USAID ENERGY POLICY PROGRAM

MONTHLY PROGRESS REPORT NO. 5
MARCH 2015

ESTABLISHMENT OF
FAST TRACK LNG IMPORT TERMINAL

April 2015

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FAST TRACK LNG IMPORT TERMINAL

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Establishment of Fast Track EETPL LNG Import Terminal

Monthly Progress Report
March 2015

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Establishment of Fast Track EETPL
LNG Import Terminal
At Port Qasim

PROGRESS REPORT
FOR THE MONTH OF MARCH 2015

1. Introduction:

1.1 This report covers the activities and progress of the work for the month of March, 2015, which includes updated status of field works and the Desk Studies carried out this month. The Sub-consulting Services Contract for Study and Review of past Studies Reports and Quality assurance of project works was awarded to Engineering Consultants International Limited (ECIL) and Granada Group (GG) by main Consultant "Advanced Engineering Associates International" (AEAI). M/s. Sellhorn, Germany were associated with ECIL for review of Structural Works and overview of Navigation Channel requirements.

The Subcontract No.EPP-C1-SC-010 included description of services and LNG Specific Services. By Delivery Order No.EPP-C1-DO-001, the Task Order becomes effective w.e.f. 20th October, 2014, which covered a period from October 20, 2014 to March 31, 2015. Consultants commenced work after having the kick off meeting with PQA officials on October 20, 2014. The tenure of the first Task Order is completed on March 31, 2015. Issuance of 2nd Task Order effective from April 01 to August 31, 2015, is awaited.

1.2 Location of Project

The newly constructed LNG Terminal is located in the Port Operation Zone of Port Qasim, between the existing Engro Vopak (EVTL) Liquid Chemical Jetty and PQA's Iron Ore & Coal berth (IOCB). The distance between the LNG jetty and the open sea is about 40 Km. measured along the navigation channel (refer Fig. A, B, C). The berthing line of the (EETPL) Jetty is about 150m from toe line.

The RLNG pipeline 24" dia. runs from Loading Platform of jetty to the Custody Transfer Station (CTS) with a length of 6.5 Km. 42" dia. Pipeline (SSGC) runs from CTS to SMS Pakland. The total length of both the pipelines is 22.7 Km.

1.3 FSRU, LNG Carriers and Gas Delivery

a) Upon completion of the terminal facilities, arrival of the FSRU & LNG Carriers were scheduled around March 01, 2015. However the loaded FSRU arrived at the new LNG Terminal on March 26, 2015. Testing of the FSRU, RLNG pipeline and installations at CTS, shall be carried out after arrival of LNGC as per IA and start feeding the FSRU and resultantly supply of RLNG to SSGC network is resumed.

b) The FSRU has nominal capacity of 173,400 M^3 although in the first phase it may handle LNG load 138,000 /151,000 M^3.

c) The RLNG will be delivered to SSGCL gas distribution network at a nominal rate of 400 MMSCFD under pressure ranging between 300 psig & 1200 psig and temperature between +5°C and + 38.8^{o}C.

2. Salient features of the Project:

2.1 General

a)	Client	:	Advanced Engineering Associates International (AEAI)
b)	Consultants	:	▪ Engineering Consultants Intl. (Pvt.) Ltd. Pakistan (Sellhorn of Germany were associated by ECIL). ▪ Granada Group of Companies Inc. USA.
c)	Developer	:	Engro Elengy Terminal (Pvt.) Limited, Pakistan.
d)	Award of Construction Contract	:	May 5, 2014
e)	Commencement of Bathymetry	:	May 5, 2014
f)	EPC Contractor (Civil Works)	:	China Harbour Engineering Company (CHEC)
g)	Date of signing of Implementation Agreement between PQA and EETPL	:	June 23, 2014
h)	Date of deployment of Consultants	:	October 20, 2014
i)	Implementation Schedule of the Developer	:	Annex-5
j)	Tendered Cost of Infrastructure	:	Confidential.
k)	Completion date as per developers programme	:	12-15 March 2015

2.1.1 Other main Parties engaged by EETPL for Project Work

a)	TUV (Austria)	:	Third Party supervision.
b)	Artelia	:	Mooring simulation work.
c)	Exelerate	:	FSRU related work.
d)	Technica	:	All design work.
e)	Siport 21	:	FBMS simulation.

2.2 Major Components of the Project:

a) Dredging of Berthing Basin.
b) Construction of coffer Dam and disposal of dredged material,(reclamation keeping due consideration of environmental protection aspects)
c) Loading Platform supported on Steel Tubular piles.
d) Breasting Dolphins supported on Steel Tubular piles.
e) Mooring and supporting Dolphins, supported on steel tubular piles.
f) Loading arm installed on loading platform.

g) Trestle supported on prestressed concrete piles.

h) Walkways – prefabricated steel sections resting on supporting dolphins constructed on steel tubular piles.

i) RLNG pipelines and Allied works.

j) Electrical Power Supply, Lighting and Control System

k) Electro-Mechanical Works mainly including:

   i) Metering System
   ii) Water Bath heater
   iii) Back Pressure Skid
   iv) Fire Protection / Fire Fighting Arrangement
   v) FSRU along with allied equipment brought and berthed at the Jetty and to be stationed on long term basis.
   vi) Fenders
   vii) Bollards
   viii) Quick Release Hooks

3. Updated Physical Progress of Field Work (till March 31, 2015).

3.0 Overall Progress

Overall physical progress of the project upto March 31, 2015, is almost 100% excluding minor item of remedial works being carried out.

3.1 Dredging and Related Works

Dredging was carried out during the period from 20th Aug to 1st October 2014. The dredged area is about 89,000M^2.and the designed dredged depth is -14m CD which may be increased to -15m CD in next phase. Post dredging survey was conducted by PQA. (Note No.5 in Design Drawing 145400-DD-DWZT-2001-2002).

3.1.1 Bathymetry and topographic surveys were carried out during 5 to 18 May, 2014.

3.1.2 Geotech studies were carried out during May / June 2014.

3.1.3 Construction of coffer dam was carried out during 15 May 2014 to 5 August 2014.

3.1.4 Dredging was carried out during 20th August to 1st October, 2014.

3.2 Jetty Structure:

A) Status / Progress of work
All the activities related to Steel Tabular Piles, Concrete works and miscellaneous elements of jetty, Trestle and walkway were substantially completed by the end of February 2015.

During the available time after mobilization w.e.f. October 20, 2014, activities were carefully monitored by Consultants in the light of quality assurance requirement.

B) Issues of concern recorded during construction work:

- The STP were driven not to the designed toe level of – 30 meter. EETPL to get a confirmation with supporting calculation from their designers, that the reduced driven depth of STP satisfies the required factor of safety keeping in view geotech studies.

- EETPL did not provide to Consultants various documents related to civil works despite repeated requests when construction activities were going on.

- EETPL did not submit the Factory Test Certificates from the manufacturer of Fenders and other fixtures installed at LNG terminal and neither submitted various 3rd party inspection report.

3.3 Pipeline Works

Overall work on construction of both the pipelines i.e. 24” dia. & 42” dia. is completed except few touch up works which continued during the month of March 2015.

Related works and progress of works are detailed as under:

3.3.1 Major items of Pipeline Works

- Acquisition of land for 15 meter wide ROW, for laying of pipelines in PQ area.
- Excavation of trenches for laying pipeline.
- Sand Blasting as per Swedish standard SA-2.5 and wrapping up of Heat shrink sleeve application on welding joints.
- Laying of pipeline in trenches, holiday testing for determination of integrity of coating, inspection and backfilling of trenches.
- Thrust boring and horizontal drilling at road, railway, nallah and other crossings.
- Installation of Cathodic Protection (CP) System.
- Hydrostatic testing from LNG Jetty to CTS & from CTS to SMS Pakland.
- Testing & Commissioning.

3.3.2 Status / Progress:

A. Pipeline

All the activities related to installation of pipelines of 24" dia & 42" dia including welding of joints, radiography, application of heat shrink sleeves and allied works, were completed and were carefully monitored in the light of quality assurance requirement.

Observations:

a) Monolithic Insulating Joint:
On Intake Channel of Pakistan Steel, steel truss was placed for crossing of 24" dia pipeline without installation of insulation joints. The suggested joints are used for ensuring functioning of cathodic protection system and providing electrical safety to the pipelines.

b) Backfill in trenches:
It was noted that inside EVTL premises, excavation & back filling was not done as per code of API-1104 / ASME B31.8, It was back filled as 1.5 fts on top cover of buried pipeline instead of 3.3 ft. as per Quality Inspection Plan (QIP) submitted by EETPL.

B. Custody Transfer Station (CTS):

Work completed.

Custody Transfer Station comprising construction of metering skid, intake manifold assembly, filter vessels, pig receiver for 24" dia pipeline & pig launcher for 42" dia pipeline, water bath, etc. including civil foundation works.

Observations:

It is to be noted that proper monitoring / QA is difficult without access to the documents listed in Annexure-4 which have been requested earlier on many times.

4. Electromechanical Works

4.1 Mechanical Works (CTS)

All works completed.

Review of relevant documents including specification, drawings, methodology, manufacturers instructions regarding installation and field activities related to compliance of quality assurance, could not be fully done to our satisfaction. Post authentication of documents & installations can only be done at this stage, an option available to us after completion of the physical work.

4.2 Electrical and instrumentation Works

All works completed.

Review of relevant documents including specification, drawings, methodology, manufacturers instructions regarding installation and field activities related to compliance of quality assurance, could not be done. Post authentication of documents & installations can only be done at this stage as mentioned above at 4.1.

5. Review of Reports, Studies and Comments.

5.1 Health Safety Environmental (HSE):

Various environmental monitoring related works were already undertaken and finished by the time HSE Consultant was mobilized. Such activities which were finished include e.g. capital dredging, dumping of dredged material in the cofferdam, mangrove removal etc.

The Environmental Consultant has gone through the project documents received from EETPL and offered his comments / observations, where applicable or required particularly the documents listed below:

- Environmental and Social Impact Assessment study
- Sindh Environmental Protection Agency (SEPA) approval of ESIA report and conditions\
- HAZOP / HAZID Study
- Lloyd Quantitative Risk Assessment Study (QRA)
- USAID Environmental Document Form (EDF)
- Monthly Environmental Monitoring Reports prepared by Independent Monitoring Consultant (IMC) for EETPL
- Quarterly Environmental Monitoring Reports being submitted to SEPA on a quarterly basis

The Environmental Consultant noted that environmental requirements under the SEPA's NOC have been partially fulfilled. These include testing and acquiring approval for disposal of dredged material from SEPA, Mangrove replantation, etc.

It had been pointed out that SEPA issued NOC for both the parts of the project namely LNG Terminal and RLNG pipeline laying works thus required monitoring of both components of the project. Environmental Monitoring has been carried out for Terminal component only while the pipeline installation works under the scope of SSGC have not been subjected to Environmental Monitoring activities by the IMC.

Upon the completion of project the requirement for site cleanup works and mangrove replantation works have been discussed with EETPL. These are pending as EETPL has scheduled these activities for future.

Regarding the "comments of Environmental Consultants on reply by IMC in respect of Report of October, 2014, the status remains same as in February 2015 and the table is again attached at Annex-6.

5.2 Hydrographic Studies:

There have been no substantial activities during the month of March 2015. Therefore the status remained unchanged and is reproduced as under:

A) Based on the available PQA documents and charts following works were done.

- Exact location of all jetties/terminals have been marked on the drawing.
- The coordinates of the LNG terminal were plotted on the existing drawing of the main channel.
- The latest bathymetric data were plotted for the entire PQA channel with all existing navigational facilities which will help to review the critical bends, widening, volume & quantum of dredging involved.
- The LNG terminal & berthing basin have been incorporated in the PQA channel drawing.
- Bathymetric chart of Chan Waddo creek has been prepared on scale 1:10000
- Two reports on soil & Bio-chemical studies received from PQA Hyd. Deptt. were reviewed.
- Latest Bathymetric digital data of the entire PQA navigational channel for straightening, passing bays for two way traffic, widening & dredging etc. was reviewed.

B) List of additional requested information is given in Annex-4 (item-2).

5.3 Port Operation / Marine Consultants Activities:

- Visited Port Qasim for attending meetings with the Chairman, and Port Officials and participated in the discussions on "Port Tariff for LNG ships & alternate Channel dredging" and Pilots observations on berthing of LNG ships at EETPL LNG Terminal within present port parameters.

- Discussions with Hydrographer, Mr.Bakhtiar at ECIL office on BA CHART PAK-20 PQA CHANNEL Buoys positions with respect to LNG Carrier transit, dredging and straightening of Channel at various places.

- Reviewed / studied Terminal "EETPL operations manual" in coordination with Capt. Farooq Hussain (GG).

- Reviewed / Studied and made amendments in draft of “LNG regulations for handling of LNG carriers and terminals”. Discussion with Capt. Nouman Hassan DG-OPS / PQA and Messrs Mohsin Siddiqui, Capt. Farooq Hasan and Qabulio at ECIL Conference Room.

- Review and Study of Emergency Response at EETPL by Excelarate. Discussion with Mr. Mohsin Siddiqui in the light of Port Operation activities.

5.4 Synopsis of Overall Activities of ECIL

1. Constructional activities of civil works of the Terminal comprising jetty, trestle, berthing & mooring, dolphins, and other ancillary structures remained substantially complete. Likewise, laying of RLNG pipeline works were completed except minor works and installations at CTS.

2. A number of joint working sessions were held at PQA and ECIL offices mainly to assist PQA in framing most appropriate replies to the actions attributed to Port Qasim in the Action Register of Qatar Gas. Replies were prepared very carefully with the view to safeguard PQA interest, as part of Consultants core responsibility on the specific desire of Chairman and DGs (Ops), (Tech), (Adm) and (Fin).

3. These type of activities were repeated every time, in the long sessions of Consultants and PQA as the matter was accorded highest priority and timely report was to be made to the Ministries and all stakeholders with the view to adhere to the timeframe for import of LNG in the country. Points related to other stakeholders were also gone through wherever reference was felt necessary to safeguard GOP / PQA interests.

4. A major chunk of documents was finally delivered by EETPL. Thanks to AEAI's efforts and pursuance on our requests and hue and cry. Still some documents pertaining to civil works and pipeline have not been handed over to the Consultants.

   As the EPC Contractor was of Chinese origin, test certificates furnished were generally found to be in the Chinese language. The documents since furnished at this belated stage, after substantial completion of work, could now only be reviewed generally but not much could be done or advised by the Consultants particularly because of language issue unless translations are provided to make them legible.

5. A meeting was held with SSGC officials in presence of AEAI officials including Party Chief, Mr. Jim Hicks, Mr. Akbar Yousuf, Mr. Tahawar, Mr. Masood Bhatty and Consultants Mr. Mohsin Siddiqui & Capt. Farooq Hussain. The purpose was to interact with them before forthcoming commissioning tests, assist them in the witnessing of tests under agreed acceptance protocols, advise them wherever they require assistance and offering availability of Consultants services. Details of tests and methodologies were discussed and accordingly site joint visits were conducted before and after the arrival of FSRU.

6. Subsequent to work carried out in previous months a series of joint working sessions were arranged with PQA with respect to tariff financial model and determination of suggestive tariff figure in connection with handling of LNG Vessels (FSRU and LNG Carriers) at Port Qasim. There was lot of debate and difference of opinion also. Finally, it was okayed by PQA Chairman in a meeting presided over by him and

attended by all DGs of PQA including DG (Ops) & Consultants. Modifications in the structure proposed by Chairman and brief presentation were prepared on the guidelines same day and forwarded to him and others to meet the target.

7. EETPL submitted Terminal Operation Manual was reviewed by the consultants. A very useful document. It was taken into consideration while performing acceptance tests and helped in great deal in determining the outline and contents of Standard Operating Procedure (SOP) and Notice to mariners / LNG vessel carriers and PQA LNG Regulations.

8. Port Regulations were finalized by Legal Expert/Advisor. He shared initial thoughts with PQA DG(Ops) and other officials before giving it shape of regulations. The purpose of meeting with PQA official was initially information gathering and taking of soundings. Besides others Mr. Mohsin Siddiqui and Capt. Hashmat. Operation Expert, contributed in the light of FMBS, Report, Qatar Gas Action Register, LNG Terminal Operation Manual prepared by EETPL Excelerate Security appraisal and other relevant documents.

   It was agreed to implement them as SOP, a document which was finally developed. Jointly agreed by PQA Operation Division and submitted to PQA.

9. A complete review of HSE implementation and outstanding issues was made with AEAI Environmental Expert, Mr. Sadaf Iqbal. Documents and details available with ECIL / Environmental Expert were shared with him and view point of each other was well taken and analyzed. Mr. Sadaf Iqbal advised action which was noted for compliance. Outstanding issues with EETPL and IMC were monitoring of 24” dia & 42” dia RLNG pipeline work and replantation of mangroves in lieu of uprooted mangroves as committed EETPL with SEPA.

10. Reports of the Pilots after Full Mission Bridge Simulation Study (FMBS) carried out at Siport for small and Q. Flex LNG vessels using real time manoeuvre simulator developed by Marin MSCN and PNV-GL was reviewed in-house and with PQA in joint work sessions.

11. Visit of Port Qasim was made by Party Chief of AEAI. Initially he visited EETPL Terminal to see physical work. He was taken around and given briefing by EETPL officials later he participated in the briefing by LNG Consultants for him attended by Chairman PQA, DGs and other officials of PQA, followed up by presentations by PQA pilots on SiPort FMBS on their return from Spain and Port Qasim Tariff Financial Model.

12. SOP for handling of LNG Vessel (LNGC & FSRU) for Port operational activities was prepared in association with and in joint deliberations with PQA Operation Division particularly DG (Ops). While preparing SOP documents such as PQA Port Operation Regulations 1981, the input

from LNG Regulations prepared by Legal Advisor, FMBS Report, Qatar Gas Action Register Points, Excelerate Security appraisal, EETPL Terminal Operation Manual and other relevant documents such as operation manuals of Dahej and Inchon LNG Terminals.

13. It was desired by AEAI / PQA that the Consultants to make a proper presentation to the PQA Board in the next meeting about the consultants activities on QA work about the EETPL LNG Terminal Project assignment. Consultants worked together toward achieving this end covering all points in a sequential mode to apprise the Board fully identifying GAPS in the studies, physical work of LNG Terminal and RLNG pipelines (status and QA), present status of closing of those Gaps still found open, general overview of documents received, identifying where doubts are there and navigation channel desk study findings by Sellhorn and mitigation measures proposed by the Consultants for remedy.

5.5 Extensive Review of Existing Reports and Various Studies carried out by LNG Experts, Granada Group of Companies.

Both consultants of Granada Group provided the necessary support and the consulting services to AEAI clients including the Ministry of Petroleum, the SSGC, PSO and the PQA.

Considering the fact that most of the construction work of the terminal was already completed prior to our arrival in mid-February, 2015, it was decided to defer the verification of the close-out of all non-compliance items until after the commissioning and establishment of normal operation of the Terminal. These non-compliant items were identified through evaluation of the available planning and design documents/drawings through gap studies that were conducted through comparing these documents against the PIANC, SIGTTO and NFPA regulations templates.

During this month priority was given to all those items that needed to be completed and verified prior to the arrival and berthing of FSRU and subsequent commissioning of the LNG Terminal. These items included:

1. Progress on 91 Open items in the Action Register eceived from Qatar after their initial visit in Port Qasim and the Terminal.

2. Review and comment on the Terminal Operations Manual draft submitted by EETPL.

3. Review and comment on the Performance and Acceptance Tests of the Terminal

4. Review and evaluate the Port Qasim Operations Manual draft for LNG Operations.

5. Prepare the Standard Operating Procedures (SOPs) for handling LNG vessels calling at Port Qasim for guidance of the Port Operations staff, pilots, the Masters of the LNG carriers and the Operations staff of the EETPL LNG Terminal. The SOPs were approved and issued by the management of Port Qasim.

6. Prepare the Conditions of Use (COU) document for approval and implementation by the Port Qasim Management. This is a standard contract that is executed between the Master of the calling LNG vessel and the PQA under which the Master certifies that he has checked and tested all his critical operation and safety equipment prior to entering the channel of the Port and has taken necessary steps to familiarize all his staff with the vessel's equipment and operations and that they are fully conversant with their duties and funcetions onboard the vessel.

7. Through the execution of the COU the Master also exempts the PQA from any responsibility for any mishaps, accidents or incidents caused due to any reason whatsoever, and indemnifies the Port Qasim Authority against any claims due to those mishaps made by the owner of the LNG carrier or any other third party.

8. Assist the PQA in determining the tariff for the Port service charges to be levied on LNG carriers calling at Port Qasim. A financial model was created with all applicable costs provided by the PQA finance department to calculate and determine the tariff which was also advised to Qatargas for their information.

9. Assist the negotiating team of the Government of Pakistan with the resolution of multiple differences of position between the buyers and sellers of LNG in order to progress towards the finalization of the Sales & Purchase Agreement (SPA) of LNG between Pakistan and Qatar.

10. Witness the Performance and Acceptance Tests of the Terminal on behalf of the SSGC and the PQA and submit the final reports of the tests to stake holders.

11. A number of meetings were held with PQA, SSGC and AEAI to update status of the project and assist PQA and SSGC in meeting their commitments towards completion of the projects. Assistance was provided in correspondence with Qatargas and the Ministries in order to make the Government decision makers with the critical issues affecting the safety, security and the commissioning of the Project.

12. Meetings were held with the management and staff of EETPL to agree on close-out process of non-compliant items identified in the HAZID-HAZOP studies and the Gap Studies conducted through comparison with SIGTTO, PIANC and NFPA Templates. Progress was made in closing out a number of non-compliant items identified in the PIANC Gap Study.

13. Analyzed the findings of FMBS study carried out at SiPort Spain from February 16 to 22 and incorporated them in the SOPs developed for handling LNG carriers in Port Qasim.

Progress has been made in receiving and reviewing various studies and documents in from EETPL in order to progress the quality assurance process of the Terminal. Appended below is the status of the quality assurance process:

Overall Project Schedule	**Received**
Currently updated copy of the milestone schedule of project implementation activities :	**Received and verified**
A complete list of all the studies and data used for design basis of the Terminal Jetty infrastructure and site selection.	**List of Studies has been received. Review for Quality Assurance of these studies has commenced.**
A complete list of all the vetted and approved design drawings	**A list of Civil Engineering and Structural Drawings has been received from ECIL. No drawings or data received for LNG infrastructure details or the equipment and machinery**
A copy of the Testing Schedule of all the machinery and infrastructure along with the planned testing procedures	**Protocol for Testing has now been received. Testing procedures have been completed and witnessed as per the LSA between SSGC and EETPL.**
A copy of Commissioning Schedule and Commissioning Procedure of the Terminal.	**Received and completed**

A copy of the Safety and Operations Manual for the Terminal.	**Operations Manual Draft has now been received and reviewed. EETPL is to forward a revised version for comments incorporating the PQA SOPs, COU and the Marine Service Certificate.**
A list of operational staff and their training details as well as qualifications who are to be responsible for the operation of the Terminal and handling any emergency situations	**Not received**
Details of Fire Fighting and Emergency Stations including design and equipment details as well as the training of staff responsible for handling LNG spill and fires	**Not received**
Copy of a Full Mission Bridge Simulation (FMBS) Study carried out by the Terminal Developers and results of the same	Has been received and evaluated. Comments forwarded to AEAI. **Fresh FMBS Study has been carried out at SiPort, Spain from 16th February to 22nd February. Findings and recommendations were reviewed and incorporated in the PQA SOPs for LNG Carriers calling at Port Qasim.**
List of additional pertinent drawing and documents has also been submitted by ECIL for obtaining the same from PQA/Engro for review.	**Full Status not known at this time. However, EETPL has now agreed to provide access to all the drawings and studies for our review and verification to meet the quality assurance criteria in their data room. Review of Drawings and Data has commenced 13th March, 2015.**

A verification program for verification of close-out with evidence for non-compliant items identified during the SIGTTO, PIANC and NFPA Gap Studies has been launched and is currently underway to conclude the accuracy of the model and studies based on this data. Accuracy of the Mooring Study and the Mooring layout Verification Mathematical Model can neither be accepted nor denied.

Routine correspondence was carried out through emails and telephone calls with AEAI, ECIL, SSGC, the ISGS, Qatargas and the PQA representatives in order to resolve day to day issues related to LNG Procurement and smooth completion and commissioning of the Terminal Project.

Refer Annex-7 for write up on Standard Operating Procedure of LNG Carriers.

5.6 Review of the jetty design and desk study on anchorage area, existing navigational channels and alternate channel and suggestions to upgrade by Sellhorn of Germany.

Based on the initial observations Mr. Peetz of Sellhorn submitted the inception report refer Annex-8.

5.7 ECIL response to Inception Report prepared by Sellhorn is given in Annex-9.

5.8 Activities on Legal Matters

- Continued review of relevant material existing Port Qasim Authority Regulations 1981 and recommended Draft for rules for LNG Vessels to be made part of SOP, etc.
- Attended meetings at Port Qasim pertaining to recommended LNG Regulations draft.
- Meeting with ECIL officials to discuss and review possible issues on Port Qasim LNG Regulation.
- Reviewed NFPA 59A; Codes & Standards for reference/guidance in developing LNG Regulations.
- Continued Reviewing NFPA 59A; Codes and Standards, for developing LNG regulations final draft.
- Reviewed and discussed PQA Security Assessment report by M/s "Excelerate Energy"; with ECIL for developing safety and security rules pertaining to LNG Vessels operations in port, and incorporate the same in Port Standard operating procedures in recommended LNG rules.
- Drafted Berthing Agreement for Port Qasim.
- Attended meeting at ECIL to review Action register from Qatar Gas.
- Develop the First draft for HSE Policy.

5.9 Activities of Sellhorn Experts / Engineers

Main activities comprise of review of structural design and desk study on anchorage area, existing navigational channels, alternate channels and suggestions to upgrade.

Subsequent to site visit to Port Qasim / Pakistan and meeting of Mr. Norbert Peetz, with PQA, ECIL, Granada Group and EETPL during 19 to 24 Feb, 2015, his observations and activities are reproduced as under:

A. Observations:

1. *With regard to the site visit and general impressions please note that based on the meeting with PQA I got a pretty good impression of the actual needs of POA and how Engro is positioning themselves.*

2. *Part of the scope of work with regard to the Quality Control of Jetty design has now become more a review and mitigation process.*

3. *It was noted that major attention is now required on the subject of access channel issues present there related to handling of LNG vessels, and also utilization of alternative channel, directly or indirectly related to LNG Terminal's development and opening up of channel even its utilization as passing bay.*

4. *Next course of actions:*

   a. *With regard to the jetty Sellhorn is awaiting the final input from Engro which will be the basis to elaborate a bit more on the general design approach and particularly applied design parameters. The aim is to compile this input in a kind of "general observation report"*

   b. *Currently Sellhorn is in the process of determining the design vessel and resulting navigational requirements such as channel draft, width, bending radius and so on to elaborate in more detail on the present situation and potential improvements to the channel. We believe that we will come up with different scenarios.*

   c. *The above will also consider the requirements for emergency anchor places and potential passing bays.*

   d. *For the second (alternative) channel we will check on the general requirements and resulting issues and the way forward to study possible scenarios and solution.*

   e. *In addition we will consider and elaborate on position and content for additional field measurements, such as waves, currents, tidal data at the inner and outer channel.*

B. Activities:

(i) Norbert Peetz

- Review of Dolphin design, Document register.
- Meetings PQA Officials**.**
- Meeting at ECIL, Meeting with PQA, Site Visit Fotco Jetty (tide, wave and weather recording devices.
- Meeting Engro, Site Visit Engro LNG Jetty, De-briefing at PQA and ECIL.
- Processing of channel issues.

(ii) Brinkmann Birgitt

- In-house Team meetings and project introduction.
- Briefing on access channel.

Based on initial review of some EETPL's documents Sellhorn submitted an Inception Report (Refer Annex-8).

6. Material Test Reports

Concrete and Concrete Material Test Report (1) consisting of 16 Pages received from EETPL, was reviewed. Comments are given as under:

Description	Remark
• Coarse aggregate test carried out as per BS: 812 Parts 105.1 & 105.2. Source of material – Hub river.	
Elongation 16% < 35%	Ok
Flakiness 8% < 20%	Ok
Crush (5-20mm) test method BS: 812 Part 103.	
Material finer than 0.075mm. – 0.5 < 1%	Ok
Aggregate Density (BS: 812 Part-2): 2.71>2.6	Ok
Absorption (BS: 812 Part-2): 0.7% < 2%	Ok
Sieve analysis: Sieve analysis (BS: 812 Part 103).	Ok
• Sand:	
Source of sand: Report says "Pakland"	Unidentified location
Density: 2.68 to 2.69 > 2.6	Ok
Absorption: 0.5 to 0.6 < 2%	Ok
Material finer than 0.075 – 1% < 3%	Ok
Grading: (BS"812 part 103 and ASTM C125)	Grading of sample FA-1 is OK but the related graph differs from the figures given in the table.
• Cement: CEM-1 used	Chemical composition and physical Test Report by the Contractor or the Manufacturer was not submitted.
• Curing Compound: Masterkure MK-7 manufactured by BASE was used KM-7 is solvent free membrane forming wax emulsion and solar reflective.	Ok
• Reinforcing steel used for RCC works	Test report or manufacturer's test certificate not received.
• Admixture: BASF / RHEO BUILD 858	Material information not received.
• Mix Design: Test Method BS: 5328	
Concrete grade 35/45	
Cube strength (average) - 7 days result – 49.5 Mpa	Ok
Cube strength (average) - 28 days result – 57.5 Mpa	Ok
Concrete grade 40/50	
Cube strength (average) 7 days result - 52.3 Mpa	Ok
Cube strength (average) 28 days result - 59.5 Mpa	Ok

7. Consultants Staffing:

List of Local and Expatriate staff involved for the project work, is attached as Annex-1.

8. Contractor's Field Establishment & Staffing.

Substantially demobilized.

9. Equipment and Construction Facilities used at the Site during construction.

Most of the equipment and construction facilities used have been demobilized from Site.

10. Weather Report.

Monthly Weather Report not received from the EETPL.

Date	Weather		Temperature		Remarks
	Rain	Wind	Maximum	Minimum	

11. Tidal Observations:

Not yet received from EETPL.

12. Status of Documents Received from EETPL.

13.1 Refer Annex-2 for list of Documents received from EETPL.

13.2 Refer Annex-3 for list of Drawings of Jetty & related structures.

13. Documents yet to be received from EETPL

Refer Annex-4

14. Project Progress Photographs

Refer Annex-10

15. Conclusion

- The construction works, pertaining to establishment of a dedicated Floating LNG Terminal, carried out on fast track basis, are substantially complete. A FSRU as per IA has been successfully navigated and berthed on the new LNG Jetty. The progress of work has been almost as per construction schedule. No major adverse observations regarding quality of the field work have so far been received from the Consultants' field staff. However, Civil Engineer's comments and observations stated under items 3.2B, 3.3.2A, 3.3.2B & Annexes-A&B, need attention / necessary action.

- The appointment and deployment of the Consultants QA of the project, was done at a belated stage much after the actual commencement of work which was done even before the formal signing of IA. Therefore review and comments on various reports, studies and finalization of some vital documents are still outstanding although the construction works already completed. After having mobilized and lot of pursuance, various reports and documents have been received by consultants late, in the disjointed position, piecemeal and many after the completion of the particular activity.

- The consultants have been mobilized about five months by now with the aim to effectively involve themselves in the quality assurance work which they had to carry out without various documents made available to them. Some of data / reports are yet to be furnished by EETPL.

- Foreign consultants Sellhorn could only be mobilized w.e.f. February 17, 2015, when Civil works, laying of RLNG and allied works as well as pipeline including most of the E&M works were already completed. They virtually saw substantially complete structure.

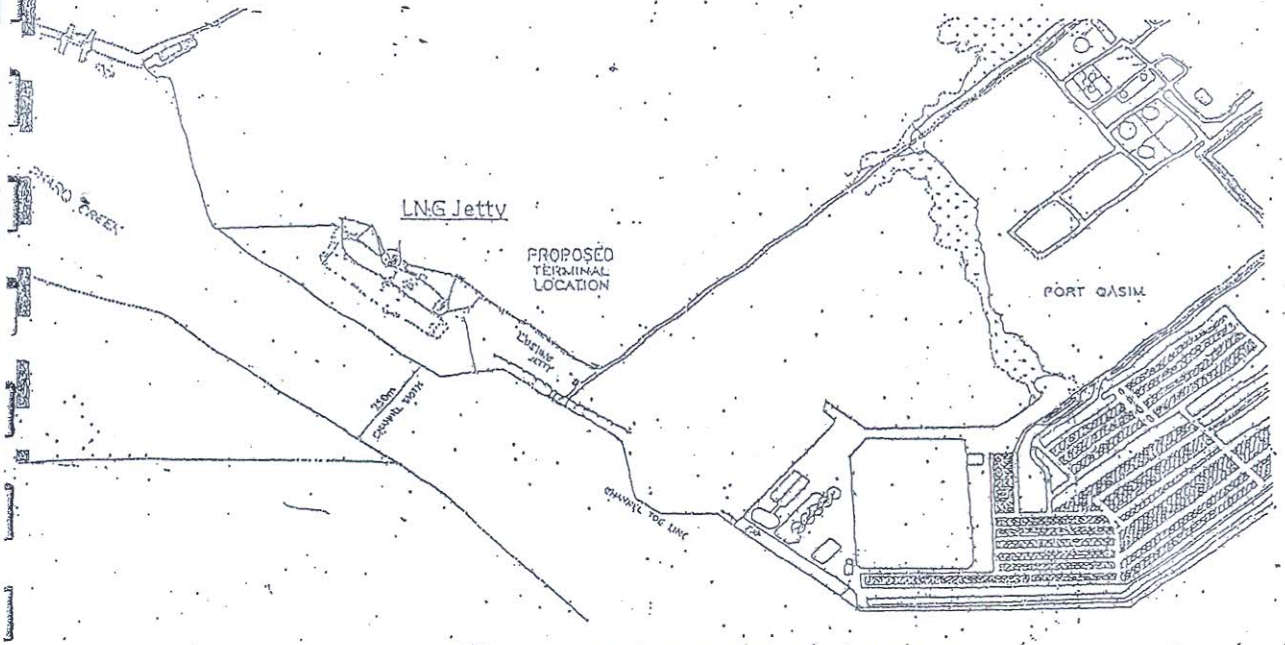
- The consultants continued the post authentication of various items of works already completed. Some documents were forwarded to Sellhorn for their study & review. They have submitted Inspection Report and continuing review of documents.

- Based on initial available information Sellhorn submitted their Inception Report (refer Annex-8). The Inception Report indicates marginal factor of safety in few cases which is a serious concern.

- The initial observations are yet to be finalized on comprehensive study of various documents received from EETPL.

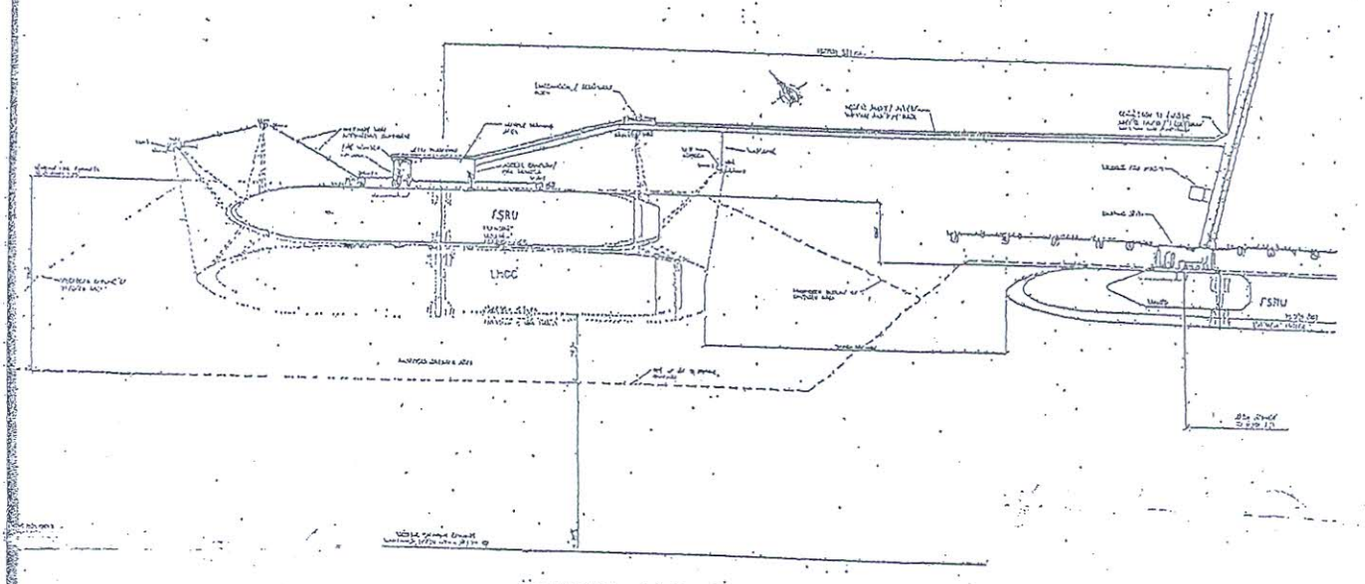
F I G U R E S

Figure "A"



LNG Jetty shown adjacent to EVTL Chemical and LPG Berth

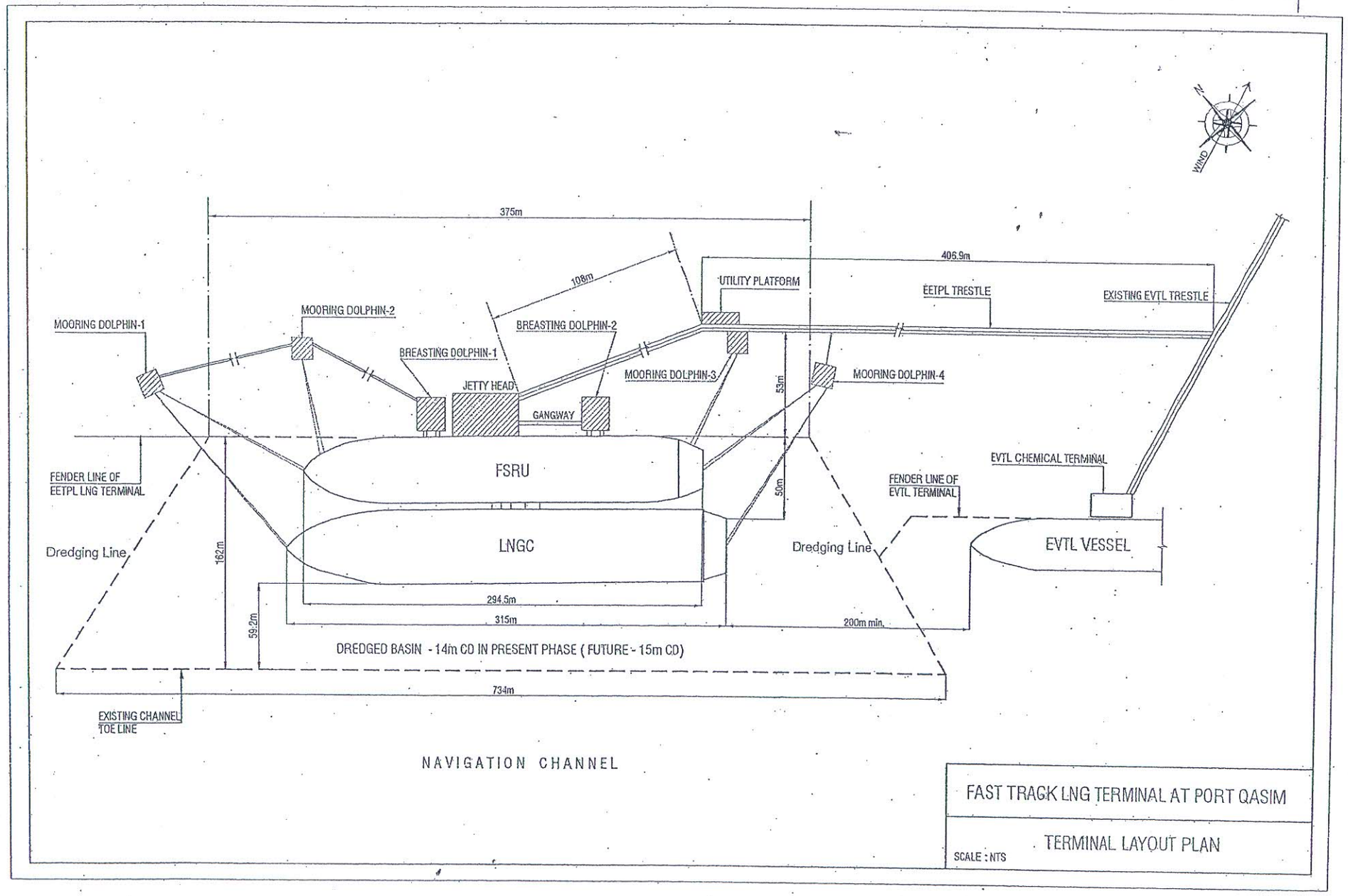
Figure "B"



Layout (Double Bank Arrangement)

NOTE: The Sketch has been copied from IA of EETPL.

Figure "C"


375m
108m
406.9m
UTILITY PLATFORM
EETPL TRESTLE
EXISTING EVTL TRESTLE
MOORING DOLPHIN-1
MOORING DOLPHIN-2
BREASTING DOLPHIN-2
BREASTING DOLPHIN-1
JETTY HEAD
MOORING DOLPHIN-3
MOORING DOLPHIN-4
53m
GANGWAY
FSRU
LNGC
FENDER LINE OF
EETPL LNG TERMINAL
Dredging Line
162m
50m
EVTL CHEMICAL TERMINAL
FENDER LINE OF
EVTL TERMINAL
Dredging Line
EVTL VESSEL
294.5m
315m
200m min.
59.2m
DREDGED BASIN - 14m CD IN PRESENT PHASE (FUTURE - 15m CD)
734m
EXISTING CHANNEL
TOE LINE
NAVIGATION CHANNEL
WIND
FAST TRACK LNG TERMINAL AT PORT QASIM
TERMINAL LAYOUT PLAN
SCALE : NTS

A N N E X E S

ANNEX – 1

LIST OF STAFF

LNG TERMINAL AT PORT QASIM

LIST OF STAFF

Sr.No.	Name	Nationality	Position
ECIL			
1.	A.N. Qabulio	Pakistani	Project Director
2.	Tanweer A. Khan	Pakistani	Port & Harbour Development Engineer
3.	Capt. Hashmat Ullah Shah	Pakistani	Port Operation Expert
4.	Zafar H. Ismail	Pakistani	Financial Expert
5.	Agha Taimur Khan	Pakistani	Port Charges, Royalty, Tarrif
6.	Tufail Ali Zubedi	Pakistani	Environmental Engineer
7.	Shahid H. Mirza	Pakistani	Civil Engineer
8.	Mohammad Shoaib	Pakistani	Electrical Engineer
9.	Jamiluddin	Pakistani	Mechanical Engineer
10.	Zahid Ali Mahesar	Pakistani	Pipeline expert
11.	Muhammad Bakhtiar Hussain	Pakistani	Hydrographer
12.	M.A.G. Siddiqui	Pakistani	Legal Expert
Sellhorn			
13.	Nobert Peetz	German	Civil & Structure Engineer
14.	Birgitt Brinkmann	German	Civil Engineer
Granada Group (Foreign Consultants)			
15	Mohsin M. Siddiqui	USA	Project Coordinator, LNG and FSRU Specialist
16	Capt. Farooq Hussain	USA	LNG Marine, Navigation & FSRU Terminal Specialist
Support Staff			
1.	Sheikh Shahid Hussain	Pakistani	Coordinating Engineer
2.	Shaikh Abdus Salam	Pakistani	Office Secretary

ANNEX – 2

DOCUMENTS RECEIVED

Annex-2

Status of Documents Received from EETPL.

1. **General:**

   i. Project Quality Plan.

   ii. Procedure for Undertaking Project Management Review

   iii. Procedure for Formulating Plans and Procedure.

   iv. Procedure for Undertaking Contract Review.

   v. Procedure for Control of Documents and Communications.

   vi. Procedure for Control of Purchasing including Evaluation of Sub-contractors and Suppliers.

   vii. Procedure for Materials Receiving Inspection, Testing, Identification and Traceability.

   viii. Procedure of Management Resources and Recording of Works Executed, resources utilized and Site records.

   ix. Procedure for Control of Inspection, Monitoring, Measuring and Test Equipment (IMMTE).

   x. Procedure for control of Non-conforming Product.

   xi. Procedure for Implementing Corrective and Preventive Action.

   xii. Procedure for Handling and Storage of Permanent Materials.

   xiii. Procedure for control of Management Records

   xiv. Procedure for Internal Auditing.

   xv. Procedure for Dealing with Complaints and Enquiries.

2. **Pipeline:**

   i. Pipeline Alignment Drawings.

   ii. Pipeline Construction And Technical Specification.

   iii. Pipeline BOQ.

   iv. 42” Pipeline WPA, PQR & WQT.

   v. 24” Pipeline WPA, PQR & WQT.

   vi. 24” and 42” Pipeline QIP.

   vii. HDD MSDS (42” and 24”).

   viii. HDD and Thrust Boring Methods Statements.

ix. Methods Statement for Hydrostatic test.

x. Materials Safety Data Sheet

xi. Ultrasonic Weld Inspection Report

xii. 24” and 42” Dia RLNG Pipeline Construction Manual QA QC Manual.

xiii. Construction Specifications (RLNG) Re-gasified Liquid Natural (RLNG) Gas Pipeline.

3. List of Documents related to Jetty Design.

a) Studies / Specification

- Manoeuvring Simulation Study
- Specification for Qluick Release Hook
- Specification for Test of Tubular Steel Pile
- Corrosion Protection Coating of Tubular Steel Pile Technical Submission
- Specification for Dredging (incl. List of STS Activity)

b) Design Documents

- Basis of Design – Marine and Structural Engineer
- Marine Structure Calculation Sheet for Mooring Dolphin Foundation
- Marine Structure Calculation Sheet for Breasting Dolphin Foundation
- Marine Structure Calculation Sheet for Loading Platform Foundation
- Marine Structure Calculation Sheet for Trestle Foundation
- Marine Structure Calculation Sheet for Prestress Longitudinal Beam
- Marine Structure Calculation Sheet for Longitudinal Beam (non-prestress)
- Marine Structure Calculation Sheet for Traverse Beam

c) Construction Records and Reports

- Pile Reports of Breasting Dolphin 1
- Pile Reports of Breasting Dolphin 2
- Pile Reports of Loading Platform
- Pile Reports of Mooring Dolphin 1
- Pile Reports of Mooring Dolphin 2
- Pile Reports of Mooring Dolphin 3
- Pile Reports of Mooring Dolphin 4
- Pile Reports of Supporting Dolphin 1
- Pile Reports of Supporting Dolphin 2
- Concrete Test Report / Concrete Mix Design
- Data Sheet of Curing Admixture – BASF Masterkure 107
- Quality Certificate of 100 PHC Piles
- Quality Certificates of Structural Steel – Grade O235B

d) Miscellaneous

- Survey Reports for LNG Terminal
- Hydrostatic test Procedure
- Geotech Investigation Report
- Specification for Dredging
- Mooring Layout Report-B
- Mooring Layout Final Report

ANNEX – 3

LIST OF DRAWINGS

Annex-3

List of the Drawings received from the office of PQA.

S. No.	DOCUMENT No.	TITLE	REV	PAGES	REMARKS
1	14S400-DD-DW-ZT-1001	General Layout	1	1	Issued for Construction
2	14S400-DD-DW-ZT-1002	Terminal layout	1	1	- do -
3	14S400-DD-DW-ZT-1003	Coordinates of Terminal layout	1	1	- do -
4	14S400-DD-DW-ZT-2001	Dredging Works	1	1	- do -
5	14S400-DD-DW-SG-1001	Plan and Elevation of Jetty	0	1	- do -
6	14S400-DD-DW-SG-1002	Hand Rail Arrangement	0	1	- do -
7	14S400-DD-DW-SG-1003	Structual Drawing for loading Plat form	0	1	- do -
8	14S400-DD-DW-SG-1004	Structual Drawing for Breasting Dolphin 1&2	0	1	- do -
9	14S400-DD-DW-SG-1005	Structual Drawing for Mooring Dolphin 1&4	0	1	- do -
10	14S400-DD-DW-SG-1006	Structual Drawing for Mooring Dolphin 1&3	0	1	- do -
11	14S400-DD-DW-SG-1007	Structual Drawing for Supporting Dolphin 1&2	0	1	- do -
12	14S400-DD-DW-SG-1008	Pile Location Of LNG Jetty	0	1	- do -
13	14S400-DD-DW-SG-1009	Detail of Piles for LNG Jetty	0	1	- do -
14	14S400-DD-DW-SG-1010	Reinforcement of Loading Platform(1)	0	1	- do -
15	14S400-DD-DW-SG-1011	Reinforcement of Loading Platform(2)	0	1	- do -
16	14S400-DD-DW-SG-1012	Reinforcement of Mooring Dolphin(1)	0	1	- do -
17	14S400-DD-DW-SG-1013	Reinforcement of Mooring Dolphin(2)	0	1	- do -
18	14S400-DD-DW-SG-1014	Reinforcement of Mooring Dolphin(3)	0	1	- do -
19	14S400-DD-DW-SG-1015	Reinforcement of Mooring Dolphin(4)	0	1	- do -
20	14S400-DD-DW-SG-1016	Reinforcement of Supporting Dolphin 1&2	0	1	- do -
21	14S400-DD-DW-SG-1017	Structure of Pile Head of Tabular Steel Pile 1250	1	1	- do -
22	14S400-DD-DW-SG-1018	Structure of O 1250 Tabular Steel Piles	0	1	- do -
23	14S400-DD-DW-SG-1019	Structure of O 1200 Tabular Steel Piles	0	1	- do -
24	14S400-DD-DW-SG-1020	Reinfocement of Breasting Dolphin 1(1)	0	1	- do -
25	14S400-DD-DW-SG-1021	Reinforcement of Breasting Dolphin 1(2)	0	1	- do -
26	14S400-DD-DW-SG-1022	Reinforcement of Breasting Dolphin 1(2)	0	1	- do -
27	14S400-DD-DW-SG-1023	Reinforcement of Breasting Dolphin 2(2)	0	1	- do -
28	14S400-DD-DW-SG-1024	Structure of Pile Head of Tabular Steel Piles 1200	1	1	- do -
29	14S400-DD-DW-SG-1025	Structure Detail For 1500KN Triple Quick Release Hook	0	1	- do -
30	14S400-DD-DW-SG-1026	Structure Detail For 1500KN Quadruple Quick Release Hook	0	1	- do -
31	14S400-DD-DW-SG-1027	Cathodic Protections & Anode Installation-Typical	0	1	- do -
32	14S400-DD-DW-SG-1028	Detail of Bracket of Breasting Dolphin 1	0	1	- do -

S. No.	DOCUMENT No.	TITLE	REV	PAGES	REMARKS
33	14S400-DD-DW-SG-1031	Reinforcement of Prominence on Mooring Dolphin 1	0	1	Issued for Construction
34	14S400-DD-DW-SG-1032	Reinforcement of Prominence 1 on Mooring Dolphin 2	0	1	- do -
35	14S400-DD-DW-SG-1033	Reinforcement of Prominence 2 on Mooring Dolphin 2	0	1	- do -
36	14S400-DD-DW-SG-1034	Reinforcement of Slab on Mooring Dolphin 2	0	1	- do -
37	14S400-DD-DW-SG-2001	Plan and Elevation of Trestle	0	1	- do -
38	14S400-DD-DW-SG-2002	Structual Drawing for trestle	0	1	- do -
39	14S400-DD-DW-SG-2003	Pile Location of Trestle	0	1	- do -
40	14S400-DD-DW-SG-2004	Detail of Piles of Trestle	0	1	- do -
41	14S400-DD-DW-SG-2005	Strcture of PHC Pile And PHC Pile Shoes	0	1	- do -
42	14S400-DD-DW-SG-2006	Strcture of Pile Head PHC Pile	2	1	- do -
43	14S400-DD-DW-SG-2007	Beam Arrangement of trestle	0	1	- do -
44	14S400-DD-DW-SG-2008	Reinforcement for Prestress Logitudinal Beam (1)	1	1	- do -
45	14S400-DD-DW-SG-2009	Reinforcement for Prestress Logitudinal Beam (2)	1	1	- do -
46	14S400-DD-DW-SG-2035	Reinforcement for Prestress Logitudinal Beam (4)	1	1	- do -
47	14S400-DD-DW-SG-2034	Reinforcement for Prestress Logitudinal Beam (3)	1	1	- do -
48	14S400-DD-DW-SG-2010	Reinforcement of Logitudinal Beam (6)	1	1	- do -
49	14S400-DD-DW-SG-2011	Reinforcement of Logitudinal Beam (7)	1	1	- do -
50	14S400-DD-DW-SG-2012	Reinforcement of Logitudinal Beam (8)	1	1	- do -
51	14S400-DD-DW-SG-2013	Reinforcement of Logitudinal Beam (9)	1	1	- do -
52	14S400-DD-DW-SG-2014	Reinforcement of Logitudinal Beam (10)	1	1	- do -
53	14S400-DD-DW-SG-2015	Reinforcement of Logitudinal Beam (11)	1	1	- do -
54	14S400-DD-DW-SG-2016	Reinforcement of Logitudinal Beam (12)	1	1	- do -
55	14S400-DD-DW-SG-2017	Reinforcement of Logitudinal Beam (13)	1	1	- do -
56	14S400-DD-DW-SG-2018	Reinforcement of Logitudinal Beam (14)	1	1	- do -
57	14S400-DD-DW-SG-2019	Reinforcement of Logitudinal Beam (15)	1	1	- do -
58	14S400-DD-DW-SG-2020	Reinforcement of Transverse Beam TB1	0	1	- do -
59	14S400-DD-DW-SG-2021	Reinforcement of Transverse Beam TB2(1)	1	1	- do -
60	14S400-DD-DW-SG-2022	Reinforcement of Transverse Beam TB2(2)	1	1	- do -
61	14S400-DD-DW-SG-	Structure for Transverse Beam TB3	-	1	- do -

S. No.	DOCUMENT No.	TITLE	REV	PAGES	REMARKS
62	14S400-DD-DW-SG-2023	Reinforcement of Transverse Beam TB3(1)	0	1	Issued for Construction
63	14S400-DD-DW-SG-2024	Reinforcement of Transverse Beam TB3(2)	1	1	- do -
64	14S400-DD-DW-SG-	Structure of Transverse Beam TB4	-	1	- do -
65	14S400-DD-DW-SG-2025	Reinforcement of Transverse Beam TB4(1)	0	1	- do -
66	14S400-DD-DW-SG-2026	Reinforcement of Transverse Beam TB4(2)	1	1	- do -
67	14S400-DD-DW-SG-	Structure of Transverse Beam TB5	-	1	- do -
68	14S400-DD-DW-SG-2027	Reinforcement of Transverse Beam TB5(1)	0	1	- do -
69	14S400-DD-DW-SG-2028	Reinforcement of Transverse Beam TB5(2)	1	1	- do -
70	14S400-DD-DW-SG-2029	Reinforcement of Transverse Beam TB6	1	1	- do -
71	14S400-DD-DW-SG-2030	Reinforcement of Slab 1	0	1	- do -
72	14S400-DD-DW-SG-2031	Reinforcement of Slab 2(1)	0	1	- do -
73	14S400-DD-DW-SG-2032	Reinforcement of Slab 2(2)	0	1	- do -
74	14S400-DD-DW-SG-2033	Reinforcement of Slab 3	0	1	- do -
75	14S400-DD-DW-SG-2036	Reinforcement for Ribbed Slab (Type-1 & Type-3)	0	1	- do -
76	14S400-DD-DW-SG-2037	Reinforcement for Ribbed Slab (Type-4)	0	1	- do -
77	14S400-DD-DW-SG-2038	Plan for Ribbed Slab of LB(6-10)	0	1	- do -
78	14S400-DD-DW-SG-2039	Plan for Ribbed Slab of LB(11-15)	0	1	- do -
79	14S400-DD-DW-SG-2040	Reinforcement of Transverse Beam TB7(1)	0	1	- do -
80	14S400-DD-DW-SG-2041	Reinforcement of Transverse Beam TB7(2)	0	1	- do -
81	14S400-DD-DW-JG-1001	Layout Plan of Pipe-Rack	0	1	- do -
82	14S400-DD-DW-JG-1002	Elevation And Reinfocement of Pipe-Rack (Part-1)	0	1	- do -
83	14S400-DD-DW-JG-1003	Elevation And Reinfocement of Pipe-Rack (Part-2)	0	1	- do -
84	14S400-DD-DW-QL-1001	General Layout Plan of Steel Walkways	1	1	- do -
85	14S400-DD-DW-QL-1002	The Structure of #1 and #2 Steel Wakway (1)	1	1	- do -
86	14S400-DD-DW-QL-1003	The Structure of #1 and #2 Steel Wakway (2)	1	1	- do -
87	14S400-DD-DW-QL-1004	The Structure of #1 and #2 Steel Wakway (3)	1	1	- do -
88	14S400-DD-DW-QL-1005	The Structure of #1 and #2 Steel Wakway (4)	1	1	- do -
89	14S400-DD-DW-QL-1006	The Structure of #1 and #2 Steel Wakway (5)	1	1	- do -
90	14S400-DD-DW-QL-1007	The Accessory of #1 and #2 Steel Wakway	1	1	- do -
91	14S400-DD-DW-QL-1008	The Structure of #3 and #4 Steel Wakway (1)	1	1	- do -

S. No.	DOCUMENT No.	TITLE	REV	PAGES	REMARKS
92	14S400-DD-DW-QL-1009	The Structure of #3 and #4 Steel Wakway (2)	1	1	Issued for Construction
93	14S400-DD-DW-QL-1010	The Structure of #3 and #4 Steel Wakway (3)	1	1	- do -
94	14S400-DD-DW-QL-1011	The Structure of #3 and #4 Steel Wakway (4)	1	1	- do -
95	0-DD-DW-QL-1012	The Structure of #3 and #4 Steel Wakway (5)	1	1	- do -
96	0-DD-DW-QL-1013	The Accessory of #3 and #4 Steel Wakway	1	1	- do -
97	14S400-DD-DW-QL-1014	The Structure of #5 Steel Wakway (1)	1	1	- do -
98	14S400-DD-DW-QL-1015	The Structure of #5 Steel Wakway (2)	1	1	- do -
99	14S400-DD-DW-QL-1016	The Structure of #5 Steel Wakway (3)	1	1	- do -
100	14S400-DD-DW-QL-1017	The Structure of #5 Steel Wakway (4)	1	1	- do -
101	14S400-DD-DW-QL-1018	The Structure of #5 Steel Wakway (5)	1	1	- do -
102	14S400-DD-DW-QL-1019	The Accessory of #5 Steel Wakway	1	1	- do -
103	14S400-DD-DW-QL-1020	The Structure of #6 Steel Wakway (1)	1	1	- do -
104	14S400-DD-DW-QL-1021	The Structure of #6 Steel Wakway (2)	1	1	- do -
105	14S400-DD-DW-QL-1022	The Accessory of #6 Steel Wakways	1	1	- do -
106	14S400-DD-DW-QL-1023	Anchor Chain and Anti-Seismic Damping Pad	1	1	- do -
107	14S400-DD-DW-QL-1024	The Structure of Steel Ladder (1)	1	1	- do -
108	14S400-DD-DW-QL-1025	The Structure of Steel Ladder (2)	1	1	- do -

ANNEX – 4

DOCUMENTS YET TO BE RECEIVED

Annex-4

A. <u>Documents Yet To Be Received</u>:

1. Pipeline Works

(a) Custody Transfer Station (CTS):

- Design & Drawings (Mechanical, Electrical & Instrumentation).
- Pipe & Equipment, Filter Assembly, Metering Skids, Water bath heater Third Party inspection report (factory) etc.
- BOQ – (Mechanical, Electrical & Instrumentation) - supply & installation of equipment
- Firefighting system, Fire & Gas detection

(b) 24" dia pipeline from Jetty loading Platform to Custody Transfer Station (CTS) Length 6.5 km:

- Design & Drawings to be provided in A-1 size (Plot Plan, sectional drawings & Detail / shop drawings), Isometric drawings
- Technical specification for all material & Installation / construction of pipeline
- Pipeline 24"dia (MSDS) and three layer P.E. coating manufacturer's inspection report
- Monolithic joints for isolation of underground to above ground pipelines
- Rubber sleeve for isolating casing pipeline & carrier pipeline.
- Heat shrink sleeve
- Tape coating on elbows/ bend (MSDS)
- Vent pipe installation on casing pipe on both sides

(c) 42" dia pipeline from Custody Transfer Area (CTS) up to SSGC Network.

- Design & Drawings to be provided in A-1 size (Plot Plan, sectional drawings & detailed shop drawings), Isometric drawings
- Technical specification for all material & Installation / construction of pipeline including:
    - Pipeline pipe 42"dia (MSDS) and Third Party inspection report (factory).
    - Monolithic joints for isolation of underground pipeline
    - End seal for isolating casing pipeline & carrier pipeline
    - Heat shrink sleeve, tape coating on elbows & bend.
    - Vent pipe installation on casing pipe on both sides

(d) Fire Protection & Firefighting system:

- Drawing, Design
- Technical specification & safety philosophy & applicable codes / standards
- BOQ included supply of material & installation of all material/equipment's etc

(e) Installation at Jetty:

- Submission of Design & Drawings must be in A-1 size including (Plot Plan, sectional drawings & Detail/ shop drawings) and Isometric drawings/detail drawing in A-3 size.
- Technical specification of equipment, installation & details procedures.

- Quality Inspection Plan
- Data sheets (manufacturing)
- List of mechanical equipment to be installed on Jetty along with technical specification**.**

(f) Methodology & Test Procedures:

- Thrust Boring
- Pile coating/painting application procedure
- Holiday test procedure to check the coating integrity of pipelines

B) <u>Documents partially received.</u>.

Following documents were partially received:

(i) Test Report:

Pipeline 24" & 42" dia. of Chemical, Mechanical & Metallurgy factory reports received, but same were not segregated for different dia & wall thicknesses of line pipes.

Required:- Number of pipeline with different schedules, length coated & uncoated / bare manufactured at Factory, Quality Inspection Plan, monitoring procedure & three layer coating application procedures, QIP during manufacturing & test reports**.**

(ii) WPS PQR, WQT Inspection Record:

- Welding procedure specification (WPS) for 24"dia pipeline API-5LX-70 found ok, but for 24"dia sch.100 material A-333 Gr.6 WPS have not been submitted, commenced the welding work without submitting WPS,WQT.

- Procedure qualification record (PQR) of material (pipeline with different schedule such as (24"dia Sch-100 SMLS material A-333 Gr.6) have not been submitted.

(iii) Material specification of relevant Document:

a) 24"dia sch.100,SMLS,BE A-333 Gr.6- length-576m (New Trestle)
WPS, WQT, PQR are still awaited

b) 24"dia sch.40 SAW, BE API-5L Gr.X-70- length-1080m (Old Trestle) & 1284 m inside underground EVTL area.
WPS reviewed and found ok
WQT record is missing
PRQ for material & welder missing

c) 24"dia 10.74 mm ,SAW, BE API-5L Gr.X-70- length-4500m EVTL battery limits to Custody Transfer System(CTS)
WPS reviewed and found ok
WQT record is missing
PRQ for material & welder missing

d) 42"dia 16.74 mm wt ,SAW, BE API-5L Gr.X-70- length-1200m CTS battery limits to D.Factor
WPS reviewed and found ok
WQT record is missing
PRQ for material & welder missing

e) 42”dia 13.81 mm wt ,SAW, BE API-5L Gr.X-70- length- 4104 m D.Factor to SMS Pakland

WPS reviewed and found ok
WQT received
PRQ reviewed and found ok

(iv) Technical & Construction Specifications:

Technical specification reviewed. Found following documents were missing:

- Pipeline material specification
- Valves & fittings
- Three layer Poly ethylene coating
- Heat shrink sleeve specification
- Monolithic Joints/ Isolation joints
- Spacers for carried and casing pipeline
- End seal material casing pipe & carrier pipelines.
- Pig launcher & Pig receiver
- Anchor block
- Pigging material for (Foam, Cleaning wire, Gauging & Testing pigs)
- CP System (design, drawing, technical specification BOQ material supply & installation)

(v) Pipe Alignment Drawings:

Pipe Alignment drawing have been provided by EETPL in A-3 size from 1 to 14 EVTL Gate to CTS & SMS Pakland, Plant inside area layout drawings were missing. Drawings were required in A-1 size. Shop drawings are in A-3 size to monitor/check the work on site. A-1 size are required.

- In the above drawings Plot plan of pipeline was not provided which shows pipeline from LNG Jetty Platform to SMS PakLand.
- All isometric drawings to be provided.
- Layout Plan of jetty top side drawing submitted in A-3 size which was required in A-1 size. Also isometric drawings of jetty top required
- Layout plan of Custody Transfer Drawing provided in A-3 size, is required in A-1 size & also was required isometric drawings to monitor the works conveniently**.**

(vi) Quality Inspection Plan (QIP) :

- Quality Inspection Plan (QIP) for 24”dia pipeline received & reviewed. Found satisfactory. 42” dia pipeline QIP have not been submitted, but mentioned in Transmittal #06, dated:09/12/2014.
- QIP Plan submitted on plain paper, without logo or signature of Developer/Engro. All documents need to be submitted in proper way for documentation**.**

(vii) Horizontal Direction Drilling (HDD) / Thrust Boring:

Horizontal direction drilling / Thrust Boring methodology document were reviewed. It was noted that it was written on plain paper, without proper stamping or signature. It did not indicate exact crossing road or railway & canal / nallah, length of crossing, type of equipment and procedures they have followed/applied to conduct Thrust boring & HDD. Signed and stamped copies were needed.

2. Hydrography:

Following information / report / data were required.

- PQA Wish List from Mr. Jawad, Director (Channel Dredging) as per requirement of Director General (Technical), PQA.

- Bathymetric data of Chara / Chhanwaddo Creek to study the prospect of developing navigable channel as alternate passage bay.

- Met-Ocean data, reports or studies.

- **Environmental Studies:**

Following information / report were needed.

- Second Quarterly Environmental Monitoring report (Sep/Oct/Nov-2014), the one submitted to SEPA
- Monthly Environmental Monitoring report (Dec 2014)
- Updated schedule of activities at EETPL
- Mooring Simulation.
- Report on 1 UCN responding mangrove replantation.
- EETPL's Response to Nov 2014 Environmental Monitoring Report.
- EETPL to share Dec 2014 Environmental Monitoring Report (monthly report).
- EETPL to share Sep/Oct/ Nov 2014 Environmental Monitoring Report (2nd Quarterly Report).
- EETPL to share copy of receiving of submission of Jun/Jul/Aug Environmental Monitoring Report (First Quarter) to SEPA.
- EETPL to share Mangrove Replantation (scoping) Study by IUCN.
- EETPL to share minutes of meeting 7 Jan, 14 Jan.
- Updated Schedule of activities overall and especially environmental post construction.

3. Piling and Concrete Work:

- Test result of deformed and plane steel reinforcement.
- Concrete test result of imported precast concrete piles (English version needed including third party certification).
- Field test result of different coats of painting on steel piles
- Test results of spiral welding of steel piles
- Test report of galvanization of various elements used in the project.
- Test report or manufacturing test report of cement used.
- Punch list for all completed works.
- As built drawings of jetty and pipeline works including allied works.
- Representative cube test result of various elements.

4. Third Party Inspection Report & Approved Documents:

a) Fenders & Accessories.
b) Prefabricated segments of Walkways.
c) Imported mechanical and electrical items including those at jetty and STS Sites.
d) Verified / signed copy of the post dredging survey (soundings) of the berthing basin.

5. Documents required by Granada Group:

Overall Project Schedule	Received
Currently updated copy of the milestone schedule of project implementation activities.	Not Received
A complete list of all the studies and data used for design basis of the Terminal Jetty infrastructure and site selection.	List of Studies has been received which shows a number of essential studies are missing. Met Ocean Data Acquisition Report and the missing parts of the Mooring Study and Mathematical Model of the Hydraulic Study for Terminal Site has now been received.
A complete list of all the vetted and approved design drawings.	A list of Civil Engineering and Structural Drawings has been received from ECIL. No drawings or data received for LNG infrastructure details or the equipment and machinery.
A copy of the Testing Schedule of all the machinery and infrastructure along with the planned testing procedures.	Protocol for Testing has now been received but the Schedule still remains to be finalized.
A copy of Commissioning Schedule and Commissioning Procedure of the Terminal.	Not received
A copy of the Safety and Operations Manual for the Terminal	Operations Manual has now been received for our review which is in progress.
A list of operational staff and their training details as well as qualifications who are to be responsible for the operation of the Terminal and handling any emergency situations	Not received
Details of Fire Fighting and Emergency Stations including design and equipment details as well as the training of staff responsible for handling LNG spill and fires	Not received

Copy of a Full Mission Bridge Simulation (FMBS) Study carried out by the Terminal Developers and results of the same	Has been received and evaluated. Comments forwarded to AEAI. Fresh FMBS Study has been scheduled to be carried at Spain from 16th February with updated data. Results of the Study are being awaited.
List of additional pertinent drawing and documents has also been submitted by ECIL for obtaining the same from PQA/Engro for review.	Full status not known at this time.

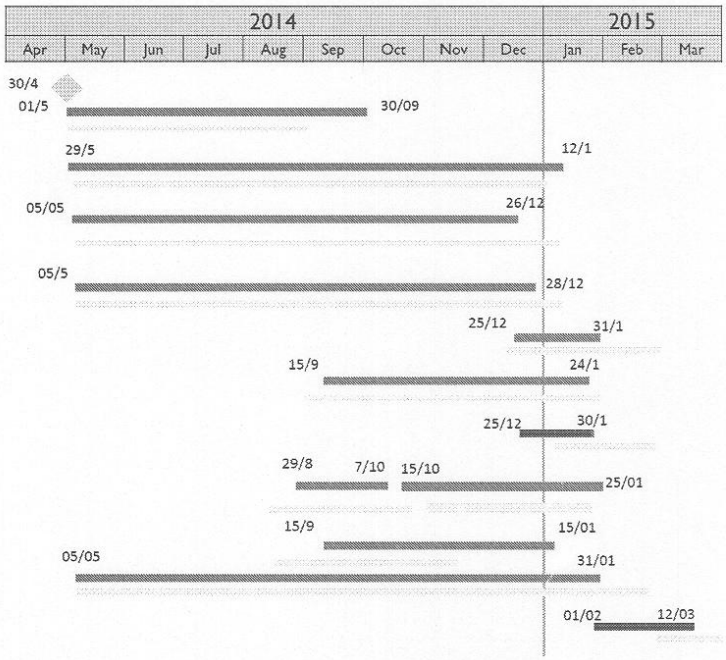
ANNEX – 5

EETPL CONSTRUCTION SCHEDULE

Annex 5

FAST TRACK LNG PROJECT

Project Update
Project Schedule



Current Bar
Baseline
Critical.Path

Note: FSRU Arrives without Carrier

CTS - Custody Transfer Station

JTS - Jetty Top Side

ANNEX – 6

Comments of Environmental Consultants on Reply by IMC in respect of Report of October 2014

Comments of Environmental Consultants on Reply by IMC in respect of Report of October 2014.

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
1.	Pg 2 states that "Mangrove Removal has been completed in July". Details of area affected is missing and need to be provided.	Please see page #3 of October monitoring report where the details of the reclamation are provided in Fig 1.3 The quantity of dredged material is 1.07 million m^3.	The area from which mangrove ecosystem was destroyed is not identified. The extent of reclamation and its area depends on the exactness of the damaged area,
2.	Work Methodology comprising of data collection, sampling technique and testing methodology is not attached. The report (Annexure 1), contains Monitoring Frequency in the Methodology section.	Sampling of air emissions, wastewater and noise are conducted as per the Sampling Rules. The testing methodology is provided in the testing report (please see Annex I).	1) Work Methodologies comprising of: i. Site data collection ii. Sampling & iii. Testing need to be specified in the report. 2) Please specify as to which 'Sampling Rules' are being followed.
3.	October Report Annexure I (as Sept 2014 report): details the monitoring frequency of environmental parameters. The monitoring frequency do not coincide with the frequency given in ESIA approved by SEPA. These include solid waste, dredged material, Bentic Fauna.	The monitoring frequency as per the revised ESIA report. Solid waste is disposed off as per EETPL waste management Plan (**Annex II)** Dredged material is tested monthly and was tested for Oil & Grease and TPH in Sep. and Oct. and tested for Oil & grease, TPH and Heavy metals in November.	For Solid Waste, Annexure-II comprising of 'EETPL's Waste Management Plan' was not in the Environmental Monitoring report of Sep. or Oct. or Nov. 2014 reports provided to ECIL Environmental Consultant. For Dredged Material EETPL and EETPL's IMC are requested to provide document /

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
		Benthic Fuana was checked in December as it takes some time for the regeneration for the species after dredging. (**Report attached in Annex III)**	communication which authorize the change in testing parameters and its frequency within this parameter. For Benthic Fauna: Annexure III was not in the Env. Monitoring report of Sep, Oct or Nov 2014, provided to the ECIL Environmental Consultant. **It is the Consultant's opinion that the reports provided to them were not complete as is evident from IMC's reply also.**
4.	"Occupational Safety" parameter proposed for monitoring in SEPA approved ESIA is not included in the October Report also.	Please see page 9 (Heading: Temporary Construction Camp site) and 12 (Heading: Health and Safety) of October report in which no photograph of slip trip hazard was identified.	A similar heading of the section might have avoided this confusion. Occupational Safety Parameter comprising of Accident and PPE are covered. Any reference to the third parameter of Occupational Safety i.e. Annoyance, could not be seen.
5.	"Land Reclamation" parameter proposed for monitoring in SEPA approved ESIA is not included in the October Report also.	Land Reclamation – Reclamation site is present and the dredged material is stored there pending instructions from PQA regarding its reuse /disposal/ The dredged material sample is checked	The parameter in Land Reclamation is 'Soil Quality' which is interpreted by IMC as Oil & Grease and Total Hydrocarbons. This Consultant interprets Soil Quality to include minerals also.

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
		monthly. Please see section 2.1.5 for dredged material results.	It needs to be decided by SEPA, what is included in Soil Quality.
6.	Test Parameters of different pollution medium as approved in ESIA by SEPA are not followed in October 2014. These include Dredged material (Benthic community, erosion and sedimentation, vegetation,) Marine ecology (biodiversity) Solid waste (quantity and quality) Waste water (Primary pollutants: This needs further interpretation) Soil(contamination, erosion, sedimentation,) Occupational Safety (accidents, PPEs, Annoyance) Land Reclamation (soil quality)	Benthic Community , marine ecology has been checked in December and Report is attached in **Annexure III.** ▪ The reclamation site is lined with geotextile material and the status of the site is checked during monthly visits. ▪ Wastewater is generated only at the temporary constructions site and it is collected in the septic tank and disposed off through KMC . The following parameters are checked for wastewater : pH, BOD, COD , TDS, TSS and Oil and grease against NEQS limits. ▪ Occupational Health and Safety: It is checked and reported on monthly basis under the heading of Temporary Construction Camp Site and Health & Safety. A safety statistics board is	Annexure III was not in the Env. Monitoring report Sep or Oct or Nov 2014 reports provided to Environmental Consultant of ECIL. ▪ PQA may like to comment. ▪ Reference to ECIL Env. Consultant comments, items missing are as follows: i. Dredged material (erosion and sedimentation & vegetation). ii. Solid waste (quantity and quality) iii. Soil contamination, erosion and sedimentation,

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
		maintained notifying accidents /incidents against hours worked (Photo attached in page 12 of October report. ▪ EETL has a comprehensive project management plan and conduct internal audits, toolbox talks and training sessions regularly. (Photos on page 13 of the October report)	
7.	Text of observation is the same with minor changes a) Temporary construction camp site b) Ambient Air Quality c) Generator Emissions d) Noise e) Waste water f) Water and drinking water g) Solid waste h) Health & Safety i) Mangroves removal and replantation. 95% of the text is the same and does not added any value the second time it is repeated. Hence it is better if the same is excluded.	The text of observation remains the same as no major changes have occurred over the past months. The same is included for clarification purposes and summary is included in the quarterly monitoring report to SEPA. It shall be excluded after discussion with EETL	No Comments

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
8.	Ambient Air Quality refers to SEQS pg 14 while Noise refers to NEQS pg 15 while IFC standards proposed for waste water are never referred.	Ambient air quality parameters SEQS were referred in the beginning but after receiving clarification from SEPA regarding the SEQS for ambient air quality, the NEQS for ambient air quality is being followed. IFC standards for wastewater are not being applied here as the wastewater from septic tank is not treated and neither is it being discharged out. The waste water from septic tank is disposed through KMC.	No Comments
9.	October 2014 report does not have laboratory test reports attached to the main report	The reports are being sent to EETL. The test results are reported and discussed in the report. The reports shall be annexed from December.	EETPL should include and provide Test reports with the main Environmental Monitoring Report.
10.	Waste water parameters shown in Oct 2014 report do not comply with NEQS. Environmental Monitoring Report states (pg 16) that "waste water is disposed off via PQA".	The mistake is regretted. The wastewater is disposed off via KMC.	What recommendations / mitigations are being proposed by IMc and implemented by EETPL for wastewater parameters not complying with NEQS?

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
	This transfers the responsibility to PQA the disposal of waste water that is not in compliance with NEQS. Further clarification is needed so as to determine the party responsible for disposal of non-compliant waste water. Corrective measures for complying waste water with PK-NEQS, is in any case, the responsibility of EETPL. Recommendation as to comply waste water with NEQS need to be provided / included in the report for construction as well as operations phase.	The wastewater is collected and disposed via KMC and since no treatment is being done, hence mitigation measures are not recommended . For Operation Phase the wastewater treatment and disposal shall conform to the EMP of the revised ESIA Report.	The comments are repeated. "Corrective measures for complying waste water with PK-NEQS, is in any case, the responsibility of EETPL. Recommendation as to comply waste water with NEQS need to be provided / included in the report for construction as well as operations phase."
11.	Solid waste was generated in the October and its disposal mechanism is stated (pg 10) to be through contractors. Solid waste inventory is required in line with SEPA NOC dated 07-07-2011 section (xv).	Please see Annex II for Solid Waste Management Plan and inventory.	For Solid Waste: Annexure II comprising of 'EETL's Waste Management Plan' was not in the Env. Monitoring report Sep or Oct or Nov 2014 reports provided to Environmental Consultant of ECIL. **It is this Consultant's opinion that the reports provided to us were not complete as is evident from IMC's reply also.**
12.	SEPA Approved ESIA stated that baseline monitoring will be done for:	Baseline monitoring of air emissions and noise was conducted during the ESIA	OK, baseline for air and noise emission were established in the revised ESIA Jan

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
	a) Air emissions and b) noise. The report does not refer to any such activity and discussion of incremental effects on environment due to this project is missing in October report also	study of the project. (ESIA Report dated January 2014) The incremental effects on environment from baseline shall be provided in the December Report.	2014 and also provided to the consultants. What about the Oct, Nov reports?
13.	Because the objective of October report also, stated (Page 4), "IMC will monitor implementation of EMP" SEPA NOC section (vi) "<u>EETPL will strictly adhere to minimize negative environmental impacts on marine ecosystem</u>"; hence the responsibility of implementation of Environmental Management and Monitoring Plan lies on EETPL. Mitigation efforts on EETPL's part in light of Environmental Monitoring Report October 2014, is missing for non-complying items such as waste water.	EETL has a comprehensive Project Management Plan and their contractors M/s China Harbour also have their own Project management plans which have been shared with EMC. As reported earlier, please see reply of #10	No Further Comments from the previous one
14.	Some typo / formatting issues found (e.g. page number missing after pg 13, etc) in Oct Report.	Typo error is regretted and shall be rectified.	No Comments.

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
15.	[Carried forward partially from Sept Report] September Report Executive Summary states that dredging commended in August, however no further discussion is found regarding its quantity, commentary of test results, mode of disposal and approval from SEPA for disposal of the same	The amount of dredged material is 1.07milliom m^3 The dredged material is collected in the cofferdam constructed for the purpose and the testing of dredged material commenced from September. The dredged material shall be disposed off as per advice from PQA.	No Further Comments from the previous one.
16.	[Carried forward partially from Sept Report] Engro and its IMC need to see what parameters for Waste Water and Air Emission, it ought to test in light of **National Environmental Quality Standards (Self-Monitoring and Reporting by Industries) Rules** in line with SEPA NOC dated 07-07-2011 section (xiv)	Wastewater is generated only at the Temporary construction camp and air emissions are generated from the generator at the temporary construction camp and from pipeline laying activity at the jetty The wastewater is collected in septic tank and it is not discharged out but is disposed off through KMC. The primary parameters that are checked are: pH, BOD, COD, TDS, TSS and Oil and Grease. As per the SMART Rules 2001, the wastewater that is discharged out of site	Noted, EETPL has a Zero Liquid Discharge Facility and waste water during its operations phase shall be disposed through contractors to comply with EMP of ESIA.

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
		are to be checked and EVTL is a zero discharge facility	
17.	[Carried forward from Sept Report] Copy of quarterly report submitted to SEPA is required in line with SEPA NOC dated 07-07-2011 section (xiii)	Has been sent and copy provided to EETL with SEPA receipt	Submission of 1st Quarterly Report still pending. Received copy of Submission of 2nd Quarterly Report in Jan 2015.
18.	[Carried forward from Sept Report] Copy of submission to SEPA of lab analysis of dredged material along with approval of mode and area for disposal of the same is required in line with SEPA NOC dated 07-07-2011 section (viii)	Quarterly monitoring report is submitted to SEPA. Two reports have so far been submitted June-August 2014 and September to November 2014.	Issue still pending.
19.	[Carried forward from Sept Report] SEPA approval through NOC dated 07-07-2014 states that IUCN / WWF and Forest Department of Govt. of Sindh will be consulted for mangrove replantation. Engro is only going ahead (as per meeting held on site on 24 dec 2014) with IUCN's proposal; to be shared after August 15, 2014.	EETL has signed MOU with IUCN. EETL shall be consulting with WWF and Forest Department as per conditions of SEPA NOC for the project.	Issue still pending.

Sr. No.	Description	Reply by IMC	ECIL Environmental Consultant's Comments on IMC's reply
20.	[Carried forward from Sept Report] September and October report: mangrove section Pg 19 and Pg 13 respectively states that "mangrove atleast 5 times will be replanted" but SEPA NOC states that it will be ten times the area destroyed.	Typo error is regretted. It is *ten times the amount removed*	No Comments.
21.	[Carried forward from Sept Report] Sept / Oct Report : The concept of testing dredged material is to check the underlying minerals in the sea bed that will be re-suspended due to dredging. Mineral testing is missing in September / October 2014 report.	Heavy metals as well as Oil and Grease and TPH have been tested and reported in November report.	Noted.

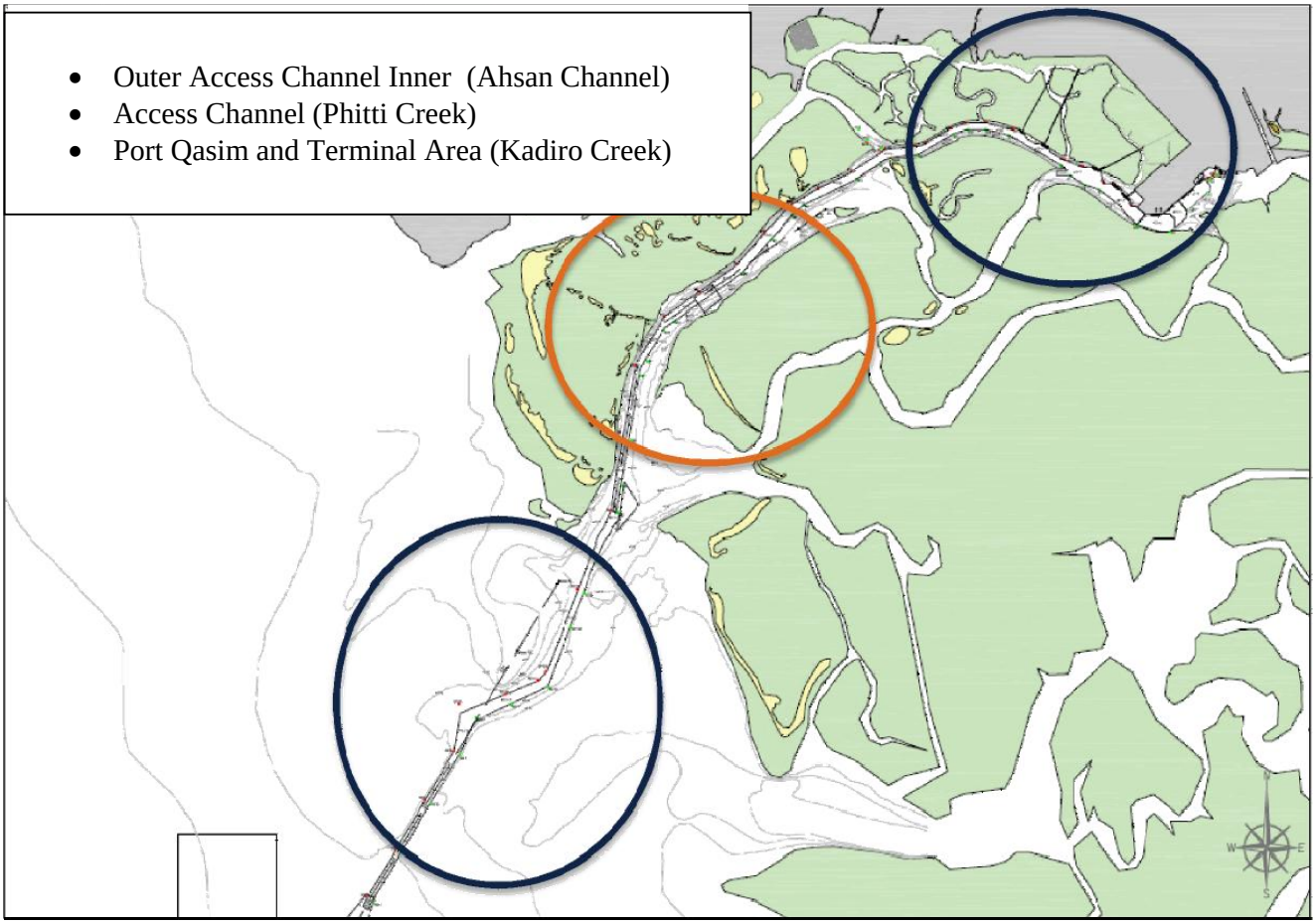
Annex-7

STANDARD OPERATING PROCEDURES FOR OPERATING LNG CARRIERS

The following Standard Operating Procedures (SOPs) have been developed for the operation of Liquefied Natural Gas (LNG) vessels within the limits of Port Qasim and its approaches.

These SOPs have been developed based on recommendations of simulation study carried out at "SiPORT 21" in February 2015. The LNG vessels of up to 217,000 m3 cargo capacity having maximum LOA of 315 meters and maximum Beam of 50 meters with arrival drafts varying from 10.8 meters to 11.50 meters were considered. The corresponding wave heights at these drafts were limited between 2.0 meters to 1.2 meters respectively prevailing at the mouth of the channel entrance (Ahsan channel). Other factors including the existing port regulations, practices and traffic patterns of the port were also considered in the development of these SOPs.

These SOPs are to be read in conjunction with the existing Port Qasim Regulations 1981 and PQA act 1973 and are to be incorporated in the comprehensive Operations Manual to be prepared, duly approved by the PQA and issued by each of the LNG Terminals located within the jurisdiction of Port Qasim Authority.



1. Masters of all ships' using LNG Terminal will be required to sign a copy of the Conditions of Use (COU) and the Marine Services Certificate (MSC) in acknowledgment of the ship's responsibilities and liabilities whilst using the Tug boats, Pilot boats and Terminal etc. prior transiting the Port channel. Copies of both these documents can be found in Appendices at the end of this document.

2. Upon departure of LNG carriers from the load port the Master shall communicate arrival information to the Port Qasim Control through local Agents according to the following requirements:
   - Name and particulars of the LNG Carrier with arrival draft
   - Loading port of the LNG Carrier
   - Time and date when LNG loading was completed
   - The quantity and quality of LNG loaded and the portion of such quantity to be unloaded at the terminal in Port Qasim, if less than the full quantity

- ETA Notice of the LNG Carrier shall be updated (as the case may be) at intervals of 72, 48, 24, 12 & 6 hours prior to vessel's arrival at Port Qasim.

3. If the cargo to be unloaded has been acquired or diverted to the Terminal in Port Qasim, after the departure of the LNG Carrier from the load port or after the relevant time specified above, then the ETA Notice shall be submitted as soon as possible after such acquisition or diversion, but in any event taking into account any applicable requirement for the final time by which the arrival of LNG Carrier shall be notified to the Port Qasim Authority.

4. When in VHF range of the Port Qasim Control, the LNG Carrier shall contact and maintain a listening watch on the Port Qasim Control VHF Operating Channels.

5. Upon arrival at Pilot Station: Notice of Readiness (N/R)
   The notice of readiness is issued by the Master of the Vessel on behalf of the Shippers, Charters or Owner, when the Vessel has arrived at the Arrival Point, has received all necessary Port Clearances and is ready in all respect to proceed to the berth for unloading operations.
   - Vessel's name and IMO number.
   - Date and Time.
   - All equipment's are in good order.
   - Vessels ready to unload in all points.

6. Communication Information

- All communications between the Ship and shore shall be conducted in the English language.
- All pre-arrival information shall be communicated by the Master of the vessel to the Port Qasim Authority through the local shipping agent of the vessel.
- VHF "Operating Channels" Channel 10 or 16 all round the clock.
  Port Qasim Call Sign: PORT QASIM PORT CONTROL
  - Harbor Master Office: +92-21-99272172 24- Hour Phone: +92 21 – 9927 2111-20 Ext. 4294
- PORT FACILITY SECURITY OFFICER' (PFSO)
  PFSO Name : Colonel (Retd) Tanveer Farooqui
  Title : Director Security
  Address : PQA, Bin Qasim Karachi
  Telephone : +92 (021) 99 272 111 (Office), +92 (021) ???? ????
  (Mobile) +92 (021) ???? ???? Fax : +92 (021) ???? ????

Email : secretary@pqa.gov.pk

7. The following checks and tests shall be carried out successfully on board the LNG Carrier according to the specified intervals and duly recorded one day prior to the estimated time of arrival at the Fairway buoy:
   - IMO Water Spray systems …… Every three months
   - Fire pumps ……...……..Every week
   - Inert condition of annular space, primary and secondary space if applicable ……..……At all times
   - Operation of cargo system remote control valves and their position indicators ……...Every week
   - Alarm function of fixed gas detection equipment …….Every week
   - Primary custody transfer and alarm set points ……...Every week
   - Operation of the ESD system…….48 hours prior arrival

8. Through the vessel's Agents, the Masters are obliged to immediately report to the Harbor Master any defects or deficiencies that may affect the safety or the performance of operations to be conducted while the LNG Carrier is within the Port limits/or when the LNG Carrier is at the Terminal.

9. LNG vessels may arrive at Port Qasim Anchorage at any time of the day or night. If required to await berthing at the anchorage, the vessels are to drop their anchors at the designated anchorages for LNG vessels at positions shown below:

   - LNG ' NORTH ' OUTER ANCHORAGE (1.5 NM - 1.82 NM)

     LAT: 24* 33'.50" N -- LONG: 066* 55'.00" E
     LAT: 24* 35'.00" N -- LONG: 066* 55'.00" E
     LAT: 24* 33'.50" N -- LONG: 067* 57'.00" E
     LAT: 24* 35'.00" N -- LONG: 067* 57'.00" E

   - LNG ' SOUTH ' OUTER ANCHORAGE (1.5 NM - 1.82 NM)

     LAT: 24* 32'.00" N -- LONG: 066* 55'.00" E
     LAT: 24* 33'.50" N -- LONG: 066* 55'.00" E
     LAT: 24* 32'.00" N -- LONG: 067* 57'.00" E
     LAT: 24* 33'.50" N -- LONG: 067* 57'.00" E

   The Master of the LNG ship will tender his Notice of Arrival at the LNG Anchorage or on boarding of the Pilots – whichever is earlier, for registration with PQA Control. Embarkation of Pilots onboard the LNG carriers will take effect prior to vessel's entry in the Ahsan channel about 2.5 miles SW of the Fairway Buoy. During the South West Monsoon season or in bad weather conditions, the Pilots may board the inbound vessel through Tugboats instead of Pilot Boats.

10. Pilot allocation will be two Pilots for the transit (in and out). A third berthing pilot will embark on the vessel while she approaches the harbor area to safely berth the vessel alongside. Depending of the duration of the stay of Pilots onboard a due consideration will be given to their rest period and if necessary they will be relieved accordingly without causing any delays to the vessel.

11. As shown in the picture on top of this document, the Port Qasim navigation channel is divided in three legs. The outermost leg (Ahsan Channel) starts from the entry in the Port near the Fairway Buoy and connects with the Phitti Creek at Buoy # B-1/B-2. Phitti Creek (Inner channel) ends in the Kadiro Creek at Buoy G-1/G-2, which extends into Gharo Creek where the Terminal, Turning Basins and the berthing areas of the Port are located.

12. LNG vessels shall transit the Channels escorted by a speed boat carrying armed guards and two tugs at speeds up to about 10 knots with the stern tug made fast. Although the decision as to where to make the tugs fast will be made after consultation between the Pilots and the Master. Preferably, one of the escort tugs shall be attached on the stern (tandem deployment) for inbound and outbound transits of the Port.

13. Based on the results of the navigation simulations with LNG vessels up to 217,000 m3 cargo capacity, the following procedures for entering and navigating the three legs of the channel have been developed and shall be complied with:
    a. The LNG carrier shall enter the Ahsan channel about one hour prior to the top of the High Water provided the transit through the channel to the berth can be completed during daylight hours.
    b. The LNG carrier shall be allowed to enter the channel all-round the year including the South West Monsoons (approximately 15th May – 15th September) under controlled and closely monitored conditions.
    c. Draft of the vessels have to be controlled to meet the PIANC guidelines for the channel which gives the guidance for under-keel clearance depending on High Water Level linked to the height of waves that can exceed 2 meters during the SW Monsoon season. After boarding of the Pilots and prior to commencing the passage in Ahsan channel, an LNG Tug will be made fast to the stern of the vessel. For the tugs to render effectively they have to operate during wave heights limited to 2 meters. A second LNG Tug will escort

ahead of the vessel to keep the channel clear and render any required assistance in case of emergencies. The draft of the LNG vessel has to be maintained between 11.5 meters to 10.8 meters at the starting point of Ahsan Channel according to the following scale of wave heights:

i. Wave Height 2.0 Meters: ……. Arrival Draft 10.8 meters
ii. Wave Height 1.2 Meters……Arrival Draft 11.5 meter

Maximum speed limit of the vessel at the starting point of the Ahsan Channel is 10 knots. For Ahsan Channel arrival maneuvers the wind is to be 20 knots (mean).

14. LNG vessels will not be handled in weather conditions that make operations hazardous (typically wind speeds in excess of 25 knots and wave heights above 2.0m). The actual weather conditions to be determined at the time of the maneuver. Initiating of transit is prohibited if the visibility is less than 2 mile.

15. If weather conditions deteriorate in the Channel, where wave exposure is higher (wave conditions greater than Hs 2.0m) such that there is a concern over the safety of tugs in a tandem deployment, a single escort tug attached to the transom may be deployed with the second tug in passive escort mode. One or more of the following practices shall also be adopted:
    - the speed through the water is reduced to 8 knots or less in the outer channel transit; OR
    - the planned transit of the outer channels will be undertaken on a stemming tide; OR
    - the LNG vessel waits until weather conditions improve.

16. No passing shall take place between an LNG vessel and any vessel other than controlled craft/s during the transit through the Channel area. However, controlled passing with other vessels may be permitted by the PQA under special circumstances provided the LNG vessel is anchored at a safe distance from the channel and is attended by tugs

17. Separation between LNG vessels and other vessels in the Channel in the same direction shall be minimum one (1) hour for all type of vessels throughout the

transit. The draft of the vessel and the escort tug assistance allows for the option of safely aborting the transit at either IOCB or QICT turning basins.

18. LNG vessels to have Electronic Chart Display and Information System (ECDIS).

19. During passage through Phitti Creek the limits of environmental conditions, vessel movement and Tugs assistance is expected to remain as above. However, the senior Pilot and Master will make necessary adjustments depending on the actual conditions prevailing in the channel during passage.

20. On transiting from Phitti Creek to Kadiro Creek the speed will be maintained between 10 to 6 knots at the discretion of the Senior Pilot in conjunction with the Master taking in to account the prevailing weather conditions. The two escort tugs will follow and assist in swinging and berthing the vessel. In addition, two other LNG Tugs will join to assist with the swinging and berthing the vessel as per the requirements of the Pilots.

21. By the time the LNG carrier arrives near the Terminal located within the Gharo Creek, there will be strong ebb tide running which would not be suitable to swing the vessel for bringing her in the required starboard side alongside to the FSRU for discharging her cargo in a ship to ship mode. This is also necessary in order to have the vessel heading in outward bound direction, in case she has to depart during an emergency.

22. The Pilot to make a careful assessment of the prevailing wind, wave, tide and the current condition. If considered safe, the Pilot after consulting with the Master of the ship may decide to swing the vessel on arrival at the turning basin without awaiting the floodtide. Otherwise, the vessel to be anchored at the turning basin waiting for the Flood tide.

23. Whether the LNG vessel is swung to port or starboard is at the discretion of the ship's Pilot and Master.

24. For normal operations a minimum Under Keel Clearance (UKC) of 10% of the vessel's arrival draft shall be retained throughout vessel arrivals and departures in fair weather. During SW monsoons or bad weather when wave heights 2.0 M, then this requirement will increase to 15% when entering the

Ahsan Channel. A UKC of 1.2m is the minimum deemed satisfactory for swinging on arrival and departure for LNG vessels with drafts up to 11.50 meters.

25. A berthing display board (rate, angle, distance off berth) located on wharf shall be provided to be visible from the LNG vessel's bridge in all conditions of daylight and dark. However, since this cannot be arranged on an FSRU for STS operation. The LNG vessel shall carry reliable PPU or other equipment to assist the Pilot in determining the distance of the berth and the speed of the vessel while approaching the FSRU/Berth for mooring.

26. On departure from the Terminal, two tugs will be released in the vicinity of Turning Basin. The remaining two tugs will escort the vessel outbound.

27. While the FSRU is in operation alongside the Terminal jetty, a Tug with firefighting capabilities and a Pilot will remain stand-by at all times with a 30 minutes response time. Pilots will not be required to remain onboard an LNG vessel whilst alongside but must be available within the time specified for the second tug to be in attendance.

28. An additional tug with full fire-fighting capability will be on station at the Terminal whilst an LNG vessel is at the berth alongside the FSRU and should standby during close passing of other ships.

29. As long as practical the passing ship's speed should not exceed more than 6 knots at the toe line.

30. In case where an emergency departure from the berth is necessary, two tugs and a Pilot will be required to un-berth the LNG carrier. Since the vessel will be undergoing cargo operations, she would be pulled away from the FSRU by the two attending tugs after the activation of ERC (to release cargo discharge hoses) and the quick release of mooring hooks on the mooring dolphins and the FSRU, within a short time. The LNG vessel will be removed from the FSRU berth and held in the Turning Basin to await the arrival of additional tugs and Pilots to safely assist her in holding the vessel or for safe departure from the Turning Basin, as necessary. The LNG carrier and the FSRU shall have a dedicated Pilot cabin available for the stand-by Pilot at all times.

31. Operating parameters covering LNG vessel e.g. draft/daylight hour, operation/environmental conditions etc. will be set at a restricted level in the early stages of an LNG Operations. These parameters will be reviewed during the 'settling in period' where the working results can be validated against the simulation results in order to mirror or modify the "operational condition requirements" determined during simulation.

32. Once validation has been completed, then it is expected that LNG vessels will be handled during the hours of darkness subject to suitable weather conditions (simulated first).

33. On departure of LNG Carrier from the Terminal during SW Monsoons or bad weather conditions, the LNG carrier shall provide good lee for the disembarkation of Pilots off the Fairway Buoy. In case, the Pilots are unable to disembark safely from the LNG carrier outbound, then the Pilots will remain onboard and repatriated from the next available disembarkation point with minimal deviation and delay to the vessel on Owner's account. This arrangement, if found necessary, will be made in close coordination between the PQA, the vessels Agents and the Owners of the LNG Carriers.

34. Subject to meeting all the other requirements, the entry of the vessel into the PQA channel on her arrival and the departure from the berth will only commence during daylight hours when it is estimated that the vessel transit will also be completed during daylight hours.

35. Vessel scheduling:

    Priority of shipping will remain as per existing Port Rules except as stated below. Ship scheduling will be carried out as at present by the PQA ship schedulers and in accordance with the following principles:

    a. LNG Vessels will advise their ETAs 48/24/12 and 6 hours prior to arrival at the Fairway Buoy.
    b. Where the schedule of the departing vessels is in conflict with the arrival of the LNG vessel, priority of the use of channel will be given to the departing vessels.

c. Where the channel entry schedule of the LNG vessel comes in conflict with other vessels, priority would be given to the LNG vessels.
d. The ship scheduler will schedule the berthing of the LNG vessel after vessel's ETA is confirmed by the vessel's local agents requesting berth and embarkation of the pilot. This would however depend on the availability of the time slot in consultation with the port and the required environmental conditions.
e. LNG vessels that miss their time slot will be allocated the next available time slot that fits in with other port movements;
f. All vessel movements shall be subject to the approval of the PQA;
g. For tandem tethered towage the vessels will be equipped with adequate bollards and fairleads with the required capacity and configuration for indirect mode of operation of the escort tugs;
h. Vessels will have an International Association of Classification Societies, (IACS) Rating of a minimum CAP 2 for vessels 15 years and older.

36. Additional parameters may be placed on operations at individual terminals as circumstances dictate.

37. These SOPs will be reviewed on a regular basis as the LNG trade continues to develop and may be varied from time to time as considered necessary.

38. Emergency Procedures: The following Terminal information related to "Emergency Signals and Procedures" should be made available to all personnel, on board, involved in the cargo handling or de-ballasting operations at the LNG terminal:

(a) Fire in the terminal
(b) Major Emergency requiring evacuation of terminal
(c) Fire On Board
(d) Medical Emergency On-Board
(e) Emergency Escape Route
(f) Lightening
(g) Safety Clothing: All ship's personnel working on deck must wear the appropriate Personal Protective Equipment
(h) Emergency (remote) Mooring Hooks Release: The Terminal Operator is responsible for the operation of the mooring hooks. Under normal

circumstances, only manual (local) activation of the hook releases is permitted and this operation is to be conducted by the mooring crew of Terminal Operator. In emergency situations, the mooring hooks may be remotely released by the Terminal. For emergency releases, the following procedure must be complied with:

- The Terminal, after receiving clear instructions from the Master shall immediately request verbal confirmation for the emergency release from the duty Pilot, or PQA Operation Room Officer (ORO).
- The duty Pilot or Port Operation Room Officer (ORO) shall confirm emergency release using the statement below:
    - Quote "This is the Duty Pilot, [name] or Operation Room Officer (ORO)- Name, (Name of the Terminal) Terminal, you are authorized for emergency release of the mooring hooks. I repeat, (Name of the terminal) Terminal, you are authorized for emergency release of the mooring hooks. This is the Duty Pilot (Name) or Operation Room Officer (ORO)- Name." Unquote
- This is Duty Pilot, [name] or Operation Room Officer (ORO)

The sequence of hook release indicated by the Ship's Master/Pilot must be strictly adhered to.

(I) Emergency Contact Numbers (From Ship to Shore)

Hot line between Ship and

1. Operations Room Officer : 021-99272174
2. Jetty Control Room : 021-???
3. Fire Station : 021 99272145
4. Medical Centre : 021 99272111-30 (Ext 4275)
5. Security (Main Gate) : 021 9927214511-30 (Ext) 4482

MARINE SERVICES CERTIFICATE

Towage pilot transfer and pilotage
(Marine Services)

Towage and Pilot Transfer

All towage and Pilot transfer services to be provided by PQA Crafts, SMIT Lamnalco / Seamax Marine Services on behalf of Port Qasim Authority within their jurisdiction are subject to the United Kingdom Standard Towage Conditions (1986 edition and following amendments) UKSTC.

Pilotage

At all times the master of the vessel remains responsible for the safety and proper navigation of the vessel. The pilot and Port Qasim Authorites shall be without any responsibility or liability whatsoever, for damage arising directly or indirectly from the advice and actions from the pilot regarding the pilot's services rendered to the vessel regardless of any gross negligence or willful misconduct of the pilot and/or Port Qasim Authorites. Furthermore and in addition to this, the pilotage conditions as publiclsed in the Port Qasim Port Regulations shall apply.

Prior to commencement of any Marine Services, Master shall agree fully to above conditions and to the Port Qasim Port Regulations by signing this form.

Vessel: _____ (Name)
Master: _____ (Name)

_____(Signature)

On termination of the Marine Services, the master and the pilot shall complete and sign this Form. Certifying the details of the services rendered as requested by Master of the vessel.

_____ Inward ____ outward

Name of vessel:	_____	Date:	_____
L.O.A	_____	Forward draft:	_____
G.R.T	_____	Aft draft:	_____
N.R.T	_____	Deepest actual draft:	_____
Time pilot embarked:	_____	Time pilot disembarked:	_____
Passing fairway water:	_____	Berth No:	_____
Ships agent:	_____	Port clearance No:	_____

Assisted / towed / Transferred / stood by:

From:_____to:_____by:_____Pilotboat(s)
From:_____to:_____by:_____tugboat(s)
From:_____to:_____by:_____tugboat(s)
From:_____to:_____by:_____tugboat(s)

Master_____(Name) Pilot_____(Name)

_____(Signature) _____(Signature)

The above name services have been provided by Port Qasim Authorites, SMIT Lamnalco / Seamax Marine Services

Annex - 8

INCEPTION REPORT
FOR GENERAL REVIEW OF JETTY DESIGN
AND
DESK STUDY OF NAVIGATIONAL CHANNELS

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1 INTRODUCTION

In December 2012 the USAID Energy Policy Program (EPP) was launched and includes the services of an international LNG Company to construct a new LNG Terminal at Qasim Port, Pakistan. Together with Engineering Consultants International (Pvt) Limited (ECIL) as the main consultant, Sellhorn Ingenieurgesellschaft mbH, Hamburg, Germany (Sellhorn) provides consultancy services and is reviewing the structural designs concerning marine and civil structures.

In addition, Sellhorn has been requested to carry out a desk study in which the Port Qasim Authority (PQA) anchorage area, the existing navigational channel and alternative channels will be reviewed and suggestions for upgrade will be given.

The present report summarises the results of the above mentioned tasks. It is divided into two parts concerning the following aspects:

Part 1: General Review of Jetty Design

This part is a general observation report on jetty design comprising document review and quality assessment. It investigates the design approaches and particular applied design parameters of trestle, loading platform, mooring and breasting dolphins, and their foundations.

Part 2: Desk Study of Navigational Channels

This part encompasses the study and review of PQA anchorage area, existing navigational channel and alternative channels. Available documents have been collected and investigated and relevant results of hydrological and geological studies compared. Based on this, recommendations for upgrade (straightening, passing bays for two way traffic, widening, and dredging, etc.) are given on conceptual basis. In addition, position and content for additional field measurements, such as waves, currents, and tidal data at the inner and outer channel have been elaborated.

2 GENERAL REVIEW OF JETTY DESIGN

2.1 Scope

As already quoted in Introduction, this observation report investigates the design approaches and particular applied design parameters of trestle, loading platform, mooring and breasting dolphins, and their foundations primarily made by or on behalf of the construction company China Harbour Engineering Company Ltd. (CHEC).

2.2 Received and Reviewed Documents

From January 2015 to March 2015, Sellhornreceived several documents regarding the new LNG terminal at Port Qasim. Table 1 shows the selection of documents directly concerning the jetty design.

Table 1: List of received and reviewed documents concerning jetty design

Internal Doc. No.	Description	Latest Rev.	Document Date	Author	Author's Document Number	Pages	Received
	Studies / Specification						
01	Manoeuvring Simulation Study	2	Oct 2014	Siport21		130	28.01.2015
02	Specification for Quick Release Hook	B	Jul 2014	CCCC	14S400-DD-SP-SG-1004	7	28.01.2015
03	Specification for Test of Tubular Steel Pile	0	Sep 2014	CCCC	14S400-DD-SP-SG-1007	12	28.01.2015
04	Corrosion Protection Coating of Tubular Steel Pile Technical Submission	A	Jul 2014	CCCC	14S400-DD-SP-SG-1008	11	28.01.2015
05	Specification for Dredging (incl. List of STS Activity)	1	Oct 2014	CCCC	14S400-DD-SP-ZT-0001	20	10.03.2014
	Design Documents						
06	Basis of Design - Marine and Structural Engineering	4	Jun 2014	Technica	E-10100111-C-0500-004	38	10.03.2014
07	Marine Structure Calculation Sheet for Mooring Dolphin Foundation	A	Jul 2014	CCCC	14S400-DD-CL-SG-1001	56	28.01.2015
08	Marine Structure Calculation Sheet for Breasting Dolphin Foundation	A	Jul 2014	CCCC	14S400-DD-CL-SG-1002	40	10.03.2014
09	Marine Structure Calculation Sheet for Loading Platform Foundation	A	Jun 2014	CCCC	14S400-DD-CL-SG-1003	39	10.03.2014
10	Marine Structure Calculation Sheet for Trestle Foundation	0	Sep 2014	CCCC	14S400-DD-CL-SG-1004	50	10.03.2014
11	Marine Structure Calculation Sheet for Prestress Longitudinal Beam	A	Jul 2014	CCCC	14S400-DD-CL-SG-1005	45	10.03.2014
12	Marine Structure Calculation Sheet for Longitudinal Beam (non-prestress)	A	Jul 2014	CCCC	14S400-DD-CL-SG-1006	47	10.03.2014
13	Marine Structure Calculation Sheet for Transverse Beam	0	Sep 2014	CCCC	14S400-DD-CL-SG-1007	45	10.03.2014
	Drawings						
14	List of Drawings		Dec 2014			5	28.01.2015
15	Pile Location of Loading Platform	A	Jun 2014	CHEC	14S400-DD-DW-SG-1007	1	28.01.2015
16	Structure of Φ1200 Tubular Steel Pile	A	Jun 2014	CHEC	14S400-DD-DW-SG-1013	1	28.01.2015
17	Pile Location of Trestle	B	Jul 2014	CHEC	14S400-DD-DW-SG-2003	1	28.01.2015
18	Detail of Pile of Trestle	B	Jul 2014	CHEC	14S400-DD-DW-SG-2004	1	28.01.2015
19	Structure of PHC Pile and PHC Pile Shoe	A	Jun 2014	CHEC	14S400-DD-DW-SG-2005	1	28.01.2015
20	Dredging Work	B	Jul 2014	CHEC	14S400-DD-DW-ZT-2001	1	28.01.2015
	Construction Records and Reports						
21	Pile Reports of Breasting Dolphin 1		Oct 2014	CHEC		17	10.03.2014
22	Pile Reports of Breasting Dolphin 2		Oct 2014	CHEC		18	10.03.2014
23	Pile Reports of Loading Platform		Oct 2014	CHEC		20	10.03.2014
24	Pile Reports of Mooring Dolphin 1		Dec 2014	CHEC		14	10.03.2014
25	Pile Reports of Mooring Dolphin 2		Dec 2014	CHEC		9	10.03.2014
26	Pile Reports of Mooring Dolphin 3		Nov 2014	CHEC		9	10.03.2014
27	Pile Reports of Mooring Dolphin 4		Nov 2014	CHEC		14	10.03.2014
28	Pile Reports of Supporting Dolphin 1		Dec 2014	CHEC		2	10.03.2014
29	Pile Reports of Supporting Dolphin 2		Dec 2014	CHEC		2	10.03.2014
30	Concrete Test Report / Concrete Mix Design		Sep 2014	CHEC		29	10.03.2014
31	Data Sheet of Curing Admixture - BASF Masterkure 107		Sep 2005	BASF SE		2	10.03.2014
32	Quality Certificate of 100 PHC Piles		Aug 2014	CHEC		3	10.03.2014
33	Quality Certificates of Structural Steel - Grade Q235B		Aug 2014	misc.		10	10.03.2014

Authors

BASF	BASF SE
CCCC	CCCC-FHDI Engineering Co., Ltd.
CHEC	China Harbour Engineering Company Ltd.
Siport21	Siport21 - Port Engineering and Maritime Safety Consulting
Technica	Technica Ltd.

2.3 Review of jetty design

2.3.1 Studies and Specifications

2.3.1.1 Manoeuvring Simulation Study

Doc 01 is the "Manoeuvring Simulation Study for the New Re-Gasification Terminal in the Port of Qasim (Pakistan)" by Siport21. In this comprehensive technical study the feasibility of access and departure manoeuvres of LNG carriers is analysed from a navigational point of view. Full-bridge real time simulation is used to assess safe navigation and manoeuvring conditions of LNGC vessels in the study area.

The study is inter alia based on bathymetry data from British Admiralty Chart 59 since data from detailed soundings has been received after the study had already started and many manoeuvres executed. Nevertheless, a comparison of obtained bathymetry data and those from detailed sounding has been conducted.

Remarks:

Sellhorn did not receive any bathymetry study or related drawings until completion of this report.

2.3.1.2 Mooring Layout Verification and Mathematical Mooring Model Study

Doc 02 is Report A of the "Mooring Layout Verification and Mathematical Mooring Model Study" by Artelia. It is the draft report of a desk study and berthing energy study to confirm the terminal general layout and the fender characteristics. It presents the methodology used and the results obtained in terms of validation and recommended modification concerning mooring layout and mooring equipment.

Remarks:

Conclusions of the desk study say that

- Mooring Dolphin MD-1 has to be moved 12 m towards NNW
- Fenders on each breasting dolphin have to be replaced by 2 systems (1+1 spare), composed each of one SCK2500H E1.4 fender linked by a panel of at least 20.8 m²
- Layout and mooring configurations will possibly be further improved according to the results of the DIODORE simulations

Since this Report A is dated 1st December 2014, it has to be checked whether these results have been implemented in general layout and finally in construction of the jetty.

Report B, a mathematical mooring study to get tension in each mooring line, breasting force between FSRU and the berth face, and force between the FSRU and the LNG carrier moored to the FSRU to further validate the mooring layout, is not included in this document.

2.3.1.3 Specification for Quick Release Hook

Doc 03 "Specification for Quick Release Hook" by CCCC covers technical requirements for the mooring hooks to be installed by the contractor. It comprises technical requirements (weather and ignition proof, operation in hazardous environment) and codes to be applied (essentially British standards). Details are given for properties, assemblies, coating, and

testing of triple hook and quadruple hook mooring units. Design load for hook design shall be at least 1.25 times the maximum breaking load of mooring lines.

These specifications comply with our assessment.

Remarks:

Sellhorn did not receive any documents regarding construction of quick release hooks until completion of this report. Hence, an evaluation of compliance with the specification is not possible.

2.3.1.4 Specification for Test of Tubular Steel Pile

Doc 04 “Specification for Test of Tubular Steel Pile” by CCCC covers requirements for tests of tubular steel pile for the marine works of LNG terminal. Key objectives of pile tests are to establish the bearing capacity and provide design parameters for tubular steel pile foundation. Provisions are made for test setup and test procedure, and analysis and evaluation of test data. Two types of tests (axial compression and tension test and high strain dynamic test) shall be performed strictly in accordance with BS EN 1997-2:2007 (Eurocode 7).

Remarks:

Sellhorn did not receive any reports or records regarding test of tubular steel pile until completion of this report. Hence, an evaluation of compliance with the specification is not possible.

2.3.1.5 Corrosion Protection Coating of Tubular Steel Pile Technical Submission

Doc 05 “Corrosion Protection Coating of Tubular Steel Pile Technical Submission” by CCCC defines requirements of the materials, surface preparation, application, and inspection of steel tubular pile external corrosion protection coating, including above ground and immersion zone. Provisions are made for corrosion protection coating design, construction process, paint system, product characteristics, and physical and chemical properties.

Remarks:

Coating is designed for an effective period of protection of 30 years; design life time of the jetty is 50 years. For remaining 20 years steel thickness surcharge is 2 mm. According to Doc 6 “Basis of Design - Marine and Structural Engineering” an annual corrosion rate of 0.15 mm/year on each exposed face is adopted. Based on that, the thickness surcharge should be at least 3 mm.

2.3.1.6 Specification for Dredging

Doc 06 “Specifications for Dredging” by CCCC covers technical specifications for dredging work in basin area. It does not include turning area and approach channel. Related drawing is Doc 20 “Dredging Work”. Provisions are made for contractor’s dredging plant, submission of methods of working, tolerances, and general marine works requirements (i.e.

surveys for dredging, spillage and siltation monitoring, bathymetric surveys, and their presentation).

Remarks:

Besides “Specification for Dredging” and one single drawing named “Dredging Work” Sellhorn did not receive any survey and monitoring records nor related drawings until completion of this report.

2.3.2 Design Documents

2.3.2.1 Basis of Design - Marine and Structural Engineering

Doc 07 “Basis of Design - Marine and Structural Engineering” by Technica Ltd (UK), shall be design basis for all marine structures of the jetty and their foundations. The document provides relevant information on facility layout and mooring parameters like mooring arrangement, expected vessels, deck levels, and mooring equipment.

The chapter Metocean Parameters covers a desk study on tides and tidal current, wind, waves, and tsunami at Port Qasim. As a result three different metocean design cases are derived for mooring equipment and hooks (FSRU Only and Ship2Ship Arrangement) as well as for dolphins and platform (Structures Extreme).

In chapter Marine Structures design philosophy and design criteria based on British standards are provided for mooring and berthing dolphins, platform, trestle, and walkways. The definitions for surface finish state that steelwork used for installations should generally be hot-dip galvanized for durability. Items within the splash and intertidal zones may be coated. For determination of losses due to corrosion of unprotected steel plates, it is recommended that an annual corrosion rate of 0.15 mm/year on each exposed face is adopted.

Furthermore, some seismic criteria are recommended. The values Peak ground acceleration (PGA) is derived from Unified Facilities Criteria UFC 3-301-01 by Department of Defence of United States of America (DoD). For Karachi a PGA of 0.158g with a probability of exceedance of 10% in 50 years (or equivalent reference return period of 475 years) is given. This complies with our assessment.

Mooring line load philosophy is based on minimum breaking loads (MBL) of mooring lines. For in-place analysis, one winch shall be considered to be stuck (100% MBL), and the remaining winches slipping (60% MBL). For seismic analysis, all lines shall be considered to have reached 60% MBL, with no winches sticking. This approach corresponds to recommendations of EAU, taking into account 25% increase in line pull due to strong currents (5 knots).

Remarks:

In chapter Geology it is stated solely that geotechnical design parameters are to be provided by CHEC. Sellhorn did not receive them until completion of this report.

There are no provisions made regarding the following aspects:

- Increase of design depth for foundation design because of scouring and over-dredging.

- Limitation of crack width in concrete structures to prevent corrosion induced by chlorides from sea water; Sellhorn recommends to use a crack width for reinforced concrete structures in quasi-permanent load combination, and decompression for pre-stressed concrete members in frequent load combination according to Eurocode 2 (exposure class XS3: tidal, splash and spray zones).

2.3.2.2 Marine Structure Calculation Sheet for Mooring Dolphin Foundation

Doc 08 “Marine Structure Calculation Sheet for Mooring Dolphin Foundation” by CCCC covers the calculation of tubular steel pile foundation for mooring dolphins MD-1 and MD-4 (12 m x 12 m) and mooring dolphins MD-2 and MD-3 (9 m x 9 m). Applied design codes and standards are API RP2A, Eurocode 3, EAU 2004, OCDI and BS 6349-1-6.

Geotechnical data is taken from geotechnical report, which has not been received by Sellhorn until completion of this report, but some relevant results of borehole MT31 are summarized in calculation sheet in hand.

Modelling of pile foundation and superstructure using linear-elastic 3D finite element analysis, load application, and derivation of internal forces look reasonable, although load direction could not be checked because of missing detailed mooring-plan showing mooring lines for different mooring scenarios of FSRU and LNGC vessels.

Stress results are assumed to be right.

Safety factors are derived according to API. For ultimate static capacity loads are multiplied by a factor of 2.0 (seismic 1.3); for working stress of steel a factor of 1.0 (seismic 1.7) is applied. Seismic force is calculated based on design ground acceleration being 1.4 times the proposed peak ground acceleration. For internal resistance of tubular steel piles this safety concept corresponds to Eurocode. Additionally, remaining safety for external pile resistance is derived. Calculated values are greater than 3.0, but are based on over-estimated axial bearing capacity (see remarks). After re-calculation remaining safety for external pile resistance shall not be less than 1.5.

Remarks:

Detailed soil identification from geological report is missing. Summary of adopted soil parameters provides subsoil data down to pile tip level at -30 mCD (referred to Chart Datum). Sections of mooring dolphins show minimum level of coarse gravel of -31.74 mCD only. To activate pile tip resistance to derive ultimate bearing capacity for compression piles it has to be verified that there are no soft soil layers or depositions within a range of three times the pile diameter underneath the pile tip. Hence, existence of soil type ④1 (hard sandy CLAY) has to be proven down to -34 mCD at least.

Additionally, portion of pile bearing capacity resulting from shaft friction is derived taking into account subsoil layers ②4 (-11.5 mCD to -15.2mCD) and ②5 (-15.2 mCD to -16.3mCD). Constructed dredging bottom level is –14 mCD (according to drawing 14S400-DD-DW-ZT-2001) to accommodate Q-Flex vessels. Proposed dredging level by CHEC is -15 mCD. Design depth for piles should be at least -17 mCD, taking into account scouring and over-dredging. Hence, vertical pile resistance in compression and tension is slightly over-estimated (max. 10%). Furthermore, no calculations are made to proof lateral pile bearing capacity and pile group effects.

Results for static and calibrated dynamic load tests have not been received.

2.3.2.3 Marine Structure Calculation Sheet for Breasting Dolphin Foundation

Doc 09 “Marine Structure Calculation Sheet for Breasting Dolphin Foundation” by CCCC covers the calculation of tubular steel pile foundation for breasting dolphins BD-1 and BD-2 (16 m x 18 m). Applied design codes and standards are API RP2A, Eurocode 3, EAU 2004, OCDI and BS 6349-1-6.

Geotechnical data is taken from geotechnical report, which has not been received by Sellhorn until completion of this report, but some relevant results of borehole MT04 are summarized in calculation sheet on hand. Summary of adopted soil parameters provides subsoil data down to pile tip level at -30 mCD (referred to Chart Datum). Sections of breasting dolphins show minimum level of coarse gravel of -33.8 mCD.

Modelling of pile foundation and superstructure using linear-elastic 3D finite element analysis, load application, and derivation of internal forces look reasonable, although load direction could not be checked because of missing detailed mooring-plan showing mooring lines for different mooring scenarios of FSRU and LNGC vessels.

Stress results assumed to be right.

Berthing load is based on rubber fender SCK2500H E1.4 resulting from “Mooring Layout Verification and Mathematical Mooring Model Study” (Doc 02).

Safety factors are derived according to API. For ultimate static capacity loads are multiplied by a factor of 2.0 (seismic 1.3); for working stress of steel a factor of 1.0 (seismic 1.7) is applied. Seismic force is calculated based on design ground acceleration being 1.4 times the proposed peak ground acceleration. For internal resistance of tubular steel piles this safety concept corresponds to Eurocode. Additionally, remaining safety for external pile resistance is derived. Calculated values for compression piles are greater than 3.79, but are based on over-estimated axial bearing capacity (see remarks). After re-calculation remaining safety for pile resistance shall not be less than 2.0. At berthing dolphin BD-2 the factor of safety against pullout is only 1.9 (less than 2.0), based on over-estimated axial bearing capacity.

Remarks:

Detailed soil identification from geological report is missing.

No calculations are available to proof lateral pile bearing capacity and pile group effects.

Pull-out capacity of tension piles at BD-2 should be re-evaluated in more detail (including consideration of pile group effects) in order to achieve safety of 2.0 for ultimate static capacity.

2.3.2.4 Marine Structure Calculation Sheet for Loading Platform Foundation

Doc 10 “Marine Structure Calculation Sheet for Loading Platform Foundation” by CCCC covers the calculation of tubular steel pile foundation for loading platform (40 m x 18 m). Applied design codes and standards are API RP2A, Eurocode 3, EAU 2004, OCDI and BS 6349-1-6.

Geotechnical data is taken from geotechnical report, which has not been received by Sellhorn until completion of this report, but some relevant results are summarized in calculation sheet on hand. Summary of adopted soil parameters provides subsoil data down to pile tip level at -32.6 mCD (referred to Chart Datum).

Modelling of pile foundation and superstructure using linear-elastic 3D finite element analysis, load application, and derivation of internal forces look reasonable. Stress results assumed to be right.

Safety factors are derived according to API. For ultimate static capacity loads are multiplied by a factor of 2.0 (seismic 1.3); for working stress of steel a factor of 1.0 (seismic 1.7) is applied. Seismic force is calculated based on design ground acceleration being 1.4 times the proposed peak ground acceleration. For internal resistance of tubular steel piles this safety concept corresponds to Eurocode. Additionally, remaining safety for external pile resistance is derived. Calculated values are greater than 2.7, but are based on over-estimated axial bearing capacity (see remarks). After re-calculation remaining safety for pile resistance shall not be less than 2.0.

Remarks:

Detailed soil identification from geological report is missing.

Portion of pile bearing capacity resulting from shaft friction is derived taking into account subsoil layers ②3 (-15.0 mCD to -16.1 mCD) and ③2 (-16.1 mCD to -21.7mCD). Constructed dredging bottom level is –14 mCD (according to drawing 14S400-DD-DW-ZT-2001) to accommodate Q-Flex vessels. Proposed dredging level by CHEC is -15 mCD. Design depth for piles should be at least -17 mCD, taking into account scouring and over-dredging. Hence, vertical pile resistance in compression and tension is slightly over-estimated (max. 10%). Furthermore, no calculations are made to proof lateral pile bearing capacity and pile group effects.

2.3.2.5 Marine Structure Calculation Sheet for Trestle Foundation

Doc 11 “Marine Structure Calculation Sheet for Trestle Foundation” by CCCC covers the calculation of the trestle foundation made of precast, pre-stressed tubular concrete piles (PHC piles Ø1000 mm, wall thickness 130 mm). Length of trestle is 515.1 m, width is 7.9 m. Applied design codes and standards are API RP2A, Eurocode 2, EAU 2004, OCDI and BS 6349-1-6.

Geotechnical data is taken from geotechnical report, which has not been received by Sellhorn until completion of this report, but some relevant results are summarized in calculation sheet on hand. Summary of adopted soil parameters provides subsoil data down to pile tip level at -23.0 mCD (referred to Chart Datum).

Modelling of pile foundation and superstructure using linear-elastic 3D finite element analysis, load application, and derivation of internal forces look reasonable. Stress results assumed to be right.

Safety factors are derived according to API. For ultimate static capacity loads are multiplied by a factor of 2.0 (seismic 1.3). Seismic force is calculated based on design ground acceleration being 1.4 times the proposed peak ground acceleration. For internal resistance of tubular steel piles this safety concept corresponds to Eurocode. Additionally, remaining safety for external pile resistance is derived. Calculated values are greater than

3.2, but are based on over-estimated axial bearing capacity (see remarks). After re-calculation remaining safety for pile resistance shall not be less than 2.0.

Partial factors and combination factors for Limit State Design (ULS and SLS) are derived according to BS 6349, what corresponds to Eurocode.

Remarks:

Detailed soil identification from geological report is missing.

Portion of pile bearing capacity resulting from shaft friction is derived taking into account subsoil layers ②4 (-12.0 mCD to -16.3 mCD) and ③2 (-16.3 mCD to -22.0 mCD). Constructed dredging bottom level is –14 mCD (according to drawing 14S400-DD-DW-ZT-2001) to accommodate Q-Flex vessels. Proposed dredging level by CHEC is -15 mCD. Design depth for piles should be at least -17 mCD, taking into account scouring and over-dredging. Hence, vertical pile resistance in compression and tension is slightly over-estimated (max. 10%).

Furthermore, no calculations are in hand to proof lateral pile bearing capacity.

Pile group effects may not be considered here.

2.3.2.6 Marine Structure Calculation Sheet for Prestress Longitudinal Beam

Doc 12 “Marine Structure Calculation Sheet for Prestress Longitudinal Beam” by CCCC covers the design of the prestressed longitudinal beams for the trestle. Applied design codes and standards are Eurocode 2, BS 6349-2 and EN 10138.

Modelling of precast, prestressed concrete beams using linear-elastic 2D finite element analysis, load application, and derivation of internal forces look reasonable. Stress results assumed to be right.

Design calculations of pre-stressed concrete structure are done according to Eurocode 2 for ultimate limit state (ULS) and serviceability limit state (SLS); crack width calculations and prestress loss are included. Partial safety factors for jetty structures are derived from BS 6349-2. Specified concrete cover for prestressing strands and ordinary reinforcement is sufficient for the exposure of the structure to chlorides from sea water.

Remarks:

Crack width of bottom flange is calculated to 0.12 mm under frequent combination; Eurocode 2 recommends decompression for prestressed members with bonded tendons exposed to chlorides from sea water (XS3).

Unusual mix of standards for loads (partial safety factors) and design procedure for precast, pre-stressed concrete beams.

2.3.2.7 Marine Structure Calculation Sheet for Longitudinal Beam (non-pre-stress)

Doc 13 “Marine Structure Calculation Sheet for Longitudinal Beam (non-prestress)” by CCCC covers the design of the shorter, non-prestressed longitudinal beams for the trestle. Applied design codes and standards are Eurocode 2 and BS 6349-2.

Modelling of concrete beams using linear-elastic 2D finite element analysis, load application, and derivation of internal forces look reasonable. Stress results assumed to be right.

Design calculations are done according to Eurocode 2 for ultimate limit state (ULS) and serviceability limit state (SLS); crack width calculation is included. Partial safety factors for jetty structures are derived from BS 6349-2. Specified concrete cover for reinforcement is sufficient for the exposure of the structure to chlorides from sea water.

Shear design of concrete beams is done using angle of compression strut $\theta = 21.8°$ ($\cot\theta = 2.5$); recommended for reinforced concrete beam subjected to bending (no axial compression) is $\theta = 40°$ ($\cot\theta = 1.2$). Hence, required shear reinforcement is $A_{sw,req} = 156.5\ mm^2 \approx 157.1\ mm^2 = A_{sw,design}$.

Remarks:

Unusual mix of standards for loads (partial safety factors) and design procedure for reinforced concrete beams.

Shear design barely sufficient.

2.3.2.8 Marine Structure Calculation Sheet for Transverse Beam

Doc 14 “Marine Structure Calculation Sheet for Transverse Beam” by CCCC covers the design of the transverse beam of the trestle. Applied design codes and standards are API RP2A, Eurocode 2, EAU 2004, OCDI and BS 6349-1-6.

Modelling of concrete superstructure using linear-elastic 3D finite element analysis, load application, and derivation of internal forces look reasonable. Same model as for the design of trestle foundation (Doc 11) is used.

Design calculations are done according to Eurocode 2 for ultimate limit state (ULS) and serviceability limit state (SLS); crack width calculation is included. Partial safety factors for jetty structures are derived from BS 6349-2. Specified concrete cover for ordinary reinforcement is sufficient for the exposure of the structure to chlorides from sea water.

Design is done for uniaxial bending (M_y) and shear (SF_z) only. Due to foundation on three inclined piles bending moments and shear forces about the two cross-sectional axes as well as torque do arise (M_z, SF_y and M_x, respectively). Bending moment M_z is small compared to M_y, hence design calculations might be omitted.

Remarks:

Unusual mix of standards for loads (partial safety factors) and design procedure for reinforced concrete structures.

2.3.3 Drawings

Few drawings have been received by Sellhorn, which do not give an overview of the structure(s) but showing construction details. One general drawing of dredging works and pile locations of loading platform and trestle structural details of tubular steel piles and PHC piles is in hand.

Detailed design drawings, section drawings, and mooring-plan have not been received.

2.3.4 Construction Records and Reports

2.3.4.1 Record Sheets of Piling Work

Docs 22 to 30 provide "Record Sheets of Piling Work" for all structures with steel pile foundations. The tubular steel piles (Ø1250 mm, Steel Grade Q345B) of different length have been driven by Diesel Hammer D180.

Some of the piles did not archive design depth. Hence, high dynamic load tests as specified in Doc 04 "Specification for Test of Tubular Steel Pile" should have been performed.

At some piles coating was damaged and had to be repaired as per specification "Corrosion Protection Coating of Tubular Steel Pile Technical Submission" (Doc 05).

Remarks:

Record sheets of breasting dolphin BD-1 and loading platform LP are wrongly designated as PHC piles.

2.3.4.2 Certificates

Docs 31 to 34 provide various certificates and reports on product quality and material tests. Most of them are written in Chinese language.

2.4 Summary of remarks on jetty design

2.4.1 General

A set of documents has been received by Sellhorn during the months December till March 2015 to be reviewed and evaluated concerning proper design and construction quality. Some of them apply to safe construction (e.g. Construction Site HSE Manual etc.) and proper port operation (e.g. HAZID/HAZOP Study etc.) of the LNG terminal, and therefore they are not part of this review.

Various essential documents have not been received by Sellhorn, so that the design review could not be done as detailed as necessary.

An indicative list of documents which should be prepared is shown below:

Studies and Specifications:

- bathymetry study of mooring basin
- geotechnical investigations / geology / design ground profile

Design calculations

- Structural design calculations for superstructures of dolphins and loading platform including connection of steel piles and superstructure
- Calculation Sheet for Supporting dolphins

- Calculation of lateral pile resistance and pile group effects

Drawings

- Plan of general layout
- Elevation of jetty with level of different structures
- Detailed design drawings
- Detailed section drawings of
  - Trestle and supporting structures
  - Mooring and breasting dolphins
  - Loading platform
- Sequence of working (dredging, drilling, reclamation etc.)

Construction Records and Reports

- Sounding of basin after dredging
- Results of pile tests

2.4.2 Evaluation of Jetty Design

Besides the fact that essential information is missing to completely assess the overall jetty design, remarks and recommendations on jetty design can be summarized as followed:

- Generally, the structural design of the jetty coincides with requirements of European standards and design codes, but is not fulfilling them completely
- Vertical pile resistance has to be re-evaluated considering pile group effects.
- Reinforced and pre-stressed concrete members, where calculated crack width does not satisfy recommendations of Eurocode 2, should be monitored on a frequent basis, and mitigations measures brought in place if found faulty.

This evaluation of jetty design is based the assumption, that all design parameters in the calculation sheets for foundations and superstructures which could not have been cross-checked because of missing documents (especially soil identification from geological report) are correct and accurately applied.

3 DESK STUDY OF NAVIGATIONAL CHANNELS

3.1 Overview

The desk study on the navigational channels aims to explore the current limitations relating to ship size of the existing channel and the required dimensions for the prospected design ships.

Furthermore, recommendations are made for limitations on physical conditions, e.g. wind, waves, tide levels and current, to ensure safe navigation.

It is not the intent of this study to replace real time simulation for the navigation or in depth mooring studies by numerical modelling.

Design guidelines used for the development of the access channel have been published by various organizations that specialize in the transportation of petroleum products and / or navigation safety issues, namely:

- OCIMF – Oil Companies International Marine Forum
- PIANC – Permanent International Association of Navigation Congresses
- SIGTTO – Society of International Gas Tanker and Terminal Operators Ltd
- Transport Canada– TERMPOL review process

3.2 Physical Conditions

3.2.1 General

The port of Qasim is located in the Indus river delta region South East of Karachi on the Arabian Sea. A 45 km long access channel from the sea through the mangroves and mudflats of the Indus River leads to the port.

The channel can be divided in to four main stretches:

- The Ashan channel compromises the entire entrance channel from the ocean up to the Phitty Creek entrance. See Figure 1.

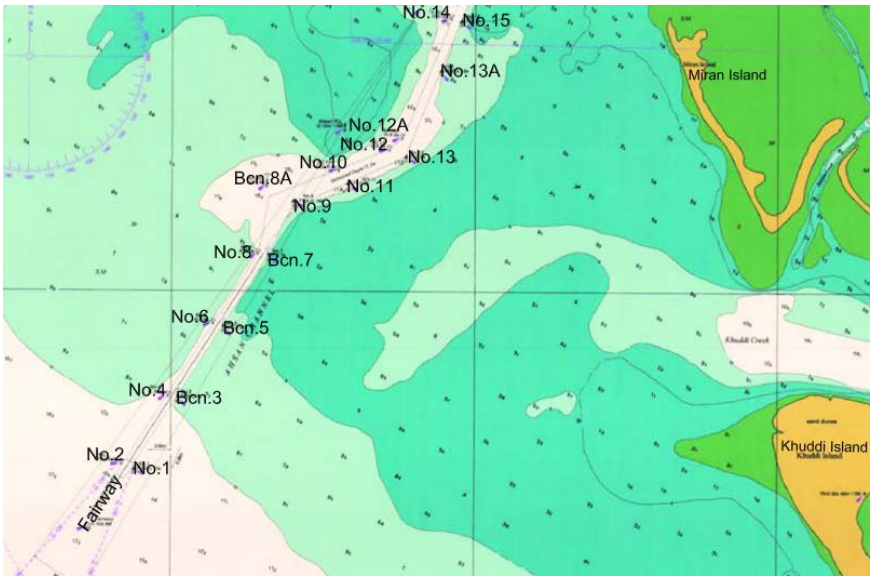

Figure 1: Entrance and Ashan channel

Source: Admiralty Nautical Chart 20 Port Muhammad Bin Qasim and Approach

- Phitti Creek comprises the beginning of the inner channel from the start of the Phitti Creek to the start of the Kadiro Creek. See Figure 2.

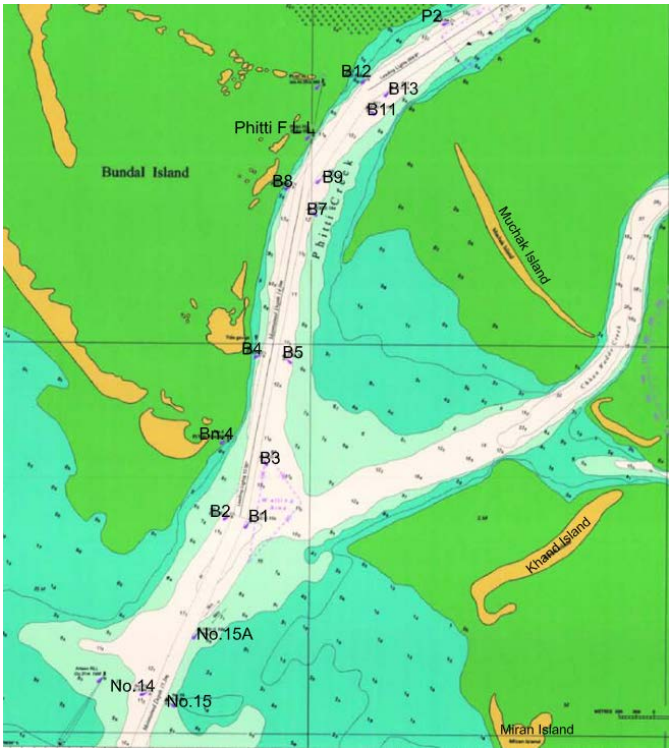

Figure 2: Phitti Creek

Source: Admiralty Nautical Chart 20 Port Muhammad Bin Qasim and Approach

- Kadiro creek comprises the last part of the inner channel before reaching the port. See Figure 3.

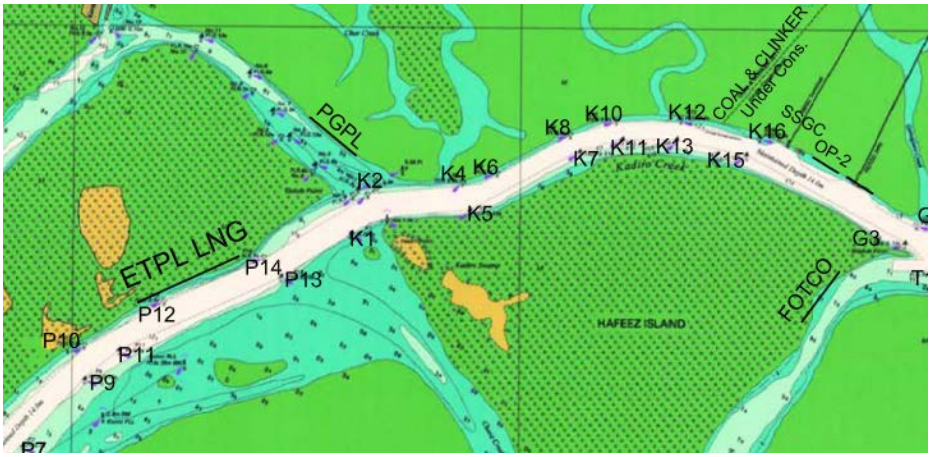

Figure 3: Kadiro Creek

Source: Admiralty Nautical Chart 20 Port Muhammad Bin Qasim and Approach

- At the end of a 45 km long access channel lies port Qasim. See Figure 4.

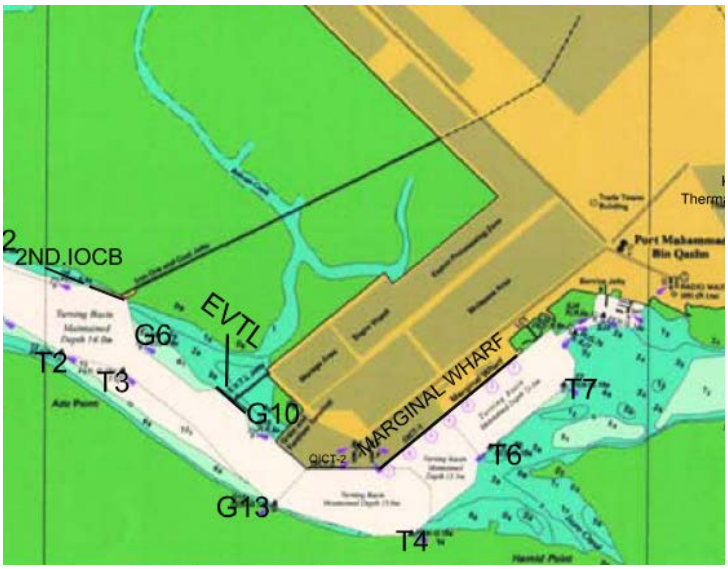

Figure 4: Port Qasim

Source: Admiralty Nautical Chart 20 Port Muhammad Bin Qasim and Approach

3.2.2 Wind

The wind mainly comes from NE during the winter monsoon with a maximum speed of 25 knots. During the summer monsoon the wind comes from the SW and reach speeds up to 35 knots.

3.2.3 Current

Tides affect the intensity of the currents. Tides are generally stronger during ebb than flood. See below Table 2 for current in the channel, based on table 4 in the Manoeuvring Simulation Study.

Table 2: Currents in the channel

Area	Max. Speed (knots)	Orientation relative to ship movement
Turning Basin	1	parallel
Kadiro Creek	2	slight transverse
Phitty Creek	5	transverse
Phitty Entrance	3	transverse
Ahsan Bend	3	transverse
Ahsan Channel	3	transverse

3.2.4 Tide

The port experiences a semi-diurnal tide with a diurnal component. The average tide period is 12,4 hrs. The highest astronomical tide is at +4 m CD (HAT) and the lowest astronomical tide at +0,6m CD (LAT)

3.2.5 Waves

Wave information is not dependable, but PQA pilots estimates that waves in the entrance channel reach heights of 3 to 4 m. The waves break on the flats near the Ashan channel limiting the height of the waves to 0,5 to 0,7 m. Waves in the inner channel are limited to 0,5 m.

Wave data can be obtained by installing wave rider buoys or alternatively doing near shore transformation modelling with data from offshore buoys.

3.2.6 Water Density

The water density used throughout this document is 1025 kg/m³. It is however important to note that the location of the port and access channel is in a transition zone between fresh and sea water. Changes in the water density are possible. This in turn will have an effect on ships draft and channel depth requirements.

3.2.7 Depth

Depths given by the port for the channel sections are given in Table 3.

Table 3: Water depths

Area	Depth (m CD)
Turning Basin	15
Kadiro Creek	14
Phitty Creek	14
Ahsan Channel	15,3

3.2.8 Width

The channel sections have varying width. See Table 4 below.

Table 4: Channel widths

Area	Width min (m)
Turning circle	± 225 m (diameter)
Kadiro Creek	200-250
Phitty Creek	200
Phitty Entrance	200

Ahsan Bend	565
Ahsan Channel	200

3.3 Design Ship

3.3.1 Planned

For the LNG jetty two different types of ships are foreseen:

- FSRU: Floating Storage and Regasification Unit
- LNGC: Liquid Natural Gas Carrier

In the start of the terminal operations a FSRU with a 138,000m³ capacity is foreseen. The FSRU will later be replaced by a larger 150,900m³ FSRU and in the last stage with a 173,400 m³, if the terminal proves sustainable.

See below Table 5 and *Table 6: LNGC dimensions*Table 6 for the ship dimensions.

Table 5: FSRU dimensions

Capacity (m³)	138.000	150.900	173.400
LOA (m)	277	291	294,5
Breadth (m)	43,4	43,4	46,4
Draft (m)	11,5	11,6	11,6
Displacement (t)	100.900	107.000	121.000

Table 6: LNGC dimensions

Capacity (m³)	125.000	217.000 (Qflex)	266.000 (Qmax)
LOA (m)	285,3	315,0	345,0
Breadth (m)	43,7	50,0	53,8
Draft (m)	11,1	12,0	12,0
Displacement (t)	98.546	143.400	175.000

3.4 Channel Nautical Requirements

3.4.1 Depth

Depth requirements given by PAINC consider various factors as shown in Figure 5. SIGGTO recommends a minimum ratio between the ship's draft and UKC, but only considers relatively calm conditions.

Description	Vessel speed	Wave conditions	Channel bottom	Inner channel	Outer channel
Depth, h	≤ 10 knots	None	-	1.10 T	-
	10-15 knots		-	1.12 T	-
	>15 knots		-	1.15 T	-
	All	Low swell ($H_s < 1$ m)	-	-	1.15 T to 1.2 T
		Moderate swell (1 m < H_s < 2 m)	-	-	1.2 T to 1.3 T
		Heavy swell ($H_s > 2$ m)	-	-	1.3 T to 1.4 T
	Add for channel bottom type:				
	All	All	Mud	None	None
			Sand/clay	0.4 m	0.5 m
			Rock/coral	0.6 m	1.0 m

Notes.
1. Assumes ship draught, T, greater than or equal to 10 m. If draught is less than 10 m, then use values for 10 m draught
2. Swell means waves with peak periods greater than 10 s
3. For outer channel, use lower value for northern hemisphere and higher value for southern hemisphere
4. Value of Hs is dependent on required operation, design ship type, level of accessibility, wave period, and relative wave direction
5. Salt-water assumed for ship draught so additional adjustments required for fresh water

Figure 5: Channel depth consideration

Source: PIANC Report 116, 2012

The main ship dimension for determining the depth / vertical requirement for the channel is the draft of the ship. See Table 7 for the required depths for the type of ship and section of the channel. The depths as shown in the table are required water depths and are not to Chart datum. To determine Chart datum levels for the channel tidal restrictions will need to be determined.

Table 7: Channel depth requirements

Area	H_s (m)	Ship	Draft (m)	Depth requirement PIANC (m)
Turning Basin / Kadiro Creek / Phitty Creek	0.5	LNGC 125,000 m³	11.1	12.77
	0.5	FSRU 138,000 m³	11.5	13.23
	0.5	FSRU 150,900 m³ / 173,400 m³	11.6	13.34
	0.5	Qflex / Qmax	12.0	13.80
Phitty Entrance	0.7	LNGC 125,000 m³	11.1	12.77
	0.7	FSRU 138,000 m³	11.5	13.23
	0.7	FSRU 150900 m³ / 173,400 m³	11.6	13.34
	0.7	Qflex / Qmax	12.0	13.80
Ahsan Bend / Ashan Channel	3	LNGC 125,000 m³	11.1	15.54
	3	FSRU 138,000 m³	11.5	16.10
	3	FSRU 150,900 m³ / 173,400 m³	11.6	16.24
	3	Qflex /Qmax	12.0	16.80

3.4.2 Width

Considering the existing channel width for the desk study a one way channel is considered. Due to the 45 km length of the channel safe passing areas will be considered and the possibility of dredging an additional/alternative channel cf. 3.9.

The minimum width recommended by the SIGGTO is 5 times the beam of the ship while TERMPOL recommends a minimum of at least 4 times the beam. PIANC recommends the following calculation be done: $w = w_{BM} + \sum_{i=1}^{n} w_i + w_{Br} + w_{Bg}$

w_{BM} is the basic manoeuvring lane of the ship, w_{Br} and w_{Bg} are bank clearance required to reduce bank effect on ships. For w_i, w_{Br} and w_{Bg} see Figure 6 and Figure 7.

For channel width requirements see Table 8.

Width W_i	Vessel Speed	Outer Channel (open water)		Inner Channel (protected water)	
(a) Vessel speed V_s (kts, with respect to the water)					
$V_s \geq 12$ kts	fast	0.1 B			
8 kts ≤ V_s < 12 kts	mod	0.0			
5 kts ≤ V_s < 8 kts	slow	0.0			
(b) Prevailing cross wind V_{cw} (kts)					
- mild	fast	0.1 B			
V_{cw} < 15 kts	mod	0.2 B			
(< Beaufort 4)	slow	0.3 B			
- moderate	fast	0.3 B			
15 kts ≤ V_{cw} < 33 kts	mod	0.4 B			
(Beaufort 4 - Beaufort 7)	slow	0.6 B			
- strong	fast	0.5 B			
33 kts ≤ V_{cw} < 48 kts	mod	0.7 B			
(Beaufort 7 - Beaufort 9)	slow	1.1 B			
(c) Prevailing cross-current V_{cc} (kts)					
- negligible V_{cc} < 0.2 kts	all	0.0		0.0	
- low	fast	0.2 B		0.1 B	
0.2 kts ≤ V_{cc} < 0.5 kts	mod	0.25 B		0.2 B	
	slow	0.3 B		0.3 B	
- moderate	fast	0.5 B		0.4 B	
0.5 kts ≤ V_{cc} < 1.5 kts	mod	0.7 B		0.6 B	
	slow	1.0 B		0.8 B	
- strong	fast	1.0 B		-	
1.5 kts ≤ V_{cc} < 2.0kts	mod	1.2 B		-	
	slow	1.6 B		-	
(d) Prevailing longitudinal current V_{lc} (kts)					
- low	all	0.0			
V_{lc} < 1.5 kts					
- moderate	fast	0.0			
1.5 kts ≤ V_{lc} < 3 kts	mod	0.1 B			
	slow	0.2 B			
- strong	fast	0.1 B			
$V_{lc} \geq 3$ kts	mod	0.2 B			
	slow	0.4 B			
(e) Beam and stern quartering wave height H_s (m)					
- $H_s \leq 1$ m	all	0.0		0.0	
- 1 m < H_s < 3 m	all	~0.5 B		-	
- $H_s \geq 3$ m	all	~1.0 B		-	
(f) Aids to Navigation (AtoN)					
- excellent		0.0			
- good		0.2B			
- moderate		0.4 B			
(g) Bottom surface					
- if depth $h \geq 1.5\ T$		0.0			
- if depth h < 1.5 T then					
- smooth and soft		0.1 B			
- rough and hard		0.2 B			
(h) Depth of waterway h		$h \geq 1.5\ T$	0.0 B	$h \geq 1.5\ T$	0.0 B
		1.5 $T > h \geq 1.25\ T$	0.1 B	1.5 $T > h \geq 1.15\ T$	0.2 B
		h < 1.25 T	0.2 B	h < 1.15 T	0.4 B
(i) High cargo hazards		See explanation in box(i) overleaf			

Figure 6: Channels width addends w_i

Source: PIANC Report 116, 2012

Width for bank clearance (W_{BR} and/or W_{BG})	Vessel Speed	Outer channel (open water)	Inner channel (protected water)
Gentle underwater channel slope (1:10 or less steep)	fast moderate slow	0.2 *B* 0.1 *B* 0.0 *B*	0.2 *B* 0.1 *B* 0.0 *B*
Sloping channel edges and shoals	fast moderate slow	0.7 *B* 0.5 *B* 0.3 *B*	0.7 *B* 0.5 *B* 0.3 *B*
Steep and hard embankments, structures	fast moderate slow	1.3 *B* 1.0 *B* 0.5 *B*	1.3 *B* 1.0 *B* 0.5 *B*
Note: W_{BR} and W_{BG} are widths on 'red' and 'green' sides of channel			

Figure 7: Width for bank clearance w_{Br} and w_{Bg}

Source: PIANC Report 116, 2012

Transitions between lengths of channel with different widths should be done by straight lines and should not have plan variations greater than 1:10 (preferably 1:20) on both sides of the channel.

Table 8: Channel width requirements

Area	Ship	Ship beam (m)	Channel width requirement (m)		
			PIANC	TERMPOL	SIGTTO
Kadiro Creek / Phitty Creek	FSRU 138,000 m³ / 150,900 m³	43.4	164.92	173.60	217.00
	LNGC 125,000 m³	43.7	166.06	174.80	218.50
	FSRU 173,400 m³	46.4	176.32	185.60	232.00
	Qflex	50.0	190.00	200.00	250.00
	Qmax	53.8	204.44	215.20	269.00
Ashan Channel	FSRU 138,000 m³ / 150,900 m³	43.4	212.66	173.60	217.00
	LNGC 125,000 m³	43.7	214.13	174.80	218.50
	FSRU 173,400 m³	46.4	227.36	185.60	232.00
	Qflex	50.0	245.00	200.00	250.00
	Qmax	53.8	263.62	215.20	269.00

3.4.3 Bend radii, length and width

Bend length should be as short as possible with radii as long as possible. Bends in an access channel should be avoided when possible. Furthermore many bends forming a "S" or "snake" like pattern should be avoided. Long enough distances in between bends should be provided to give pilots time to prepare for turning manoeuvres.

Additional width is required in the bends to accommodate the swept track of the ship. The swept track is reduced with shallower water when compared to deeper water.

Assuming a max rudder angle of 20° a recommended bend radius recommended by PIANC is approx. 7 times the length of the design ship. See Table 9 for the bend radii requirements.

Table 9: Bend radii requirements

Ship	LOA (m)	Bend radius (m)
FSRU 138,000 m³	277.0	1939
FSRU 150,900 m³	291.0	2037
LNGC 125,000 m³	294.5	2061.5
FSRU 173,400 m³	294.5	2061.5
Qflex	315.0	2205
Qmax	345.0	2415

Additional channel width is required in bends to accommodate two factors:

- Response speed of the captain and the ship
- Swept track of the ship when turning

For the concept stage it is recommended that one additional design ship beam be added to accommodate for these factors.

The length of curved legs must not be greater than half the bend's radius (not more than 30° change in ship course), when possible. (PIANC 116, 2014)

The distance between consecutive bends should be more than five ship lengths. Bends in the same direction should be the greater than 3 ship lengths

This recommendation is unfortunately not possible in the bend in the Ashan channel at the entrance and should be investigated in the manoeuvring simulation study.

3.4.4 Turning Circle

Turning circle diameter recommended by TERMPOL is 2 to 2.5 times the length of the design ship. SIGGTO recommends 2 times the length, but to add the distance of the ships drift to the diameter in the case of currents. PIANC also recommends 2 times the ships diameter for the turning circle. The turning circle does not necessarily need to be round and could be elongated in the direction of the expected currents and/or wind.

Depth requirements for the turning circle are the same as for the channels at 1,15 times the ships draft.

3.4.5 Passing Areas

The channel is a one way channel and due to its length it would be preferable to have passing areas where ships can pass each other. The alternative channel Chan Waddo creek can be dredged to be used as a passing area (cf. 3.9.), but will require a substantial amount of dredging.

Alternatively one passing area approx. halfway from the port to the entrance can be created. The first ship to arrive at the passing area will be expected to wait for the second ship to pass. The length required it twice the stopping distance required of the design ship plus the distance travelled during the reaction time and one ship length. Additional width required is 2,5 times the beam of the design ship.

3.4.6 Anchorages

Anchorages should be as close as practical to the channel and should provide good holding ground. Maximum depth at the port entrance should not be more than 100 m. Anchorages' diameters should be atleast 1 nautical mile. It is recommended that PQA pilots be querried on ideal loactions of anchorages outside of the port. Factors to be considered include the quality of the holding ground to reduce anchor drag, protection from wind and sea and maritime traffic in the area.

3.4.7 Safety Domains

Areas around the LNGC's and FSRU's should be kept to ensure timely reaction in case of an unfavourable event. The distance between ships should be greater than the minimum stopping distance of said ships.

3.4.8 Berth

The required depth of the berth is at least 1.1 times the maximum draft of the ship over the length of at least 1 design ship length on each side of the centre of the berth (2 times LOA).

For safe passage of ships TERMPOL, 2001, recommends that the centre of the channel is at least 6 ship beams from the berthed ship's hull. SIGTTO, 1997, recommends for concept stage a passing ship distance of at least 4 times the design ship beam be kept between the moored and passing ship.

3.4.9 Pilot Boarding

Boarding of pilots should be done sufficiently far away from the start of piloting to give the pilot enough time to allow for safe boarding and information exchange.

It is recommended that the PQA pilots be queried on the distance from the channel and area boarding of the ship should take place to allow for the above two aspects before piloting will need to start.

3.5 Channel Navigation Aid Requirements

3.5.1 Buoys

Marker buoys clearly indicating the channel width and the start end and apex of bends should be installed. Care should be taken to ensure theses buoys do not drift / drag on the ground from current, wind or wave action.. The distance between buoys should be less than the minimum visibility range ships will be allowed to access the port. Buoys should preferably be lit.

3.5.2 Leading Marks / Beacons

Leading marks or lit beacons should mark channel centrelines and help facilitate rounding bends.

3.5.3 Electronic Aids

A VTMS / VTS system should be installed to help with navigation during night time or adverse conditions affecting vision and to control all ships coming into the port's operational area.

3.5.4 Tugs

LNG vessels should be accompanied by at least 2 tugs with bollard pull sufficient to overcome the maximum wind force on the ship during the maximum allowed wind / current speed conditions.

3.6 Recommended Limitations on Ship Size

The existing channel dimensions should allow the safe navigation of the FSRU 138,000m³ and the LNGC 125,000 m³ vessels.

It is recommended that the channel dimensions be increased to allow the safe navigation of larges size ships.

See Table 10 for recommended dimensions to allow the safe navigation of the channel by the Qmax ship.

Table 10: Channel dimensions required for Qmax navigation

Area	Ahsan Bend / Ashan Channel	Turning Basin / Kadiro Creek / Phitty Creek	Port
Depth*	16,8 m	13,8 m	13,8 m
Width	270 m	270 m	270 m
Additional Width in Bends	50 m	50 m	-
Bend Radii	2400	2400	-
Bend length	< 30°	< 30°	-
Turning Circle Diameter	-	-	700 m

*Depth requirement is not to CD, but rather the minimum depth requirement. The relation to CD will change depending on the tidal restrictions decided on.

3.7 Recommended Limitations on Physical conditions

3.7.1 Wind

To ensure that tugs, mooring rope strength is sufficient wind speeds for the safe navigation of the channel should be less than 25 knots.

3.7.2 Waves

Waves within the inner channel should not be problematic, but to ensure than the entrance channel has sufficient UKC for safe entrance it is recommended that the significant wave height be less than 3 m.

3.7.3 Current

To ensure safe navigation the cross current speeds should be less than 3 knots.

3.7.4 Tide levels

Limitations on the tide levels should be sufficient to allow passage of the ship through the channel while maintaining the recommended depths.

3.7.5 Visibility

Navigation by sight rather than instruments is advisable when navigating in port areas. Visibility is there for a big factor in determining limitations on navigation of the channel.

It is recommended that visibility be farther than the ship's stopping distance at its maximum speed.

3.8 Passing Ship Requirements

3.8.1 Speed

To reduce the risk of a ship strike that could rupture the LNG containment tanks of a stationary LNGC a speed limit need to be in place. See Figure 8 for speeds of ships colliding with a LNGC without rupturing the containment tanks. With proper speed limits in place the possibility of LNG release due to a ship strike becomes remote.

Hull Resistance for a 135,000 m^3 LNG Carrier	
Displacement of Colliding Ship (tonnes)	Critical Impact Speed (knots)
93,000	3.2
61,000	4.2
20,000	7.3

Figure 8: LNGC hull resistance

Source: SIGTTO, 1997

SIGTTO recommends a speed limit for passing ships during the concept stage of 6 knots at a passing distance of at least 4 times the beam of the design ship (hull to hull).

The determined speed limit applies for LNG and other ships. The speed limit should be enforced by VTMS.

3.8.2 Offset Distance

TERMPOL, 2001, recommends 6 times the ship's beam to the centre of the channel.

SIGGTO ,1977, recommends 4 times the beam hull to hull.

Also see 3.4.8.

3.9 Alternative Channel

Caution is advised with the dredging of a new channel as it could severely change the sedimentation pattern in the channels. Sedimentation modelling is proposed. The channel does not need to be of similar dimensions as the main channel and a much smaller design ship can be chosen.

3.10 Recommendations and further steps

3.10.1 Proposed Channel Layout

To be added

Figure 9: Proposed channel layout

4 NEXT STEPS

As this report presents the findings from the Consultant's first review of documents and initial analyses, the next steps to be carried out are:

1. Preparation of summary list with remarks and comments to be forwarded to Engro Elengy Terminals with regard to jetty design
2. Validation of used input data for modelling studies, in particular Metocean data
3. Finalising the layout drawing of access channel
4. Elaborate recommendation on additional Metocean data collection (type and location)
5. Continuing channel design and merging with layout drawing
6. Required dredging volume calculation
7. Workshop regarding conceptual design
8. Identification of required hydraulic and sediment modelling

Additional proposed tasks

1. Specify and tender of hydraulic and sediment modelling
2. Execution and / or supervision of modelling
3. Nautical simulation

5 REFERENCES

[1] EAU 2012: Empfehlungen des Arbeitsausschusses „Ufereinfassungen", 10th Edition

[2] Eurocode 1: Actions on structures, 2010

[3] Eurocode 2: Design of concrete structures, 2011

[4] Eurocode 3: Design of steel structures, 2010

[5] Eurocode 7:Geotechnical design,2009

[6] Admiralty Nautical Chart 20, Port Muhammad Bin Qasim and Approach

[7] PIANC, 2012, Report 116 "Aspects Affecting the Berthing Operations of Tankers to Oil and Gas Terminals"

[8] PIANC, 2014,Harbour Approach Channels - Design Guidelines

[9] SIGTTO 1997; Information paper no. 14; Site selection and Design for LNG ports and jetties; Society of International Gas Tanker and Terminal Operators

[10] TERMPOL 2001; Termpol Review Process,

Annex - 9

ECIL OBSERVATIONS
ON
INCEPTION REPORT
OF
SELLHORN

Annex-9

ECIL Observations On Inception Report of Sellhorn

A ECIL Observations

- INTRODUCTION:

  The 1st paragraph needs a little modification. It may be read as:

  "In December 2012 the USAID Energy Policy Program (EPP) was launched and the Consulting Firm AEAI (Advanced Engineering Associates International) Inc. was engaged to provide broad range of advisory services for a new LNG Terminal planned to be established at Port Qasim on fast track. AEAI contracted ECIL + Granada Group (GG) to provide various services on this LNG Project. ECIL associated Sellhorn to provide consultancy services study of navigation channel issues, upgradation, alternate channel, project monitoring and review of the structural design concerning the marine civil structure".

- Items 2.3.1.1 – Manoeuvering Simulation Study - Remarks:

  PQA bathymetric data and chart already sent.

- Items 2.3.1.2 – Mooring Report:

  Hopefully you have received it by now.

- Items 2.3.1.4 - Specs / tests of tubular piles:

  Pile driving tests reports are already sent to you. We are trying to find any additional information available with like pile specification. Would appreciate if list of information needed is annexed to be sent to EETPL.

- Items 2.3.1.5 – Corrosion Protection:

  Your approach is logically o.k. As regards surcharge of 3mm instead of available 2mm, you may please give your views on combined effectiveness of paint and Cathodic protection. Also please suggest possible mitigation measures which can be taken at this stage, if your final observation indicates a potent deficiency.

- Items 2.3.2.1 – Marine Structures Calculation Sheet:

  - *Your concern regarding lateral pile bearing capacity and group effect is definitely important. When you are in receipt of the geo-tech reports (which has been sent to you currently), perhaps the situation may be more clear. However, we will try to obtain relevant calculations from EETPL.*

  - *After your final review, if the calculated crack width comes up more than the 0.1mm, adopted by EEVTL, in that case you may suggest possible mitigation measures.*

    - Item 2.3.2 -
    - Item 2.3.2.1 -
    - Item 2.3.2.3 -
    - Item 2.3.2.4 -
    - Item 2.3.2.5 -
    - Item 2.4.2 -

    Geotech Report has now been sent to Sellhorn. It will hopefully enable you to finalize most of the observations.

- Items 2.3.2.6 – Prestressed Longitudinal Beam:

  - *Remarks regarding crack width of the bottom flange may please be further clarified with reference to "XS3".*

- Items 2.3.3 – Drawings:

  We have requested EETPL for providing us the as-built drawings. We expect that these drawings will clarify some of your queries.

- Items 2.3.4.2 – Certificates:

  We have requested EETPL to provide us the same in full English version.

- Items 3.2.7 – Depth:

  Negative sign (-) may be used for depths related to CD.

B. PQA Observations

The observations of Channel Dredging Department (PQA) on desk study of Navigation Channel with respect to Inception Report of Sellhorn is as follows:

1. The HAT & IAT at Bin Qasim (Port Area) are 14.01m & -0.57m respectively.
2. Channel width at Phitti Creek varies from 280 to 310m.
3. Channel width at Kadiro Creek varies from 200 to 280m.
4. Channel width at Gharo Creek abreast LNG Terminal is 250m.
5. The bend radii, length and width need elaboration, preferably by diagram of bends at the outer channel (Siport simulation study report should be taken into account).
6. Did turning circle have no consideration for the Nos of tugs and their total power, just LOA and tidal currents determine its dimensions? Please add / elaborate.
7. Phitti creek with 280 to 310 meter width is generally used for real time crossing of the vessel. Please indicate this width is safe for a vessel of what size beam.
8. What's the safe distance of Navigation Buoys from toe line? PQA observe 25 to 30m for outer channel and 10 to 20m for inner channel. Please guide.
9. LNG terminal is constructed with 153m offset from adjoining toe line (273m from centre line), LNGC will be parked about 50m from toe line (175m from centre line). How much shift in adjoining toe is suggested for the safe passage of passing traffic when LNG transfer process is in operation. Can you please guide?
10. TERMPOL guide line practiced in Canada, suggest channel width 4 times the beam of vassal, why can't we adopt it and width be redefined after some simulation study as suggested by SiPort. Please clarify is this code / guideline used in other countries of the world?
11. Before finalizing the Navigation channel layout, what fresh met ocean data acquisition is mandatory / recommended? Kindly indicate its location and duration.
12. Criteria / Tools for the establishment of geotechnical investigation be indicated (Soil investigation through borehole, sub bottom profile survey or hybrid).
13. Dredging being the most expensive and non friendly activity for environments, what kind of hydraulics study is recommended to have a safe, stable navigation channel with minimum dredging (Numerical modeling, simulation study, …….etc). Kindly indicate minimum time required to complete such study with fresh data. Can any broad guidelines be included? Can Sellhorn do it? Can alternate channel be made part of this exercise?

ANNEX – 10

PROJECT PHOTOGRAPHS

Heat Shrink Sleeve poor quality of material
& workmanship on 24”dia pipeline

Heat Shrink Sleeve poor quality of material & workmanship on 24”dia pipeline

Monolithic insulating joints must be installed between underground & above ground pipelines to eliminate the short circuit to ensure the cathodic protection of pipeline as per design life. EETPL have not installed Isolating joints on both side of crossing, eventfully this will be the question mark for the life of RLNG Pipeline.

`

Catwalk (Steel Walkway) installed

PIPELINE PLACED OVER TRESTLE ,WELDING WORK WERE IN PROGRESSING

LOADING ARM UNDER TEST

FSRU BERTHED ON THE LNG TERMINAL

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