Annexure - I

নর্থ-ওয়েস্ট পাওয়ার জেনারেশন কোম্পানী লিমিটেড

NORTH-WEST POWER GENERATION COMPANY LIMITED

ISO 9001: 2008, ISO 14001: 2004 & OHSAS 18001: 2007 Certified

(An Enterprise of Bangladesh Power Development Board)

Bidyut Bhaban (Level-14), 1 Abdul Gani Road, Dhaka-1000, Bangladesh

Phone : 9513527-29, Fax : 9513530, e-mail : info@nwpgcl.org.bd, web : www.nwpgcl.org.bd

Memo No: 02/NWPGCL/Khulna-LNG/2017 Date: 01/01/2017

Mr. Manish Kumar Tiwari
General Manager
Origination, Trading & Marketing
H-Energy Private Ltd.
Mumbai-400076, India.

Sub: Long term demand of NWPGCL for pipeline capacity determination

Dear Mr. Tiwari,

This refers to your letter no. HEPL/OTM/2016/08 dated: 26.12.2016 requesting NWPGCL's long term requirement of Natural Gas / Regasified LNG (R-LNG) from India.

As per the MoU and the Term Sheet executed by and between H-Energy Pvt. Ltd. and North-West Power Generation Co. Ltd. (NWPGCL), the R-LNG to be supplied to NWPGCL is 1.0 MMTPA for a period of 22 years starting from end of 2019. Based on future requirement of NWPGCL, this volume is expandable to 2.0 MMTPA as per mutual agreement between the two companies.

This letter does not constitute any binding commitment of NWPGCL. However, we wish to take our discussion forward for importation of R-LNG for our proposed Khulna 800 MW LNG based CCPP Project.

Thanking you,

Yours faithfully,

01/01/17

(Engr. A. M. Khurshedul Alam)
Managing Director
North-West Power Generation Co. Ltd
Bidyut Bhaban, 1-Abdul Gani Road, Dhaka-1000

Memo No: 02/NWPGCL/Khulna-LNG/2017 Date: 01/01/2017

Copy:

1. Chairman, North-West Power Generation Co. Ltd., Dhaka
2. Executive Director (Engineering / Finance), North-West Power Generation Co. Ltd., Dhaka
3. Project Director, Khulna 800 MW LNG Based CCPP Project, NWPGCL, Dhaka
4. Office copy

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Company Secretary
North-West Power Generation Co. Ltd.

Annexure - II

No. 219 /Dir(BM)/ 2015
Ministry of External Affairs
BM Division

South Block
New Delhi

26 October 2015

OFFICE MEMORANDUM

This is with reference to your letter No. HEECPL/MEA/2015/004 dated August 31, 2015 regarding cross border supply of re-gasified LNG to a proposed 750-850 MW gas based power project of North West Power General Company Limited in Khulna, Bangladesh by a pipeline from India.

2. This Ministry has no objection to your pursuing this opportunity with Ms. North West Power General Company Limited.

[Pratibha Parkar]
Director (BM)
Tel: 011-23013830
Fax: 011-23013280
Email: dirbm@mea.gov.in

Shri Darshan Hiranandani,
Managing Director,
H-Energy East Coast Private Limited, 514,
Dalamal Tower, Nariman Point,
Mumbai – 400 021

Copy to:

1. **Shri Ashutosh Jindal,** Joint Secretary (IC), Ministry of Petroleum & Natural Gas, Shastri Bhawan, Room No. 214-A, New Delhi
2. **Shri Pankaj Saran,** High Commissioner of India, Dhaka

H-Energy Private Limited Mumbai

Annexure - III

210

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H-ENERGY

power to the people

Detailed Feasibility Report

Kanai chatta - Shrirampur Dedicated Natural Gas Pipeline Project

January 4, 2017

H-Energy Private Limited Mumbai

Contents

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List of Tables

Abbreviations

AGA	Amercian Gas Association
ASME	American Society of Mechanical Engineers
CCOE	Chief Controller of Explosives
CS	Carbon steel
CTF	Custody Transfer Facility
CTP	Custody Transfer Point
EPF	Entry Point Facility
ERDMP	Emergency Response and Disaster Management Planning
FSRU	Floating Storage and Regasification Unit
GOV/AV	Gas Operated Valve/Actuated Valve
HEPL	H-Energy Private Limited
KSPL	Kanai chatta – Shrirampur Dedicated Natural Gas Pipeline
LSAW/HSAW	Longitudinal Submerged arc weld/Horizontal Submerged arc weld
MMSCMD	Million Metric Standard Cubic Meter per Day
MMTPA	Million Metric Tonne Per Annum
MoEF	Ministry of Environment and Forests
NWPGCL	North West Power Generation Company Limited
OISD	Oil Industry Safety Directorate
ORF	Onshore Receiving Facility
PCB	Pollution Control Board
PNGRB	Petroleum and Natural Gas Regulatory Board
RLNG	Re-gasified Liquefied Natural Gas
ROU	Right of Use
SCADA	Supervisory Control And Data Acquisition
SV	Sectionalizing Valve
TMBV	Trunnion Mounted Ball Valve
TE	Temperature Element
TT	Temperature Transmitter
UFM	Ultrasonic Flow Meter

1. Executive Summary

1.1 Introduction

H-Energy Private Limited (HEPL) plans to set up a Floating Storage and Regasification Unit (FSRU) Project located at offshore Digha region of West Bengal, near the East Coast of India. The FSRU will have a regasification capacity of about 4 MMTPA.

In response, North West Power Generation Company Ltd. (NWPGCL), a wholly owned subsidiary of Bangladesh Power Development Board, expressed its interest in purchasing R-LNG from H-Energy Private Limited and signed a MoU on February 4, 2016 and also a Term Sheet on March 31, 2016 to purchase R-LNG for their Gas Based Power Plant Project at Khulna, Bangladesh. Further, NWPGCL vide letter no. memo No.2/NWPGCL/Khulna-LNG/2017 dated 01.01.2017 had confirmed the requirement of 1 MMTPA of Natural Gas for their power plant at Khulna for a period of 22 years. Based on the agreements signed between the two companies this volume is expandable to 2 MMTPA in future.

To meet this requirement, HEPL proposes to lay, build and operate a Dedicated Natural Gas Pipeline of 24" size with an approximate length of 275 km from Kanai chatta village in East Medinipur District to Shrirampur village in Nadia district at India–Bangladesh border. This dedicated pipeline is planned to be built under regulation 19(2) of the Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand Natural Gas pipelines) Regulations 2008. The pipeline shall be commissioned within 36 months from the date of receipt of Final Acceptance Letter from PNGRB.

1.2 Demand Projection

North West Power Generation Company Ltd. (NWPGCL) expressed its interest in purchasing R-LNG from H-Energy Private Limited and signed a MoU on February 4, 2016 and also a Term Sheet on March 31, 2016 to purchase R-LNG for their Gas Based Power Plant Project at Khulna, Bangladesh. Further, NWPGCL vide letter no.

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memo No.2/NWPGCL/Khulna-LNG/2017 dated 01.01.2017 had confirmed the requirement of 1 MMTPA of Natural Gas for their power plant at Khulna for a period of 22 years. Based on the agreements signed between the two companies this volume is expandable to 2 MMTPA in future.

This Natural Gas Demand from North West Power Generation Company Ltd. (NWPGCL) has been used for designing and conceptualizing the Kanai-chatta Shrirampur Dedicated Natural Gas Pipeline.

1.3 Pipeline Route

The proposed Kanai chatta Shrirampur Dedicated Natural Gas Pipeline will originate from Kanai chatta village of East Medinipur, District to the India-Bangladesh border near Shrirampur of Nadia district in the state of West Bengal.

The pipeline route has been optimized based on a preliminary desktop survey. The pipeline route shall be finalized after a Detailed Route Survey which will be conducted post final acceptance from the PNGRB.

Summary of the proposed Kanai chatta-Shrirampur Dedicated Natural Gas Pipeline route is as follows:

Section	Length (in km)
Kanai chatta – Shrirampur	~275

The Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline route starts from the Entry Point Facility (EPF) at Kanai chatta village of East Medinipur District of West Bengal. From take-off, the pipeline route runs in west direction for approximately 15 km where it meets the National Highway (NH) 116B.

- From there the pipeline route runs in the North-eastern direction along the NH 116B for approximately 20 km and crosses the Rasulpur River. The pipeline is routed primarily through paddy fields. Salt pans and Aqua culture ponds may be present in the initial section of the pipeline route.

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- The pipeline thereafter crosses the State Highway (SH) 4 and continues to run in North-eastern direction mostly through paddy fields for approximately 25 km.
- The pipeline then crosses Kaliaghai Nadi (Haldi River). A variety of flora and fauna is likely to be encountered near the river.
- From Kaliaghai Nadi, the pipeline route runs in the North direction for approximately another 40 km where it crosses National Highway – 6. Dense habitation is likely to be present along the pipeline route near the highway.
- After crossing National Highway – 6, the pipeline route runs in North-eastern direction for approximately 20 km where it crosses Rupnarayan River.
- After crossing Rupnarayan River, the pipeline route continues to run in North-eastern direction through paddy fields for another 25 km where it crosses State Highway – 15.
- After crossing State Highway – 15, the pipeline route continues in the North-eastern direction for another 35 km and crosses NH – 19.
- The pipeline route thereafter crosses State Highway – 13 at an approximate distance of 220 km from the EPF. The pipeline route appears to run through paddy fields.
- The pipeline continues in the North-eastern direction for another 20 km and crosses Hugli River. The pipeline thereafter crosses NH – 34 and continues in the North Eastern direction up to the CTF and further to the CTP near Shrirampur in Nadia District at an approximate distance of 275 km from the EPF.

1.4 Project Salient Details

Based on the demand projection of natural gas for NWPGCL, the Kanai chatta – Shrirampur Dedicated Natural Gas Pipeline shall be designed for a total capacity of 7.2 mmscmd (~ 2 MMTPA). Pipeline diameter has been selected based on the

preliminary hydraulic analysis carried out using TG Net (Pipeline Studio) software. The pipeline diameter as calculated based on these studies is 24". The salient details of the facilities along this pipeline are as follows:

	Salient details of Kanai chatta – Shrirampur Dedicated Natural Gas Pipeline		
S.No.	Description	Unit	Natural Gas Pipeline
1	Entry Point Facility at Kanai chatta		
2	Custody Transfer Point at India – Bangladesh border near Shrirampur		
3	Length	Km	~ 275
4	Capacity	mmscmd	7.2
5	Inlet pressure at Entry point	Kg/cm^2 g	70 - 90
6	Pipeline Size (NPS)	Inch	24
7	Pipeline operating Life	Years	30
8	Design Temperature	°C	-29 to 65
9	Sub- Soil Temperature	°C	20 - 25
10	Material of Construction		Carbon Steel (CS), APL 5L, X-70 Grade (PSL-2)
11	Pipeline Design Codes		Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B 31.8, OISD#226

Note: The pipeline length and size has been estimated based on preliminary desktop study of the route. Actual design parameters (i.e. length, diameter, wall thickness, etc.) will be determined after conducting the detailed route survey and basic engineering.

1.4.1 Process Design Basis

Source of supply of natural gas for Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline is as shown in the table below:

S.No.	Source name	Origin	Gas type
1.	Floating, Storage and Regasification Unit Project of H-Energy Private Limited located in the Offshore Digha region of West Bengal	Onshore Receiving Facility (ORF) of H-Energy Private Limited at Kanai chatta, in East Medinipur district of West Bengal	R-LNG

H-Energy Pvt. Ltd is setting up an FSRU project in the offshore Digha region of West Bengal with a proposed capacity of 4 MMTPA. R-LNG from the FSRU will be received at the Onshore Receiving Facility (ORF) and subsequently delivered into the Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline through the Entry Point Facility (EPF) at Kanai chatta.

1.4.2 Design

For hydraulic calculation, a design factor of 0.40 has been considered for taking care of the worst condition of maximum pressure drop corresponding to higher thickness and minimum internal diameter, which is in accordance with ASME B31.8. For the whole pipeline, design factor is based on class location as below:

Location Class	Design Factor
1	0.72
2	0.60
3	0.50
4	0.40

The latest editions of referred codes shall be used for designing the pipeline. Pipeline is proposed to be coated with 3 – layer polyethylene coating to protect it against external corrosion. Additionally an impressed current permanent cathodic protection system will also be provided. Remotely operated mainline valves will be provided in accordance with the design code requirements for the purpose of isolation of the pipeline section during emergency or maintenance.

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Minimum depth of burial of the pipeline will be 1 meter all along the route. This depth will be increased keeping in view the sensitivity of the location and code provisions.

The pipeline at major water crossings will be installed by using the Horizontal Directional Drilling (HDD) method. Pipeline will be laid below the predicted scour profile of the river bed.

Internal coated pipes will be used and a corrosion monitoring system shall be installed to monitor the health of the pipeline.

1.5 Basic Design

1.5.1 Pipeline Design

Based on the optimization studies, the following design parameters have been considered for the mechanical design of the pipeline system:

- Pipeline diameter : 24"
- Design Pressure:
  - Main Line : 99 Kg/Cm^2 (g)
- Design temperature: -29 to 65°C
- Coating:
  - External : 3 Layer Polyethylene Epoxy
  - Internal : Epoxy Paint
- Material of Construction : Carbon Steel (CS), API-5L, X-70 Grade (PSL-2)

1.5.2 Pipeline Material

Pipeline and its appurtenances shall be provided with carbon steel material suitable for the intended service.

Line Pipe

LSAW/HSAW, line pipe shall conform to API Specification 5L, PSL-2 quality. The grade of line pipe shall be API 5L, X-70 Grade (PSL-2). Pipe wall thickness shall conform to Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations,

2009, ASME B31.8 and shall also meet the requirement of OISD-226 and API 5L. At river crossings, higher wall thickness shall be used.

Pipeline Fitting and Flanges

All mainline materials such as flanges and fittings etc. shall be of class 600#.

Mainline Valves/ Sectionalizing Valves

All above ground mainline valves are full bore GOV/AV type operated and designed as per API 6D and API 6FA/ API 607 fire safe design requirements. The sectionalizing valves shall be full bore and designed as per API 6D and API 6FA / API 607 fire safe design requirements.

Mainline valves and sectionalizing valves shall be ball valves. First isolation valve in mainline shall be butt- welded type.

Station Pipes, Flanges and Fittings

Above ground piping system shall be of equivalent grade to match 600# pressure and temperature rating. All fittings shall conform to ANSI 600#.

Ball Valves

Ball valves within the stations shall be full bore/reduced bore type. Above ground station valves can have a bolted configuration.

All underground ball valves shall be of welded configuration and TMBV type.

Flow Tees

Branch connection on the main line, which is greater than 40% of mainline would be provided with flow tees to allow smooth passage of pigs. Flow tees material would be same as that of line pipe.

Insulating Joints

Insulating joints would be provided at transition point of above ground and underground portion of pipeline for electrical isolation. These will be mono-block type suitable for both above/ underground installations. Tap-offs from main line for GOV's, vent lines, etc., shall also be electrically insulated.

Bends

Cold field bends shall be in accordance with codes. Induction bend shall only be used in case of space constraints, including all stations. 6D bends shall be used only in mainline stations.

1.5.3 Corrosion Protection Coating

External Coating

The selected corrosion protection coating shall be suitable for the design temperature range. In addition to that, it should have following properties:

- High integrity
- Resistance to ageing and degradation
- Resistance to attack by micro-organism
- Resistance to soil stresses
- Water impermeability
- Abrasion resistance
- Impact strength
- Good adhesion
- Resistance to cathodic disbondment
- Resistance to creep
- UV resistance
- Ease of application

The minimum total thickness of the 3 LPE coating shall be as per DIN 30670. The sequence of application of coating shall be as follows:

- Epoxy
- Co-polymer layer applied by extrusion (adhesive)
- Polyethylene layer applied by extrusion.

Internal coating

Epoxy coating has to be applied to internal surface of pipeline. The pipeline shall be furnished with Internal Epoxy Coating conforming to ISO 15741.

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1.5.4 Pipeline Construction

Pipeline and associated facilities shall be constructed in accordance with the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B31.8, OISD #226 and other applicable reference standards. The pipeline shall be laid underground with minimum top cover of 1(one) meter.

Welding shall be carried out as per API 1104. All welds shall be 100% radiographed. After the installation is completed, the entire pipeline shall be hydrostatically tested. The hydrostatic test pressure at any test section shall be 1.5 times the design pressure. The maximum hydrostatic test pressure at any location in the pipeline during testing shall not exceed the pressure required to produce hoop stress equal to 95% SMYS of pipe material. The pressure holding time shall be 24 hours after stabilization for all underground pipelines.

1.5.5 Instrumentation and Control System

Instrumentation and Control shall be provided for safe and efficient operation of the pipeline and associated facilities. Field mounted instruments as well as Panel mounted instruments are envisaged. Panel mounted instruments necessary interface is envisaged in each station including SV stations to connect operational parameters to the SCADA system for remote control and monitoring.

1.5.6 Metering System

Minimum four-path ultrasonic meter shall be used for Custody transfer at CTF. All the meters shall be suitably calibrated. The configuration of meter at CTF shall be in series. The installation of ultrasonic meter shall be upstream of pressure regulating station as per the latest AGA-9. Panel mounted flow computer is envisaged with each metering UFM. Online Gas Chromatograph is envisaged at the CTF. All the instruments shall be as per the latest configuration and specifications. The metering PT and TE/TT shall be of highest accuracy.

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1.5.7 Supervisory Control and Data Acquisition System and Communication

The Control Center shall be located at both the EPF and CTF. Sectionalizing Valves along the route of the pipeline will be remotely operated through the SCADA system.

1.5.8 Gas Detection System

Infrared (IR) and Open Path type detection system having adequate numbers of gas detectors at various critical locations in the EPF, CTF, Sectionalizing Valve Stations and intermediate pigging station shall be provided for continuous monitoring of hydrocarbon level.

- **Fire Alarm for Gas Detection System**

Suitable fire and gas detection system for field area shall be provided. The supply shall include fire detectors, monitor/ controllers, and enunciators in fire panel to be placed in control rooms (CR).The fire and gas detector layout shall cover the entire plant area system following NFPA-72 standard. All the connections for fire/ gas/ smoke detection system will lead for annunciation to the fire panel to be placed in the control rooms.

1.5.9 Fire Fighting Facilities

Fire-fighting facilities such as static firefighting equipment, DCP type fire extinguisher at EPF, SVs, IPs and CTF shall be installed. All remote operated unmanned station shall be provided with CO_2 flooding system.

1.6 Environmental Aspects

This section of the DFR provides an assessment of the potential impacts on different identified environmental components, which are likely to occur during construction and operation of the pipeline. However, by adopting appropriate management measures, majority of the assessed impacts can be mitigated.

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The major potential impacts associated with the proposed Kanai Chatta-Shrirampur dedicated pipeline project works shall have impact on soil, impact on water resources and area drainage, air quality degradation, noise impacts, impact on ecological environment, impact on agriculture, land use changes, impact on health and safety, impact on socio- economic features, impact on community activities, impact on cultural heritage and impact on aesthetics. These impacts can occur at any one of the three stages, i.e. planning or design stage, construction stage and operation stage.

The identified impacts due to the proposed project can be mitigated through the incorporation of appropriate measures at different stages of project execution. This will ensure the best design with minimal damage to or loss of significant or sensitive features such as roadside vegetation, local water resources, etc. All the impacts shall be studied and their mitigations are discussed in detail in the relevant section of this DFR.

1.7 Implementation Methodology and Schedule

The project implementation methodology is described broadly under the following main activities:

- Surveys and Investigation
- Acquisition of ROU
- Statutory approvals and clearances
- Design and Engineering
- Procurement of Materials
- Construction and commissioning

All activities will be planned in a manner so as to achieve the overall completion of the project.

1.7.1. Surveys and Investigations

The reconnaissance survey for the pipeline route shall be carried out. Required cadastral data will be collected through detailed route survey. Detailed route survey, including additional surveys and investigations required for the design of crossing river, roads and railways etc. will be undertaken prior to commencement

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of detailed design considering the overall constructability, geo hazards and environmental requirements.

1.7.2. Acquisition of ROU

ROU would be acquired under the provisions of the Petroleum and Minerals Pipelines (Acquisition of Right of User in Land) Act, 1962. The ROU will be restored to near original condition after completion of construction of the Pipeline.

1.7.3. Statutory Clearances and Approvals

The company will apply to relevant authorities for the statutory clearances and approvals that are required. Requisite clearances from PCB, CCOE, etc. shall be obtained from the respective Government Organizations. In addition, authorities concerned with grant of approvals in respect of crossing of railway tracks, roads and highways, canals, rivers, ponds, power lines, cables and the like as applicable will be taken in order to implement the project.

1.7.4. Design and Engineering

The Design and Engineering of the Project will be entrusted to experienced engineering consultants. The design of the pipeline and related facilities will comply with the requirements of the applicable Indian and international codes and standards, and the requirements and conditions of applicable authorities and government agencies.

1.7.5. Procurement of Materials

The specifications and QA/QC requirements of materials will be finalized during the design and engineering stage and will comply with project requirements and any other conditions imposed under statutory approvals and clearances. All materials will be procured from reputed and authorized manufacturers, and will be subjected to third party inspection and QA/QC during various stages of manufacturing and testing.

1.7.6. Construction and Commissioning

Pipeline will be constructed as per Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations 2009, ASME B 31.8, OISD standards. The pipeline will be buried with a minimum depth of 1 m below the natural ground level. Such cover will be increased at certain places, in particular at railway lines, highways, foreign pipelines, canals and river crossings to provide a higher safety factor to the pipeline in accordance with the provisions of the design codes and the requirements of the authorities having jurisdiction over such facilities. Typical minimum cover to be adopted for the different locations will be as follows:

S. No.	Location	Minimum Cover (m)
1	Normal Terrain	1.0
2	Minor water crossings / canals	1.5
3	Rocky areas	1.0
4	Uncased / cased road crossings	1.2
5	Rail crossings	1.7
6	River crossings	2.5 (below scour depth)

Adequate measures will be taken to avoid inconvenience to public, and ensure minimum cutting of trees during construction of the pipeline. Water used for hydrostatic testing will be properly treated and disposed of in such a manner that no damage is caused to the public and environment.

1.8 Organizational Structure

A suitable organization structure, both for project implementation and operation and maintenance, has been worked out and shown in Figures –2 & 3, respectively, detailing the number of personnel required and their respective organizational functions.

It is expected that organizational improvements, accompanied by new perceptions of the functions to be carried out, shall evolve over a period of time as the organization and gas transmission systems grows. Structural changes may be

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required as the organization gains experience and particular challenges of the local operating environment are addressed.

Initially, the organization shall need to focus on construction and installation of the Main pipeline, Sectionalizing Valve (SV) stations, Intermediate Pigging (IP) stations, Entry Point Facility, Custody Transfer facility etc. Therefore, planning, pipeline laying, facility works and other associated construction/erection works shall be the main activities. As the transmission network infrastructure commences operation, there shall be a need for operation and maintenance of pipelines and associated facilities.

The proposed organization structure caters to the work change requirements anticipated as the organization grows.

1.9 Manpower Requirement

1.9.1 For Project Implementation

Keeping in view the long length of the proposed pipeline, project work has to be taken up in various locations simultaneously and for the said reason the total project has been divided into separate spreads. The organizational set-up for project implementation for the Project shall be headed by a Dy. General Manager (Projects) who shall be assisted by Senior Managers dedicated for different spreads of the mainline system. They in turn shall be assisted by adequate number of Managers and staff members having the requisite skills to look after the distinct areas and the functions assigned to them (refer Figure -3), namely:

- Mainline and Facilities
- Contracts and Procurement
- Safety and Stores
- Administration and Finance

The project implementation group will function under an organizational set-up at suitable locations along the pipeline route. Services of an Engineering & Project Management Consultant and a Third Party Inspection Agency are also envisaged during project implementation period. There shall also be manpower for common

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areas like contracts and procurement, safety and stores, Finance and Administration, etc.

Total permanent manpower envisaged for project implementation is 21 nos.

1.9.2 For Operation and Maintenance

The Organizational Set-up for Operation and Maintenance is planned as detailed in Figure-2

It is proposed that a unified O & M mechanism headed by a Dy. General Manager and assisted by three Sr. Managers, out of which one would be incharge of Mechanical-Operation and Maintenance while the other two senior managers would be responsible for Finance, Administration and Safety/Stores. There shall be dedicated teams for O and M based at EPF, Kanai Chatta and CTF, Shrirampur headed by a Managers. Managers at respective locations shall in turn be supported by Dy. Managers (Operation, Maintenance and Safety), Store-in-charge, Office-in-charge (Administration) & Office-in-charge (Finance), Supervisors. All these teams would be responsible for the following areas :

- Main Pipeline and associated facilities
- Pressure Regulating Installation
- Operation and Maintenance
- Safety (HSE)
- Stores (Materials)
- Administration & Finance

It is further proposed that the services are out-sourced where ever possible, i.e. services be contracted as required than employed as permanent staff. However, there shall be a requirement for a permanent core group with expertise to carry out work, supervise and ensure quality control on work performed by contractors.

Such an arrangement shall provide flexibility to the organization to contract appropriately skilled personnel, as the skill requirement changes and as the organization expands and customer base grows.

Key management staff shall be required to manage the different departments. This shall range from Managers to Supervisors and clerical staff.

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Total permanent manpower envisaged for operation & maintenance of network is 16 nos.

1.8. Capital Cost Estimate

Capital cost based on the facilities envisaged for EPF and CTF, Main Pipelines including SV Stations, IP Stations and other associated facilities for the entire pipeline system has been estimated as Rs. 1297.6 Crores.

1.9. Operating Cost

The annual operating costs for the project at 100% capacity for the pipeline systems have been worked out to be Rs 38.4 Crores.

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2. Introduction

H-Energy Private Limited (HEPL) plans to set up a Floating Storage and Regasification Unit (FSRU) Project located at offshore Digha region of West Bengal, near the East Coast of India. The FSRU will have a regasification capacity of about 4 MMTPA.

Against a tender floated by the Kolkata Port Trust(KoPT) in Feb 2015, a letter of award was received in August 2015 granting permission for operating non-jetty based offshore disconnectable Floating Storage and Regasification Unit (FSRU) for import, storage and transfer of LNG in the open sea within KoPT limits involving the following operations :-

a) Import of LNG by LNG carriers

b) Transfer of LNG to storage tank of FSRU

c) Regasification of LNG on the FSRU

d) Transfer of Natural Gas to landfall point through sub-sea pipeline

The FSRU located in the Offshore Digha Region of West Bengal will be connected by a 115km subsea pipeline to a Land Fall Point (LFP) close to Kanai chatta. Both the FSRU as well as the connecting subsea pipeline will be within the Port Limits of Kolkata Port Trust.

All major technical and commercial feasibility studies have been completed for the project and CRZ clearance from the Ministry of Environment, Forest and Climate Change has also been received.

H-Energy Pvt. Ltd. had submitted a proposal to the Power Division of Ministry of Petroleum Energy and Mineral Resources (MoPEMR), Bangladesh to supply R-LNG to an appropriate entity in Bangladesh from its FSRU project in offshore Digha region of West Bengal.

In response, North West Power Generation Company Ltd. (NWPGCL), a wholly owned subsidiary of Bangladesh Power Development Board, expressed its interest in purchasing R-LNG from H-Energy Private Limited and signed a MoU on February

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4, 2016 and also a Term Sheet on March 31, 2016 to purchase R-LNG for its upcoming 800 MW Gas Based Power Plant Project at Khulna. Further, NWPGCL vide letter no. memo No.2/NWPGCL/Khulna-LNG/2017 dated 01.01.2017 had confirmed the requirement of 1 MMTPA of Natural Gas for their power plant at Khulna for a period of 22 years. Based on future requirement of NWPGCL this volume is expandable to 2 MMTPA as per mutual agreement between the two companies.

To meet this requirement, HEPL proposes to lay, build and operate a Dedicated Natural Gas Pipeline of 24" size with an approximate length of 275 km from Kanai chatta village in East Medinipur District to Shrirampur village in Nadia district at India–Bangladesh border. This dedicated pipeline is planned to be built under regulation 19(2) of the Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand Natural Gas pipelines) Regulations 2008. The pipeline shall be commissioned within 36 months from the date of receipt of Final Acceptance Letter from PNGRB.

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3. Details of the Customer

Electricity is a major contributory factor in GDP of Bangladesh, as agricultural, industrial and other products as well as development of education largely depends on its reliability and quality of supply. Unfortunately, for the last few years, Bangladesh is acutely suffering from inadequate supply of this vital commodity. Along with the sectors mentioned, domestic consumers are also suffering due to frequent and unannounced load shedding.

In Bangladesh, Khulna is having the third largest load centre in the country, where the power supply situation is very serious, as is the case with the whole country. In order to meet the demand of electricity in the long term, North West Power Generation Company Ltd. (NWPGCL) which is a wholly owned subsidiary of Bangladesh Power Development Board(BPDB) is coming up with a 800 MW Dual Fuel (R-LNG/HSD) Combined Cycle Power Plant Project at Khulna. This power plant is expected to be commercially operational by December 2019. As per the future plans the capacity is expected to increase further leading to incremental gas demand.

North West Power Generation Company Ltd. (NWPGCL) had expressed its interest in purchasing R-LNG from H-Energy Private Limited and had signed a MoU on February 4, 2016 followed by a Term Sheet on March 31, 2016 to purchase R-LNG for its upcoming 800 MW Gas Based Power Plant Project at Khulna. Further, NWPGCL vide letter no. memo No.2/NWPGCL/Khulna-LNG/2017 dated 01.01.2017 had confirmed the requirement of 1 MMTPA of Natural Gas for their power plant at Khulna for a period of 22 years. Based on the agreements signed between the two companies this volume is expandable to 2 MMTPA in future.

This Natural Gas Demand of North West Power Generation Company Ltd. (NWPGCL) has been used for designing and conceptualizing the Kanai-chatta Shrirampur Dedicated Natural Gas Pipeline.

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4. Pipeline Route (Including Pipeline length)

4.1 General

The proposed Kanai chatta - Shrirampur Dedicated Natural Gas Pipeline will originate from Kanai chatta village of East Medinipur, District to the India-Bangladesh border near Shrirampur of Nadia district in the state of West Bengal.

The pipeline route has been optimized based on a preliminary desktop survey. The pipeline route shall be finalized after a Detailed Route Survey which will be conducted post acceptance from the PNGRB and shall be based on the following criteria:

- Safety of public lives and property and safety of the pipeline from engineering and other considerations.
- Shortest pipeline length to the extent feasible
- Easy and favorable terrain condition free of very large water bodies, low laying marshy lands, obstacles like ravines, depressions and unstable grounds, meandering rivers, etc.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Minimum crossing of existing pipelines, transmission lines, parallel alignment, etc.
- Minimum road, rail, river and canal crossings.

4.2 Pipeline Route

Pipeline route selection for Kanai chatta – Shrirampur dedicated natural gas pipeline system is based on desktop study by H-Energy Pvt. Ltd.

Summary of the proposed Kanai chatta - Shrirampur Dedicated Natural Gas Pipeline route is as follows:

Table 1: Pipeline Length

Section	Length (in km)
Kanai chatta – Shrirampur	~275

4.3 Route description

The Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline route starts from the Entry Point Facility (EPF) at Kanai chatta village of East Medinipur District of West Bengal. From take-off, the pipeline route runs in west direction for approximately 15 km where it meets the National Highway (NH) 116B.

- From there the pipeline route runs in the North-eastern direction along the NH 116B for approximately 20 km and crosses the Rasulpur River. The pipeline is routed primarily through paddy fields. Salt pans and Aqua culture ponds may be present in the initial section of the pipeline route.
- The pipeline thereafter crosses the State Highway (SH) 4 and continues to run in North-eastern direction mostly through paddy fields for approximately 25 km.
- The pipeline then crosses Kaliaghai Nadi (Haldi River). A variety of flora and fauna is likely to be encountered near the river.
- From Kaliaghai Nadi, the pipeline route runs in the North direction for approximately another 40 km where it crosses National Highway – 6. Dense habitation is likely to be present along the pipeline route near the highway.
- After crossing National Highway – 6, the pipeline route runs in North-eastern direction for approximately 20 km where it crosses Rupnarayan River.
- After crossing Rupnarayan River, the pipeline route continues to run in North-eastern direction through paddy fields for another 25 km where it crosses State Highway – 15.

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- After crossing State Highway – 15, the pipeline route continues in the North-eastern direction for another 35 km and crosses NH – 19.
- The pipeline route thereafter crosses State Highway – 13 at an approximate distance of 220 km from the EPF. The pipeline route appears to run through paddy fields.
- The pipeline continues in the North-eastern direction for another 20 km and crosses Hugli River. The pipeline thereafter crosses NH – 34 and continues in the North Eastern direction up to the CTF and further to the CTP near Shrirampur in Nadia District at an approximate distance of 275 km from the EPF.

4.4 Major Crossings

For the selected route, the pipeline will have to cross through a number of Rivers / water bodies, Railway and Road Crossings. Major amongst these have been summarized in the table below:

Table 2: Major Crossings

MAJOR CROSSINGS	
National Highways	4
State Highways	9
Railway Lines	10
Asphalted roads	67
Other Roads	227
Rivers	9
Canals	28
Stream/Nalas	96
Other water bodies	51
Power Lines	24

Note: The crossings along the pipeline route have been estimated based on preliminary desktop study of the route. Actual crossing details will be determined after conducting the detailed route survey.

5. Project Details (Including Capacity)

Based on the demand projections of natural gas for NWPGCL, the Kanai chatta – Shrirampur Dedicated Natural Gas Pipeline shall be designed for a total capacity of 7.2 mmscmd (~2 MMTPA). Pipeline diameter has been selected based on the preliminary hydraulic analysis carried out using TG Net (Pipeline Studio) software. The pipeline diameter as calculated based on these studies is 24". The salient details of the facilities along this pipeline are as follows:

Table 3: Salient details of Kanai chatta – Shrirampur Dedicated Pipeline

	Salient details of Kanai chatta – Shrirampur Dedicated Natural Gas Pipeline		
S.No.	Description	Unit	Natural Gas Pipeline
1	Entry Point Facility at Kanai chatta		
2	Custody Transfer Point at India – Bangladesh border near Shrirampur		
3	Length	Km	~ 275
4	Capacity	mmscmd	7.2
5	Inlet pressure at Entry point	Kg/cm^2 g	70 - 90
6	Pipeline Size (NPS)	Inch	24
7	Pipeline operating Life	Years	30
8	Design Temperature	°C	-29 to 65
9	Sub- Soil Temperature	°C	20 - 25
10	Material of Construction		Carbon Steel (CS), APL 5L, X-70 Grade (PSL-2)
11	Pipeline Design Codes		Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B 31.8, OISD#226

Note: The pipeline length and size has been estimated based on preliminary desktop study of the route. Actual design parameters (i.e. length, diameter, wall

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thickness, etc.) will be determined after conducting the detailed route survey and basic engineering.

5.1 Process Design Basis

Source of supply of natural gas for Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline is as shown in the table below:

Table 4: Source

S.No.	Source name	Origin	Gas type
1.	Floating, Storage and Regasification Unit Project of H-Energy Private Limited located in the Offshore Digha region of West Bengal	Onshore Receiving Facility (ORF) of H-Energy Private Limited at Kanai chatta, in East Medinipur district of West Bengal	R-LNG

H-Energy Pvt. Ltd is setting up an FSRU project in the offshore Digha region of West Bengal with a proposed capacity of 4 MMTPA. R-LNG from the FSRU is received at the Onshore Receiving Facility (ORF) and subsequently delivered into the Kanai chatta–Shrirampur Dedicated Natural Gas Pipeline through the Entry Point Facility (EPF) at Kanai chatta.

5.2 Gas Composition

Gas composition of R-LNG at Entry Point Facility (EPF) shall be as per applicable PNGRB regulations and standards.

5.3 Design

For hydraulic calculation, a design factor of 0.40 has been considered for taking care of the worst condition of maximum pressure drop corresponding to higher thickness and minimum internal diameter, which is in accordance with ASME B31.8. For the whole pipeline, design factor is based on class location as below:

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Table 5: Design Factor

Location Class	Design Factor
1	0.72
2	0.60
3	0.50
4	0.40

The latest editions of referred codes shall be used for designing the pipeline. Pipeline is proposed to be coated with 3 – layer polyethylene coating to protect it against external corrosion. Additionally an impressed current permanent cathodic protection system will also be provided. Remotely operated mainline valves will be provided in accordance with the design code requirements for the purpose of isolation of the pipeline section during emergency or maintenance.

Minimum depth of burial of the pipeline will be 1 meter all along the route. This depth will be increased keeping in view the sensitivity of the location and code provisions.

The pipeline at major water crossings will be installed by using the Horizontal Directional Drilling (HDD) method. Pipeline will be laid below the predicted scour profile of the river bed.

Internal coated pipes will be used and a corrosion monitoring system shall be installed to monitor the health of the pipeline.

6. Basic Design

6.1. Pipeline Design

Based on the optimization studies, the following design parameters have been considered for the mechanical design of the pipeline system

- Pipeline diameter : 24"
- Design Pressure:
  - Main Line : 99 Kg/Cm^2 (g)
- Design temperature: -29 to 65°C
- Coating:
  - External : 3 Layer Polyethylene Epoxy
  - Internal : Epoxy Paint
- Material of Construction : Carbon Steel (CS), API-5L, X-70 Grade (PSL-2)

6.2. Pipeline Material

Pipeline and its appurtenances shall be provided with carbon steel material suitable for the intended service.

Line Pipe

LSAW/HSAW, line pipe shall conform to API Specification 5L, PSL-2 quality. The grade of line pipe shall be API 5L, X-70 Grade (PSL-2). Pipe wall thickness shall conform to Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B31.8 and shall also meet the requirement of OISD-226 and API 5L. At river crossings, higher wall thickness shall be used.

Pipeline Fitting and Flanges

All mainline materials such as flanges and fittings etc. shall be of class 600#.

Mainline Valves/ Sectionalizing Valves

All above ground mainline valves are full bore GOV/AV type operated and designed as per API 6D and API 6FA/ API 607 fire safe design requirements. The sectionalizing valves shall be full bore and designed as per API 6D and API 6FA / API 607 fire safe design requirements.

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Mainline valves and sectionalizing valves shall be ball valves. First isolation valve in mainline shall be butt- welded type.

Station Pipes, Flanges and Fittings

Above ground piping system shall be of equivalent grade to match class 600# pressure and temperature rating. All fittings shall conform to ANSI 600#.

Ball Valves

Ball valves within the stations shall be full bore/reduce bore type. Above ground station valves can have a bolted configuration. All Underground ball valve shall be welded configuration and TMBV type.

Flow Tees

Branch connection on the main line, which is greater than 40% of mainline would be provided with flow tees to allow smooth passage of pigs. Flow tees material would be same as that of line pipe.

Insulating Joints

Insulating joints would be provided at transition point of aboveground and underground portion of pipeline for electrical isolation. These will be mono-block type suitable for both above/ underground installations. Tap-offs from main line for GOVs, vent lines, etc., shall also be electrically insulated.

Bends

Cold field bends shall be in accordance with codes. Induction bend shall only be used in case of space constraints, including all stations. 6D bends shall be used only in mainline stations. Appropriate bends shall be selected and installed considering the pigging purpose.

6.3. Corrosion Protection Coating

External Coating

The selected corrosion protection coating shall be suitable for the design temperature range. In addition to that, it should have following properties:

- High integrity
- Resistance to ageing and degradation
- Resistance to attack by micro-organism

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- Resistance to soil stresses
- Water impermeability
- Abrasion resistance
- Impact strength
- Good adhesion
- Resistance to cathodic disbondment
- Resistance to creep
- UV resistance
- Ease of application

The minimum total thickness of the 3 LPE coating shall be as per DIN 30670. The sequence of application of coating shall be as follows:

- Epoxy
- Co-polymer layer applied by extrusion (adhesive)
- Polyethylene layer applied by extrusion.

Internal coating

Epoxy coating has to be applied to internal surface of pipeline. The pipeline shall be furnished with Internal Epoxy Coating conforming to ISO 15741.

Pipeline Construction

Pipeline and associated facilities shall be constructed in accordance with the Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B31.8, OISD #226 and other applicable reference standards. The pipeline shall be laid underground with minimum top cover of 1(one) meter.

Welding shall be carried out as per API 1104. All welds shall be 100% radiographed. After the installation is completed, the entire pipeline shall be hydrostatically tested. The hydrostatic test pressure at any test section shall be 1.5 times the design pressure. The maximum hydrostatic test pressure at any location in the pipeline during testing shall not exceed the pressure required to produce hoop stress equal to 95% SMYS of pipe material. The pressure holding time shall be 24 hours after stabilization for all underground pipeline.

Construction Methodology

a) Main Pipeline

Pipeline associated facilities shall be constructed in accordance with Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations, 2009, ASME B 31.8 , OISD 226 and other applicable reference standards.

In case of soft soil, conventional trenching and backfilling can be considered for laying of pipeline.

In case of sub surface encountered being weathered rock, a minimum of 150mm thick layer of soft back-fill material shall be provided all around the pipeline prior to back-filling the trench with excavated material. Where blasting cannot be carried out due to close proximity of existing facilities, mechanical equipment for rock excavation can be used. Conventional trenching and back-filling using trenching machine has been considered for laying of the pipeline in the soft soil areas other than described above.

The type of corrosion coating selected (3 LPE) for the pipeline has adequate mechanical properties to withstand the hard surface features. A typical cover of one (1) meter over the top of pipeline shall be considered.

The field joint anti-corrosion coating material shall either be heat shrinkable wraparound sleeve or cold applied tape suitable for maximum design temperature and shall conform to designation EN 12068 – C HT 60 UV.

b) Pipeline Crossings

i. Rail

Railway lines shall be crossed by boring method. Approval of designs and construction methodology shall be obtained from concerned railway authorities. Pipeline at railway crossing shall be provided with casing pipe. The carrier pipe shall be installed inside casing pipe. The casing pipe shall be three nominal sizes larger than carrier pipe. The minimum clear cover at the crossing above top of pipeline shall be 1.7m. The crossing angle shall be as close to 90° as possible. The railway crossing shall comply with the

requirement of API 1102 and Indian Railway authorities. Casing insulator and seals shall be provided to isolate carrier and casing pipes.

ii. Road & Canal

Road crossing shall comply with the requirement of API 1102 and requirements of the concerned road authorities. Pipeline at National Highways and State Highways crossing (wherever required) shall be provided with the casing pipe. Metalled roads other than the national highways and state highways shall be crossed by open cut method. However at locations where it is not possible to cross the road by open cut method, boring / jacking method shall be used. No casing pipe shall be considered at such locations. All cart tracks crossings shall be carried out by open cut method. The road crossing shall be provided with minimum cover of 1.2m measured from top of the carrier pipe.

Irrigation land canals shall be crossed by boring method wherever required by the statutory authorities. All other minor canals and nala crossings shall be carried out with conventional open cut method unless directed otherwise by concerned authorities. The canal/drain/nala and ditches crossings shall be provided with a minimum clear cover of 1.5m.

iii. River Crossing

All rivers crossing are proposed to be crossed by conventional open cut method except for the rivers specifically proposed to be crossed by HDD Method. Pipeline shall be installed approx. 1.5m (for rocky) / 2.5m (for normal soil) below the lowest bed level. Lowest bed level shall be calculated after giving due consideration to scour depth of such water crossings.

The line pipe shall be concrete coated, if required for sufficient negative buoyancy.

At all major crossing two number of HDPE conduits shall be laid in steel casing pipe along with carrier pipe to take care of future requirement.

6.4. Facilities

a) Entry Point Facility (EPF) at Kanai chatta

The EPF will be located adjacent to the Onshore Receiving Facility (ORF) for the FSRU project. The gas from the FSRU will be received at the ORF and from there the gas shall flow into the Dedicated Natural Gas Pipeline through the EPF. The main equipment at the EPF will be as follows:

- Scrapper Launcher – 01 No.
- Pressure Reduction Installation (PRI)
- Ultrasonic Metering Skid:
  - Ultrasonic Metering Facility
  - Panel Mounted Flow Computers
  - Cartridge Filter with PSV
- Local and panel mounted instruments such as PG, PT, TE, TG and Signalers
- Control Panel
- Corrosion Protection System
- Associated Piping and Instrumentation
- Emergency Shutoff Valve (ESV)
- UPS
- SCADA and Telecom
- Fire and gas detection system
- Gas Chromatograph
- Storm water disposal, waste disposal etc.
- Access road, fence, gates and security guard room etc.

b) **Sectionalizing Valves/Stations (Approx. 16 Nos.)**

The Sectionalizing Valves/Stations will have the following:

- Isolation Valve
- Venting facilities
- SCADA and Telecom
- Fire and gas detection system
- Solar power source with battery back-up and grid power
- Storm water disposal, waste disposal etc.
- Access road, fence, gates and security guard room etc.

c) **Intermediate Scrapper Receiving / Launching Facility (1 No.)**

There will be 1 Intermediate Scrapper Receiving / Launching Facility which will consist of:

- Scrapper Receiver – 01 No
- Scrapper Launcher – 01 No
- SCADA and Telecom
- Fire and gas detection system
- Venting facilities
- Local and panel mounted instruments such as PG, PT, TE, TG and Signalers
- Control Panel
- Associated Piping and Instrumentation
- Emergency Shutoff Valve (ESV)
- Solar power source with battery back-up and grid power
- Storm water disposal, waste disposal etc.
- Access road, fence, gates and security guard room etc.

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d) **Custody Transfer Facility (CTF) near Shrirampur**

The main equipment at the CTF will be as follows:

- Scrapper Receiver – 01 No.
- Pressure Reduction Installation (PRI)
- Ultrasonic Metering Skid:
  - Ultrasonic Metering Facility
  - Panel Mounted Flow Computers
  - Cartridge Filter with PSV
- Local and panel mounted instruments such as PG, PT, TE, TG and Signalers
- Control Panel
- Corrosion Protection System
- Associated Piping and Instrumentation
- Emergency Shutoff Valve (ESV)
- UPS
- SCADA and Telecom
- Fire and gas detection system
- Gas Chromatograph
- Storm water disposal, waste disposal etc.
- Access road, fence, gates and security guard room etc.

e) **Custody Transfer Point**

This is the point in the no-man's land near Shrirampur, between the Indian border and the Bangladesh border. The facility here will consist of:

- Isolation Valve – Manual Trunnion Mounted Extended Stem Ball Valve (TMBV)

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- Venting facilities
- Storm water disposal, waste disposal etc.
- Access road, fence, gates and security guard room etc.
- The downstream joint of the TMBV shall be the Custody Transfer Point for handing over gas to NWPGCL, Bangladesh.

f) Corrosion Protection

Both active and passive corrosion protection systems shall be provided to prevent external corrosion of the pipeline. The system will comprise of a high integrity three layer polyethylene coating system. This will be supplemented by an impressed current Cathodic Protection system. New Transformer Rectifier (TR) / Cathodic Protection Power Supply Module (CPPSM) units shall be installed at all associated facilities and SV stations. During construction, the pipeline shall be protected by Temporary Cathodic Protection until Permanent Cathodic Protection (PCP) commissioning is in place. Insulation joints will be provided at the underground and above ground transition of the pipeline for electrical isolation.

6.5. Instrumentation and Control System

Instrumentation and Control shall be provided for safe and efficient operation of the pipeline and associated facilities. Field mounted instruments as well as Panel mounted instruments are envisaged. Panel mounted instruments necessary interface is envisaged in each station including SV stations to connect operational parameters to the SCADA system for remote control and monitoring.

Instrumentation and Control system has been envisaged to ensure optimum performance of the Natural Gas transportation and to achieve safe, reliable and trouble free operation. For this purpose, microprocessor based electronic instruments having 4 – 20 mA DC unified current analog and digital signal as input/ output have been envisaged. The basic function

of the Instrumentation system is to monitor and control of natural gas parameters viz., pressure, temperature, flow, % of LEL, actuated valve status, etc. These functions will be achieved with the help of panel mounted receiver instruments, annunciation lamps, push buttons, etc. in the control room along with equipment/ pipeline mounted sensors, transmitters, gauges, switches, actuated valves, etc. in the field.

The design shall employ the latest technology of proven capabilities. The selection of equipment shall be such as to offer flexibility for future modification and expansion without affecting the system reliability.

All instruments shall be capable of operating for the specified turndown conditions. All instruments unless otherwise specified, shall be electronic type. However, final control element shall be pneumatic or gas operated.

All plant safety shutdown and interlocks shall be carried out using electromagnetic relays for fail safe and reliable shutdown. Control Panel and Relay Panel / Marshalling Rack shall be located in control room.

All field instruments, junction boxes and cable glands shall be certified for use in hazardous area as per area classification. The Instrumentation shall be certified intrinsically safe in general, as per IEC-79. However, field switches, solenoid valves shall be certified flameproof for use in classified area as applicable (IS-2148/ IEC-79). Moreover, all field instruments, junction boxes, cable glands and local control panels shall be weather proof to NEMA-4 / IP 65 as per IS:2147 / IEC-529 as a minimum and explosion proof/ flame proof to NEMA-7 or equivalent IS Standard. Junction boxes, cable glands and accessories shall be Weather-proof only when connected to intrinsically safe circuit and NEMA-7 or equivalent IS Standard, when connected to explosion proof instruments / circuits.

The philosophy of power supplies for Instrumentation purposes are as follows:

i) 230 V AC 50 HZ. UPS ,

ii) 230 V AC 50 HZ. Non-UPS

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iii) 24 V DC

230 V AC 50 Hz. UPS shall be used for main incoming power to control panel. 24 V DC (Dual Redundant) power supply to be used for panel mounted receiver instruments, transmitters, barriers, signal repeaters (SDC) etc. shall be derived from 230 V AC (UPS) power supply as part of control panel . 24 V DC shall also be used for interlock based relay system, solenoid valves LEL detectors. 230 V AC non-UPS shall be used for panel lighting, electrical heat tracing. The UPS and 24 V DC shall be sized to meet the control system / relay based logic system load and other non-UPS loads shall also be sized based on the requirement.

Isolated 230V AC @50 Hz, 24V DC and its distribution within the battery limits including UPS and battery backup shall be considered. AC distribution board and DC distribution board shall be provided in control room with suitable isolator for each feeder.

All open and close loops shall have an individual MCB in the panel for isolating the field instruments for maintenance (i.e. for field switches, transmitters, SOV, Control Valve etc.).

The design and installation of instruments shall be generally in accordance with ISA / API recommended practices and other applicable standards like ASI, IBR etc. Material specifications and practices shall, in general, conform to appropriate ASTM or equivalent standards. All standards, code of practice shall be of the latest edition.

Instruments and equipment shall be suitable for use in hot, humid and tropical industrial climate in which corrosive gases and/ or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof, weather proof to NEMA 4 (IP 65) and secure against the ingress of fumes, damages, insects and vermin. All external surfaces shall be suitably treated to provide anti-corrosion protection against plant atmosphere.

Pressure Reduction is envisaged at EPF and CTF. The self-actuated active regulator and monitor regulator shall be one working and one standby with Slam Shut valve (SSV) mounted at upstream of each regulators stream. The regulator shall be as per the PED regulations and EN334.

6.6. Metering System

Minimum four-path ultrasonic meter shall be used for Custody transfer at CTF. All the meters shall be suitably calibrated. The configuration of meter at CTF shall be in series. The installation of ultrasonic meter shall be upstream of pressure regulating station as per the latest AGA-9. Panel mounted flow computer is envisaged with each metering UFM. Online Gas Chromatograph is envisaged at the CTF. All the instruments shall be as per the latest configuration and specifications. The metering PT and TE/TT shall be of highest accuracy.

6.7. Supervisory Control and Data Acquisition System and Communication

The Control Center shall be located at both the EPF and CTF. Pipeline Application Software (PAS) will be installed for the pipeline to monitor key parameters and leak detection. Sectionalizing Valves along the route of the pipeline will be remotely operated through the SCADA system.

6.8. Leak Detection System

- **Gas Detection System**

Infrared (IR) and Open Path type detection system having adequate numbers of gas detectors at various critical locations in the EPF, CTF, Sectionalizing Valve Stations and intermediate pigging station shall be provided for continuous monitoring of hydrocarbon level in the air in the proximity of piping , equipments, etc. The basis of location for gas detection system shall be based on wind direction, gas component density and coverage of gas detections in EPF, CTF, Sectionalizing Valve Station and

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intermediate pigging and shall be integrated with SCADA, through RTU serial communication/hardwired communication.

The panel (completely wired) for housing the monitor/ controller for gas detectors with relays, hooters/ annunciators indicating the location shall be provided in the new control rooms.

The single channel monitor shall be used with two channels as spare. The gas detection system shall give low gas alarm on 20% low explosion level (LEL) and high gas alarm of 40% LEL detection in the gas detectors. One number of calibration kit complete with calibration gas cylinders for gas detector calibration with portable type gas detectors shall be provided.

- **Fire Alarm Gas Detection System**

Suitable fire and gas detection system for field area shall be provided.

The supply shall include fire detectors, monitor/ controllers, and enunciators in fire panel to be placed in control rooms (CR).The fire and gas detector layout shall cover the entire plant area system following NFPA-72 standard. All the connections for fire/ gas/ smoke detection system will lead for annunciation to the fire panel to be placed in the control rooms

6.9. Fire Fighting Facilities

Fire-fighting facilities such as static firefighting equipment, DCP type fire extinguisher at EPF, SVs, IPs and CTF shall be installed. All remote operated unmanned station shall be provided with CO2 flooding system.

Also, safety and fire hydrant protection system shall be provided as per OISD-226 at all installations, except IPs and SVs. The fire water system shall comprise fire water pumps, fire water storage, distribution piping network and water sprinkler / deluge system.

6.10. List of Standards / Codes

The following Standards and Codes shall be followed:

- PNGRB's Applicable Regulations and Standards

- American Society of Mechanical Engineers (ASME)
  - ASME B31.8 : Gas Transmission and Distribution Piping System
  - ASME B16.25 : Gas Transmission and Distribution Piping System
  - ASME B16.9 : Factory – Made Wrought Iron Steel Butt-Welding Fittings
  - ASME B31.3 : Process Piping
  - ASME B31.4 : Pipeline Transportation System for Liquid Hydrocarbons and others
  - ASME B16.5 : Pipe Flanges and Flanged Fittings
  - ASME B16.9 : Factory Made Wrought Steel Butt Welding Fittings
  - ASME B16.10 : Face to Face and End to End – Dimensions of Valves
  - ASME B16.11: Forged Fittings, Socket-Welding and Threaded
  - ASME B16.20: Metallic Gaskets for Pipe Flanges – Ring Joint, Spiral Wound and Jacketed.
  - ASME B16.21 : Non-Metallic Flat Gaskets for Pipe Flanges
  - ASME B16.25 : Butt Welding Ends
  - ASME B16.28 : Wrought Steel Butt Welding Short Radius Elbows
  - ASME B16.34 : Valves – Flanged, Threaded & Welding Ends
  - ASME B16.36 : Orifice Flanges
  - ASME B18.2.1 : Square and Hex. Bolts and Screws
  - ASME B18.2.2 : Square and Hex. Nuts
  - ASME B31.3 : Process Piping
  - ASME B36.10M: Welded and Seamless Wrought Steel Pipe
  - ASME Boiler & Pressure :Section-IX – Qualification standard for welding and Brazing
  - Vessel Code procedures, welders, brazes, and welding and brazing operators
  - ASME Boiler & Pressure :Part C – Specifications for Welding Rods, Electrodes, and Vessel Code-II Filter Metals
  - ASME Boiler & Pressure: Section-V, Nondestructive Examination

- ASME Boiler & Pressure : Section-II Materials Part A – Ferrous Materials Specifications

American Petroleum Institute (API)

- API Spec 5L : Specification for Line Pipe
- API RP 1102 :Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways
- API Std 1104: Standard for Welding Pipeline and Related Facilities
- API Std 607: Fire Test for Soft Seated Quarter Turn Valves
- API RP 500 :Recommended practice for classification of locations of Electrical installations at Petroleum Facilities classified as Class I, Div. 1 and 2.
- Spec 6FA : Specification for Fire Test for Valves
- STD 590 : Steel Line Blanks
- STD 594: Check Valves, Wafer, Wafer Lug and Double Flanged Type
- STD 598 : Valve Inspection and Testing
- STD 600 : Steel Gate Valves Flanged or Butt Welding Ends, Bolted and Pressure Seal Bonnets
- STD 602:Compact Steel Gate Valves – Flanged, Threaded, Welding and Extended Body Ends.
- STD 607:Fire Test for Soft-Seated Quarter-Turn Valves

British Standard Institute

- BS1868 :Steel Check Valve (Flanged and Butt-Welding Ends) for Petroleum, Petro-Chemical and Allied Industries
- BS1873:Steel Globe, Globe Stop and Check Valves (Flanged and Butt Welding Ends) for the Petroleum, Petrochemical and Allied Industries
- BS5154 : Copper Alloy Globe, Globe Stop and Check, Check and Gate Valves

- BS5351 :Steel Ball Valves for Petroleum, Petrochemical and Allied Industries
- BS5352: Steel Wedge Gate, Globe and Check Valves 50mm and Smaller for Petroleum, Petro-Chemical and Allied Industries
- BS6755 Part-I :Testing of Valves Part-1 : Production Pressure Testing Requirements
- BS6755 Part-2 :Testing of Valves Part-2 : Specification for Fire Type Testing Requirements.
- EN 288-9 : Specification and approval of welding procedures for metallic materials – part 9. Welding procedure test for pipeline welding on land and offshore site butt-welding of transmission pipeline
- NDB EN 1594:Gas supply systems – pipeline for maximum operating pressure over 16 bar – Functional requirements
- NBN EN 10208-2: Steel pipes for pipelines for combustible fluids – Technical delivery conditions - Part 2
- ISO-15590-1: International Standard for Petroleum and natural gas industries – Induction bends, fittings and flanges for pipeline transportation systems
- DIN 30672:Coatings of corrosion protection tapes and heat-shrinking products for pipelines for operational temperatures up to 50°C
- SEL 072 – 1st Edition: Ultrasonically tested heavy plate
- DIN 20670: Polyethylene coatings for steel pipes and fittings
- DIN 2413 Part-II: Design of steel bends used in pressure pipelines
- ISO/TR 5168 :Measurement of fluid flow-Evaluation of uncertainties

Oil Industry Safety Directorate (OISD Standards)

- OISD-GDN-115 : Guidelines on Fire Fighting, Equipment and appliances in Petroleum Industry
- Fire Protection Manual : Fire Engines, Trailer Pumps and Hydrant Systems - TAC

- OISD-Standard-141: Design and construction requirements for cross country hydrocarbon pipelines
- OISD-Standard-118 : Layouts for oil and gas installations

American Society for Testing and Materials (ASTM)

- ASTM A82 : Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
- ASTM A185 : Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- ASTM E92 : Standard Test Method for Vickers Hardness Testing of
- Metallic Materials
- ASTM E94: Standard Practice for Radiographic Testing
- ASTM E165: Standard Practice for Liquid Penetrate Inspection Method
- ASTM E709: Standard Guide for Magnetic Particle Examinations

Manufacturers Standardization Society (MSS)

- MSS-SP-6 : Standard Finishes for Contact Faces
- MSS-SP-9 : Spot Facing for Bronze, Iron and Steel Flanges
- MSS-SP-25 :Standard Marking Systems for Valves, Fittings, Flanges and Union
- MSS-SP-75 :Specification for High Test Wrought Welding Fittings

List of Typical Drawings

6.11. Following are attached in Annexure-II:

1) Pipeline Schematic Route Diagram
2) Typical P & ID for Entry Point Facility
3) Typical P & ID for SV Station
4) Typical P & ID for Intermediate pigging Station
5) Typical P & ID for Custody Transfer Facility

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7. Statutory Clearances and Approvals

Immediately after receiving the letter of Acceptance for the Kanai chatta - Shrirampur dedicated natural gas pipeline project from the PNGRB , HEPL shall start preliminary works like land identification, acquisition of land and initiate action to obtain the applicable statutory clearances and approvals as listed below:

1. PNGRB approval.
2. PESO (CCoE) approval.
3. Forest land conversion for non-forest use.
4. Environmental clearance
5. Consent to establish / operate from SPCBs.
6. Acquisition of Private / Govt. land.
7. Working permission from Collectorate.
8. Protected / Reserve Forests for pipeline laying.
9. Social Forests for pipeline laying.
10. Wildlife Sanctuaries / National Parks for pipeline laying.
11. CRZ clearance
12. Major water body crossing for pipeline laying.
13. Minor water body crossing for pipeline laying.
14. NH crossing for pipeline laying.
15. SH crossing for pipeline laying.
16. MDR and other road crossing for pipeline laying.
17. Railway crossing for pipeline laying.
18. RoU acquisition in Private / Govt. land for pipeline laying.

Futher, Ministry of External Affairs, BM Division, vide their Office Memorandum No. 219/Dir(BM) 2015 dated 26 October 2015 (copy enclosed as **Annexure-I**) have conveyed their No Objection to the Cross Border Supply of Regasified LNG to the proposed gas based power project of North West Power Generation Company Limited.

8. Environmental Impact and Mitigation

This section of the DFR provides an assessment of the potential impacts on different identified environmental components, which are likely to occur during construction and operation of the Kanai chatta – Shrirampur dedicated natural gas pipeline. However, by adopting appropriate management measures, majority of the assessed impacts can be mitigated.

The major potential impacts associated with the proposed Kanai chatta – Shrirampur dedicated natural gas pipeline project works shall have impact on soil, impact on water resources and area drainage, air quality degradation, noise impacts, impact on ecological environment, impact on agriculture, land use changes, impact on health and safety, impact on socio- economic features, impact on community activities, impact on cultural heritage and impact on aesthetics. These impacts can occur at any one of the three stages, i.e. planning or design stage, construction stage and operation stage.

The identified impacts due to the proposed project can be mitigated through the incorporation of appropriate measures at different stages of project execution. This will ensure the best design with minimal damage to or loss of significant or sensitive features such as roadside vegetation, local water resources, etc.

8.1 Pipeline Construction Activity

Major activities involved during pipeline construction are as follows:

- Pre-construction route survey.
- RoU clearing, grubbing and grading.
- Transportation of pipes from the line pipe coating yard to site dump / stack yard.
- Transportation of pipes from the site dump / stack yard to suitable places along the route of the pipeline.
- Line pipe stringing
- Line pipe welding

- NDT of welded joints
- Coating of field welded joints
- Excavation and preparation of trenches for the pipes. Top soil to be kept separately
- Lowering the line pipe strings into the trench and padding
- Jointing of line pipe strings inside the trench
- Backfilling of trench with topsoil layer after lowering of pipeline
- Hydrostatic pressure testing of the pipes and rectification of defects (if any) and re-testing
- Construction of valve chambers and erection of valves
- Fabrication of fittings and special fittings and coating of the same
- Construction of necessary pipe supports, anchor blocks
- Installation of pipeline markers
- RoU restoration

8.2 Size of the Pipeline Trench

The pipeline will be placed 1.2m below the ground surface. A trench of 1300 mm wide at the bottom for normal soil (1500 mm wide for rocky / hard soil), 1600 mm at the top and 1900 mm deep will be cut in the acquired RoU for laying the pipeline.

8.3 Impacts During Construction Phase

8.3.1 Ambient Air Quality

The air quality during the execution of the project along the road stretch may get affected. Particulate matter will be the predominant pollutant affecting the air quality during the construction phase as the construction activities are likely to generate dust.

Additional automobile traffic and construction machineries involved during construction activities will generate gaseous pollutants. However this will not

lead to any tangible effect, as the additional traffic volume related to construction activities will be low.

Impacts

During the construction period the impacts that are associated with the air quality shall be:

- Deterioration of air quality due to fugitive dust emissions from construction activities (especially during dry season) like excavation, back-filling and dumping of earth materials, from construction spoils, vehicular movements along unpaved roads, loading / unloading and transportation of construction materials.
- Generation of pollutants due to operation of heavy vehicles and movement of machineries and equipment for material handling, earth moving, etc.

8.3.2 Noise Level

During construction phase, noise will be generated due to movement of vehicles, and operation of light and heavy construction machineries including pneumatic tools (hot mixer, dozer, tipper, loader, excavator, grader, scrapper, roller, concrete mixer, generator, pump, vibrator, crane, compressor, etc.).
The main sources of noise during construction period are:

- Movement of vehicles during the construction period for procurement of construction material.
- During site preparation, surface preparation, etc.

Noise generated from sources mentioned above will be mostly during daytime. Moreover, villages / settlements being mostly away from the route, no significant impact on local people is apprehended (as all the congested human habitation has been bypassed); as the noise will generally dissipate by the time it reaches the inhabited locations. However, the workers are likely to be exposed to high noise levels that may affect them.

Impacts

The typical impacts associated with the construction process are:

- Increase in noise level due to construction activities like operation of construction equipment and vehicular traffic. Operation of construction machinery will lead to rise in noise level to the range between 80-85 dB. The magnitude of impact from noise will depend upon types of equipment used, construction methods and also on work scheduling.

8.3.3 Water quality

Small quantity of water will be used during construction process and hydro-testing of the pipeline. Waste water from construction activities would mostly contain suspended impurities. Other pollutants, which may find their way to it, will be insignificant concentrations and may not cause significant impact on the receiving water bodies.

The deterioration of water quality during construction phase is expected due to wastewater disposal from the workers camp and sullage generated from construction sites. If adequate arrangements are not made to ensure proper drainage of wastewater from construction sites, such waters may form stagnant pools and aggravate soil erosion. Stagnant pools of water promote breeding of mosquitoes and create generally unsanitary conditions.

Impacts

- Increase of sediment / silt load in the runoff from construction sites / earth moving activities and increase in turbidity in receiving stream / water bodies.
- Erosion of soil into the water bodies due to removal of vegetation.
- Contamination by fuel and lubricants by spills from machineries.
- Contamination of water bodies due to improper sanitation and disposal of wastes at the construction camps.
- Contamination of water bodies due to water from Hydro-testing of the pipeline.

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- Impact on ground water quality due to leachates from the solid waste dumpsites.

8.3.4 Soil and Land Environment

The construction activities such as earth moving and felling of trees may lead to reduction in vegetal cover on ground thus leading to soil erosion. During the construction period the movement of heavy vehicles will result in compaction of soil by making it hard and impermeable.

The erosion at construction stretches will result in increased sediment load in recipient streams. Any leakage of lubricants in equipment yard will cause soil contamination. Solid waste disposal along roadside also adds to impact on the land environment during the construction.

During construction activity for laying of pipeline cutting of existing land will be done and the dug material generated will be replaced back after laying of the pipes.

Impacts

The typical impacts on land environment generally associated with the construction phase are:

- Loss of topsoil from excavation areas.
- Loosening of topsoil and loss of vegetative cover (land clearing) along the route and construction areas due to excavation and back filling which lead to enhance soil erosion.
- Compaction of alluvial soils by earth moving equipment.
- Solid waste disposal along the route also adds to impact on the land environment during the construction phase.

8.3.5 Topography and Geology

The Pipeline will be laid 1.2m below the ground by open cut digging and after laying of pipeline the pit will be refilled back to original state. Thus there will be a temporary impact on topography of the area, which will be temporary and cannot be avoided.

Impacts

The typical impacts on topography and geology associated with the construction phase are:

- Temporary disfiguration of and change in existing profile of the land due to construction activity.
- Disturbance on geological setting due to cutting of hills, where the pipeline passes through hilly terrain.

8.3.6 Land Use

Preparatory activities like clearing of RoU, construction of temporary construction camps and godowns, storage of construction materials, etc., will be confined within the camp and RoU. This will not hamper the land use aspects outside RoU. However, indirectly there may be some changes in the land-use pattern of proximate area due to influx of construction work force who are likely to construct temporary tents in the vicinity. The on-site land use will more or less have a temporary impact in terms of fugitive emission from handling of construction material.

The pipeline route lies mostly in plain terrain (except for some stretches where the existing route passes through hilly areas) and thus, no disfiguration of land is envisaged due to construction activities.

Land use changes along the pipeline route corridor are also anticipated due to a change in socio-economic characteristics of the adjacent lands. There would be succession of land uses and higher return uses would displace the lower return uses. This phenomenon will occur at gas outlet stations and in settlement areas along the project route.

Impacts

Land use impacts associated with the projects are:

- Temporary loss of agricultural land resources due to land acquisition for new RoU.

- Generation of solid wastes from construction spoils from construction sites.

8.3.7 Rivers and Drainage

The water resources present in the study area may get impacted during the construction phase of the project. Impacts of construction will have significant impact on the surface water whereas the impact on the ground water resources will be minimum. Out of the above possible impacts the no major impacts are anticipated associated with the proposed project. While crossing perennial rivers and drainages, HDD method shall be used for laying of pipeline.

The indicators chosen for assessing the impact on the water resources include number of water crossings along the route.

8.3.7.1 Water bodies

No ponds or lakes are getting affected (complete / partial filling) due to the proposed project along the project route.

Impacts

- Loss of water resources due to complete or partial filling up of ponds / water bodies.

8.3.8 Water use

During construction period water is required for compaction of, dust suppression, concrete making and domestic use in construction camps. The water demand for construction will be met from the existing sources like ponds, ditches and rivers close to the route. However, the quantity being very small it is not likely to have significant impact on other users.

Impacts

- Impact on the local water sources due to use of construction water.

8.3.9 Social Aspects

The possible impacts of the proposed project related to social aspects are:

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8.3.9.1 Amenities and Cultural Properties

Impacts

- Due to additional land acquisition as RoU, educational institutions (schools and colleges), medical amenities (hospitals and health centres), and other amenities (markets and banks), drinking water sources (tube wells), houses and religious and cultural properties (temples and mosques) may get impacted.

8.3.9.2 Rehabilitation and Resettlement

The proposed laying of gas pipe line will involve temporary acquisition of land in new RoU which will be duly compensated and no permanent rehabilitation and resettlement will be involved.

Impacts

- Temporary acquisition of agricultural land, which is the source of sustenance of the affected families

8.3.9.3 Employment and Trading Opportunities

Impacts

- It is estimated that substantial construction personnel including skilled, semi-skilled and unskilled laborers employed by various contractors will work at site during the peak period of construction phase. Since most of sizeable labour force will be drawn from neighborhood, no charge in demographic profile is anticipated. Only for a few skilled personnel, brought to site from outside the locality, proper housing / accommodation would be provided in the construction camps. Due to employment opportunities, some competition for work during construction phase is therefore anticipated.
- The construction materials like stone chips and sand will be procured locally from identified quarry sites. The other important materials like cement, steel will be procured through various local sources. Thus there is

a possibility of generation of local trading opportunities, though temporary.

8.3.10 Migration

From the viewpoint of employment of migrant skilled workers the project is small. Therefore no social tension is expected due to very small number migrant skilled workers. As the construction phase has a very short time span in comparison to the operation phase, it would not have any long-term effect. Moreover the different groups of people engaged in different construction activities will leave the place after specified time span.

Impacts

- Influx of construction work force and supplier are likely to construct temporary tents in the vicinity.
- Likely sanitation and health hazards and other impacts on the surrounding environment due to inflow of construction laborers.

8.3.11 Aesthetics

The construction activity will involve activities like land clearance activity, cut and fill, transport of materials to construction site, dumps of construction material at site, construction workers camp, WMM plant and Hot mix plant. All these activities will generate dust, noise and fumes, which will give an ugly look to the project site. The deterioration in aesthetic look of the project site cannot be avoided during construction phase but all proper mitigation measures will be taken to minimize the same. However, once the construction phase is over the proposed project will be in final shape, the left over material at site will be taken care of and the excavated areas will be leveled up. The construction workers camp will be dismantled. All these activities will improve the aesthetics of the area.

8.3.12 Safety Aspects

Occupational Health and Safety

During the construction period the dust released around the construction sites may lead to a number of respiratory and skin diseases. Excessive production of noise during construction may lead to psychological problems in the residents living in the nearby areas (if exposed for a very long period). The disposal of solid wastes along the road side and stagnant water bodies created due to construction activities would lead to a number of endemic diseases like typhoid, cholera, dysentery, gastroenteritis etc. in the nearby localities.

Impacts

- Health and safety related problems to construction workers due to inadequate health and safety measures.

8.3.13 Road Safety / Traffic

Impacts

Increase in incidence of road and Rail accidents due to disruptions caused in existing traffic movements, when the construction activity will be taking place near road or when the pipeline will be crossing the road.

8.3.14 Rail Traffic / Safety

Impacts

- In case of pipeline crossing Railway, construction activities may disrupt the rail traffic and there may be increase in incidence of Rail accidents due to disruptions caused in existing traffic movements, when the construction activity will be taking place near railway line or when the pipeline will be crossing the road.

i. Positive or Beneficial Impacts during Construction

- Employment opportunities due to recruitment of local laborers.
- Trading opportunities due to procurement of some construction materials locally.

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- Clean-up operations, landscaping and plantations

8.4 Impacts During Operations Phase

8.4.1 Air Quality

Impacts

- The gas pipeline will be 1.2m below the ground and thus no air pollution due to operation of the project is anticipated.
- Some vehicular emission from maintenance is anticipated during maintenance phase, which will be temporary.

8.4.2 Water Environment

Impacts

The material/product to be transported is natural gas, i.e. > 90% methane. Any release of this will be in the gaseous form and there is no possibility of mixing it with any water/water bodies. So possibilities of any water pollution are non-existent. During the operation period the expected impacts on the water resources is not anticipated.

8.4.3 Solid Waste

Impacts

Once the pipeline is being commissioned, no solid waste will be generated due to operation of the pipeline.

8.4.4 Noise Pollution

Impact

- The workers / staff may be exposed to high noise levels.

8.4.5 Land Use and Encroachment

In the operation phase, the temporarily modified land use pattern such as temporary construction camps / tents would be dismantled. The route after completion of its development would, would consist of neat landscape to lead to a pleasing outlook.

The existing route passes mainly through agricultural field / barren and forest areas.

Impacts

- Likely change in land use due to induced commercial development.

8.4.6 Ecological Features

Impact

There will be no impact during the operation phase of the project. However, some impacts are anticipated during maintenance phase, which will be the same as described for construction phase but will be of lesser magnitude.

8.4.7 Positive / Beneficial Impacts During Operation Phase

The possible positive impact of on people may include, ultimately:

- Creation of jobs during construction phase.
- Will build strong socio-economic relationship between India and Bangladesh

8.5 Future Studies

Appropriate mitigation measures need to be adopted for all the environmental impacts during pipeline construction and operation as detailed above.

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9. Implementation Methodology and Schedule

The project implementation methodology is described broadly under the following main activities:

- Surveys and Investigations
- Acquisition of ROU
- Statutory approvals and clearances
- Design and Engineering
- Procurement of Materials
- Construction and commissioning

All activities will be planned in a manner so as to achieve the overall completion of the project.

9.1. Surveys and Investigations

The reconnaissance survey for the pipeline route shall be carried out. Required cadastral data will be collected through detailed route survey. Detailed route survey, including additional surveys and investigations required for the design of crossing river, roads and railways etc. will be undertaken prior to commencement of detailed design considering the overall constructability, geo hazards and environmental requirements.

9.2. Acquisition of ROU

ROU would be acquired under the provisions of the Petroleum and Minerals Pipelines (Acquisition of Right of User in Land) Act, 1962. The ROU will be restored to near original condition after completion of construction of the Pipeline.

9.3. Statutory Clearances and Approvals

The company will apply to relevant authorities for the statutory clearances and approvals that are required. Requisite clearances from PCB, CCOE, etc. shall be obtained from the respective Government Organizations. In addition, authorities

concerned with grant of approvals in respect of crossing of railway tracks, roads and highways, canals, rivers, ponds, power lines, cables and the like as applicable will be taken in order to implement the project.

9.4. Design and Engineering

The Design and Engineering of the Project will be entrusted to experienced engineering consultants. The design of the pipeline and related facilities will comply with the requirements of the applicable Indian and international codes and standards, and the requirements and conditions of applicable authorities and government agencies.

9.5. Procurement of Materials

The specifications and QA/QC requirements of materials will be finalized during the design and engineering stage and will comply with project requirements and any other conditions imposed under statutory approvals and clearances. All materials will be procured from reputed and authorized manufacturers, and will be subjected to third party inspection and QA/QC during various stages of manufacturing and testing.

9.6. Construction and Commissioning

Pipeline will be constructed as per Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Natural Gas Pipelines) Regulations 2009, ASME B 31.8, OISD standards. The pipeline will be buried with a minimum depth of 1 m below the natural ground level. Such cover will be increased at certain places, in particular at railway lines, highways, foreign pipelines, canals and river crossings to provide a higher safety factor to the pipeline in accordance with the provisions of the design codes and the requirements of the authorities having jurisdiction over such facilities. Typical minimum cover to be adopted for the different locations will be as follows:

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Table 6: Typical Minimum Cover

S. No.	Location	Minimum Cover (m)
1	Normal Terrain	1.0
2	Minor water crossings / canals	1.5
3	Rocky areas	1.0
4	Uncased / cased road crossings	1.2
5	Rail crossings	1.7
6	River crossings	2.5 (below scour depth)

Adequate measures will be taken to avoid inconvenience to public, and ensure minimum cutting of trees during construction of the pipeline. Water used for hydrostatic testing will be properly treated and disposed of in such a manner that no damage is caused to the public and environment.

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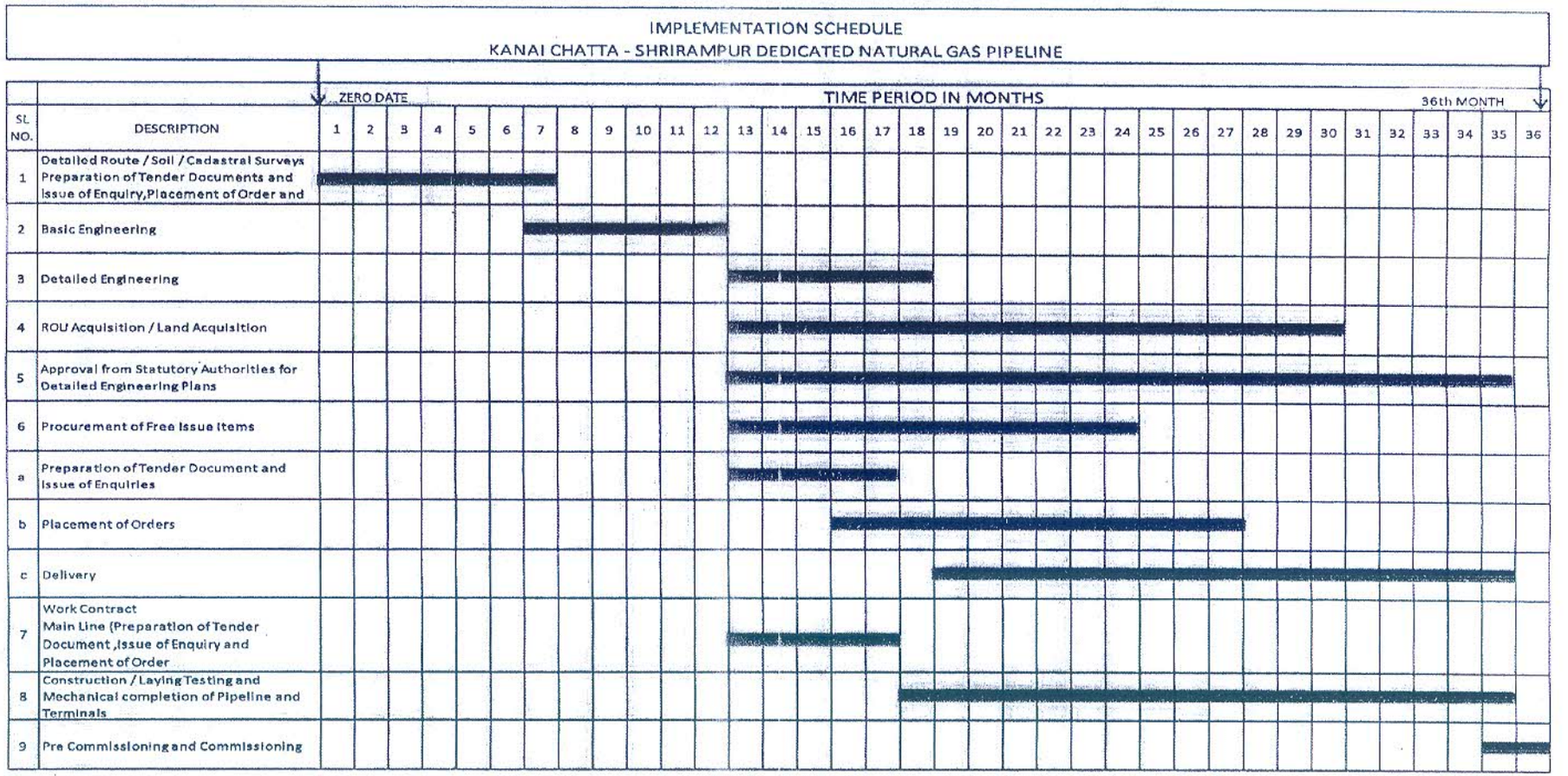
Figure 1: Implementation Schedule Kanal chatta- Shrirampur dedicated natural gas pipeline



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10. Organizational Structure

10.1. Introduction

In order to successfully undertake the execution of a pipeline project of this magnitude at the project implementation stage and to then subsequently, operate and maintain the same efficiently and profitably, an adequate and effective organization setup comprising dedicated team of engineers, technicians and other supporting staff, possessing the requisite skill sets would be needed. The organization structure detailed in the following paragraphs defines the overall responsibilities for successful implementation of the project, which entails execution of Main pipeline along with all associated facilities, Entry Point Facility at Kanai Chatta, SV stations at various locations along the route of the pipeline, Custody Transfer Point at India-Bangladesh Border near Shrirampur and the subsequent operation and maintenance of the network and the above mentioned facilities.

10.2. Organization and Functions

The organization's primary objective shall be safe, profitable and reliable transmission of natural gas to consumers of different segments by managing the Integrity of the gas pipeline transmission system without adverse effect on public, customer, employees and environment.

Organization will ensure that all the risks identified at the various stages of pipeline asset life cycle are properly mitigated by managing all the control barriers related to plant, process and people and by doing proper monitoring of identified Key Performances of all these control barriers. Out of these three types of control barriers, Manpower is the most critical barrier to prevent any untoward event.

A suitable organization structure, both for project implementation and operation and maintenance, has been worked out and shown in Figures 2 & 3, respectively, detailing the number of personnel required and their respective organizational functions.

It is expected that organizational improvements, accompanied by new perceptions of the functions to be carried out, shall evolve over a period of time as the organization and gas transmission systems grow. Structural changes may be required as the organization gains experience and particular challenges of the local operating environment are addressed.

Initially, the organization needs to focus on construction and installation of the Main pipeline, Sectionalizing Valve (SV) stations, Intermediate Pigging (IP) stations, Entry Point Facility, Custody Transfer facility etc. Therefore, planning, pipeline laying, facility works and other associated construction/erection works shall be the main activities. As the transmission network infrastructure commences operation, there shall be a need for operation and maintenance of pipelines and associated facilities.

The proposed organization structure caters to the work change requirements anticipated as the organization grows.

10.3. Manpower Requirement

10.1.1 For Project Implementation

Keeping in view the length of the proposed pipeline, project work has to be taken up in various locations simultaneously and for the said reason the total project has been divided into separate spreads. The organizational set-up for project implementation for the Project shall be headed by a Dy. General Manager (Projects) who shall be assisted by Senior Managers dedicated for different spreads of the mainline system. They in turn shall be assisted by adequate number of Managers and staff members having the requisite skills to look after the distinct areas and the functions assigned to them (refer Figure 3), namely:

- Mainline & Facilities
- Contracts & Procurement
- Safety & Stores
- Administration & Finance

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The project implementation group will function under an organizational set-up located at a suitable location near Kanai Chatta and Shrirampur. Services of an Engineering & Project Management Consultant and a Third Party Inspection Agency are also envisaged during project implementation period. There shall also be manpower for common areas like contracts and procurement, safety and stores, Finance and Administration, etc.

Total permanent manpower envisaged for project implementation is 21 nos.

10.1.2 For Operation and Maintenance

The Organizational Set-up for Operation and Maintenance is planned as detailed in Figure 2

It is proposed that a unified O & M mechanism headed by a Dy. General Manager and assisted by three Sr. Managers, out of which one would be incharge of Mechanical-Operation and Maintenance while the other two senior managers would be responsible for Finance, Administration and Safety/Stores. There shall be dedicated teams for O and M based at EPF, Kanai Chatta and CTF, Shrirampur headed by a Managers. Mangers at respective locations shall in turn be supported by Dy. Managers (Operation, Maintenance and Safety), Store-in-charge, Office-in-charge (Administration) and Office-in-charge (Finance), Supervisors. All these teams would be responsible for the following areas :

- Main Pipeline and associated facilities
- Pressure Regulating Installation
- Maintenance
- Safety (HSE)
- Stores (Materials)
- Administration & Finance

It is further proposed that the services are out-sourced where ever possible, i.e. services be contracted as required than employed as permanent staff. However, there shall be a requirement for a permanent core group with expertise to carry out work, supervise and ensure quality control on work performed by contractors.

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Such an arrangement shall provide flexibility to the organization to contract appropriately skilled personnel, as the skill requirement changes and as the organization expands and customer base grows.

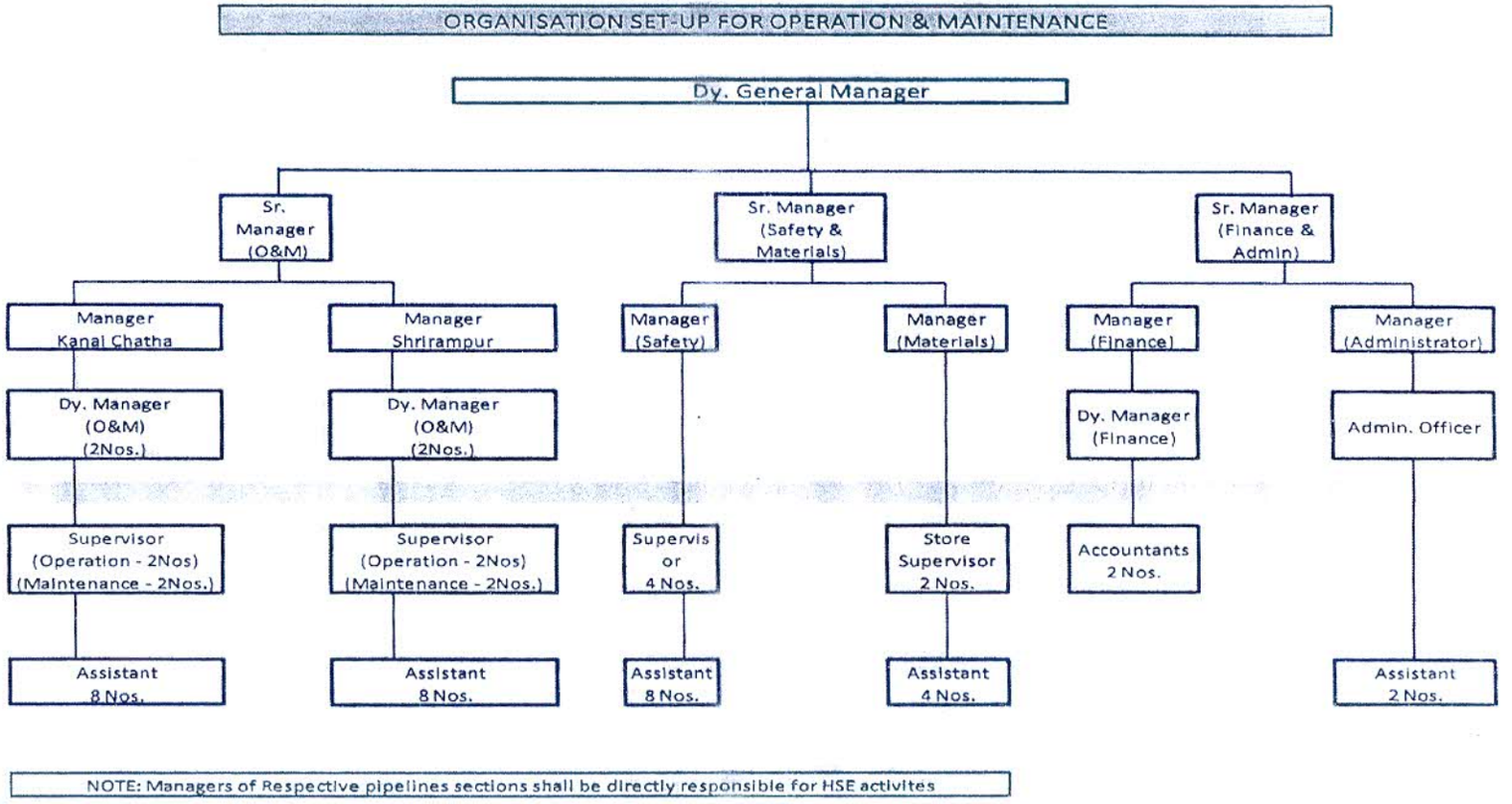
Key management staff shall be required to manage the different departments. This shall range from Managers to Supervisors and clerical staff.

Total permanent manpower envisaged for operation and maintenance of network is 16 nos.

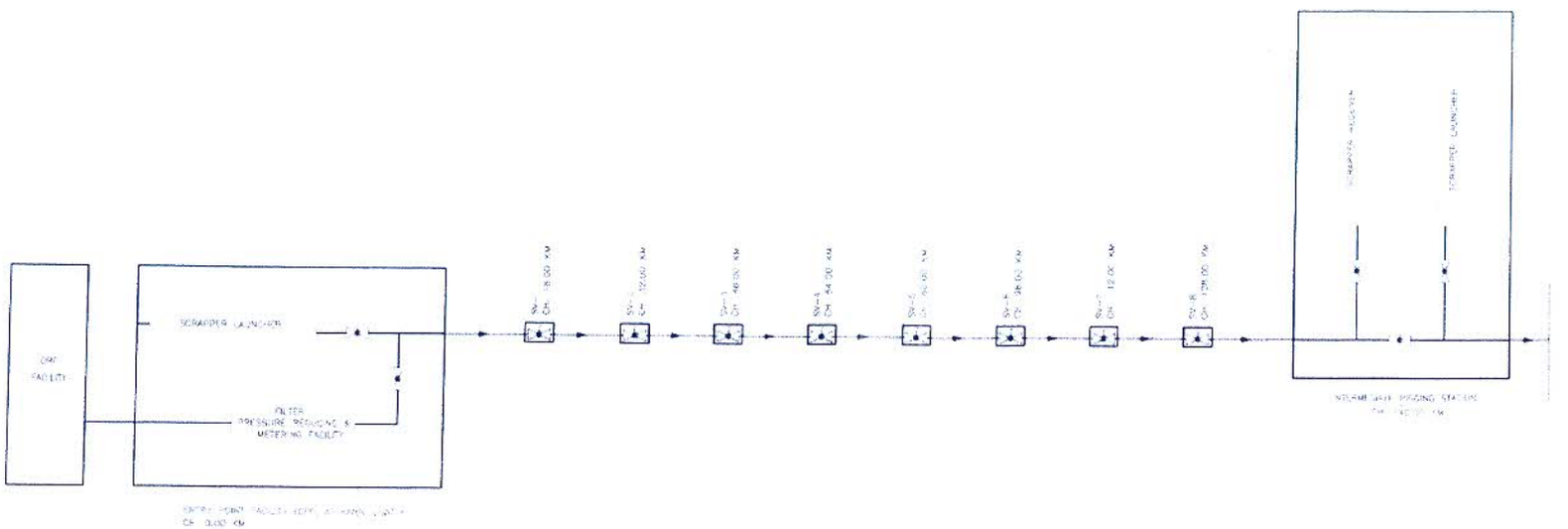
10.4. Training

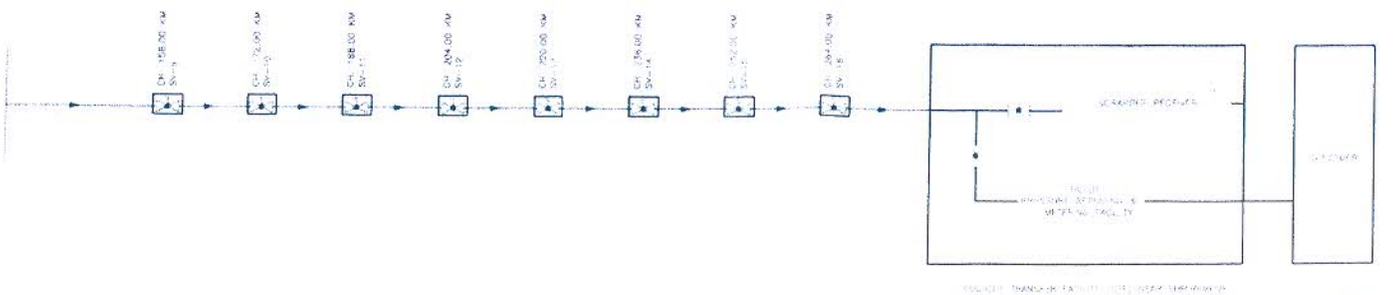
Appropriate training, both classroom and on-the-job, shall be required to ensure that construction technicians are competent and able to perform the required work safely. Instructors experienced in specific areas of the gas pipeline industry shall be used to train personnel.

Figure 2: Organization Structure for O&M



KANAI CHATTA – SHRIRAMPUR DEDICATED NATURAL GAS PIPELINE
PIPELINE SCHEMATIC ROUTE DIAGRAM





UNDERGROUND PIPELINE

LENGTH OF PIPELINE	275 KMS.
SIZE OF PIPELINE (NPS)	24"
PIPELINE MATERIAL OF CONSTRUCTION	API5L GR.X70 PSL2

REV	DESCRIPTION	DRN	CHKD	APPD	DATE
0	ISSUED				12.01.17

OWNER

H ENERGY
power to the people

H ENERGY PRIVATE LIMITED
12th Floor, Knowledge Park
Opp. Hiranandani Hospital
Hiranandani Business Park, Powai
Mumbai-400 076. INDIA

PROJECT

KANAI CHATTA – SHRIRAMPUR DEDICATED
NATURAL GAS PIPELINE

SCALE NTS | PIPELINE SCHEMATIC ROUTE DIAGRAM

DRAWING NUMBER KSPL/SCH/01 | REV. 0

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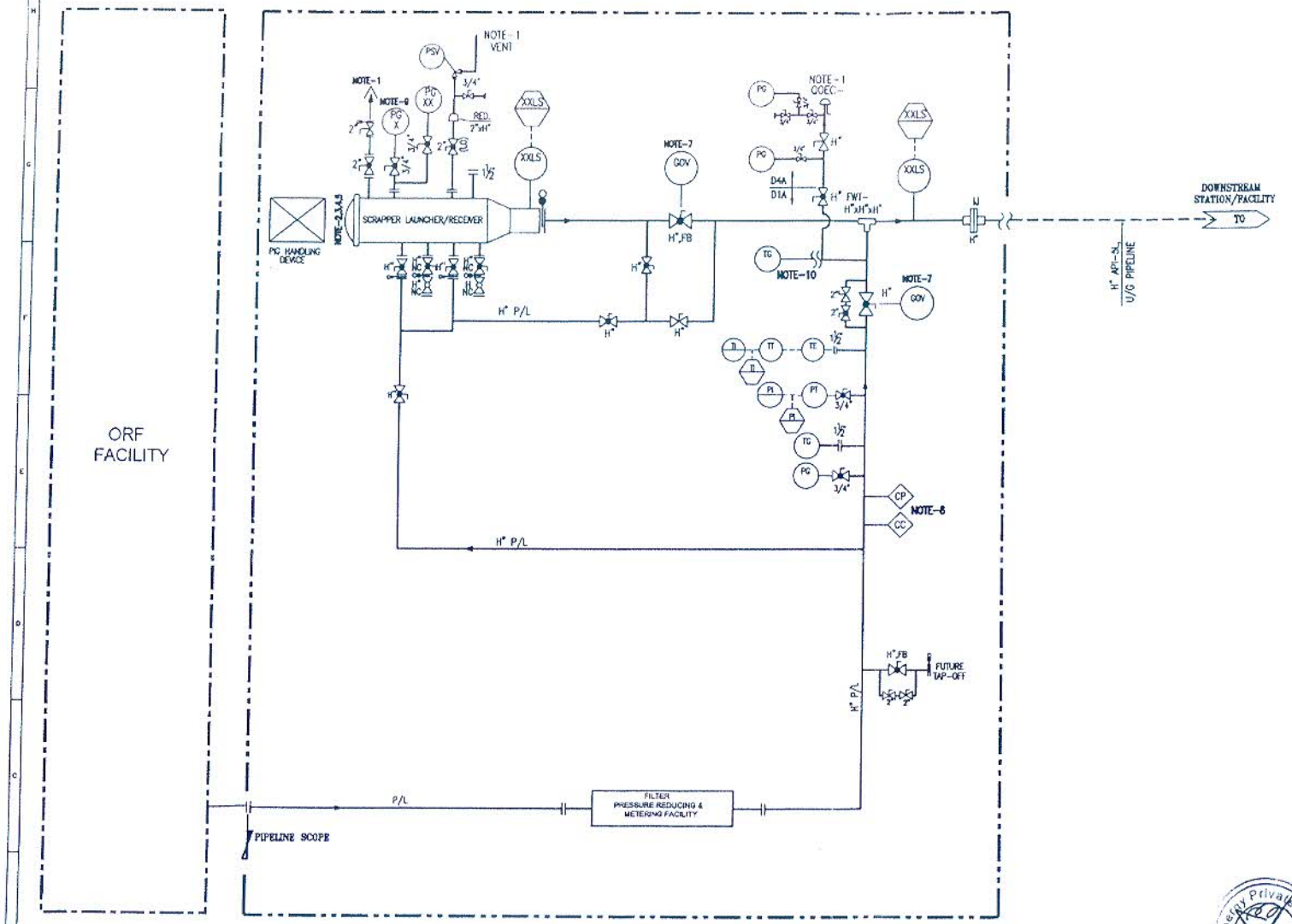

NOTES:

1. ALL VENTS SHALL BE LOCATED MIN. HEIGHT OF 3 MTR. ABOVE THE HIGHEST OPERATING LEVEL.
2. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE SCRAPPER HANDLING FACILITY.
3. SCRAPPER LAUNCHER/RECEIVER SHALL BE SUITABLE FOR HANDLING INTELLIGENT PIGS.
4. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE QUICK OPPENING CLOSURE.
5. SCRAPPER DOOR MECHANISM TO BE CONSTRUCTED SUCH THAT THE DOOR CAN NOT BE OPENED UNLESS SCRAPPER TRAP IS FULLY DEPRESSURISED.
6. ALL BALL VALVES 2" & BELOW SHALL BE FULL BORE ONLY.
7. FOR SV, AV & GOV DETAIL REFER DRG. NO. KSPL/TYP/PID/002
8. ONLINE RETRIVEL TYPE CORROSION MONITORING COUPOIN AND CORROSION PROBE SHALL BE PROVIDED. CC & CP SHALL BE INSTAL AT BOTTOM OF THE PIPE.
9. PG-X SHALL HAVE A RANGE OF 0-100 Bar(g) WITH A GAUGE SAVER.
10. DIRECT SURFACE CONTACT TYPE.

PROCESS DATA

FLUID: NATURAL GAS / RLNG
DESIGN PRESSURE: 99 KG/CM2 g
DESIGN TEMPERATURE: -29 TO 65 °C

LINE LEGEND

——— PROPOSED LINE A/G
— — — PROPOSED LINE U/G

VALVE LEGEND

- BALL VALVE FLANGE END
- BALL VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE FLANGE END
- GLOBE VALVE.

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H-ENERGY

REV	DATE	ZONE	DESCRIPTION	BY	VERIFIED
0	13-01-17		TYP. P&D FOR ENTRY POINT FACILITY	VL	KK

REVISION

REFERENCES | DRG.NO.

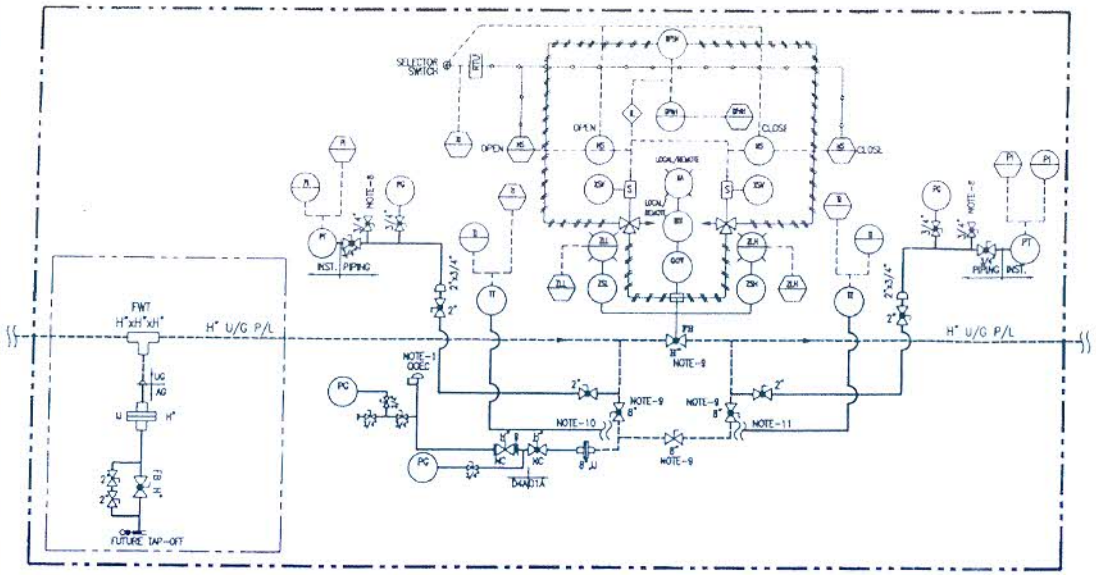
CONCURRED BY: INST. / REC

SECTION: OIL & GAS
DRAWN: VL
CHECKED AND VERIFIED: KK
APPROVED: DC

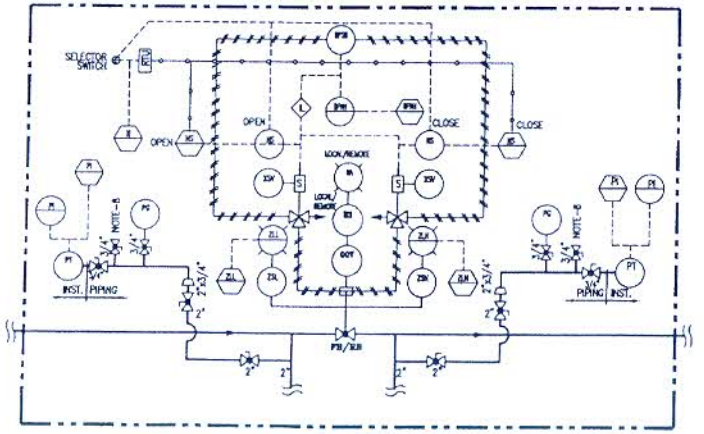
KANAI CHATTA - SHERIRAMPUR DEDICATED NATURAL GAS PIPELINE

TYPICAL P&ID FOR ENTRY POINT FACILITY

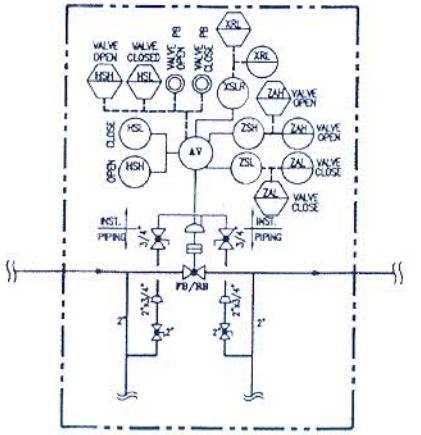
SCALE : NTS | REV
DRG. NO. KSPL/TYP/PID/001 | 0



TYPICAL ARRANGEMENT FOR 24" SV (REMOTE OPERATED)



TYPICAL ARRANGEMENT FOR GOV



TYPICAL AV ARRANGEMENT

NOTE:-

1. ALL VENT SHALL BE LOCATED MIN HEIGHT OF 3 MTR. ABOVE THE HIGHEST OPERATING LEVEL
2. ALL BALL VALVES 2" & BELOW SHALL BE FULL BORE ONLY.
3. ALL GOV (GAS OVER OIL OPERATED VALVES) SHALL BE FAILED TO STAY PUT TYPE VALVE
4. FOR ALL TAPPING FROM MAIN LINE, THE FIRST ISOLATION VALVE SHALL BE WELDED END TYPE AND OTHER SECOND VALVE MAY BE FLANGED CONNECTION.
5. ALL UNMANNED STATION SHALL BE PROVIDED WITH CO2 FLOODING SYSTEM
6. INTEGRATED INTERLOCK SHOULD BE PROVIDED IN THE GAS ACTUATED VALVE SUCH THAT WITH HIGH ΔP ACROSS THE VALVE (>3 BAR), VALVE SHOULD NOT OPEN DURING START-UP
7. ALL PG, PT CONNECTION SHALL BE TAKEN FROM 2" TWO ISOLATION VALVES AND THEN AFTER IT SHOULD BE CONVERTED TO REQUIRE NPT CONNECTION.
8. GAS TAPPING FOR VALVE ACTUATOR & VALVE ΔP SWITCH.
9. EXTENDED STEM VALVE.
10. DIRECT SURFACE CONTACT TYPE.

VALVE LEGEND

- BALL VALVE FLANGE END
- BALL VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE FLANGE END
- GLOBE VALVE.

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REV	DATE	ZONE	DESCRIPTION	BY	VERIFIED
0	12-01-12		TYP. P&ID FOR SV STATION & GOV/AV	VL	KK

REVISION

REFERENCES

DRG.NO.

REV / SUC: INST.

CONCURRED BY

SECTION	OIL & GAS
DRAWN	VL
CHECKED AND VERIFIED	KK
APPROVED	DC

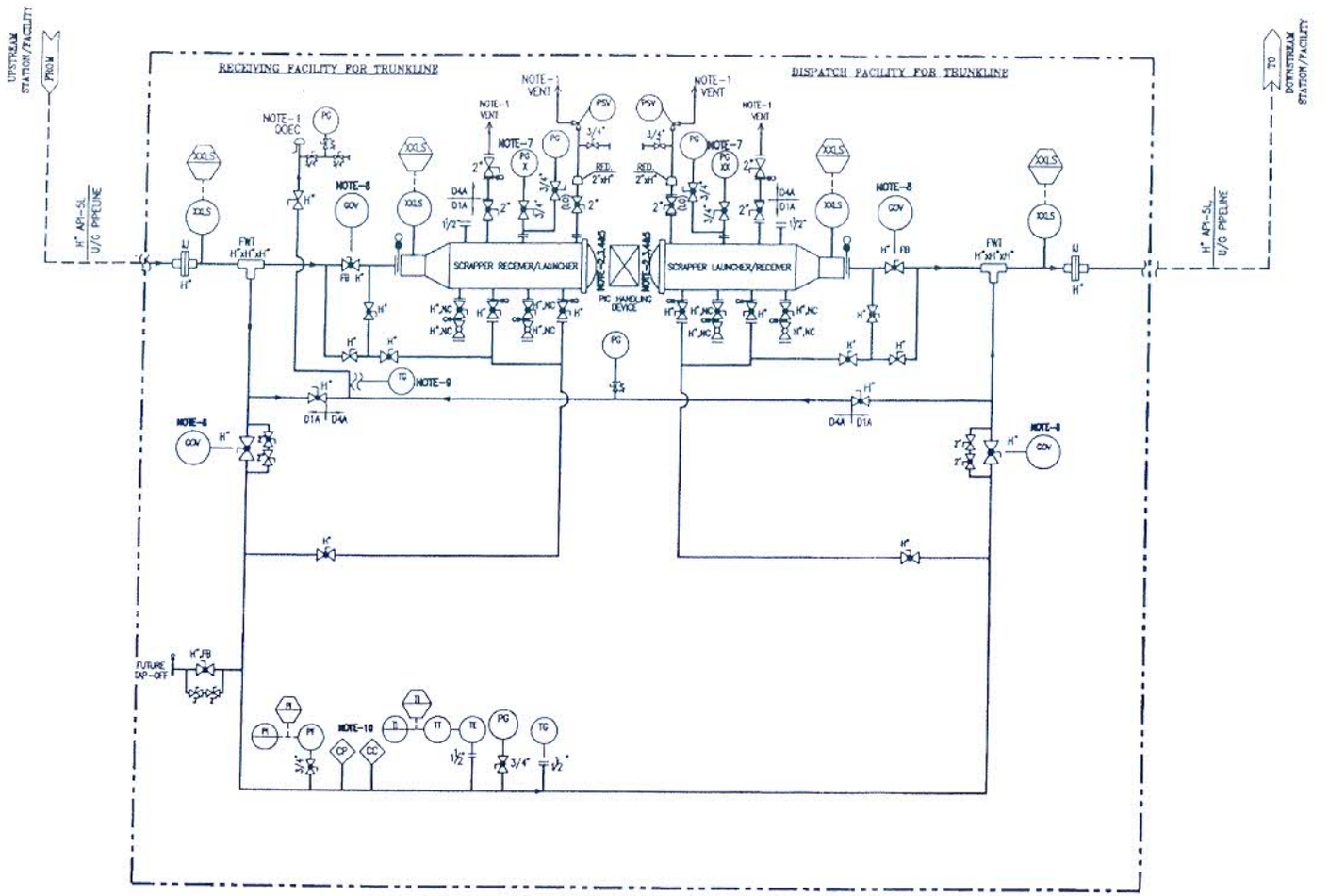
KANAI CHATTA - SHIRIRAMPUR DEDICATED NATURAL GAS PIPELINE

TYPICAL P&ID FOR SV STATION & GOV/AV

SCALE : NTS

DRG. NO. KSPL/TYP/PID/0012

REV. 0



INTERMEDIATE PIGGING STATION

NOTES:

1. ALL VENTS SHALL BE LOCATED MIN. HEIGHT OF 3 MTR. ABOVE THE HIGHEST OPERATING LEVEL.
2. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE SCRAPPER HANDLING FACILITY.
3. SCRAPPER LAUNCHER/RECEIVER SHALL BE SUITABLE FOR HANDLING INTELLIGENT PIGS.
4. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE QUICK OPPENING CLOSURE.
5. SCRAPPER DOOR MECHANISM TO BE CONSTRUCTED SUCH THAT THE DOOR CAN NOT BE OPENED UNLESS SCRAPPER TRAP IS FULLY DEPRESSURISED.
6. ALL BALL VALVES 2" & BELOW SHALL BE FULL BORE ONLY.
7. PG--X & XX SHALL HAVE A RANGE OF 0-100 Bar(g) WITH A GAUGE SAVER.
8. FOR SV, AV & GOV DETAIL REFER ORG NO. KSPL/TYP/PID/002
9. DIRECT SURFACE CONTACT TYPE.
10. ONLINE RETRIVEL TYPE CORROSION MONITORING COUPON AND CORROSION PROBE SHALL BE PROVIDED. CC & CP SHALL BE INSTAL AT BOTTOM OF THE PIPE.

PROCESS DATA

FLUID: NATURAL GAS / RLNG
DESIGN PRESSURE: 99 KG/CM2 g
DESIGN TEMPERATURE: -29 TO 65 °C

LINE LEGEND

——— PROPOSED LINE A/G
– – – PROPOSED LINE U/G

VALVE LEGEND

- BALL VALVE FLANGE END
- BALL VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE BW END/UPTO 1/2" SW END.
- PLUG VALVE FLANGE END
- GLOBE VALVE.

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REV/DEC	INST.
	CONCURRED BY

REV.NO	DATE	ZONE	DESCRIPTION	BY	VERIFIED
0	12-01-17		TYP. P&ID FOR INTERMEDIATE PIGGING STATION	VL	KK

REFERENCES | DRG.NO.

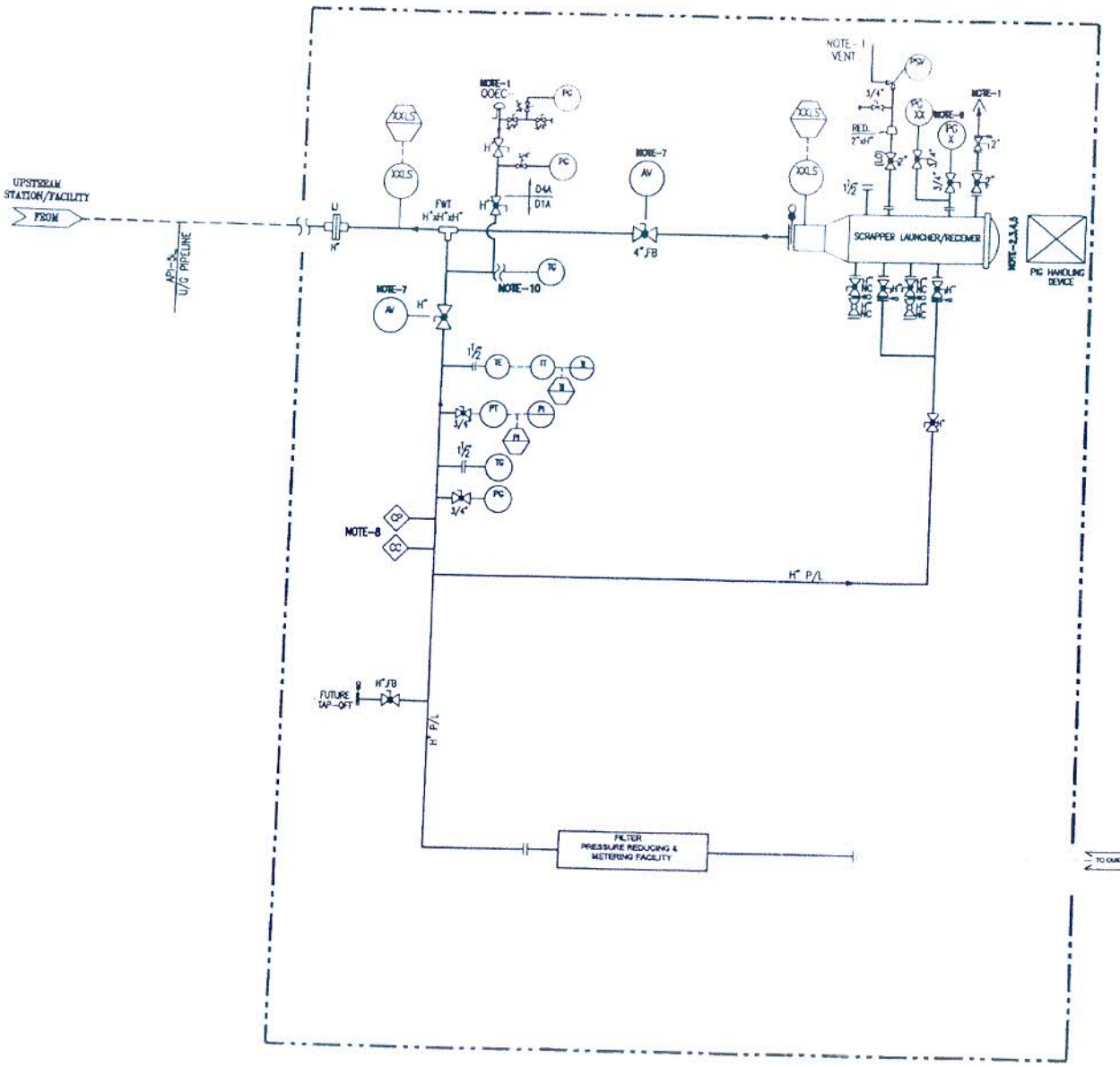
SECTION	OIL & GAS
DRAWN	VL
CHECKED AND VERIFIED	KK
APPROVED	DC

KANAI CHATTA - SHRIRAMPUR DEDICATED NATURAL GAS PIPELINE

TYPICAL P&ID FOR INTERMEDIATE PIGGING STATION

SCALE : NTS | REV

DRG. NO. KSPL/TYP/PID/003 | 0



NOTES:

1. ALL VENTS SHALL BE LOCATED MIN HEIGHT OF 3 MTR. ABOVE THE HIGHEST OPERATING LEVEL.
2. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE SCRAPPER HANDLING FACILITY.
3. SCRAPPER LAUNCHER/RECEIVER SHALL BE SUITABLE FOR HANDLING INTELLIGENT PIGS.
4. SCRAPPER LAUNCHER/RECEIVER SHALL HAVE QUICK OPENING CLOSURE.
5. SCRAPPER DOOR MECHANISM TO BE CONSTRUCTED SUCH THAT THE DOOR CAN NOT BE OPENED UNLESS SCRAPPER TRAP IS FULLY DEPRESSURISED.
6. ALL BALL VALVES 2" & BELOW SHALL BE FULL BORE ONLY.
7. FOR SV, AV & GOV DETAIL REFER DRG. NO. KSPL/TYPP&ID/002
8. ONLINE RETRIVEL TYPE CORROSION MONITORING COUPON AND CORROSION PROBE SHALL BE PROVIDED. CC & CP SHALL BE INSIDE AT BOTTOM OF THE PIPE.
9. PG-X SHALL HAVE A RANGE OF 0-100 Bar(g) WITH A GAUGE SAVER.
10. DIRECT SURFACE CONTACT TYPE.

PROCESS DATA

FLUID: NATURAL GAS / RLNG
DESIGN PRESSURE: 99 KG/CM2 g
DESIGN TEMPERATURE: -29 TO 65 °C

LINE LEGEND

——— PROPOSED LINE A/G
– – – PROPOSED LINE U/G

VALVE LEGEND

- BALL VALVE FLANGE END
- BALL VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE BW END/UPTO 1½" SW END.
- PLUG VALVE FLANGE END
- GLOBE VALVE.

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H-ENERGY

REV	INST.
REV.NO	CONCURRED BY

REV.NO	DATE	ZONE	DESCRIPTION / REVISION	BY	VERIFIED
0	12-01-17		TYP. PID FOR CUSTODY TRANSFER FACILITY	VL	KK

REFERENCES | DRG.NO.

SECTION	OIL & GAS
DRAWN	VL
CHECKED AND VERIFIED	KK
APPROVED	DC

KANAI CHATTA - SHRIRAMPUR
DEDICATED NATURAL GAS PIPELINE

TYPICAL P&ID FOR
CUSTODY TRANSFER FACILITY

SCALE : NTS | REV.
DRG NO. KSPL/TYPP&ID/004 | 0

No. 219 /Dir(BM)/ 2015
Ministry of External Affairs
BM Division

South Block
New Delhi

26 October 2015

OFFICE MEMORANDUM

This is with reference to your letter No. HEECPL/MEA/2015/004 dated August 31, 2015 regarding cross border supply of re-gasified LNG to a proposed 750-850 MW gas based power project of North West Power General Company Limited in Khulna, Bangladesh by a pipeline from India.

2. This Ministry has no objection to your pursuing this opportunity with Ms. North West Power General Company Limited.

Parkar

[Pratibha Parkar]
Director (BM)
Tel: 011-23013830
Fax: 011-23013280
Email: dirbm@mea.gov.in

Shri Darshan Hiranandani,
Managing Director,
H-Energy East Coast Private Limited, 514,
Dalamal Tower, Nariman Point,
Mumbai – 400 021

Copy to:

1. **Shri Ashutosh Jindal,** Joint Secretary (IC), Ministry of Petroleum & Natural Gas, Shastri Bhawan, Room No. 214-A, New Delhi
2. **Shri Pankaj Saran**, High Commissioner of India, Dhaka

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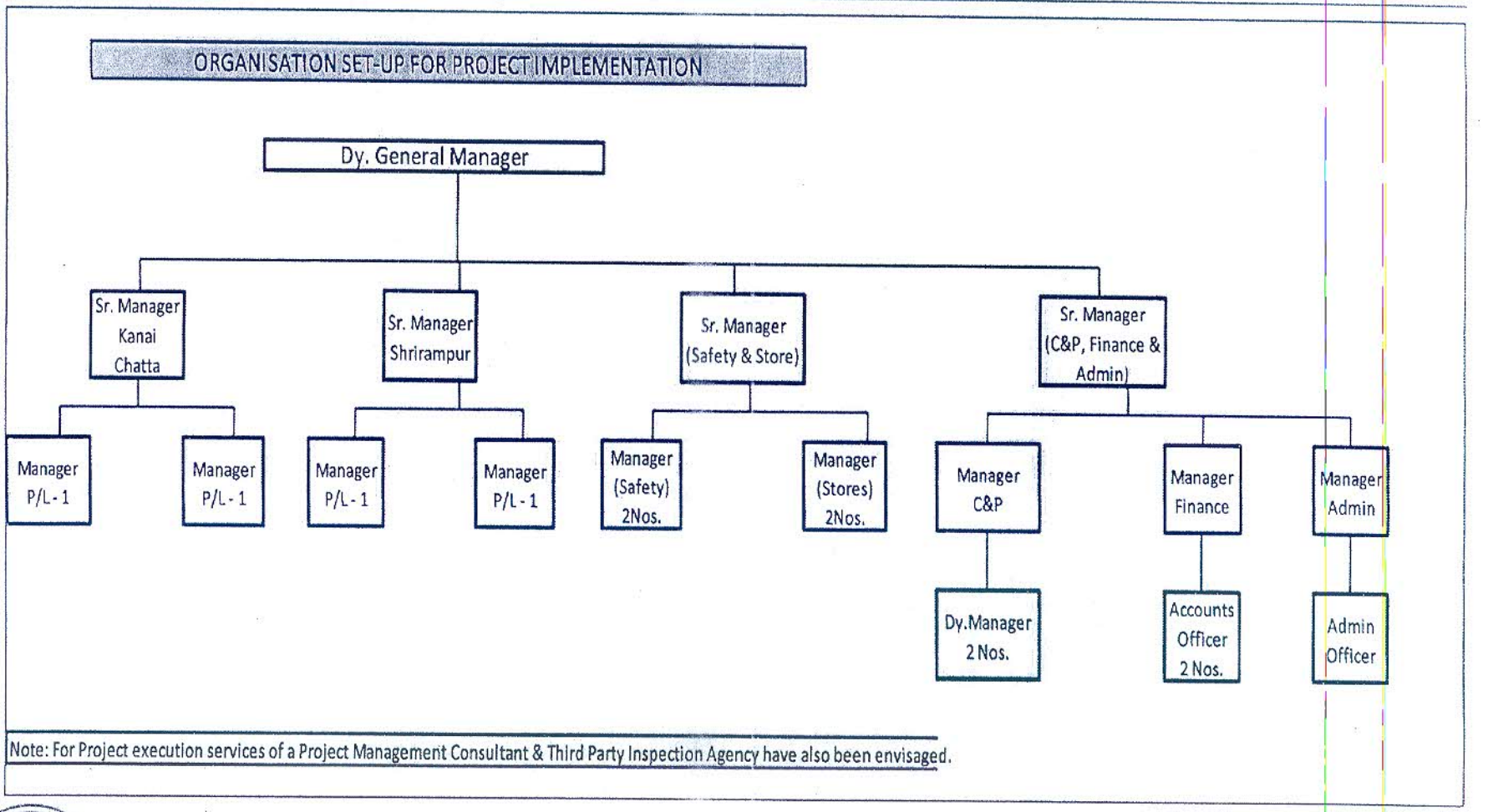
Figure 3: Organization Structure for Project Implementation phase



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11. Estimated Capital Expenditure

11.1. General

Capital expenditure based on the facilities envisaged for EPF and CTF, Main Pipelines including SV Stations, IP Stations and other associated facilities for the entire pipeline system has been estimated as Rs. 1297.6 Crores.

Table 7: Estimated Capex

Item	Amount (in Rs. Crores)
Engineering Studies and Surveys	1.6
Pipeline- Main Line	795.2
Entry point facility and Custody Transfer Facility/Point	15.4
Subtotal (1)	***812.2***
EPMC Fee	40.6
Owners Management Fee	24.4
Subtotal (2)	***877.2***
First Fill	20
Certification and Verification	12.2
Information technology	10
CSR	16.2
Other fixed Assests	21
Insurance	12.2
General and Administration	48.6
Gas sourcing and marketing	2.4
Subtotal (3)	***1019.7***
Financing Charges	201.4
Contingency	76.5
Total	***1297.6***

11.2. Major Facilities

Major facilities included in the capital cost estimates are given below:

PIPELINE SYSTEM	MAINLINE	24" x 275 km, API 5L X-70 Grade (PSL-2)

11.3. Assumptions

Following assumptions have been made for working out the capital costs.

11.4. Land and ROW/ ROU Compensation

The cost of land for facilities has been considered at a rate of Rs. 5000 per sqm. The cost towards Right of Use has been considered as Rs. 60 lakhs per km for required 18m width (of ROU) for the length of the pipeline in the region.

11.5. Pipeline and other Associated Equipment

The costs of equipment and facilities, in some areas, are based on recent LOAs/ budgetary offers. However, generally, in house information for equipment installed in other projects has been used. The cost of equipment under this head is on ex-works basis.

11.6. Spares

Provision for spares required for 2 years normal operation has been made equivalent to 5% of equipment cost excluding steel pipeline.

11.7. Civil engineering works

Cost estimates for civil engineering works have been worked out based on preliminary layout and design of grid line and route survey and rates generally prevailing for similar work in the area.

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11.8. Erection

Provision towards erection of equipment has been made on the basis of erection rates as prevailing in the region.

11.9. Duties and taxes

Excise duty, Central sales tax and Service tax are excluded while estimating the expenditure for equipment, cost of Engineering and Supervision, pure construction works etc.

11.10. Engineering, Supervision and Project Management

A provision of 5% has been made for engineering, supervision and project management services expenses. This includes detailed engineering, preparation of drawings, technical specifications, preparation of tender documents and assistance for award of contracts, designer's supervision, project management services, etc.

11.11. Owner's Management Expenses

A provision of 3% has been made for owner's management expenses. This includes preliminary and pre-operative expenses.

11.12. Contingencies

A provision of 7.5% of the project cost has been made for contingencies to take care of the unforeseen aspects of the estimate.

11.13. Time Schedule

The time schedule for construction of various facilities for the proposed project would be as per implementation schedule given in earlier chapter.

12. Estimated Operating Expenditure

12.1. General

The annual operating expenditure for the project at 100% capacity utilization of the pipeline system has been worked out to be Rs 38.4 Crores.

The various parameters considered are:

12.2. Cost of Energy

Electric energy has been considered for lighting and other power requirements of Entry point facility, Custody Transfer Facility, IP Stations and SV Stations. The energy cost @ Rs.6.5 per KWH has been considered.

12.3. Water

Considering the nature of the project it is assumed that the water requirement of the project would be negligible, therefore, no separate cost towards the same has been considered in the operating cost estimate.

12.4. Manpower

Based on salary structure and number of personnel required, direct cost on account of manpower has been taken as Rs. 20 lakh per person on average basis for regular engineers and other officers on the permanent rolls of the entity. There will be total strength of 16 permanent engineers distributed in different work areas. Further, 46 no. of other supervisory staff and 2 nos of ROU officers have also been considered.

In all 76 numbers of Security guards and 50 numbers of line walkers have also been envisaged Indirect cost towards overheads has been considered equivalent to 50% of employee's salaries.

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Table 8: Manpower Costs

CATEGORY OF MANPOWER	Unit Cost Rs Lakhs	Nos.	Manpower Cost in (Rs / Yr)
Engineers (Management)	20,00,000	16	3,20,00,000
Technical/ Supervisory staff	4,00,000	46	1,84,00,000
ROU Officers	12,00,000	2	24,00,000
Guards	2,00,000	76	1,52,00,000
Line Walkers	1,50,000	50	75,00,000
TOTAL		**190**	**7,55,00,000**

12.5. Repair and Maintenance

Provision for repair and maintenance has been kept at the rate of 1.5% of the capital cost.

12.6. Insurance

Insurance cost at the rate of 0.5% of the capital cost has been considered in the cost estimates.

12.7. ANNUAL OPERATING COSTS AT 100% CAPACITY UTILISATION

S. No.	Item	Rs.(In Crores)
A	VARIABLE COSTS	
1	Power	1.1
	Sub-total (A)	1.1
B	FIXED COSTS	
1	Manpower	7.6
2	Repair & Maintenance	19.5
3	Insurance	6.5
4	Overheads	3.8
	Sub-total (B)	37.3
	TOTAL (A+B)	38.4

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13. Disaster Management Plan

13.1. OBJECTIVE

The primary objective of the DMP is to provide a safe, timely, effective and coordinated response by the onsite Emergency Response Team (ERT), along with the other local and government agencies/departments to prevent or minimize any major emergencies that may arise from possible failures of pipeline during operation of the Kanai chatta- Shrirampur dedicated natural gas pipeline project.

The main objectives of this plan are:

- Minimize the risk to human life and common property resources, by means of an effective and efficient intervention;
- Protection of the environment
- Ensuring public safety

13.2. PURPOSE

The purpose of the DMP is to effectively manage and control the emergencies occurring during project operations. This DMP ensures:

- emergency response group is effective and adequate
- clear roles and responsibilities of key personnel and support groups
- availability and adequacy of emergency infrastructure and resources
- efficient emergency communication

13.3. EMERGENCY/CRISIS MANAGEMENT TEAM

HEPL will develop an emergency/crisis management team to respond to fire, accidents and technical emergencies. The team will be made up from operations personnel, who can be called upon 24 hours a day, supported by senior management field personnel as and when required. The role and responsibilities of specific Emergency Coordinators at Pipelines Division is discussed below:

12.3.1 Chief Incident Controller (CIC)

The Chief Incident Controller (CIC) shall have overall responsibility to protect personnel, site facility and the public before, during and after an emergency or

disaster. The CIC shall be present at the Head Office. Responsibilities of the Chief Incident Controller shall include the following:-

a) Review and updating of the ERDMP as and when required
b) Assessment of situation and declaration of emergency
c) Activation of Emergency Control Centre
d) Taking decision on seeking assistance from mutual aid members and external agencies like Police, Fire Brigade, Hospitals etc.
e) Continuous review of situation and decide on appropriate response strategy
f) Taking stock of casualties and ensure timely medical attention;
g) Ensuring correct accounting and position of personnel after the emergency
h) Ordering evacuation of personnel as and when necessary
i) Taking decision in consultation with District Authorities when an off-site emergency is to be declared.
j) Direct Site Incident Controller (SIC) to take appropriate actions and depute Crisis Coordinators to control the situation

12.3.2 Site Incident Coordinator (SIC)

The Site Incident Controller shall report to the Chief Incident Controller. The SIC shall be available at the main emergency control Centre for counsel and overall guidance. SIC should be nominated by the entity for each shift. Responsibilities of the Site Incident Controller shall include the following:-

a) The SIC shall maintain a workable emergency control plan, organize and equip the organization with ERDMP and train the personnel
b) The SIC shall be capable of making quick decisions and taking complete charge at site
c) The SIC shall communicate from the Emergency Control Centre to coordinate activities among groups
d) The SIC shall be responsible for ensuring that appropriate local and national government authorities are notified, preparation of media statements obtaining approval from the CIC and releasing such statements once approval received
e) The SIC shall also ensure the response to the incidents or the emergencies, as the case may be, is in line with entity procedures, coordinating business continuity or recovery plan from the incident. He must ensure next of kin are notified in a timely manner
f) The SIC shall, also co-ordinate if any specialist support is required for the above purpose

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g) The SIC shall decide in consultation with CIC on seeking assistance of mutual aid members and external agencies like Police, Fire Brigades, hospitals, etc.

12.3.3 Crisis Coordinators

Administration and Communication Coordinator

Responsibilities of the administration and communication controller shall include the following:-

a) To coordinate with mutual aid members and other external agencies
b) To direct them on arrival of external agencies to respective coordinators at desired locations
c) To activate the medical center and render first aid to the injured. Arrange ambulance and coordination with hospitals for prompt medical attention to casualties
d) To ensure head counts at assembly points
e) To arrange procurement of sparse for firefighting and additional medicines and drugs
f) To mobilize transport to various teams for facilitating the response measure
g) To monitor entry and exit of personnel onto and out of incident area
h) To ensure only authorized personnel enter into the incident area
i) To regulate the flow of traffic into and out of incident site and control the mob outside, if any, with the assistance of the police.
j) To provide administrative and logistics assistance to various teams
k) To arrange evacuation as directed by the Chief Incident Controller and in coordination with the civil authorities like police, panchayat / municipal authorities, etc.

Fire Safety Coordinator and Fire Team

Responsibilities of fire and safety coordinator shall include the following:-

a) To activate emergency sirens as per the practice codes
b) To take charge of all firefighting and rescue operations and safety matters
c) To ensure that key personnel are called in and to release crew of firefighting operations as per emergency procedures
d) Assess functioning of his team and communicate with the SIC and or administrative controller for any replenishment or, replacement of

manpower or firefighting equipment

e) Direct the fire brigade personnel and mutual aid members to their desired roles as also proper positioning of the manpower and equipment
f) To decide the requirement of mutual aid and instruct fire station, who in turn will contact mutual aid members
g) To coordinate with outside fire brigades for properly coordinating firefighting operation
h) To arrange requirement of additional firefighting resources including help from mutual aid partners
i) Continually liaise with the SIC to implement the emergency combat strategies as communicated by him

Note: Fire chief shall wear identification jackets at the site of disaster so that he is clearly distinguished among firefighting personnel and is visible from a distance.

Search Party Leader

He will, depending on the situation:

a) Immediately rush to the situation along with the communication devices and trained manpower
b) After locating the site ensures the closing of the up –stream and down-stream valves to contain leak.
c) Assess the situation and give feedback to the SIC for further assistance/mobilization
d) Identify nearby water sources for the fighting.
e) Ensure security at site by posting chowkidar, patrolman, local police or home guard.

Maintenance of ERDMP Records

1) There shall be maintenance of ERDMP records for all kind of emergencies covering near miss, Level-I, Level-II and Level-III. Organization shall maintain an Incident Record Register for the above purpose and post-disaster documentation like resources deployed, relief, rehabilitation measures and lesson lead to avoid re-occurrence of any such emergency. Head of HSE or any other designated personnel by the CIC/SIC shall be responsible for maintenance of such records.

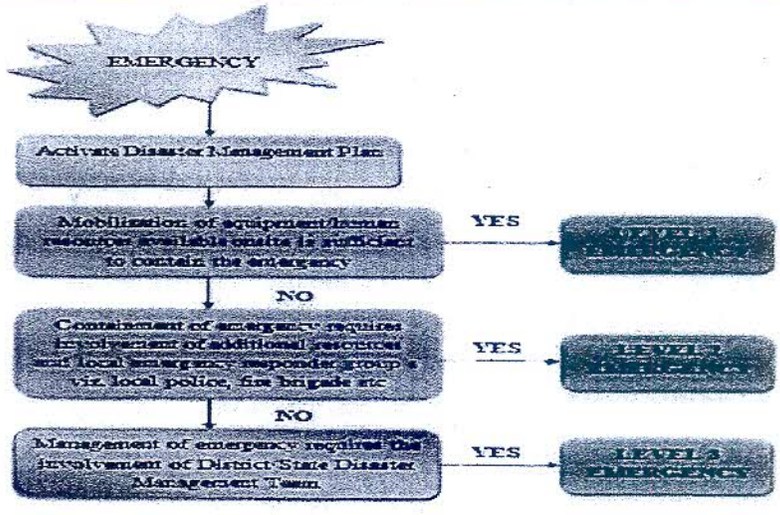
2) A good public relations program is extremely important in an emergency situation. Enquiries will normally be received from the media, government agencies, local organizations and the general public.

3) This section of the Response plan shall include a public relations or media plan. It should identify an Information Officer that is well-equipped and trained in media relations.

13.4. EMERGENCY CLASSIFICATION

Due consideration is given to the severity of potential emergency situation that may arise as a result of pipeline accidents. Not all emergency situations call for mobilization of same resources or emergency actions and therefore, the emergencies are classified into three levels depending on their severity and potential impact, so that appropriate emergency response procedures can be effectively implemented by the HEPL Emergency/Crisis Management Team. The emergency levels/tiers defined with respect to this project based on their severity have been discussed in the subsequent sections with 'decision tree' for emergency classification being depicted in Figure below

Figure 4: Decision tree for Emergency classification



12.4.1 Level 1 – Emergency

This is an emergency or an incident which

i. Can be effectively and safely managed and contained within the site, location or installation by the available resources
ii. Has no impact outside the site, location or installation.

12.4.2 Level 2 – Emergency

This is an emergency or an incident in which:

i. Cannot be effectively and safely managed or contained at the location or installation by available resource and additional support is alerted or required
ii. Is having or has the potential to have an effect beyond the site, location or installation and where external support of mutual aid partner may be involved
iii. Is likely to be dangerous to life, environment or to industrial assets or reputation

12.4.3 Level 3 – Emergency

This is an emergency or an incident with off-site impact which could be catastrophic and is likely to affect the population, property and environment inside and outside the installation, and management and control is done by district administration. Although the Level-III emergency falls under the purview of district authority but till they step in, it should be the responsibility of the unit to manage the emergency.

Note: Level-I and Level-II shall normally be considered as onsite emergency and Level-III as off-site emergency. In case of any emergency in ROW, it will be considered as offsite.

13.5. EMERGENCY RESPONSE MEASURES

(i) Declaration of Emergency

Level-I and Level-II Emergency- The emergency has to be declared by the Chief Incident Controller.

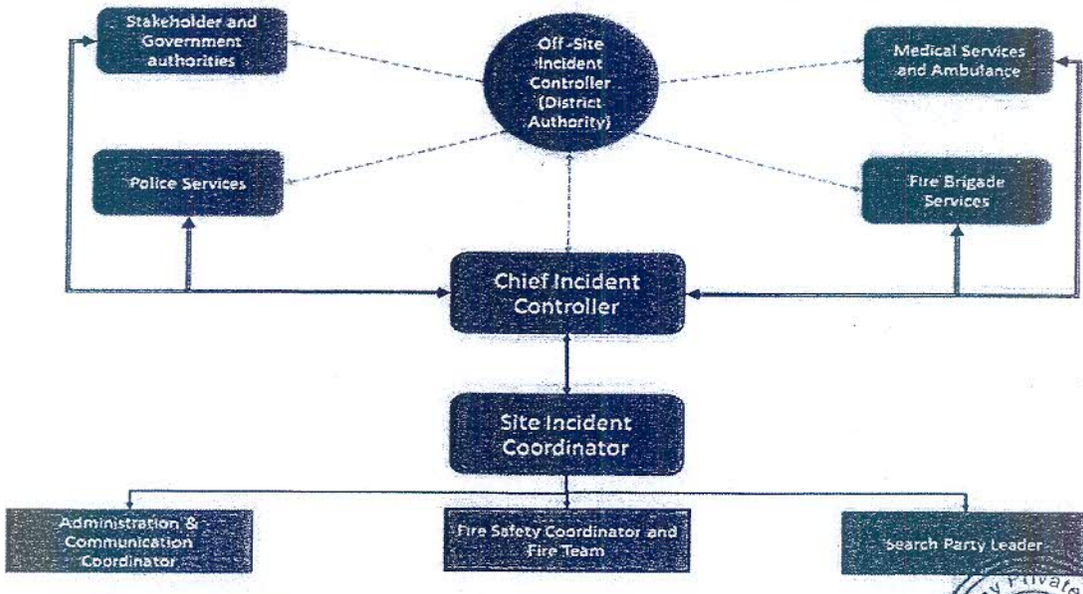
Level-III Emergency- The emergency has to be declared by District Authority.

An emergency starts as a small incident which may become a major incident with passage of time. At the initial stages, the emergency organization chart shall be

put into action. If the incident goes beyond control (inside the station or in main line) the on-site emergency plan will be activated by the chief incident controller at the appropriate stage as considered necessary.

During idle shift or holidays, the security personnel will combat the incident as per the ERDMP organization chart and at the same time inform various emergency controllers for guidance and for controlling the situation. In the mainline the line patrols men and guards who have been deployed pass on the information to the management for controlling emergency. The people deployed in the ROW are also made aware of the hazards of the pipeline and whom to inform in case of any emergency. When emergency becomes catastrophic and evacuation is considered necessary by the site incident controller, the situation will be handed over to district authority for implementing the off-site emergency plan. In the mainline ROW also, the site is handed over to the district authorities for implementing the off-site emergency plan. The management of emergency (inside the station or in main line) henceforth has to be controlled by the district crisis management group under the supervision of the District Collector/DDMA. In addition to preparation of on-site emergency plan, furnishing relevant information to the district authorities for the preparation of off-site emergency plan is a statutory responsibility of the occupier of every industry handling hazardous substance. Person reporting the fire / emergency should state the location at a prominent place to guide the firefighting crew arriving at the scene. The men should try to attempt to mitigate the emergency, extinguish the fire with the equipment available nearby till arrival of the firefighting crew.

Figure 5: Emergency Response Action and Communication



(ii) Information To Public

It is important to provide accurate information to the general public in order to prevent panic. Some citizen simply want to know what is happening while other citizens need to know as to what they could do immediately to protect themselves as well as others. In less urgent cases, however, newspaper articles to provide detailed information to enhance public understanding of gas leakage and procedures so adopted to shut the leakage. One person should be identified to serve as spokesperson. It is strongly recommended that the individual identified have experience in public information, community relations, and or media relations. The spokesperson can identify for the media, the appropriate individuals who have specialized knowledge about the event and its consequences. The chain of command should, therefore include this spokesperson. Other members of response team should be instructed to direct all communications and public relations issues to this one person (Chief Incident Controller).

Source of information to the public by issuing pamphlets containing do's and don'ts and by organizing meeting in small groups in the villages near ROW. One or two engineers from the station should visit the villages and organize the meeting with the help of village officials like Gram Pradhan on quarterly basis.

- In case of any emergency inside the station only employee and other connected persons like firefighting, security, ambulance crew are to be allowed to enter the area and outside unknown persons and laborers should not be allowed to enter the premises.
- In case of any emergency in the mainline burst, the area has to be cordoned off. Villagers and other unauthorized person should not be allowed to enter the area and smoking should be strictly prohibited in this area. It will be useful to educate the people working or living near the ROW about the hazards and Do's and Don'ts about the gas leakage. For this purpose meetings should be organized in small groups of 10 to 15 persons in the village near ROW.

General advice on the action as to what members of the public should take on hearing the warning are

- No construction should be carried out on the right of way (ROW)
- If gas leakage is found on/or near R.O.W. It should be informed to the nearest police station/HEPL office.
- If any gas leakage found, public should stay away at a minimum distance of 400 meters from the leakage point, should not light matches, smoke bidi or cigarettes. Should not carry ordinary torches, lamps near the

leakage point.

- In case of leakage in the fields, all the agriculture operation, use of tractors, Irrigation of the fields, running of the pump should be stopped till HEPL personnel give clearance.

Usually the information to the local public is given in their local language so that they can easily understand the situation. As the pipeline is located in Bengali speaking region most of the information is given to the public in Bengali.

(iii) Termination of Emergency

Termination of emergency should begin as soon as the emergency phase of the operation is completed. It should concentrate on giving accurate information to the employees, neighboring units and district authorities involved in offsite emergency etc.

Level I and level II: The Chief Incident Controller after assessing the situation declares the termination of the emergency. The Level-III termination of emergency shall be declared by district authorities through appropriate mode of information transfer so as to reach each and every one.

13.6. EMERGENCY MANAGEMENT MEASURES

(A) Infrastructure Requirements

(i) Emergency Control Center

All communication related to emergency shall be routed to crisis control room at Kanai Chatta. The Crisis Control Room will be equipped with SCADA, communication systems (Telephones, walkie-Talkies), operating manuals, Disaster Management Plans (On-Site/off-Site), Layout Plan of the pipeline, Display of names and Telephone numbers of all coordinators and heads of the organization etc. i.e. DMP Organogram of On-Site Disaster Management Plan will also be displayed. In case the scenario becomes Off-Site the names, address and telephone numbers of all off-Site groups and organization that might have to be contacted will also made available in the control room of the station.

(ii) **Medical Facilities First Aid**

The control room will be provided with a first aid box to use in case of any minor injury during operation or in case of any emergency. The first aid box is regularly monitored for any sort of shortfall.

If injury is major, person will be sent to the nearby hospitals. The hospital will be identified along the Kanai chatta Shrirampur dedicated pipeline route. The contact details of the hospital at above mentioned locations will be made available at the control room in following format:

Table 9 : Details of the nominated hospitals - Template

Locations	Nominated hospitals	Address	Phone No.

(B) Resources for controlling emergency

(i) **Fire and Gas Detection system**

Hand held Multi Gas Detector are provided at all stations to check presence of methane concentration at area of work. Leakage place will be identified through SCADA system.

(ii) Ambulance Facility

The facilities of ambulance at incident area will be from nearby hospitals. The list of medical facilities including hospitals and other necessary equipment for combating initial injuries will be provided in the control room.

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