg/m^3	--	Doesn't give for LNG	20 µg/m^3

Also the cumulative effect of these emissions coupled with those from the construction of the FOTCO LNG Terminal & PIBT and from operation of FOTCO Oil, FAP, QICT, Pro-Gas and IOCB needs to be considered. Air quality impacts from the construction of the other terminal facility is expected to come from fugitive dust emissions from excavation and fill operations, and emissions from construction equipment/ vehicles, marine vessels and portable generators. Of these, emissions from ships, vehicles and generators would likely contribute emissions similar to those from the operation of ETPL LNG Terminal and are considered in the cumulative impacts. Ships may have heavy fuel-driven engines that emit high levels of SOx and NOx. Gas turbine-driven ships and onshore gas generators emit primarily NOx, but at lower levels than heavy fuel-driven ships, and construction equipment and vehicles may emit NOx and CO. However, these emissions would be limited to the construction period and in the vicinity of the construction works areas.

Existing/In-Place Controls

The ETPL LNG Terminal facility will use natural gas for its main fuel source, thereby reducing significant emissions compared to other fuels. Construction impacts to air quality at the FOTCO and ETPL LNG Terminal sites will be mitigated through construction management practices such as the implementation of suppression measures for fugitive dust and gaseous emissions. Mitigation of emissions from vehicles and other engine-driven construction equipment will include proper maintenance and controlling unnecessary idling of equipment. Selective Catalytic Reduction or alternative systems would be incorporated onboard ships associated with construction of this project to reduce NOx emissions.

Significance of Impacts

Given the spatial distribution of vapour emissions from ETPL LNG Terminal during operation, as shown in Figure 10.1 below,

these emissions are expected to have limited overlapping with those emitted from the construction of the FOTCO LNG Terminal & PIBT and from operation of FOTCO Oil, FAP, QICT, Pro-Gas and IOCB, and construction-related air quality impacts are expected to be temporary and localized. Also, given that the predicted emissions are expected to fall within allowable limits according to NEQS and IFC emission standards, the cumulative air quality impacts from operation of the ETPL LNG Terminal Project concurrently with the construction of FOTCO project are considered to be minor. An evaluation of impacts is summarized in Table 10.2.

Additional Mitigation Measures, Management and Monitoring

It is recommended that further controls, such as those listed in the IFC EHS General Guidelines for air emissions and ambient air quality, be implemented during operation of the ETPL LNG terminal facility to reduce and maintain levels of emissions within applicable standards.

Significance of Residual Impacts

With the implementation of the proposed further controls and if all emissions are controlled to within applicable standards, residual impacts on air quality would be considered of negligible significance.

10.1.1 IMPACTS FROM NOISE EMISSIONS

The main sources of noise generated in LNG facilities include pumps, generators, compressors, recycle piping, air dryers, heaters, air coolers at liquefaction facilities, vaporizers used during re-gasification, and loading/unloading of vessels.

The main sources of noise generated from Container terminals are the maneuvering of container trailers, stacking of containers, loading and unloading of containers.

The main sources of noise generated from Oil terminal are

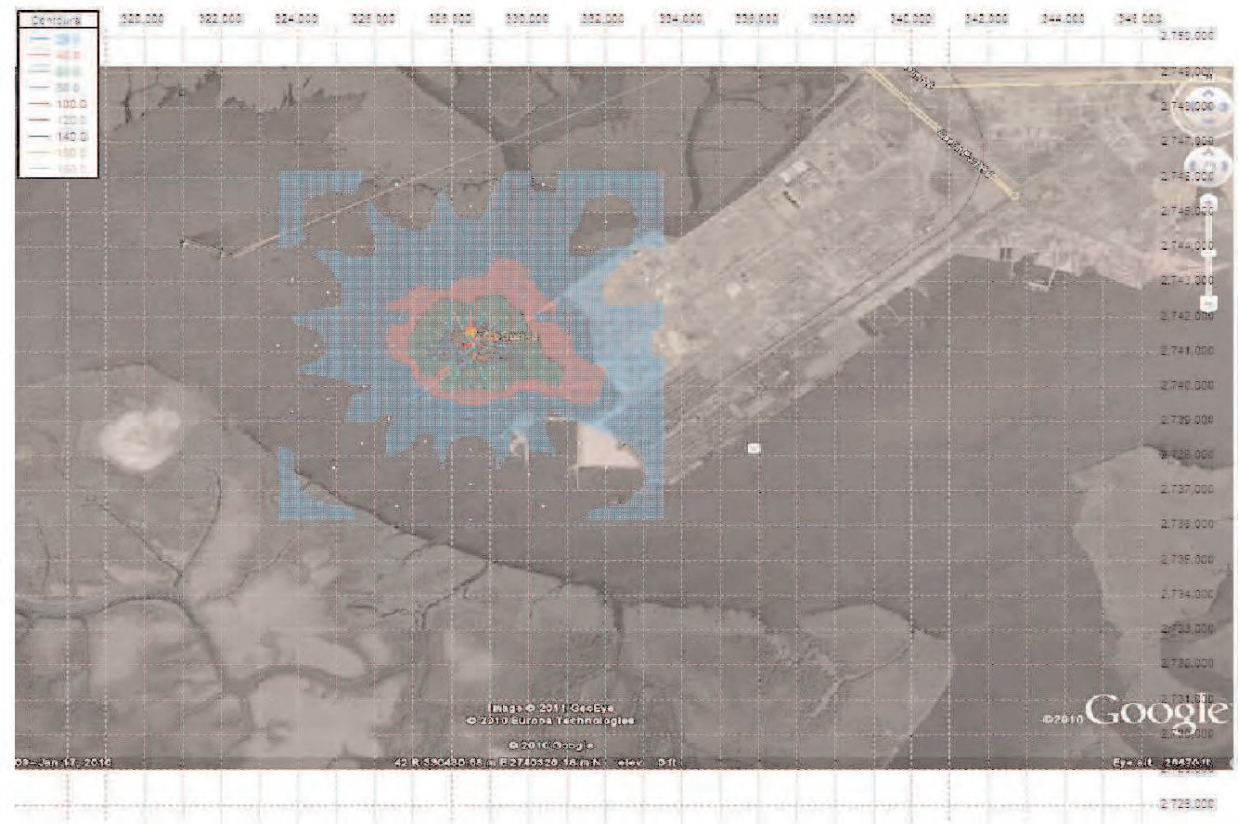


Figure 10.2 Color Average 24-hourly Contour Map for Vapor Emission at Normal Scenario. Yellow circle indicate the location of the FOTCO LNG terminal construction sites.

Table 10.2 Evaluation of Cumulative Impacts to Air Quality from Operation of ETPL LNG terminal during Construction of FOTCO LNG projects.

Impact	Emissions from operation of ETPL LNG Terminal (NOx, SO2, CO, PM10) in combination with emissions from ships and equipment associated with the construction of FOTCO LNG Terminal & PIBT.				
Impact Magnitude	The magnitude of operations emissions from ETPL LNG Terminal is shown in Figure 10.1 above. Emissions from construction of FOTCO LNG site and PIBT would be small and localized to the construction areas.				
Receptor Sensitivity	**Low**	Low Medium	Medium	Medium High	High
	The project locations are far from developed urban areas; however, mangroves and mudflats are the primary habitat in the vicinity and support a variety of fauna, including migratory birds.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to air quality are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts are considered.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Cumulative impacts will only last for the duration of construction of the FOTCO floating LNG facility, expected to 24 months respectively				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area immediately around the two project sites.				
Impact Severity	No Change	Slight	**Low**	Medium	High
	Severity is ranked as Low-Medium. Though emissions from construction will be short-term and localized, the current predicted emissions from operation of ETPL LNG Terminal exhibit some exceedence which need to be addressed. Suggested mitigation measures will be adopted.				
Significance	Negligible	**Minor**	Moderate	Major	Critical
	The combination of a Low-Medium Receptor Sensitivity and Low-Medium Impact Severity results in an overall Minor significance.				

pumps, oil suction machinery, generators etc.

The main sources of noise generated from grain terminal are suction of grains from ships, pumps, generators, conveyor belts noise etc.

Noise will also be generated during construction works such as pile-driving, dredging, drilling, earthworks, etc. Acoustic effects at the creeks are expected to echo the noise, especially at low tide during activities with sharp bursts of noise such as those emitted during piling.

The NEQS stipulate that noise levels should not exceed 85dBA at 7.5 m from the sound source. World Bank Guidelines stipulate noise levels should not exceed 70 dBA day or night at industrial or commercial sites, or 55 and 45 one hour dBA for day and night, respectively, at residential sites, or result in background levels of 3dB at the nearest receptor location off-site. The ambient noise levels measured at the ETPL LNG terminal site were well within World Bank Guideline.

There are no developed residential areas close to the Projects. However, construction noise has the potential to disturb wildlife, in particular birds which may be roosting, foraging or breeding in the area, and marine mammals which may be affected by underwater noise generation. But as the types of noise will differ during construction and operation (loud, percussive versus low, continuous noise), it is not expected that the suite of sensitive receivers affected will be the same for two activities. For example, marine mammals may be negatively affected by underwater piling activities associated with construction but may not be disturbed by the much lower noise generated by operation of the LNG facility.

The operations involving FAP grain and fertilizer cargo unloading, rice loading and handling of storage facilities are low impact activities with respect to noise pollution. Operations involving container handling are also medium impact activities with respect to noise pollution. But the noise is localized inside the terminal and due to non-development of residential areas, the noise effect is minimal. Operations involving unloading of oil and gas are very low noise activities.

As such, noise impacts are expected to be associated more with construction rather than operation of the facilities.

Existing/In-Place Controls

During operation of the ETPL LNG facility, periodic monitoring of noise at the nearest receptors will be carried out. If noise levels exceed guidelines, the equipment suppliers will be required to reduce noise at the source in order to meet ambient noise targets. Additionally, noise-producing equipment will be placed inside acoustic enclosures to reduce noise at the source. During construction of the FOTCO facility, if noise levels exceed World Bank limits, noise control measures will be implanted to reduce the noise by 5 to 10 dBA.

Significance of Impacts

Significance of impacts is expected to be minor. An evaluation of impacts is summarized in Table 10.3.

Table 10.3 Evaluation of Cumulative Impacts from Noise Emissions from Operation of ETPL LNG in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.

Impact	Noise from operation of ETPL LNG in combination with noise generated by the operation of two terminal Facilities (FOTCO LNG & PIBT) under Construction.				
Impact Magnitude	The magnitude of noise emissions is higher for construction than for operation. However, only the immediate industrial vicinity will be affected.				
Receptor Sensitivity	**Low**	Low Medium	Medium	Medium High	High
	The project locations are far from developed urban areas; however, fauna, particularly birds which may use the area for roosting, foraging or breeding, and marine mammals, may be affected.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts from noise emissions are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts are considered.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Cumulative impacts will only last for the duration of construction of FOTCO & PIBT facilities.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the industrial area around the eight project sites				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium due to the potential for disturbance to wildlife, particularly birds and marine mammals.				
Significance	Negligible	**Minor**	Moderate	Major	Critical
	The combination of a Medium Receptor Sensitivity and Medium Impact Severity results in an overall Minor significance.				

Additional Mitigation Measures, Management and Monitoring

Although the ESIAs state that in-place controls are expected to maintain noise levels within acceptable limits, quantitative noise impact assessments for the construction- and operation-phase of the projects to identify the extent of the potential cumulative noise impacts to sensitive receivers are recommended to confirmation compliance of relevant NEQS and World Bank Guidelines at sensitive receivers.

Significance of Residual Impacts

Residual noise impacts will remain minor.

10.1.2 IMPACTS ON WATER QUALITY

Sediment Dispersion

Dredging is expected to occur during the operation of the ETPL LNG facility along with 5 terminals (FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) as periodic maintenance to maintain safe navigable depths for the vessels. This will result in periodic increases in turbidity in the local waterways. The extent of impact of increased turbidity and suspended sediment depends on several factors including the duration of dredging, dredging plant used, type and volume of material being dredged, tides, and current speeds. Sloughing may occur along

the sides of dredged channels, which contributes to turbidity. In addition to causing increased turbidity and suspended sediment loads, dredging may also release toxins and heavy metals contained in contaminated bottom sediments.

Extensive dredging will also occur during the construction of the FOTCO and PIBT facilities, resulting in localized and short-term siltation and sedimentation. Disposal of dredged material into the aquatic environment will also result in elevated turbidity and suspended sediment around the disposal site and potentially at downstream areas. Construction dredging will be much more extensive than maintenance dredging with regard to volume, but will be shorter in duration (i.e. will only occur once). Although both construction and maintenance dredging by themselves can be considered short-term, continual periodic dredging, as may occur as one project completes dredging and another begins, may not allow the system to fully recover between each dredge period, and turbidity and sedimentation levels may remain elevated.

Wastes and Pollutants

At present, approximately 65 million gallons per day (mgd) of untreated industrial wastewater and over 400 mgd of untreated domestic sewage is discharged into the sea from the city of Karachi, resulting in extremely poor sea water quality in the area. The ETPL LNG project will produce liquid sewage effluent which will be discharged into the sea, in much lower quantities, and will be treated prior to discharge. Crews typically generate around 150 liters of grey water per person per day and around 50 liters of sewage per person per day. Given the small number of workers expected for operation of the ETPL LNG facility, and as the wastewater produced will also be treated, the impact to water quality from sewage and grey water is not considered to be unacceptable.

The construction of the other terminal facilities is expected to generate sewage, wastewater, deck drainage, site run-off, etc., which may result in contamination and affect water quality upon discharge. Construction activities also have the potential to release contaminating substances from spillage of construction materials, wastes, fuels and oils. Although each spill contributes little on an individual basis, many spills over the long term can cause chronic concentrations of contaminants and degradation of water quality.

Existing/In-Place Controls

For dredging projects such as these, the typical adopted range of turbidity during dredging is in the order of 30-35 Nephelometric Turbidity Units (NTU) above background. Water quality will be measured to ensure compliance with adopted standards.

The ETPL LNG project will implement several mitigation measures for management of liquid effluent streams. Toilet wastewater will be treated in an on-site sewerage treatment plant before mixing with the main wastewater stream. Effluent will be treated to meet NEQS. This treated effluent will also be recycled in flushing water to reduce freshwater consumption. The discharge rate and chemical quality of the wastewater effluent will be monitored to comply with NEQS.

Pollution prevention and cleanup measures are generally included in project Environmental Management Plans (EMPs).

Significance of Impacts

Significance of impacts is expected to be moderate. An evaluation of impacts is summarized in Table 10.4.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

Water quality modeling is recommended to be conducted to characterize local hydrodynamic conditions and to act as a tool to predict impacts to water quality due to sediment dispersion associated with marine dredging. The model would allow the assessment to be conducted in a quantitative manner and allow any unacceptable construction and operational environmental impacts to be identified to IFC Standards. Modeling will also be conducted to address concerns related to any overlapping construction periods with regard to dredging of sediments. A review of construction schedules will be undertaken and appropriate scenarios developed to address cumulative sediment transport concerns. Further mitigation measures would be developed based on the results.

In addition, it is recommended that best practice procedures are

Table 10.4 Evaluation of Cumulative Impacts to Water Quality from Operation of ETPL LNG facility in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.

Impact	Impacts to water quality from operation of ETPL LNG in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.				
Impact Magnitude	The magnitude of water quality impacts includes the immediate project areas as well as affected downstream water bodies.				
Receptor Sensitivity	Low	Low Medium	Medium	**Medium High**	High
	Estuarine and marine ecosystems are sensitive to water quality. Inputs of effluent and sediment can change water quality characteristics of aquatic habitats that are vital to biota living there. Changes in temperature can also detrimentally affect the ecosystem.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to water quality are considered to be negative impacts.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts are considered.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Cumulative impacts will only last for the duration of construction of the FOTCO & PIBT facilities.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around two project sites as well as nearby downstream areas and local tidal creeks.				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium due to the potential for adverse effects on the sensitive aquatic ecosystem.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a Medium-High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

implemented during maintenance dredging such as the installation of silt curtains, the use of dredgers that result in lower turbidity (e.g. cutter-head dredges over hopper dredges and clam shells), etc.

Project EMP should provide procedures for contractors to ensure minimization of untreated operational discharge, and spills and release and a monitoring program that maintains compliance with applicable standards.

Significance of Residual Impacts

Upon confirmation of compliance with applicable standards by modeling results, and if effluents are controlled to within applicable standards and turbidity from dredging is controlled to the maximum extent practicable through the use of best practices and feedback monitoring, residual impacts may be reduced to minor.

10.1.3 IMPACTS ON COMMUNITY HEALTH, SAFETY & SECURITY

Boating Accidents & Injuries

Traffic accidents involving fishing boats and Project vessels (including LNG, Oil and Containers carriers and transport boats of supplies and workers) have the potential to result in minor to serious injury or, in rare instances, death. During the operation of ETPL LNG terminal, local fishermen will be allowed to access their normal fishing areas beyond the Project's security buffer zone. However, the fishing boat traffic may increase in this unrestricted area as a result of reduced fishing areas during the construction of the 02 LNG terminal Projects. This can increase the risk of accidents and injuries. While the magnitude of the change in vessel traffic from these two new projects has not been quantified, the obstruction to maritime navigation is anticipated to be short-term, lasting during the construction periods of the PIBT and FOTCO Project.

Exposure to Environmental Contaminants

Residents, particularly fishermen that come within closer distance to the project activities, are at risk for exposure to project emissions and discharges to the air and water.

Considering the cumulative air quality impacts from emissions from the three projects (e.g., exhaust emissions and gas leakages) is anticipated to be minor, the potential for health

effects associated with exposure to air contaminants is anticipated to be low. It is important to note the most sensitive receptors are residents and fishermen with existing respiratory illness conditions (TB and asthma) where their conditions can be exacerbated from exposure to air contaminants.

Cumulative water quality impacts (including associated with wastes and pollutants) is anticipated to be moderate. No information is available on the communities' use of the local waterways, other than for fishing. If the residents and fishermen also use the waterways for recreational, swimming or domestic uses (e.g., laundering), then these activities can expose them to potential project-related water quality contaminants (e.g., accidental spills, waste discharge, etc.). In addition, project contaminants that have the potential to bioaccumulation in fish can create another potential pathway for community exposure. A more detailed health baseline study is recommended to fully assess the potential cumulative impacts via these exposure pathways.

Spread of Infectious Diseases

The potential for transmission of infectious diseases (including TB) may occur through direct worker-community interactions, such as during rotation of crews between onshore locations to and from the offshore Project site; or indirectly through the influx of new comers (e.g., jobseekers) into the local communities. Population influx can lead to potential water and sanitation related diseases (e.g. diarrhea) associated with increased pressures on inadequate community sewage and wastewater systems.

The ETPL LNG operational workforce will primarily be housed offshore on self-contained accommodation barges with food, clothing and medicine and/or housed away from the Project site and commute daily by boat to and from the Project site. Workforce housing plans are not known for the other project. Nevertheless, ETPL's workforce housing arrangements will limit worker-community interactions, reducing the risk of infectious disease transmission. Furthermore, the offshore barge accommodations will meet international standards, thereby reducing the potential for outbreaks (e.g., food-borne illnesses and respiratory infections) associated with overcrowded and unhygienic living quarters that can spread to the surrounding communities.

Population-Influx Related Health Issues

An assessment on the potential for population influx (i.e., newcomers moving into the local communities seeking to gain jobs or provide good and services to the two projects) is needed to assess the cumulative impacts from influx-related health issues (e.g., spread of infectious diseases, psycho-social well-being and effects on public health infrastructure).

Existing/In-Place Controls

During the operation of the ETPL LNG facility, environmental pollution controls will be in placed to limit harmful air emissions and water quality impacts (see discussion for Air Quality and Water Quality). In addition, the Project will implement a Hazardous Materials Management Plan, which includes procedures for proper storage, transport and safe disposal of medical/ clinical wastes and hazardous wastes.

To reduce the risk of accidents and injuries involving fishing boats and shipping vessels, ETPL will employ a Safety Exclusion Zone along the pipeline route throughout its operation. This zone will be marked on the relevant navigation charts. Furthermore, ETPL suggests hiring locals to monitor the waterways in the vicinity of the Project for movements of local fishing boats to avoid hindrance by Project activities.

These three projects recognize the importance of the Pakistan Fisher folk Forum and will keep them informed of all activities that could have negative impact on the fisheries operations.

Significance of Impacts

Significance of impacts is expected to be Moderate. An evaluation of impacts is summarized in Table 10.5.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

Community Health Baseline Study

Table 10.5 Evaluation of Cumulative Impacts to Community Health, Safety and Security from Operation of ETPL LNG terminal in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.

Impact	Impacts to community health, safety and security from operation of ETPL LNG in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.				
Impact Magnitude	The magnitude of the impact encompasses all local people (residents and fishermen) that use the waterways in the Project area and communities that house workers (if planned).				
Receptor Sensitivity	Low	Low Medium	Medium	Medium High	**High**
	The sensitivity of the local people to health impacts is considered high due to the limited access to emergency medical care in the event of an injury or illness				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to community health are considered to be negative impacts.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts are considered.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The cumulative impacts, particularly the increased risk of boating accidents and injuries, will be heightened during the construction of the two LNG projects. The impact is anticipated to be short-term with fishermen adapting to alternate travel routes around exclusion zones over the long-term.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around the two project sites, including the popular fishermen's transit locations around the Buddo and Bundal islands.				
Impact Severity	No Change	Slight	**Low**	Medium	High
	Local fishermen may adjust travel routes to accommodate change in boating traffic over the long-term, while increasing their familiarity with safety precautions around safety exclusion zones at the three project sites.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

A detailed community health baseline study is needed to better understand the community's current uses of the local waterways that could potentially expose them to water quality discharges; current levels of boating/vessel traffic and accident rates; and other community health vulnerabilities (such as psycho-social well-being or mental stress/anxiety associated with industrial development and social disruption).

Population Influx Assessment and Management

An assessment for the potential for population influx into the communities within the Project is recommended. If identified as a significant cumulative impact, consider preparing an influx management plan to address potential related health issues (e.g., infectious disease transmission, psycho-social wellbeing and effects on public health infrastructure).

Workforce Trainings & Code of Conduct

The following aspects are recommended for inclusion in the Health, Safety and Environmental Management Program:

- Provide safety training for vessel captains, particularly outlining local fishing areas and the need for precaution in particular with small-scale fishermen.
- Develop and enforce a worker code of conduct regarding respect for local communities and worker-community conflict management, particularly for locals hired for watch and ward of exclusion zones.
- Design worker living quarters to prevent over-crowding and unhygienic conditions (e.g., proper sewer waste disposal facilities) following industry best practices, such as Workers Accommodations: Processes and Standards (IFC and EBRD, August 2009).
- Integrate hygiene trainings (e.g., hand washing) in worker health and safety induction programs and as a regular part of continuous trainings for workers. Establish Standard Operating Procedures for Food Preparation and Handling to ensure all food handlers are medically screened on a routine basis (e.g., semi-annual medical exams) and vaccinated.
- Conduct regular TB screenings of workers and contractors, while ensuring the protection of employee rights and confidentiality.

Significance of Residual Impacts

Depending on the outcome of the additional study, and with the implementation of the recommended additional mitigation, management and monitoring measures, residual impacts on Community Health, Safety & Security may be considered minor-to-moderate.

10.1.4 IMPACTS ON FISHERIES

The majority of people living in the project area rely on fishing and other related professions to earn a living. Impacts to local fisheries may occur indirectly through impacts to habitat (disturbance and loss of fishing grounds) and water quality, thereby impacting fishing stocks and important nursery grounds for commercial species, and through physical restriction of fishing by construction and operation of the facilities within local fishing grounds and by increased marine traffic through the area. Fishermen would be excluded from PIBT & FOTCO sites during construction, and fishing activities would likely decrease in the vicinity of the two terminal sites and Phitti Creek due to vessel traffic, essentially removing a large block of intertidal and mangrove creek fishing grounds.

Existing/In-Place Controls

The ETPL LNG ESIA states that the disposal of solid or untreated liquid wastes into waterways will be prohibited, and suggests locals should be hired to monitor the waterways in the vicinity of the Project for movements of local fishing boats to avoid hindrance by Project activities. Periodic sampling of water quality will occur to ensure compliance with NEQS. Any impacts on the local fishing community determined will be compensated, if warranted, under the Community Grievance Procedure, though no in-place controls are currently provided.

Significance of Impacts

Significance of impacts is expected to be moderate. An evaluation of impacts is summarized in Table 10.6.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

Table 10.6 Evaluation of Cumulative Impacts to Fisheries from Operation of ETPL LNG terminal in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.

Impact	Impacts to local fisheries from operation of ETPL LNG terminal in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.				
Impact Magnitude	The magnitude of the impact encompasses all local people who are dependent on fisheries for sustenance and/or livelihood.				
Receptor Sensitivity	Low	Low Medium	**Medium**	Medium High	High
	For the local people whose livelihoods depend on fishing, their sensitivity to impacts to fisheries is considered high.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to fisheries are considered to be negative impacts.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from three concurrent projects are considered.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Although cumulative impacts generally last for the duration of construction of PIBT & FOTCO LNG project during the operation of the ETPL LNG terminal project, the impact will not abate when construction is completed. Those fishing grounds will remain impacted and fishing efforts impeded in the vicinity of the projects.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around the 03 project sites as well as nearby downstream areas and local tidal creeks.				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium. Although some fishing areas will be removed or fishing efforts hampered, other areas will still remain available to local fishers.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

A detailed fisheries study is recommended to be conducted to characterize the existing condition of fisheries in the area prior to the construction of the project(s) for an accurate determination of potential impacts to fisheries resources and fishing operations. The study shall include not only desktop review of recent data to identify fisheries resources and composition of commercially important species in relation to the project area as well as sites of importance such as nurseries and spawning grounds, but also field studies to determine fisheries abundance, identify nursery and spawning grounds of commercially important species, and seasonal occurrence of juvenile and spawning fisheries (fish eggs and larvae) in relation to the intake. Further mitigation measures would be developed based on the results.

Consultation with local fishing groups is also recommended to be carried out throughout the project phases to determine who may operate within the project area to capture their local knowledge of fisheries resources, spawning grounds etc. A Community Grievance Mechanism shall be developed. If significant impacts are determined, a system of compensation should be developed.

Significance of Residual Impacts

Depending on the outcome of the additional study, and with the implementation of the recommended additional mitigation, management and monitoring measures, residual impacts on fisheries may be reduced to minor to moderate.

10.1.5 IMPACTS ON ECOLOGY

Mangroves will be removed cleared for the construction of PIBT and FOTCO LNG facilities and were cleared during construction of remaining 06 projects in operation. Mangroves provide multiple important ecological functions such as shoreline protection and erosion control, water filtration and nutrient sink, nursery habitat for commercially important fish species, and feeding, roosting and breeding habitat for birds.

The mangroves are an overvalued environmental and social component of the projects in Port Qasim area. True that they are important in protecting the land area and its ecology from natural disasters such as storms. However this important aspect is taken care of by the Mangrove Forest on the ocean front lined along Bundal and Buddo Islands and the creeks as such the mangrove trees lining the Port side are unimportant. Furthermore the entire Phitti-Kadiro-Gharo creek system is designated for development of the Port related infrastructure and industries. The development activities in the Port area and along the creeks facing the Port are mandated to protect the mangrove area. Every tree that may be felled is compensated by plantation of 3-10 trees depending on the canopy lost. Institutions such as IUCN and WWF Pakistan are actively engaged in protection of the mangrove forest area and afforestation wherever needed. As such i) loss of mangrove trees on a small area of 50 hectares will not constitute any adverse impact on the ecology of the micro and macroenvironment, ii) The 50 ha of mangroves forest to be removed does not provide any "priority ecosystem services" because the area is demarcated for development and operation of Port activities under PQA Master plan.

The benthic habitat and communities within the Port Qasim area have also been substantially impacted over the years. Continuous dredging for construction of projects and maintenance of channels, as well as contamination has led to degradation of benthic sediments and the communities that live in them. Although benthic fauna are generally considered to recover rapidly, continued dredging as described above may not leave enough recovery time between dredging periods, leading to permanent or long-term impacts to these communities. This can, in turn, impact higher species that depend on in fauna for food. In addition to removal of benthic in fauna through dredging, placement of dredges spoil can also bury existing benthic fauna, and continued placement in the same area can lead to extirpation of the benthic community there.

Additionally, dredging can negatively affect water quality by re-suspending toxins and heavy metals in bottom sediments, and increasing turbidity which can clog fish gills and lower BOD (see Impacts on Water Quality above). Again, although water quality can quickly recover after dredging, continuous or multiple dredging periods by multiple projects in a single area may not allow time for recovery, leading to chronic turbidity and degradation of water quality.

The noise caused by construction of the other LNG facilities during the operation of ETPL LNG terminal, which will increase large vessel traffic in the area, may also disturb local wildlife, including migratory birds which may require mangroves for foraging and resting; disruption of this behavior may cause them to expend energy necessary for the long flights during migration. Construction noise and vessel activity may also disturb marine mammals in the area. Though dolphins are known to frequent areas with high marine traffic, construction noise in addition to vessel movement may provide enough disturbances to cause movement away from the area.

Existing/In-Place Controls

The two projects under construction claim they will plant/transplant mangroves to replace those removed from the project sites. ETPL states that any loss of mangrove habitat will be compensated by plantation/replantation of mangrove of as many mangrove trees as the canopy of the removed trees would require. The number of trees to be planted against the number removed will be determined in consultation with IUCN and Independent Monitoring Consultant (IMC).

Water quality monitoring and controls will be implemented as described under Impacts to Water Quality above.

Screens will be installed on the FOTCO cooling water riser inlets and inlet current speed will remain low (estimated at 0.5m/s) to prevent the ingress of large marine fauna into the cooling water system.

Significance of Impacts

Significance of impacts is expected to be moderate. An evaluation of impacts is summarized in Table 10.7.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

The ETPL LNG facility should include structural measures such as screens to prevent the intake of marine organisms. See Impacts to Water Quality above for additional mitigation

Table 10.7 Evaluation of Cumulative Ecological Impacts from Operation of ETPL LNG terminal in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.

Impact	Impacts to local ecology from operation of ETPL LNG terminal in Operation with two terminal Facilities (FOTCO LNG & PIBT) under Construction.				
Impact Magnitude	The magnitude of the impact encompasses the local terrestrial and mangrove areas that will be cleared and reclaimed, connected waterways that may experience impacts in water quality, and species that depend on the area (some local, others migratory).				
Receptor Sensitivity	Low	**Low Medium**	Medium	Medium High	High
	Mangroves, estuarine and marine ecosystems are considered sensitive to habitat clearing and water quality degradation.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to ecology are considered to be negative impacts.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from three concurrent projects are considered.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Some impacts, such as noise and turbidity and other disturbance generated during construction, will be temporary. However, the clearing of mangroves and terrestrial habitat is permanent as facilities will be constructed over the areas.				
Impact Extent	**Local**	Regional	Global		
	Although most impacts would be considered local, cumulative impacts to migratory species could have a regional extent. The cumulative destruction of the Indus Delta habitats would also be considered regional.				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium. The area is already degraded. Mangrove habitat will be mitigated through off-site plantation.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a Medium-High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

measures for water quality.

An ecological survey comprising both terrestrial and marine survey is recommended to be undertaken to determine the ecological sensitivity of the area, and include mapping habitats and identification of flora and fauna. This would help determine the quality and extent of the habitat lost due to the ETPL LNG terminal and other one project. Further mitigation measures would be developed based on the results.

Significance of Residual Impacts

Depending on the outcome of the additional study, residual impacts to ecology may be reduced minor to moderate if ecological assemblages of high sensitivity or large areas of habitats are not significantly affected.

10.2 ASSESSMENT SCENARIO (II): CUMULATIVE IMPACTS FROM OPERATION OF ETPL LNG TERMINAL WITH SEVEN ADDITIONAL FACILITIES (FOTCO LNG, PIBT, FOTCO OIL, FAP, QICT, PRO-GAS, IOCB) IN OPERATION

10.2.1 IMPACTS ON AIR QUALITY

World Bank Guidelines(1) suggest that plans for the establishment of a project should not lead to either the air shed dropping into "poor air quality", or to an increase of more than 5 µg/m3 in the annual mean level of SOx, NOx or PM for the entire air shed.

ESIAs provide modelling for overall dispersion of LNG vapour emissions. After LNG liquefaction, stored LNG emits methane gas vapour known as "boil-off" gas. Examination of the average 24-hourly contour maps for dispersion plumes modelled for the "normal" scenario shows that LNG vapour emissions from each project may overlap at times. Though urban centers are mostly outside the modelled extent of the vapour plumes, workers, fishers, or other people travelling through the area would be subject to the extent of the vapour cloud and its hazards.

(1) World Bank Group (1998) Thermal Power: Guidelines for New Plants, In: Pollution Prevention Handbook. Effective July 1998.

Existing/In-Place Controls

In place controls for the ETPL LNG facility are provided above under Section 10.1.1. The FOTCO ESIA states that air quality impacts from the Project's power production system will be minimized by appropriate technology to reduce the emissions to conform NEQS and applicable international standards. The power production system will be designed for high-efficiency with advanced combustion controls to minimize fuel consumption and pollutant emissions.

Significance of Impacts

Assuming emissions will be maintained within applicable standards for the duration of operation of each of the projects, impacts from these emissions are expected to be minor. An evaluation of impacts is summarized in Table 10.8.

Additional Mitigation Measures, Management and Monitoring

Operation-phase quantitative air dispersion modeling is recommended to confirm whether potential air quality impacts would be acceptable as per applicable standards. If operation-phase modeling confirms this, it is recommended that further controls, such as those listed in the IFC EHS General Guidelines for air emissions and ambient air quality, be implemented during operation of the ETPL LNG facility to reduce and maintain levels of emissions within applicable standards.

According to World Bank recommendations, facilities should be designed so that boil-off gas is collected using an appropriate vapor recovery system. For LNG plants, the vapor should be returned to the process for liquefaction or used on-site as a fuel; boil-off gas from on-board carriers should be reliquefied and returned to the process system to be used as fuel on-site, compressed and placed into the pipeline, or flared.

Other terminal operators are also committed to control air emissions from their facilities through adoption of mitigation measures as per their commitment with EPA. EPA Sindh also monitors the compliance of Environmental Management Plan

Table 10.8 Evaluation of Cumulative Impacts to Air Quality from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Emissions from operation of ETPL LNG Terminal (NOx, SO2, CO, PM) in combination with operation of seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) as well as leakage of LNG vapour.				
Impact Magnitude	The magnitude of emissions from operation is localized, extending around the three sites from Port Qasim west to the shoreline.				
Receptor Sensitivity	Low	**Low Medium**	Medium	Medium High	High
	The project locations are far from developed urban areas; however, mangroves and mudflats are the primary habitat in the vicinity and support a variety of fauna, including migratory birds.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to air quality are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from eight concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts will last as long as these eight or more of the facilities remain in operation at the same time.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area immediately around the eight project sites.				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium. The current predicted emissions from operation of ETPL LNG terminal exhibit some exceedence which need to be addressed. Vapour emissions from three LNG facilities will cover an extensive area and will produce emissions in the long-term.				
Significance	Negligible	**Minor**	Moderate	Major	Critical
	The combination of a Low-Medium Receptor Sensitivity and Medium Impact Severity results in an overall Minor significance.				

through inspections.

Significance of Residual Impacts

With the implementation of the proposed further controls and if all emissions are controlled to within applicable standards, residual impacts of air emissions would be considered of Negligible to Minor significance.

10.2.2 IMPACTS FROM NOISE EMISSIONS

Sources of noise during operation of eight terminal facilities are described in section 10.1.1. Several factors affect the potential impacts of these sources such as the distance between the terminal and sensitive receivers, acoustic barriers, and limits of tolerance. Noise emitted during operation of the facilities is expected to be lower than noise generated during construction. Noise levels immediately outside the facilities, once in operation, are expected to be controlled within acceptable limits through the in-place controls described below.

Existing/In-Place Controls

Noisy equipment, such as power generators, will be housed in sound dampening structures. The engines of marine vessels are attenuated by placement deep within the vessel. Sounds levels will be monitored for compliance.

The sources of noise during operation of the project include vehicular movements, ships offloading operations, intermittent sounding of horns by the ships etc. The noise emitting from these sources will not be significantly higher than the background noise level.

Significance of Impacts

Given that each facility will adhere to the same stringent standards and the distance of the facilities from major urban centers, it is not considered likely that there will be significant increases (>3dBA) in ambient noise levels at sensitive receivers. As such, sensitive receivers (urban centers, wildlife) are not expected to be significantly affected. Significance of the impact is considered minor. An evaluation of impacts is summarized in Table 10.9.

Additional Mitigation Measures, Management and Monitoring

Table 10.9 Evaluation of Cumulative Impacts from Noise Emissions from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Noise from operation of ETPL LNG in combination with operation of seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB).				
Impact Magnitude	The magnitude of noise emissions is substantially lower for operation than for construction. Impacts will be limited to the immediate vicinity of the project and waterways of shipping vessels.				
Receptor Sensitivity	Low	**Low Medium**	Medium	Medium High	High
	The project locations are far from developed urban areas; however, fauna, particularly birds and marine mammals, may be affected.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	ImpaImpacts from noise emissions are considered to be negative.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from three concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts will last as long as these eight or more of the facilities remain in operation				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the industrial area around the eight project sites.				
Impact Severity	No Change	Slight	**Low**	Medium	High
	Severity is ranked as Low due to low noise generation during operation.				
Significance	Negligible	**Minor**	Moderate	Major	Critical
	The combination of a Medium Receptor Sensitivity and Slight Impact Severity results in an overall Minor significance.				

Quantitative noise impact assessments for the operation phase of the projects to identify the extent of the potential cumulative noise impacts to sensitive receivers are recommended to confirmation compliance of relevant NEQS and World Bank Guidelines at sensitive receivers.

Significance of Residual Impacts

Residual noise impacts will remain negligible.

10.2.3 IMPACTS ON WATER QUALITY

Thermal Discharges

The cooling water used for heating the LNG at the ETPL LNG terminal at discharge is 3 degrees Celsius (ºC) warmer (at most) than at intake. This discharged heating water will be mixed with cooling water from power generation so that the temperature difference when discharged will be smaller. For the ETPL LNG Project the temperature of the discharged water shall be adjusted so that temperature discharges of more than 3ºC at the edge of a 100m mixing zone from the point of discharge will be avoided.

Discharges from ship engine cooling water at the FOTCO facility will be, at most, 3ºC warmer than intake. According to World Bank guidelines, discharge is required to be less than 3ºC above ambient. Discharges from the FOTCO FSRA would be approximately the same temperature as ambient. Water used for cooling machinery onboard the LNG carriers is expected to cool to within 1.5ºF (0.83ºC) of ambient temperature within 75 feet of the discharge point.

Sediment Dispersion

Maintenance dredging is part of the long-term operational plan for the eight terminal projects, as it is essential to maintain safe navigable depths for vessels transporting products (Oil, LNG, LPG, grains, containers etc.). Although elevated turbidity and sedimentation resulting from the dredging is considered short-term and localized, cumulative effects may occur from multiple projects conducting maintenance dredging in the same area.

Wastes and Pollutants

Like the ETPL LNG facility, grey water will be generated by operations of eight terminal facilities, which will be treated before discharge. All facilities have the potential for spillage and accidental release of fuels and oily wastes, and to produce

contaminated run-off during day-to-day operation. Although each spill contributes little on an individual basis, many spills over the long term can cause chronic concentrations of contaminants and degradation of water quality.

Existing/In-Place Controls

Dredging operations at the facilities will be monitored to ensure compliance with accepted standards.

The FOTCO LNG facility will treat its grey water using automatic biocide dosing, quality control and feedback systems. All sewage will be treated to NEQS prior to discharge. Discharges from ships will adhere to MARPOL 73/78 regulations.

Operation of the FAP terminal will not generate industrial effluents or solid wastes and hence no such waste will be discharged from the facility.

Other Terminal Operators (PIBT, Progas, QICT, IOCB, and FOTCO) are also bound to comply National Environmental Quality Standards (NEQS).

Periodic monitoring of water quality will be undertaken at each site to ensure compliance with applicable water quality standards.

Significance of Impacts

Significance of the impacts is considered moderate. An evaluation of impacts is summarized in Table 10.10.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

For the Operational phase, quantitative thermal plume discharge modeling is recommended to determine the area/extent of mixing zone and confirm whether potential water quality impacts associated with the combined heating water discharges would be acceptable as per the applicable standards. Since the ETPL LNG Terminal ESIA states that there are no

Table 10.10 Evaluation of Cumulative Impacts to Water Quality from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Impacts to water quality from operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.				
Impact Magnitude	The magnitude of water quality impacts includes the immediate project areas as well as affected downstream water bodies				
Receptor Sensitivity	Low	Low Medium	**Medium**	Medium High	High
	Estuarine and marine ecosystems are sensitive to water quality. Inputs of effluent and sediment can change water quality characteristics of aquatic habitats that are vital to biota living there. Changes in temperature can also detrimentally affect the ecosystem.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to water quality are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from eight concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts will last as long as these eight or more of the facilities remain in operation				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around the eight project sites as well as nearby downstream areas and local tidal creeks				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium due to the potential for adverse effects on the sensitive aquatic ecosystem.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a Medium-High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

NEQS with regard to temperature decreases in the aquatic environment, World Bank standards should be adopted to maintain the limits of discharge temperature within 3ºC of ambient. Further mitigation measures would be developed based on the results.

Water quality modeling is also recommended to characterize local hydrodynamic conditions and to act as a tool to predict impacts to water quality due to sediment dispersion associated with maintenance dredging works. The model would allow the assessment to be conducted in a quantitative manner and allow any unacceptable environmental impacts to be identified to IFC Standards. Further mitigation measures would be developed based on the results.

In addition, best practice procedures are recommended for dredging operations, such as the installation of silt curtains, the use of dredgers that result in lower turbidity (e.g. cutter-head dredges over hopper dredges and clam shells), etc.

The Project EMP should provide procedures for contractors to ensure minimization of untreated operational discharge, and spills and release and a monitoring program that maintains compliance with applicable standards.

Significance of Residual Impacts

Upon confirmation of compliance with applicable standards by modeling results, and if effluents are controlled to within applicable standards and turbidity from dredging is controlled to the maximum extent practicable through the use of best practices and feedback monitoring, residual impacts to water quality may be reduced to minor.

10.2.4 IMPACTS ON COMMUNITY HEALTH, SAFETY & SECURITY

Impacts to community health, safety and security during operation of all eight projects would be similar to those described in above section 10.1.1. The risk of accidents and injuries is associated with increase in vessel traffic from the operation of eight facilities. Overall, the workforce size will, however, be reduced during the operation of three LNG facilities as compared to the construction stages. However, the long-term operation of the three projects may attract newcomers seeking jobs and/or opportunities to provide goods and services. An assessment on the potential for population influx is needed to better understand the potential for impacts on disease transmission, psycho-social well-being, and public health infrastructure (including drinking water and sanitation services, health care services, etc.).

Existing/In-Place Controls

Existing controls and mitigation measures for impacts to community health will be adopted.

Significance of Impacts

Significance of impacts is expected to be Moderate. An evaluation of impacts is summarized in Table 10.11.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

The additional studies, mitigation, management and mitigation measures recommended are also applicable and are recommended to be implemented.

Significance of Residual Impacts

Depending on the outcome of the additional studies, and with the implementation of the recommended additional mitigation, management and monitoring measures, residual impacts on community health, safety and security may be considered minor-to-moderate.

10.2.5 IMPACTS ON FISHERIES

Impacts to fisheries during operation of all three projects would be similar to those described under Section 10.1.1. Additionally, cumulative impacts would occur from vessel traffic and impingement and entrainment of fish and crustacean at the seawater intakes associated with the operation of all three facilities.

Existing/In-Place Controls

Existing controls and mitigation measures for impacts to fisheries are described under Section 10.1.1.

Significance of Impacts

Table 10.11 Evaluation of Cumulative Impacts to Community Health, Safety and Security from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Impacts to community health, safety and security from operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.				
Impact Magnitude	The magnitude of the impact encompasses all local people (residents and fishermen) that use the waterways in the Project area and communities that house workers (if planned).				
Receptor Sensitivity	Low	Low Medium	Medium	**Medium High**	High
	The sensitivity of the local people to health impacts is considered Medium-high due to the limited access to emergency medical care in the event of an injury or illness				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to community health are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from eight concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts, particularly the potential for accidents and injuries, will last as long as eight or more of the facilities remain in operation.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around the eight project sites, including the popular fishermen's transit locations around the Buddo and Bundal islands.				
Impact Severity	No Change	Slight	**Low**	Medium	High
	Over the long-term, local fishermen may adjust travel routes to accommodate change in boating traffic, while increasing their familiarity with safety precautions around safety exclusion zones at the three new LNG project sites.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a High Receptor Sensitivity and Low Impact Severity results in an overall Moderate significance				

Significance of impacts is expected to be moderate. An evaluation of impacts is summarized in Table 10.12.

Additional Mitigation Measures, Management and Monitoring

As Moderate impacts are deemed to be "Significant", additional mitigation is considered necessary.

A detailed fisheries study is recommended to be conducted to accurately determine impacts to fisheries resources and fishing operations. Consultation with local fishing groups is also recommended to be carried out throughout the project phases and included in the Community Grievance Mechanism. Further mitigation measures would be developed based on the results of the detailed study and local consultation.

Significance of Residual Impacts

Depending on the outcome of the additional study, and with the implementation of the recommended additional mitigation, management and monitoring measures, residual impacts may be reduced to minor to moderate.

10.2.6 IMPACTS ON ECOLOGY

As described under Section 10.1.1 above, the benthic habitat and communities within the Port Qasim area have been substantially impacted over the years. Continuous dredging for construction of projects and maintenance of channels, as well as contamination has led to degradation of benthic sediments and the communities that live in them. Although benthic in fauna are generally considered to recover rapidly, continual, periodic maintenance dredging of navigation channels during operation of the eight terminal facilities may not leave enough recovery time between dredging periods, leading to permanent or long-term impacts to these communities. See Section 10.1.1 for impacts on ecology from dredging.

The increase in large marine vessel traffic in the area may disturb local wildlife, particularly marine mammals. Though dolphins are known to frequent areas with marine traffic, high vessel traffic may cause movement away from the area. In the worst case, vessel strike may actually occur, though the likelihood is low due to the evasive maneuverings of dolphins.

Table 10.12 Evaluation of Cumulative Impacts to Fisheries from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Impacts to local fisheries from operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation				
Impact Magnitude	The magnitude of the impact encompasses all local people who are dependent on fisheries for sustenance and/or livelihood.				
Receptor Sensitivity	Low	Low Medium	Medium	**Medium High**	High
	For the local people whose livelihoods depend on fishing, their sensitivity to impacts to fisheries is considered Medium-high.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to fisheries are considered to be negative impacts.				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from eight concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts will last as long as eight or more of the facilities remain in operation.				
Impact Extent	**Local**	Regional	Global		
	Impacts would be limited to the area around the eight project sites as well as nearby downstream areas and local tidal creeks.				
Impact Severity	No Change	Slight	Low	**Medium**	High
	Severity is ranked as Medium. Although some fishing areas will be removed or fishing efforts hampered, other areas will still remain available to local fishers.				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a High Receptor Sensitivity and Medium Impact Severity results in an overall Moderate significance.				

Changes in water temperature at the discharge of the LNG facilities may also detrimentally affect marine fauna such as plankton, the base of the food chain.

Existing/In-Place Controls

Water quality monitoring and controls will be implemented as described under Impacts to Water Quality above.

Screens will be installed on the FOTCO cooling water riser inlets and inlet current speed will remain low to prevent the ingress of large marine fauna into the cooling water system.

Significance of Impacts

Significance of impacts is expected to be minor. An evaluation of impacts is summarized in Table 10.13.

Additional Mitigation Measures, Management and Monitoring

The additional studies, mitigation, management and mitigation measures recommended in Section 10.1.1 are also applicable and are recommended to be implemented.

Significance of Residual Impacts

Residual ecological impacts would be expected to remain minor.

10.2.7 UNPLANNED EVENTS

Impacts may also occur from unplanned, accidental, or natural disaster events or even acts of terrorism, resulting in spills, explosions, or large-scale leakages. The cumulative impacts from loss of containment from two or more of the LNG facilities due to an unplanned event such as those mentioned above is considered here. Each of the projects conducted dispersion modeling for emission of LNG vapors resulting from an emergency scenario such as failure of temperature control system due to collision, tsunami, or other unplanned emergency events.

LNG tanks store natural gas in liquid form at -160ºC at atmospheric pressure. Therefore, a crack of puncture of the container will not create an immediate explosion. Vapour clouds would form as the liquid warms and gas is released. The cloud would ignite only if it encounters an ignition source while concentrated within its flammability range. If released over

Table 10.13 Evaluation of Cumulative Ecological Impacts from Operation of ETPL LNG with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.

Impact	Impacts to local ecology from operation of ETPL LNG terminal with seven additional facilities (FOTCO LNG, PIBT, FOTCO Oil, FAP, QICT, Pro-Gas, IOCB) in operation.				
Impact Magnitude	The magnitude of the impact encompasses the local connected waterways that may experience impacts in water quality, and species that utilize the area (some local, others migratory).				
Receptor Sensitivity	Low	**Low Medium**	Medium	Medium High	High
	Estuarine and marine ecosystems are considered sensitive to water quality degradation. Marine mammals are sensitive to marine traffic activity and associated noise.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to ecology are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from eight concurrent projects are considered.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Cumulative impacts will last as long as eight or more of the facilities remain in operation.				
Impact Extent	**Local**	Regional	Global		
	Although most impacts would be considered local, cumulative impacts to migratory species could have a regional extent.				
Impact Severity	No Change	Slight	**Low**	Medium	High
	Severity is ranked as Low. Ecological impacts are considered greater during construction.				
Significance	Negligible	**Minor**	Moderate	Major	Critical
	The combination of a Medium Receptor Sensitivity and Low Impact Severity results in an overall Minor significance.				

water, the LNG will typically float and then vaporize and dissipate. However, if large volumes are released on water, the LNG may vaporize too quickly, causing a rapid phase transition (RPT) which can range from a small pop to blasts large enough to potentially damage light-weight structures.

Cumulative impacts could occur (very large vapor cloud resulting in large fires or RPTs) if an unplanned caused loss of containment from two of more of the LNG facilities.

Existing/In-Place Controls

Appropriate separation distances will be implemented for the terminals and vessels. The facilities will be constructed away from adjacent industrial and residential areas. Safety zones will be established around LNG ships while underway based on vapour dispersion data and thermal radiation contours.

Fuelling operations will be conducted in a manner consistent with spill prevention and response plans, including visual monitoring. Fuel tenders will be instructed on the procedure for stopping, minimizing and cleaning up spills. The potential for spills and leaks will be reduced by implementing scheduled preventative maintenance for equipment. Fuel tanks will be provided with a secondary containment system (such as double hulls in tankers) to limit the potential impact of releases due to tank failure. Other safeguard systems using technologies such as alarms and back-up systems, and emergency shut-down systems may be used to control containment.

Fire and explosion risks will be minimized through use of gas detection and fire suppression systems.

To partially protect from storm hazards, the facilities will be constructed inland, away from the open shoreline. Shore hardening/protection features will also be installed.

Significance of Impacts

Although the event is considered unlikely to occur, the severity would be high if it did indeed happen. Therefore, the significance of impacts is expected to be moderate. An evaluation of impacts is summarized in Table 10.14.

Additional Mitigation Measures, Management and Monitoring

Table 10.14: Evaluation of Cumulative Impacts resulting from an Unplanned Event.

Impact	Impacts from major loss of containment from three or more LNG facilities as a result of an unplanned event.				
Impact Magnitude	The magnitude of the impact encompasses the area between Port Qasim west to the waters edge over the three facilities.				
Receptor Sensitivity	Low	**Low Medium**	Medium	Medium High	High
	The facilities will be constructed a safe distance from urban centers in case of explosive loss of containment. However, port infrastructure lies adjacent to the sites and the area contains sensitive habitats.				
Impact Nature	**Negative Imp**	Positive	Neutral		
	Impacts to ecology are considered to be negative impacts				
Impact Type	Direct	Secondary	Indirect	**Cumulative**	Residual
	Cumulative impacts from three concurrent projects are considered.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	Cumulative impacts would range from short-term (explosion and fire) to longer term as habitats would take time to recover and developments would be financially affected for some time.				
Impact Extent	Local	Regional	Global		
	Impacts would be limited to the extent illustrated by the dispersion modeling for each project.				
Impact Severity	No Change	Slight	Low	Medium	**High**
	Assuming explosive loss of containment, impact severity would be considered high.				
Likelihood	Extremely Unlikely	**Unlikely**	Low Likelihood	Medium Likelihood	High Likelihood/Inevitable
	The potential for two or more plants to experience a major loss of containment at once due to an unplanned event is considered unlikely				
Significance	Negligible	Minor	**Moderate**	Major	Critical
	The combination of a Medium Receptor Sensitivity and Low Impact Severity results in an overall Moderate to Major significance.				

Primary, secondary and tertiary containment measures should be ensured through the implementation of appropriate designs, safety procedures and safeguard systems. Stringent safety zones should be strictly maintained and appropriate contingency, emergency and spill response, and evacuation plans be developed and implemented.

Significance of Residual Impacts

Though the implementation of appropriate mitigation measures and safeguards will greatly reduce the likelihood of the event occurring, the significance of residual impacts is still considered moderate to major as major explosive loss of containment will be severe in impact if it does happen.

11 Environmental Management and Monitoring Plan

11.1 Introduction

This section lays out the Environmental Management Plan (EMP) for the works concerning the Construction and Post-Construction including the Operation stages of ETPL LNG Terminal. The EMP is meant to provide an overall approach for managing and monitoring environment-related issues and to describe the institutional framework for implementing 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 administering authorities to decide the appropriate approval conditions for the project.

The previous sections identified the environmental impacts of different activities during the construction and operation stages of the ETPL LNG terminal and mitigation measures to reduce the severity of the impacts. For successful environmental practices an essential requirement of the PEPA 1997 is to develop an environmental management plan (EMP) to guide through the procedures to the management and employees of the organization for continual improvement.

11.2 Need for EMP

The EMP is required to achieve the following objectives:

- Outlining measures to be taken during the implementation and operation of the ETPL LNG Terminal to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels.
- 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 communication, documentation, training and management and implementation of mitigation measures.
- 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.

11.3 Scope of the EMP

The initial focus of the EMP is the protection of aquatic habitat and traffic management due to increase in visiting people as well as those activities under the direct control of ETPL management where activities may give rise to significant environmental impacts, the EMP includes a number of priority strategies and actions relating to these locations. The EMP also supports collaboration and joint actions with affiliated organizations, tenants and contractors within the ETPL's sphere of influence.

In line with the Provisions of Pakistan Environmental Protection Act, 1997 and rules and regulations framed there under, the following criteria will be used to determine priorities for attention:

- Impact on the physical and biological environment;
- Contribution to innovation and definition of best environmental practice;
- Compliance with statutory requirements and other environmental commitments;
- Availability of resources.

The EMP acknowledges the social and cultural dimensions of responsible environmental management alongside the biological and physical, reflecting a holistic view of the ETPL as a "human ecosystem".

The scope of the EMP includes the following functional areas:

- Management systems: Those systems employed in the management of the ETPL's operational activities. 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 ETPL's facilities.
- Water management: Aspects of supply, usage and disposal of water pertinent to the planning, design, construction, operation and maintenance of the ETPL's facilities.
- 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.
- Planning, design and development: The planning, design and development of the ETPL's built form and associated infrastructure.
- Pollution prevention: Those aspects of planning and management which support minimization of air and water pollution and contamination of land resulting from daily routine activities.
- Transport: Programs, projects, systems and procedures which promote and support walking, cycling and public transport for trip-to-work, accommodation and other related travel.
- Biodiversity and open space: Those aspects of management and maintenance which support conservation and enhancement of biodiversity and environmentally sustainable use of open space across ETPL and other properties.

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 existing shipping channel;
- LNG terminal, storage and re-gasification unit facilities;
- Pipeline lateral and directly associated facilities (natural gas and natural gas liquid laterals);
- Supporting facilities and infrastructure

11.4 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 LNG terminal have been taken into consideration. Additionally management related issues have been provided to guide through the procedures.

11.5 ETPL's Commitment to Environment, Health and Safety

ETPL is committed to manage and operate its assets in a manner consistent with its core values to protect the health and safety of people and the environment and to comply with applicable Environment Health and Safety (SHE) laws, regulations and internal SHE standards.

The ETPL will establish environment, health & safety (SHE) department which will handle all environment related concerns and issues. The SHE manager will be the Head of SHE department and will be responsible for reporting to Chief Executive Officer. To support SHE management system, an SHE 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 the terminal.

In this regard ETPL's Safety, Health and Environmental policy is being given here:

SAFETY HEALTH & ENVIRONMENTAL POLICY

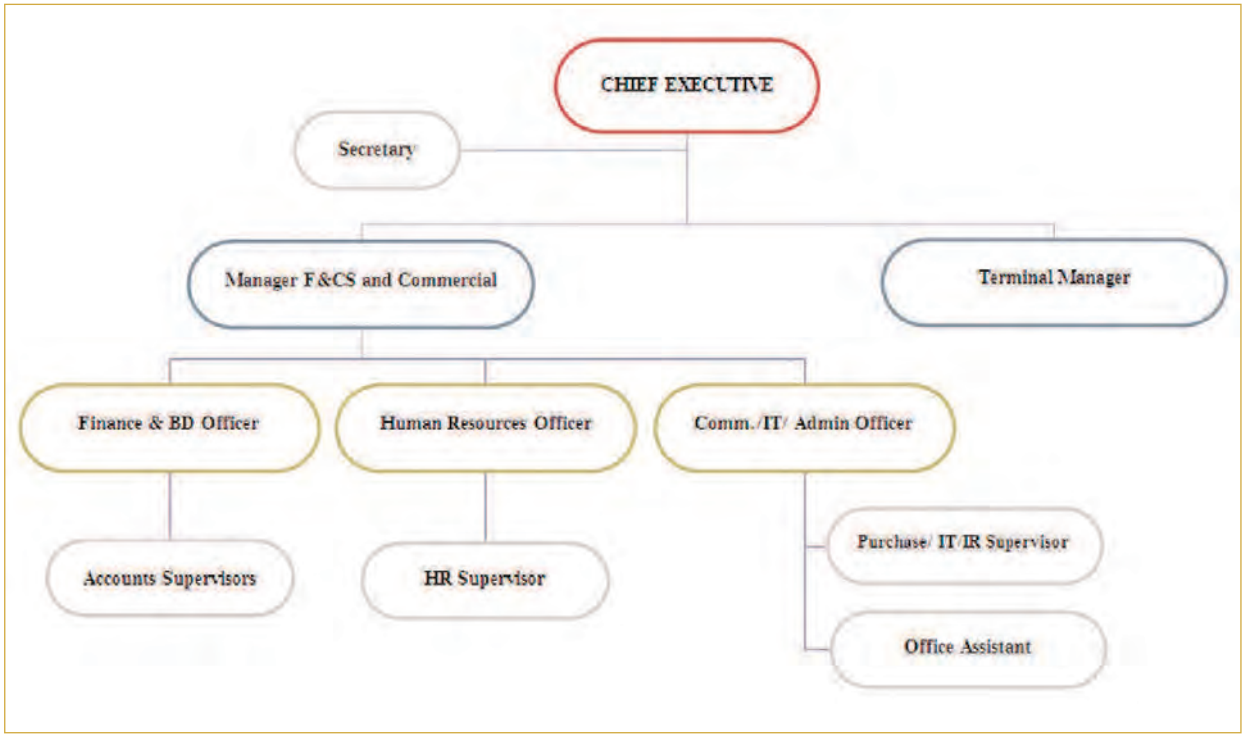
Engro Vopak Terminal Limited is firmly committed to protect the environment, the safety & health of its employees, customers, contractors, interested parties and the community while providing storage and handling services of bulk liquid and gaseous products.

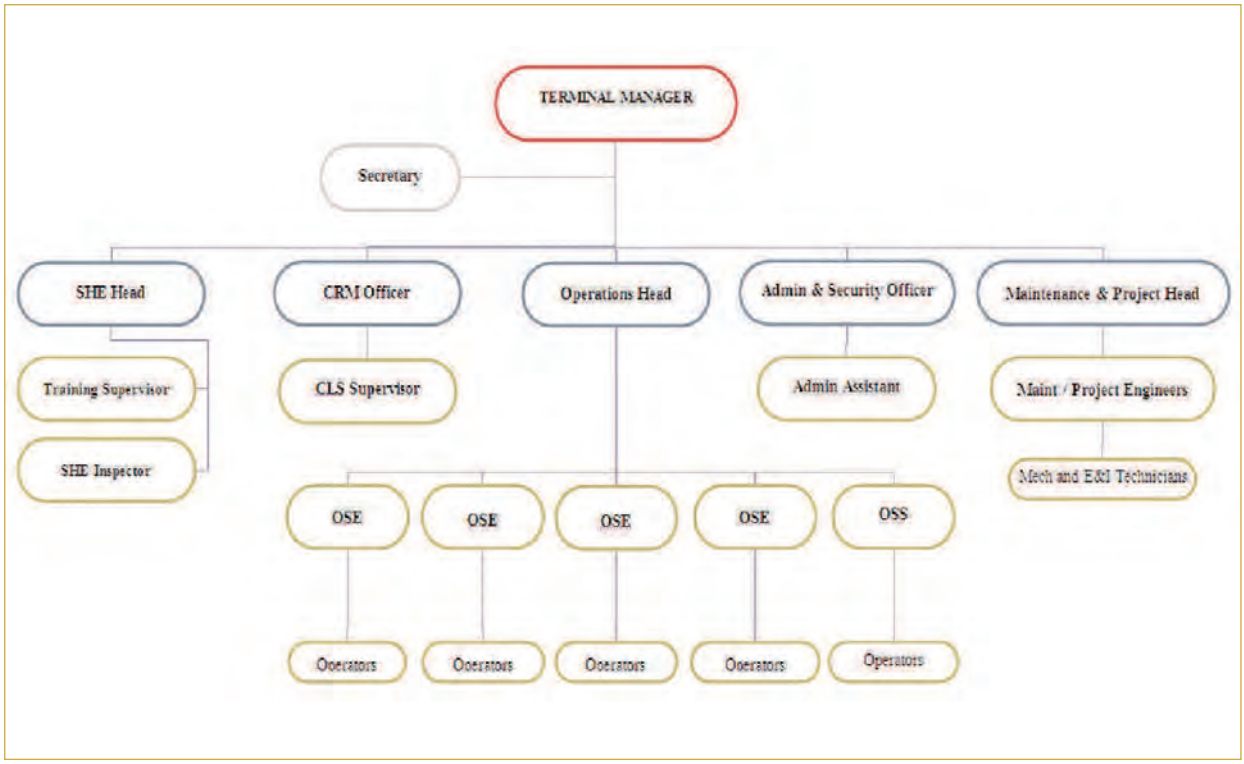
- We will continually improve our processes to manage safety, health & environmental performance and to prevent pollution to air, land and water.
- We will continuously work towards our goals of zero incidents and no damage to environment .
- We will strictly adhere to safety, health and environmental governing regulations as a minimum.
- We consider safety, health and environment a line management responsibility. Every manager will provide visible commitment and resources necessary to support the implementation of safety, health & environmental policies & its objectives.
- Every employee will contribute to the prevention of incidents by identifying, reporting, analyzing and controlling safety, health and environmental hazards. This will be supported by training programs adapted to their functions.

Issue: 02, July 2010

Sheikh Imran-ul-Haque
Chief Executive

11.6 ETPL Organization Structure





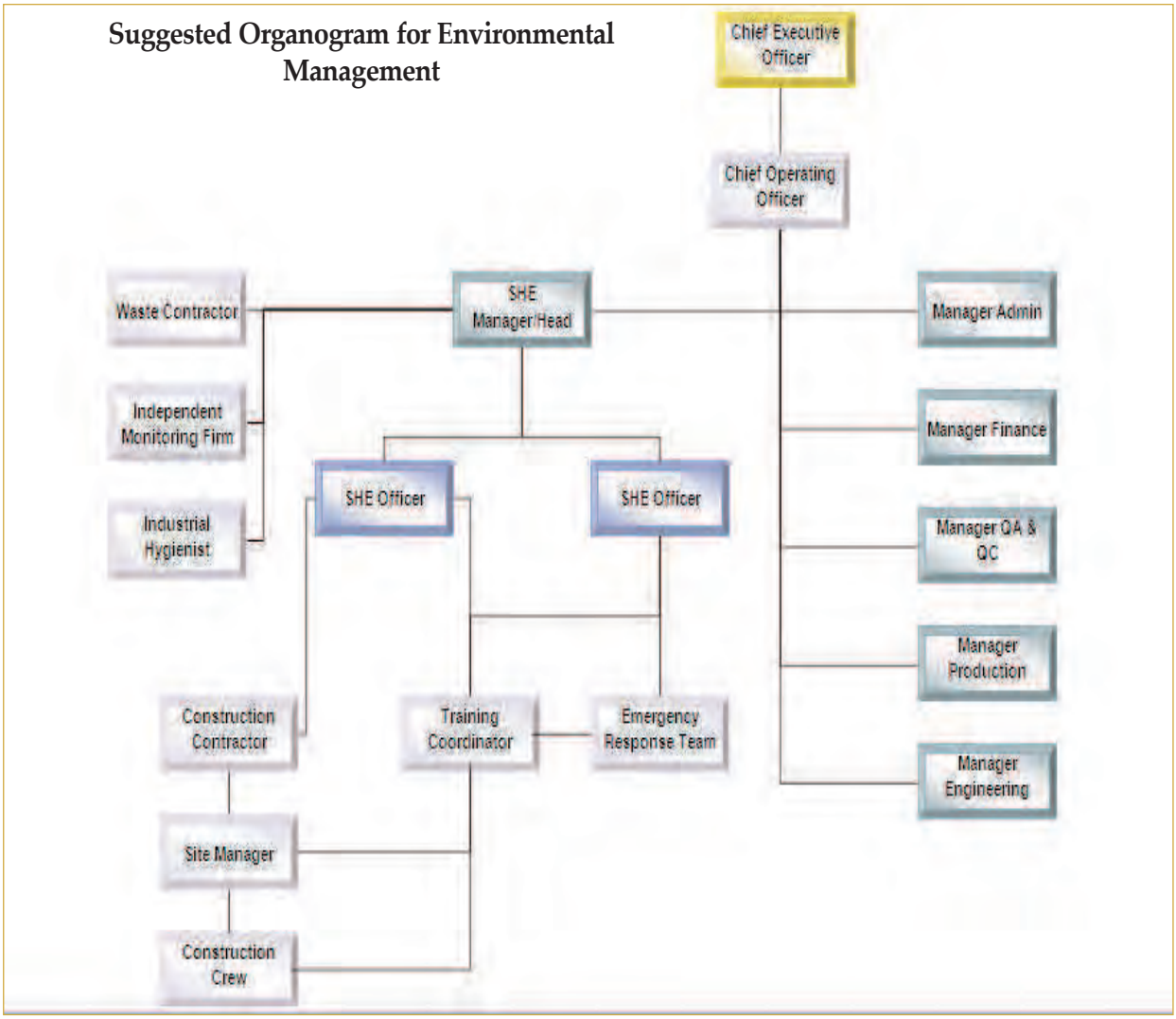
11.7 MANAGEMENT APPROACH

The environmental management will require specific approach in order to handle the issues effectively. SHE Head/Manager will assign the roles and responsibilities to be performed during the construction and operations stages of 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.

Contractor and sub-contractor will work in environment friendly manner under the supervision of SHE department of ETPL. All the regulatory agencies including EPA will be contacted as and when required to get advice for environmental management and they will be kept informed of the environmental conditions of the area periodically by ETPL management and their contractors/sub-contractors.

Some of the approaches to be followed during the environmental management practices are given below:

Suggested Organogram for Environmental Management



Compliance with EMP will be the responsibility of ETPL Management at each stage of project. ETPL Management will ensure that all executive activities during construction stage do not create adverse environmental effects.

- 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.

11.8 ROLES & RESPONSIBILITIES

Environmental management will be the integral part of corporate policy of ETPL. 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 ETPL while the daily management will be performed under the direction of Manager SHE. SHE officer and contractor will execute environmental management under the supervision of Manager SHE during construction and operations. A brief make-up of the roles and responsibilities of the system is given below:

11.8.1 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 SHE Department;
- To cooperate and consult the relevant environmental agency to perform better;
- To evaluate the progress of development and implementation of EMP;
- To approve any change in decision-making and authorities in consultation with SHE Head/Manager, if appropriate.

11.8.2 SHE HEAD/MANAGER

The success of EMP depends on proper and effective management provided by SHE manager. Following are some of the roles and responsibilities assigned to Manager SHE.

- To ensure that the points of views of staff, contractors and SHE 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 to actions required to deliver the management plan and ensure its continued development;
- To review EMP every year, tracking issues and changing EMP in accord with the solutions and suggestions;
- To monitor the progress of development and implementation of the EMP.

11.8.3 SHE OFFICER

The role of SHE officer will be authorized by SHE Head/Manager. The responsibilities of SHE officer will include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan;
- To maintain a balanced, holistic approach to the solution of concerned issues in accordance with and compliance of legislative requirements;
- To provide professional guidance on questions relating to the environment management and issues raised by contractors/relevant personals;

- To develop the EMP process by its implementation.

11.9.4 CONTRACTOR

The contractor will carry out field activities as part of the proposed LNG terminal project that includes relevant and subsidiary construction work. The contractor will have certain liabilities under the environmental laws of the country, which will be specified in the contract document with the ETPL Management.

The overall responsibility for all matters pertaining to environment will be that of the organisational head of assigned contractor. The role and responsibilities of the contractor consist of the following:

- To carry out construction activities in environmentally sound manner;
- To coordinate with the SHE officer to resolve issues arising during construction phase;
- To manage and implement environmental management practices as given in the impact assessment report as well as SHE polices adopted/prepared by ETPL;
- To administer construction crew and reduce the environmental risks;
- To appoint a dedicated environment officer to understand and handle environmental issues more easily in coordination with SHE officer.

11.10 TRAINING

All employees will be trained appropriately to work on EMP effectively. Employees training will provide workers with information on minimising waste generation. The SHE Head/Manager will determine the training requirements in consultation with contractor among the staff of both construction contractor, supervision consultant, Environment Specialist and ETPL's Manager SHE.

- 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 e.g. installing erosion and sedimentation controls, daily checks to maintain controls, cleaning up pills, waste minimization.

The Plant and Terminal will have

(i) Distributed Control System to monitor and control the plant process and operation,

(ii) Fire and gas detection and alarm system, and

(iii) An emergency shut off system. Each of these systems will be separated from each other, to provide data and communication transmission.

11.11 COMMUNICATIONS

For effective monitoring, management and documentation of the environmental performance during the operation, the Health, Safety and Environmental (SHE) matters will be discussed during daily meetings held on site. Environmental concerns raised during the meetings will be mitigated after discussions between the SHE officer and the contractor. Any issues that require attention of higher management of ETPL will be communicated to them for action. The SHE department and the contractor will also prepare a weekly environmental report. Duplicates of the report will be provided to the higher managements of ETPL and of the contractor. Communication will play a vital role in good management practices. Steps given below will assist in effective communication and documentation.

A. 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.

B. 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.

C. 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.

D. 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 ETPL and the contractor for their own record.

E. Management, Co-ordination and Information

Although ETPL 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 organisational structure, management, communication, lack of information and coordination may lead to environmental risk. The following are some of the guidelines to handle the risks:

- Ensure that management authorities have access to high quality, up-to-date and relevant data for decision-making.
- Ensure that staff associated with implementation work and SHE department have access to relevant data for implementation of EMP.
- Ensure involvement of all associated groups, management authorities and associated staff in the management plan process.
- Ensure highest-level liaison and co-ordination between contractor and ETPL staff.
- Ensure that HAZOP study has been conducted

HAZOP will be conducted to ensure safety of operations and the HAZOP will be attended by FSRU owner, LNGC Owner, ETPL, etc. Furthermore operating and commissioning procedures will be prepared in line with the industry and with the aid of FSRU owners who have ample experience of LNG Handling and operations.

11.12 Implementation Stages of EMP

Success of EMP will rest with its implementation. For that matter it will be necessary to establish an SHE department and organise a team with direct responsibility for putting the plan into practice. This set-up 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.

11.12.1 Planning and Design of ETPL 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 of ETPL LNG Jetty

It describes the ETPL 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, ETPL will assess the environmental impacts

Table 11.1: Specific Responsibilities for Management & Coordination

S.No	Strategic Objective	Proposed Implementation Process	SuggestedIn-charge	Suggested Priorit
01	To ensure high level of necessary information exchange.	■ Make review document available to interested parties. ■ Disseminate relevant information held by SHE department among the staff. ■ Produce newsletter for publication annually for general awareness in all staff. ■ Meetings using input from previous reports, advices receive from Stakeholders	■ SHE Head/Manager ■ SHE Officer ■ SHE Head/Manager ■ SHE Head/Manager	■ High ■ High ■ On-going ■ High
02	To ensure management plan is implemented, monitored and reviewed.	■ Adopt management structure as proposed. ■ Appoint full-time officer(s) with responsibility for long term management and accurate monitoring. ■ Examine annual progress report and review with respect to the monitoring progress. ■ Conduct self-monitoring regularly.	■ SHE Head/Manager ■ SHE Manager ■ CEO and SHE Head/ Manager ■ SHE Head/Manager	■ High ■ High ■ On-going ■ High
03	To improve decision-making process for management.	■ Develop an appropriate form of management process, specific to the environmental issues ■ Develop a fully comprehensive database of impact and mitigation understandable for the management.	■ SHE Officer ■ SHE Manager/ SHE officer	■ High ■ High
04	To ensure co-ordination between contractor and ETPL.	■ Obtain support for a Memorandum-of-Understanding between management and Contractor for the implementation of ■ EPA Requirements ■ EMP ■ Continue regular liaison between management of ETPL and contractor.	■ SHE Head/Manager ■ SHE Officer	■ High ■ On-going
05	To develop strategic policies for better environmental management.	Develop strong coordination between SHE department and top management.	■ SHE Head/Manager	■ High

that may arise from such changes. If the impacts are found to be different and in excess of those mentioned in the report, they will develop effective mitigation measures to address the changes to minimise the residual impacts and seek approval for the required change from SEPA as well as PQA and any other regulatory authority, if required.

B- APPROVALS

ETPL and contractor will, besides obtaining NOC from SEPA obtain relevant clearance and necessary approval from

the government and other agencies (Explosives Dept. etc) prior to commencing construction and operation. Furthermore, issuance of NOC will require the ETPL to plan for undertaking continuous monitoring, including self-monitoring and reporting. ROW for laying the Pipeline should be acquired from PQA, NHA and Railways where appropriate after a detailed route alignment survey.

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.

11.12.2 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.

A- 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 11.2. Mitigation matrix is basically a mitigation plan. These impacts and mitigation measures have already been given in detail in the earlier chapters. The matrix presented here additionally provides the responsibility clause for contractor and proponent for adoption of mitigation measures throughout the project.

B- Emergency response plan

A Project-specific Emergency Response Plan will be developed which primarily relates to the different construction activities of the Project. It supports the EMP and addresses actions and required responses all ETPL personnel, employees and 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.

C- Possible Risk

I. 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).

II. Natural Risks that may affect the facilities and their resulting damage to property and the personnel.

- Strong earthquake
- Tsunamis (flood)
- Typhoon/Cyclone
- Lightening

III. External risks arising from delinquent actions, terrorism or vandalism.

IV. Personnel Transportation Risks

All personnel of the Plant must be instructed that in the event of automobile/barges/boat accidents while the personnel is being transported to/from the Plant, using own or third-party transportation contracted by the

Table 11.2 (a): Mitigation Matrix (Overall)

S.No	Affected areas	Possible mitigation measures	Responsibility	Monitoring Frequency
1		Smoking should be prohibited at all sites	SHE Officer	Continuous Monitoring
2		Proper servicing of vehicles, provision of exhaust mufflers	Contractor	Weekly Monitoring
3	Air Quality	All equipment should be properly tuned	SHE Officer and Contractor	Monthly Monitoring
4		Fire-fighting equipment should be available in all activity areas at all times	SHE Manager	Weekly Monitoring
5		Staff should be provided with personal protective equipments	SHE Manager	Continuous Monitoring
6		Safety valves should be provided with silencers	Managers (Engg. & SHE)	Continuous Monitoring
7		Machinery and equipment should be housed in separate enclosures	Managers (. & SHE)	Continuous Monitoring
8	Noise	Working hours should be adjusted so as not to exceed 8 hours exposure in a single shift.	SHE Officer	When it is required
9		Earthmoving equipment should be kept in good condition by proper maintenance and servicing	SHE Officer	Weekly Monitoring
10		Use of horns should be prohibited within the activity area	SHE Officer and Contractor	Continuous Monitoring
11		Construction activities should not be extended beyond designated buffer zones	SHE Officer and Contractor	Continuous Monitoring
12		Natural and existing clearings should be used to the extent possible	SHE Officer and Contractor	Continuous during Construction
13		Fuel, oil and other hazardous materials if stored on land area, should be provided with impervious lining	SHE Manager SHE Manager	When required
14		Combustible and explosive material should not be stored in storage area	SHE Officer	Continuous Monitoring
15		Fuel tanks and hazardous material should be marked appropriately		Continuous Monitoring
16	Soil	Fuel storage areas should be checked regularly to identify leakage	SHE Officer	Continuous Monitoring
17		Safety equipments and utensils should be available at site at all times	SHE Manager	Weekly Monitoring
18		Vehicle Maintenance Yard should be developed at a designated location during construction work	SHE Officer and Contractor SHE Manager and Officer	Continuous upto Construction Completion
19		Where possible, segregation of solid waste during handling should be followed to manage it effectively	Contractor	Weekly Monitoring
20		Contractor should follow ETPL's emergency response plan		Continuous Monitoring
21		Machinery movement should be restricted to the construction corridor	Contractor	
22		Restoration of sites after completion of project should be mandatory	Contractor	

Table 11.2 (a): Mitigation Matrix (Overall) [Continued…]

S.No	Affected areas	Possible mitigation measures	Responsibility	Monitoring Frequency
23	Water Quality	Temporary latrines should be located at a suitable distance from water bodies	Contractor	At times of placement of latrines
24		Sewage should be treated appropriately at each unit	SHE Manager	Monthly Monitoring
25		Vehicle cleaning should be prohibited near water bodies	SHE Manager	Continuous Monitoring
26		Construction machinery should be kept off the water resources to the extent possible	SHE Officer	Continuous Monitoring
27		Weekly/monthly water/wastewater/groundwater quality monitoring should be conducted throughout construction/operation	SHE Officer	Weekly (Construction) Monthly (Operation)
28		Treated wastewater of acceptable quality, may be reused for processing construction material	SHE Officer and Contractor	Monitoring if required
29	Solid Waste	Solid waste should be collected and stored in environmental friendly manner	SHE Manager	Weekly Monitoring
30		Certified solid waste contractor should be hired for disposal of waste	SHE Manager	Weekly, if required
31		Solid waste should be kept in closed container	SHE Officer	Weekly Monitoring

Table 11.2(b): Mitigation Matrix (Pipeline)

No.	Project Component or Impact	Action	Responsibility	Timing
1.	Laying of Pipeline	Ensure that unnecessary damage to the ground surface and blockage of natural drainage is avoided.	Contractor	Construction Phase
		Ensure that a contingency plan is in place to mitigate leakages from the system and rupture of the pipeline after exiting ETPL boundary limits	SSGC	Operation Phase
		Ensure proper and timely maintenance of equipment 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.	Contractor	Construction Phase
		Ensure that after laying the NG pipeline, the disturbed surface is 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.	Contractor, ETPL/ SSGC	Post Construction Phase
		Ensure that steep cut and fill is avoided in all such cases where the risk of slope failure is high.	Contractor, SSGC	Construction Phase
		Ensure that unusable soil spoils are disposed of at the location specified by PQA & SSGCL. 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.	Contractor, SSGC	Post Construction Phase

Table 11.2 (b): Mitigation Matrix (Pipeline)

No.	Project Component or Impact	Action	Responsibility	Timing
1.	Laying of Pipeline	Ensure that fuels, oils, and other hazardous substances are handled and stored according to standard safety practices.	Contractor, SSGC	Construction & Operation Phase
		Ensure that the construction contract include provisions to limit the removal of trees/plantation to the bare minimum. Trees will be planted at 1:5 in consultation with an Independent Monitoring Consultant (IMC) at an area identified by PQA.	ETPL/SSGC, IMC	Construction and Post Construction Phase
		Ensure that a spill prevention and response plan is prepared and implemented in case of any such incident.	ETPL / SSGC	Construction & Post Construction Phase
		Ensure that photographs of the RoW and other project sites are taken prior to commencement of field activity to be used for reference when restoring the site. Ensure that the leakages are keenly monitored.	ETPL /SSGC IMC	Before and after Construction Phase Construction Phase
2	Impact on Air Quality	Ensure that the dirt road routinely used by a community for accessing the project site, is sprinkled with water regularly to reduce fugitive dust emissions resulting from heavy vehicular traffic.	Contractor	Construction Phase
		Ensure that Personal Protective Equipments (PPEs) are provided to the workers involved in construction activities to safe-guard the health of the workers.	Contractor, ETPL / SSGC	Construction Phase
		Ensure that construction materials are transported in covered vehicles.	Contractor	Construction Phase
		Ensure that all equipment, generators, and vehicles used during the project are properly tuned and maintained in good working condition, in order to minimize exhaust emission levels.	Contractor	Construction Phase
		Ensure that periodical pipe inspections are undertaken to identify and register possible pipe fractures.	ETPL / SSGC	Operation Phase
		Ensure that leak detection systems are installed at strategic locations.	ETPL / SSGC	Operation
3	Impact due to high Noise	Ensure that all equipment, generators, and vehicles used during the project are properly tuned and maintained in good working condition, in order to minimize noise emission levels.	ETPL / SSGC, IMC	Construction Phase
		Ensure that the vehicles and equipment are regularly monitored for the performance of the noise reducing equipments. Vehicles whose noise levels exceed the minimum required level must be restricted for use in the construction activity area.	Contractor	Construction Phase
		Ensure that all work is carried out during day time.	ETPL / SSGC	Construction Phase
		Ensure that operators are instructed to keep the noise level at acceptable limits so that the marine fauna is disturbed to the least. Ensure that a speed limit of 25km/hr is enforced for project vehicles passing through populated areas.	ETPL / SSGC	Construction Phase
4	Impact on Water Resources	Ensure that the oil-contaminated water (after hydro-testing) is properly disposed of. Appropriate size of mesh will be used to filter out debris including metallic residues. Efforts will be made to reuse this filtered water as far as possible.	Contractor	Post Construction Phase

Table 11.2 (b): Mitigation Matrix (Pipeline)

No.	Project Component or Impact	Action	Responsibility	Timing
4	Impact on Water Resources	Ensure that sewage generated from construction camps is appropriately treated before being discharged into the existing sewerage system.	Contractor	Construction Phase
		Ensure that heavy construction machinery is kept off the waterfront to the extent possible.	Contractor	Construction Phase
		Ensure that the RoW including the coastline is regularly inspected to monitor erosion and spills.	IMC	Construction Phase
		Ensure that erosion and sediment-control measures are employed where necessary.	Contractor, ETPL / SSGC	Construction Phase
		Ensure that all the disturbed areas including the pipeline trench, the storage and work place are restored to the original contour as far as possible.	Contractor	Post Construction Phase
5	Impact on Wildlife	Ensure that a No Hunting, No Trapping and No Capturing policy is enforced by the contractor and monitored by supervision consultant.	Contractor, Supervision Consultant	Construction Phase
6	Impact on Existing Infrastructure	Ensure that existing buried pipelines are identified in the project area through a detailed topographic survey to set the boundary of RoW.	Contractor, ETPL / SSGC	Before Construction Phase
		Ensure that prior approval for right of way is obtained from relevant authorities before the start of pipeline laying activities.	ETPL / SSGC	Before Contractor, Supervision Consultant Construction Phase
		Ensure that damage to existing infrastructure is avoided as far as possible and any damage caused to the infrastructure due to construction activities is promptly repaired.	ETPL / SSGC	Construction Phase
7	Socioeconomic Impacts	Ensure that the RoW is aligned to avoid residential areas, settlements, houses and buildings.	ETPL / SSGC	Design Phase
		Ensure that the land ownership is, if necessary, determined with extreme care.	ETPL / SSGC	Before Construction Phase
		Ensure that written agreements are made for any temporary or permanent land acquisition.	ETPL / SSGC	Before Construction Phase
		Ensure that compensation is paid according to the written agreements. Ensure that the acquired land is clearly marked and the actual land take is limited to the agreed limits.	ETPL / SSGC	Before Construction Phase
		Ensure that continuous liaison is maintained with the affected community and their concerns are addressed appropriately, if necessary.	ETPL / SSGC	Before and during Construction Phase
		Ensure that noise from campsites and construction sites is minimized using appropriate means (silencers, barriers, etc.) as required and noise levels is checked regularly at the campsite and construction sites.	Contractor, IMC	Construction Phase
		Ensure that the camps are constructed at least 500 m from any settlement.	Contractor	Construction Phase
		Ensure that no construction works is carried out during the night.	Contractor	Construction Phase

Table 11.2 (b): Mitigation Matrix (Pipeline)

No.	Project Component or Impact	Action	Responsibility	Timing
7	Socioeconomic Impacts	Ensure that the construction activities should not block the existing roads and tracks. If unavoidable, alternate routes will be provided in consultation with the affected people and concerned department.	Contractor	Construction Phase
		Ensure that the liaison with local community is maintained by project proponent and contractor and the communities are informed of the construction activities well in advance.	ETPL / SSGC	Construction Phase
		Ensure that the construction area is cordoned off, and no irrelevant personnel are allowed inside.	Contractor, ETPL / SSGC	Construction Phase
		Ensure that safe driving practice is enforced for the project vehicles. A speed limit of 25 km/hr will be enforced for the project vehicles passing through settlements.	Contractor, ETPL / SSGC	Construction Phase
		Ensure that all supplies (water, fuel, construction materials, camp supplies, etc.) are sourced in a manner not adversely affecting the local population. The capacity and existing demand on the sources will be estimated, and these will be used for the project needs only when surplus capacity is available.	Contractor, ETPL / SSGC	Construction Phase
		Ensure that the construction crew undergoes medical screening before being deployed in the field.	Contractor,	Construction Phase
		Ensure that all sites of archaeological, historical, cultural and religious significance are avoided and if any artifacts are discovered during the excavation, the relevant authorities (Department of Archaeology and Museums, Government of Pakistan, Karachi) will be contacted.	Contractor, ETPL / SSGC	Construction Phase

D- RISK MANAGEMENT

The management of contingencies at the natural gas re-gasification 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

I. 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

Emergency Contacts	Phone No.	Address
Fire/Police/Ambulance		
State Office of Emergency Services		
National Response Centre		
Post-Incident Contacts		
Fire Department Hazardous Materials Program		
EPA Department of Toxic Substances Control		
Cal-OSHA Division of Occupational Safety and Health		
Bay Area Air Quality Management District		
Regional Water Quality Control Board		
Emergency Resources:		
Poison Control Centre		
Nearest Hospital		

company, they must immediately notify the Environment, Health and Safety Environment Department (SHE) so that it will provide the necessary assistance for the injured, and proceed to issue notices not only to the health care centres but also to external support institutions (National Civil Defence, Police, Fire, Fighters, etc).

- 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.

II. EMERGENCY EQUIPMENT

The Hazardous Materials Storage Ordinance requires that emergency equipment at the facility be listed.Table 11.3 meets this requirement.

III. TRAININGS

a. Personnel Trainings General workers will be trained as per following procedures:

Personnel Training 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:

Emergency Response Training Procedures

- 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

IV. 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.

A. 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

a. First Stage: Notification

Internal Communication: Radio communication systems, channels and frequencies will be established for the

Table 11.3: 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) • 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)			

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.

b. 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.

c. Third stage: Response Operations

Response Operations refer to:

- Fire fighting 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.

d. 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.

B. 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 Plant Accident Response;
- FSRA, Loading Facility and LNGC Accident Response;
- Pipeline Rupture Contingency Plan; and
- Platform or Jetty Emergency Response.

E- MONITORING AND REVIEW

Monitoring of different activities will be required to analyse 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.

SHE officer will coordinate with manager SHE, who will be the in-charge of monitoring procedures. Monitoring techniques will be identified and the frequency of selected parameters for monitoring will be followed as per the monitoring plan given Table 11.4. SHE Head/Manager will keep a record of all non-conformities observed and report them along with actions to CEO for further action. SHE Head/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.

11.13. STANDARD OPERATING PROCEDURES

11.13.1 WASTEWATER/STORM WATER MANAGEMENT

A. 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.

B. SCOPE

Wastewater as part of construction and operational stages shall be managed as per this procedure. An integrated wastewater management system for the LNG jetty and storage 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.

Table 11.4: Environmental Monitoring Plan

Stage	Monitoring areas	Parameters and techniques to monitor	Monitoring frequency	Reason to monitor parameter	Responsibility
Construction	Dredging	• Benthic Community • Erosion and Sedimentation • Vegetation • Disposal of Dredge Material	Continuous	• Dredging results in disturbance of benthic community. • Causes soil erosion and sedimentation.	Health, Safety & Environment Department.
	Marine Ecology	• Biodiversity	Continuous	Unmitigated operations may result in loss of biodiversity	Health, Safety & Environment Department
	Air Emissions	• CO • SO_x • NO_x • PM_{10} • $PM_{2.5}$ • SPM	• Before start of construction activity • Monthly monitoring during construction and operation	Emissions from construction machinery and power production and operation of FSRU may result in deterioration of air quality	Health, Safety & Environment Department
	Solid Waste	Solid waste quality and quantity	Continuous	Improper disposal may result in deterioration of marine ecology	Health Safety & Environment Department
	Wastewater	Primary Pollutants of NEQS	Monthly	Improper disposal may result in deterioration of marine ecology	Health, Safety & Environment Department
	Noise	Noise Intensity	• Start of construction • Monthly	Uncontrolled noise may cause nuisance	Health, Safety & Environment Department
	Soil	• Soil contamination • Soil erosion • Soil sedimentation	Monthly	Surface and sea water pollution	Health, Safety & Environment Department
	Occupational Safety	• Accidents • PPEs • Annoyance	Continuous	Occupational safety and legal obligations	Health, Safety & Environment Department
	Land reclamation	• Soil Quality	Continuous	Legal obligations and structure protections. Prevention of soil erosion and sedimentation to the port.	Health, Safety & Environment Department

Table 11.4: Environmental Monitoring Plan

Stage	Monitoring areas	Parameters and techniques to monitor	Monitoring frequency	Reason to monitor parameter	Responsibility
End of construction	Restoration of sites	• Visual analysis • Photographic records	End of construction	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department.
Operations	Waste water	• Waste water minimisation • Storage and handling • Recycling and reuse • Treatment before disposal • Primary Pollutants of NEQS	Monthly	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Solid waste	• Solid waste quality and quantity • Solid waste disposal	Monthly	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Fire & Safety	• Fire Hazards & • Safety Protocols	Continuous	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Air Emissions	• CO • SOX • NOX • PM10 • PM2.5 • SPM	Monthly	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Noise	Noise intensity measurement	Monthly	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Hazardous spill	• Spill on Land • Spill on Water	Continuous	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Traffic management	Standard Operating Procedures	Continuous	Compliance of Environmental Approval Conditions	Health, Safety & Environment Department
	Compliance monitoring	• EIA Commitments • Mitigation Measures • Conditions of Environmental Approval • SOPs	Monthly	• EIA Commitments • Mitigation Measures • Conditions of Environmental Approval • SOPs	Independent Monitoring Consultant (IMC)

C. DEFINITIONS

I. 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.

II. 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

III. 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.

D. 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

I. 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).

II. STORAGE AND HANDLING

Wastewater shall be stored/retained in lined ponds or storage tanks till proper onsite treatment or remote disposal.

III. RECYCLING

Reuse of wastewater is a best way to reduce the quantity of the wastewater that requires subsequent treatment and disposal.

IV. TREATMENT

- Biological treatment of wastewater through retention in septic tanks prior to disposal
- Sludge produced as a by-product of biological treatment be disposed off 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).

V. DISPOSAL

Proper disposal should be done following the treatment through discharge into water bodies or sewerage system where available.

E. 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 refuelling 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.

Table 11.5: Wastewater Data Sheets Guidelines for Wastewater Management

FLNG 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	SHE 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 yourself from direct contact by using appropriate personal protective equipment.
Waste Reduction	Reduce water use.
Disposal Options	• Treat wastewater in Red fox or in septic tanks before disposal • Sludge removed from Red fox or septic tank during cleaning should be buried in burial pits.

- During preparation of the final EMP, ETPL 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.

F. 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

11.13.2. HYDROSTATIC TESTING

A. 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.

B. 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.

C. 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.

D. 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.

- The gas inside the pipeline is removed and replaced with water. This water contains an environmentally safe green dye to aid in determining the location of a defect, in the event of leak.
- The water inside the pipeline is pumped up to a pressure much higher than the normal operating procedure of the pipeline (i.e. transporting petroleum while in full operation). This high pressure is typically held for at least 8 hours.
- In the event of sudden leak of water from the

pipeline, the pressure will be reduced rapidly and the green water should be raised to the surface quickly.

- In the event of small leak of water from the pipeline; the pressure will be reduced slowly and the green water may not immediately reach the surface. To locate the leak, excavate the pipeline at determined locations for further investigation and testing.
- In the event that defect in the pipeline is identified, repair will be made as soon as possible and the testing will continue until the pressure remains intact for at least 8 hours.
- The pipeline will be refilled with the gas products and the distribution service to the area will be resumed.
- ETPL is committed to the continued safe operation of its pipelines and ensuring the efficient and reliable transportation of petroleum product.

E. 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.

8.13.3. Noise and air emissions

A. 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.

B. 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.

C. 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.

D. 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 (CO2), and, in case of sour gases, sulfur dioxide (SO2). 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 green house 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.

E. 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, and compliance assurance monitoring.

11.13.4. Erosion protection requirements

A. 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.

B. 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.

C. 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.

D. 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.

E. 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.

11.13.5- Cleanup and re-vegetation

A. 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.

B. 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.

C. 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.

D. Management of Cleanup and revegetation

a) 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.

b) 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 minimise 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 stabilised 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.

E. Recording & Reporting

The site environmental coordinator (SEC) will document on a Daily Environmental Inspection Reports (DIR) the progress of clearing and re-vegetation activities and status of compliance.

11.13.6. Waste management plan

A. 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.

B. Scope

The waste management plan will be been developed by the pipeline / jetty 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.

C. Definitions

i. 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.

ii. Hazardous Waste

Waste is categorized as a hazardous waste if it has one or more of the following properties:

- Ignitability (flash point less than 600oC);
- 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.)

iii. 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.

D. 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.

i. 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.

II. 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.

III. 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.

IV. 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 colour coding for easy identification, shall be kept to collect and segregate common wastes. A proposed scheme is as under:
- Food waste shall be collected in separate containers.
- All containers must be properly and clearly labelled. The label must clearly mention the name or type of waste. Also, if the waste is hazardous, it should be clearly labelled 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.

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)

V. 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.

VI. 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.

VII. 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).

VIII. 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 and economic considerations. The final disposal shall be done through EPA approved waste management contractors.

IX. Recording & Reporting

ETPL 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 Table 11.6 shall be used to record this information by all ETPL teams, while waste is being dispatched outside facility or ETPL's controlled location. It will be made necessary to sign off the Waste Tracking Form, before the waste is dispatched outside.

11.13.7- Environmental Inspection by SHE department

A. Purpose

This procedure identifies environmental responsibilities for the project offices and for the construction site SHE Incharge. It also provides procedural guidance for environmental training, inspection, monitoring functions during construction.

B. Scope

Primary scope of environmental inspector/monitor is to comply with the environmental requirements of the project. ETPL 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.

C. 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.

D. Procedure

The company will establish a plan detailing the procedures and documents required for implementing

Table 11.6: 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)			
Charcoal from Turk Amine Plant			
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			
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:**

environmental management plan thereby complying to the environmental legislations and regulations during the construction and operational phase of the project.

E. Management Options

Functions and responsibilities that will be assigned to company's SHE 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

F. 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 and other appropriate records will be logged into the field ES&H 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 SHE personnel and reviewed and signed by the appropriate supervisor, as required. Documentation that will be used by field environmental compliance personnel is summarized below.

i Daily Environmental Inspection Checklistt (Any suggested checklist)

The purpose of the checklist (to be prepared by SHE 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 SHE Head/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 SHE files.

ii. Weekly Inspection Report

A weekly inspection report is prepared by the site SHE personnel after completing a general inspection of site and submitted to the field SHE Head/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.

11.14. Contingency

PLANNING- ACCIDENTS & MALFUNCTIONS

11.14.1. 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 explosivity 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.

A. 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.

11.14.2- 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.

A. NOTIFICATION PROCEDURES

If an employee discovers a chemical spill or a vapor or material release, he or she will immediately notify the Site SHE personnel.

The Site SHE 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, vapour 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 SHE personnel to assess the magnitude and potential Seriousness of the spill or release.

B. 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 SHE personnel will inform the proper agencies in the event of its being necessary.

The designated Response personnel will take the following measures:

- Avoid breathing vapours 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 diking 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.

C. 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, e.g. CITRIKLEEN, 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 diking 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.

11.14.3. 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.

11.14.4. SECURITY

All rules and regulations set up by landowner will be followed by all personnel on site.

11.14.5. TRAINING

All site personnel are trained to operate the equipment that is present at the site.

11.14.6. 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.

11.14.7. 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 CO2 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.

11.14.8. 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.

11.14.9. MATERIALS STORAGE

- The Site SHE Head/Manager 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 SEPA regulations.

11.14.10. 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.

11.14.11. TRAINING

All employees shall receive general fire fighting 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
- Fire fighting 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 fire fighting in a confined space
- First aid
- High level rescue (if the site assigns this responsibility to this group)

11.15- ENVIRONMENTAL COMPLIANCE

As confirmed in the Preliminary EMP, Proponent will be responsible for regular audit and review of environment and safety management of the LNG facility. This will include both on-site auditing and review of performance reports. Additional onsite inspections and investigations will be undertaken in the event of significant environmental incidents. These will be undertaken in conjunction with the relevant government agencies.

Plant management will participate in the audits and inspections and investigations. Plant management will also

be responsible for regular review of the environmental performance of the site and site personnel, and for the reporting on the implementation of commitments made in the EMP.

There is also likely to be some compliance auditing associated with the licensing of the LNG Plant, for each government recommendation and proponent commitment, the following information:

- The recommendation or proponent commitment being addressed;
- The issue to be addressed by the proponent;
- How the issue is to be addressed by the proponent;
- Where the issue is addressed in the EMP;
- When the issue is to be addressed by; and
- To whose satisfaction the issue is to be addressed.

11.15.1- Audits

In particular, there will be:

- Annual audit reports.
- A triennial review and improvement of the EMP.

Proponent recognizes that periodic external compliance audits and inspections will be made to monitor, assess and validate the level of Proponent performance and compliance pursuant to the commitments made in the accepted Environmental Management Plan.

11.15.2- Environmental Management Systems Audit

Environmental Management Systems Audit would be undertaken to assess the implementation and operational success of the EMS at the site. This is achieved by assessing the objectives, organizational structure, responsibilities, procedures, processes and resources available at the site. The EMS Audit is a systems assessment, rather than an audit of environmental compliance, which is assessed through the Site Internal Environmental Audit.

Potential areas of concern for audit during construction of LNG plant mainly include:

- Jetty and unloading arms
- Process Area
- Low Pressure and High Pressure pumping systems
- Vaporizers (Regasification Area)
- Vent or flare systems (low pressure and high pressure)
- Maintenance Workshop
- Administration Building
- Guard House
- Utility Area
- Control Room
- Gas Metering Station
- Gas Receiving Station

12 CONCLUSION

ETPL intends to follow a phased approach towards developing the LNG import terminal in order to bridge the gap between supply and demand of energy. The Project is primarily based on developing the required infrastructure so that LNG can be brought into the NG market, which has witnessed phenomenal growth in the energy sector in Pakistan. In the first stage, the focus is on the fast track approach to facilitate LNG flow into the NG pipeline network in Pakistan.

This Environmental & Social Impact Assessment (ESIA) evaluates the potential environmental, social, economic, cultural, and natural impacts of the proposed Liquefied Natural Gas (LNG) Import Terminal Project. This assessment has been carried out to fulfill the regulatory requirements of Pakistan Environmental Protection Act, 1997 and to satisfy the evaluation criteria of the International Finance Corporation (IFC).

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 brown field site located in the side bay adjacent to EVTL's exiting terminal. The selection of site by the proponent depends on the qualitative / quantitative risk analysis as part of the techno-economic feasibility. EMC has carried out analysis on the siting of the LNG terminal and Laying of HP Transmission Pipeline. Environmentally the proposed Brown Field site has been found feasible provided that the mitigations suggested are carried out. The pipeline route also does not interfere with any mangroves or population centers. It raises minimum social and environmental issues and avoids the laying of pipeline in the sub-sea environment; it additionally is economically more viable than the others.

The risks unique to LNG projects include operational risks arising from gas tanker and terminal operations involving transport, storage and the transfer of LNG. In particular, some gas terminals are located within the environs of established ports. So their operations and those of the tankers serving them share a common operational environment with other port users. The management of gas shipping operations within ports is therefore a matter of some importance, and needs to be taken into account by those who administer ports and provide essential services in port areas. To a large extent, the overall positive safety record is rooted in the limited risks arising from LNG itself. Proactive planning and public private partnership can only make such projects 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:

- ETPL as project proponent will comply with all applicable laws and regulations;
- The construction phase of the project will proceed as described in Section 3; and
- ETPL as proponent will implement the mitigation measures and Environmental Management Plan in letter and Spirit.

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 in future.

The ESIA study finds that the ETPL's LNG import terminal project 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.

This ESIA Study concludes that establishment of the LNG-Import Terminal Project at Port Qasim would fulfill the requirements of sustainable development by being socially equitable, and economically viable in improving the quality of life for all citizens of Pakistan, without altering the balance in the resources of the ecosystem of the region.