

Annexure – 8

Technical scope of work for Pipeline installation by HDD

1. INTRODUCTION

This document summarizes the minimum technical requirements and the Specifications for installation through "Horizontal Directional Drilling" method of:

- a) Steel Casing Pipeline installation through HDD and insertion of PE pipeline in Steel Casing pipe
- b) Steel Pipeline installation through HDD
- c) Steel Casing Pipeline installation through HDD and insertion of Steel pipeline in Steel Casing pipe

2. REFERENECE

SPECIFICATIONS AND CALCULATION:

- PNGRB T4S - Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks
- ASME B 31.8 - Gas Transmission and Distribution Piping Systems
- ASME B 31.4 - Liquid Petroleum Transportation Piping Systems.
- API RP 1102 - Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways.
- API 1104 - Specification for Welding Pipeline & Related Facilities.
- OISD 141 - Design and Construction Requirement for Cross Country Hydrocarbon Pipeline
- ASTM F 1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
- ASCE MOP 108 - Pipeline Design for installation by Horizontal Directional Drilling

3. GEL SCOPE OF SUPPLY AND WORK

- **GEL** shall provide necessary site clearance / approval for carrying out the job.
- **GEL** shall help with locating **GEL** existing pipeline for GPR Survey.
- **GEL** shall obtain necessary principal permission for crossings and will hand over to Contractor (IF APPLICABLE). It is Contractor's responsibility to intimate and co-ordinate with the concerned authorities.
- **GEL** shall supply free issue material as per the contract
- **GEL** shall provide Work Permit to carry out the job
- **GEL** shall provide competency training regarding HSE prior to start of the job.
- **GEL** shall inform Contractor about Risk Associated with the job & it's Control Measure.

4. CONTRACTOR SCOPE OF SUPPLY:

- Supply of 9.5 mm wall thickness Steel casing pipe as per API 5L Gr. B / 153589 Gr. Fe 410 or Fe 450

- All material other than free issued by **GEL**
- All materials, equipment, trailers for transportation, loading, unloading, stringing etc. for owner's supplied material.
- All welding machines, lifting equipment, instruments, transporting vehicles and consumables for welding such as oxygen, acetylene, inert gases and all types of electrodes, filler wire, solder wire, brazing rods, flux etc. for welding/cutting and soldering purpose.
- All materials, equipment and instruments required for all types of tests such as radiography, Ultrasonic testing, magnetic particle and dye penetrate examination and any other tests as per requirement of Owner/Owner's Representative.
- All materials, equipment, instruments and consumables including primer calibrated pump required for external corrosion coating and concrete coating (where required) of field weld Joints.
- All materials, equipment, instruments and consumables required for repair of damaged Coating of line pipe.
- Casing pipes, insulators and end seals and materials for casing as per drawings, if applicable.
- All materials, equipment, instruments, temporary vehicles required for sand/soft soil padding around pipeline, PVC warning mat, select approved quality backfill, bank stabilization of water crossings, etc.
- All materials, consumables and equipment related to blasting of rock for excavating trench or grading the Right-of-Way.
- All critical measuring instruments like Cable locator, Leak surveyor etc.
- All equipment and material for HDD and HDD pits.
- HDD machine with following minimum features;
 - Auto Rod loading system
 - Power cable strike alarm
 - Earthing provision
 - Auto greasing of rod
 - Rod transfer arm barrier
 - Operator presence system
 - Remote lock out system
- All consumables, equipment (air compressors/air dryers of suitable capacity), instruments for drying of pipeline includes pigs as required.
- All materials, equipment, instruments for insertion of carrier pipe and filling of casing pipe.
- All materials, equipment required for repair/restoration of pavements, roads, bunds, other structures affected/damaged by Contractor's construction activities. Materials shall be equivalent/superior to those used for original construction of the facility.
- All other materials not specifically listed herein, but required for the execution of the WORK

5. GENERAL SCOPE OF WORK

- CONTRACTOR shall collect the PE crossing drawings and Steel alignment sheet & crossings drawing form **GEL**. On the basis of drawings survey shall be carried out and necessary calculations shall be made for the critical stresses, pulling load capacity etc.
- For each crossing, CONTRACTOR shall submit and obtain approval of **GEL/TPA** for the followings but not limited to:
 - Time Schedule

- Working method with equipment
 - General description of the construction method, sequence of operations and possible type of trench support,
 - Manufacturer and type of HDD equipment and related operating system proposed and capability of equipment chosen,
 - Bore plan, reaming and pull back,
 - Bore tracking and related equipment use,
 - Existing underground utility services location and proposed special precautions,
 - Ground monitoring equipment and methods, for example heaving, fluid loss or freak-out,
 - Calculation of size, depth and location of launching pits required and hydraulic for bypass pumping (if applicable),
 - Dewatering, flow bypass pumping, field final product testing,
 - Type of slurry or drilling fluid used, fluid design plan, and mud handling system specification,
 - Location of exit pits, trench support and work sites layout,
 - Method of temporary spoil storage and disposal,
 - New pipe product (pipe specifications) and or replacement piping type, butt-fusion methods and equipment used,
 - Programmed daily work hours and duration for the operation,
 - Test procedure
 - Manpower deployment
 - Calculations of temporary works
 - Safety management plan,
 - Risks Management plan,
- The work shall be carried out in accordance with the approved drawings and job standards, as directed by **GEL/TPIA** and to the satisfaction of **GEL/TPIA** and the authorities having jurisdiction over the facility crossed. The work carried out for road and railroad crossings shall meet the minimum requirements of relevant standards.
 - **CONTRACTOR** shall carry out utility identification and co-ordination with utility agencies prior to execute the job. In case of any utility damage **CONTRACTOR** shall have to repair at his own cost.
 - **CONTRACTOR** shall be responsible for the identification and protection of services where these are crossed by construction activities. Drains, pipes, cables, overhead wires and other services encountered in course of the work shall be guarded from damage by the **CONTRACTOR**, so that they may continue in full uninterrupted use. Damage to those utilities whether or not shown in the drawing the **CONTRACTOR** must make repair at his cost or bear the cost of making good the same without delay to the satisfaction of the Engineer-in-charge and authority having jurisdiction.
 - **CONTRACTOR** shall ensure that all activities are planned in a manner that will not create unnecessary danger, disturbance or effects on the environment or to other users.
 - Before the installation work of crossings is started, the **CONTRACTOR** shall provide suitable barricades, temporary bridge/bypass work with railing, if required by **GEL** for safety of traffic. Adequate traffic warning signals and/or traffic lights and suitable diversions shall be provided as directed by **GEL/Authority** having jurisdiction over these areas. Such diversions shall not cross the pipeline where it has already been installed, unless proper safeguarding at **GEL** opinion is ensured.
 - **CONTRACTOR** shall depute adequate and competent manpower at site for the execution of work. Based on the progress of the activity, **CONTRACTOR** shall keep readiness to increase the team size if required.

- For any work covered under company's work permit system, as informed by the **GEL** Engineer in charge, the **CONTRACTOR** shall collect the work permit or extension of work permit from **GEL** Engineer in charge at Owner office on day to day basis.
- Before Starting of Job, **CONTRACTOR** shall ensure that tool box talk with Work In charge and identified based on site specific risk assessment done at the location.
- Entry and exit pit preparation with proper shoring and shuttering as directed by **GEL** /TPA.
- **CONTRACTOR** 's drilling execution plan shall identify the equipment to be maintained onsite to check drilling fluid properties. Alternations to the mix shall be made, when warranted, to stay within the proposed boundaries of the drilling fluid plan.
- **CONTRACTOR** is to ensure that the equipment has the capability of limiting the drilling and pulling force applied to the pipe so as not to exceed the manufactures recommended tension loads for the pipe.
- In the event that the pilot bore deviates from the planned bore path, **CONTRACTOR** shall notify the Client. **CONTRACTOR** may be required to pull back and re-drill from the location along the bore path prior to the deviation occurring, if deemed necessary by the Client with no extra cost.
- In the event of a boring fluid fracture or return loss occurring during pilot hole boring operations, **CONTRACTOR** shall ensure that the contingency plan for frac-out or fluid lost is implemented. The Client and the **CONTRACTOR** will discuss additional options, and implement as required.
- Upon successful completion of the pilot hole, **CONTRACTOR** shall ream the bore hole using the appropriate tools to a minimum of 25% greater than outside diameter of pipe.
- **CONTRACTOR** shall arrange HDD machine and associated equipment's to ensure complete ream at one go including recycle system.
- **CONTRACTOR** shall pull the pipe through the borehole after successfully reaming the required size of borehole with installation of swivel in front of carrier pipe. Once pull back operations have commenced, the operation must continue without interruption until the pipe is completely pulled through the reamed hole. During the pullback operation **CONTRACTOR** will not apply more than the maximum safe pipe pull force at any time.
- In the event that the pipe becomes stuck, **CONTRACTOR** shall immediately cease the pulling operations to allow any potential hydro-lock to subside. Then if on re-commencement of the pulling operations the pipe remains stuck the **CONTRACTOR** shall immediately notify the Client. **CONTRACTOR** to initiated appropriated action to continue the work. No extra payment shall be made to **CONTRACTOR** for material and labour loss.
- **CONTRACTOR** shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself so far as practicable as to the form and nature thereof, including subsurface conditions, the extent and nature of work and materials necessary for the completion of the work and the means of access to the work area.
- **CONTRACTOR** shall be deemed to have obtained all necessary information on subject as above mentioned as to risks, contingencies and all other circumstances, which may influence the work.
- During the execution of work, **CONTRACTOR** should ensure that it should not obstruct any or all other activities performed by other agencies.
- **CONTRACTOR** shall ensure that his supervisor is present at site, till completion of work as per planning given by **GEL** Engineer in Charge.
- If the works are not done as per OWNER's satisfaction level then **CONTRACTOR** shall do the necessary rework at his own cost.
- **CONTRACTOR** shall provide calibration certificates of all measuring instruments to be used for the execution of work. **CONTRACTOR** shall rectify, repair or replace the instruments at his own cost if required

- **GEL** reserves the right at all the time to audit and review the **CONTRACTOR** facilities, services, and / or performance of its activities in respect to the compliance of his HSE plan.
- **CONTRACTOR** shall minimize nuisance, disturbance or Interference to the community, their activities, and other users of the environment.
- Engineered (modified, repaired), locally fabricated, worn out, tools shall not be allowed to use and it is the onus of **CONTRACTOR** to prove that appropriate size, fit for use and specification of drill pipe, drill bits, reamers are selected based on soil/ground condition using machine OEM selection criteria
- **CONTRACTOR** shall ensure that drill pipe with bend limit of no more than 9% of pitch over full length of each drill pipe is used and bend limits and or tension limits of pull back material pipe lengths are not compromised

6. DESIGN AND ENGINEERING

DATA REQUIRED:

- Outside Diameter
- Wall Thickness of pipe/ SDR of pipe
- Moment of Inertia
- Weight of Pipe in Air
- Cross Section of Pipe
- Modulus of Elasticity
- Radius of Curvature
- Co-efficient of Drag
- Mud Density
- Proposed Length
- Entry Angle
- Exit Angle
- Design Pressure
- Weight of Drill Pipe

For Pipe installation through HDD method, **CONTRACTOR** shall carry out following calculations and examine the stress imposed on a pipeline during the installation of a horizontal directionally drilled crossing prior to pullback, during pullback and post installation to confirm that the pipeline will not fail. Also, Pull back capacity of machine shall be calculated on the basis of above data considering the proper safety margins

The calculations are based on the following:

- Pipe empty on conveyors
- Pipe full of water on conveyors
- Pipe Pull back- empty
- The following stresses are considered
- Spanning Stress
- Curvature Stress
- Pulling Forces
- Stress on coating
- Longitudinal Stress
- External Pressure
- Internal Pressure
- Tensile Stress
- Hoop Stress
- Stress summery
- Permissible overburden

6.1. PULLING CAPACITY AND RIG CAPACITY

CONTRACTOR to consider the number of segments of HDD based on above parameters and other mandatory requirement as per alignment sheets etc. in their proposed execution methodology which shall be reviewed/approved by Owner/TPI appointed by Owner.

CONTRACTOR will submit for approval to the Owner and Third Party Inspection agency the stress calculation as described in the Deutsche standard NEN 3650 and NEN 3651 or equivalent.

The following phases should be analyzed in the pipeline design process:

6.2. Before Pull Back:

Before the pulling operation, the pipeline is outside the bore-hole and has a configuration which allows it to enter the hole. During this phase, the only bending moment is due to the curvature of the catenary and the weight. The HDD profile should be designed so that pipe behaves elastically in the bored hole.

Pipe rollers, slates or other protective devices should be used to prevent damage to the pipe from the edge of the pit during pull back, eliminate ground drag or reduce pulling force and subsequently reduce the stress on the pipe and ensuring no damage to the pipe coating or surface.

6.3. Pull-back operation:

In this phase the pipeline will be pulled back through the bore-hole. The following forces should be considered:

- Bending moment due to curvature of the hole;
- Friction force between the pipe and drilling mud including the friction due to extra cables/sleeves attached to the string;
- Friction force inside the hole, at the location where the soil reaction occurs;
- stress due to soil reaction;

CONTRACTOR will specify the means he intends to use in order to reduce the friction during the pull-back operation. The resultant stress should be calculated and the pipeline designed to behave elastically.

6.4. Operating conditions:

In this phase the loads acting on the pipeline are:

- Bending moment due to curvature of the hole;
- Internal pressure of the gas;
- Temperature difference of the line between the pipe-laying and operating conditions;
- Dead loads Vertical soil load at the top of the pipe can be calculated for different pipe laying conditions.
- The following effects should be combined for the purposes of calculating the resultant stress:
 - Calculated longitudinal stress effects on the entire pipeline system;
 - Calculated stress effects on the cross-section of the pipeline during service.
 - The stress/strain shall not exceed the relevant allowable stress (95% of SMYS).
 - The effects of soil load on the cross-section of the pipe may be analyzed. This analysis should be carried out at the deepest point reached in drilling.

7. INSTALLATION PROCEDURE

7.1. Rights of way and work space

- Prior to any HDD activity or pipeline construction work the top soil removed shall be kept in original condition.
- The temporary access road to the work sites will be determined jointly by the Owner and **CONTRACTOR** and granted by the Owner.
- The cost of improvement or execution of temporary accesses will be borne by **CONTRACTOR**.
- The right to use the specified working space will be granted by the Owner.
- If **CONTRACTOR** requires more space, it will be **CONTRACTOR**'s responsibility to negotiate such additional space in close co-ordination with the Owner. **CONTRACTOR** shall support all relevant costs.
- The Owner will provide a basic profile drawing and the constraints and particularities of the obstacle to be crossed.
- **CONTRACTOR** shall specify and submit to the Owner for approval his final profile and the different parameters or their limited value which define the location and configuration of the drilled path.

These parameters are:

Entry Point
Entry Angle
Exit Point
Pipeline elevation
Radius of curvature.

- It is acceptable that the entry and exit will vary from the design proposed location. They have to be located inside an area (1 x 1m) centered around the proposed location, 1 m shall be measured parallel to the HDD alignment.
- Except if otherwise specified in the tender document, the minimum radius shall be not less than 1000 times the Nominal Diameter (ND) in mm. The predetermined theoretical profile shall be closely adhered to when drilling the pilot hole. The permitted deviation shall not exceed 1 m laterally and 300 mm vertically from the approved theoretical profile.

7.2. The following details the methodology of Horizontal Directional Drilling (HDD) works:

HDD is a two-stage process. The first stage will consist of drilling a small diameter pilot hole along a designated directional path. The second stage involves enlarging this pilot hole to a diameter that will accommodate the carrier pipe and pulling carrier pipe back into the enlarged hole.

7.2.1. Pilot Hole

Rig up shall be done, after mobilizing the equipment at drill location. Rig shall be anchored at the specified angle as per the approved drawing before start of pilot hole with dead men in ground.

The pilot hole shall be drilled with a Horizontal Directional drilling rig, to enter the ground at a angle of entry as specified in the drawings. Pilot hole directional capability is accomplished by using a Drill Bit. The offset creates a steering bias in its direction and plane. If a change in direction is required, the same will be done by pushing drill string so that the direction of bias is the same as desired change in direction. Mechanical cutting action can be achieved by the bit attached to the offset drill string. The actual path of the pilot hole will be monitored by a state-of-art magnetic guidance system (attached). The actual path of the pilot hole is monitored during drilling by taking periodic readings of the inclination and azimuth of the leading edge. These readings, in conjunction with measurements of the distance drilled since the last survey, are used to calculate the horizontal and vertical co-ordinates along the pilot

hole relative to the initial entry point on the surface and profile is plotted for the actual path being taken along the proposed alignment. Readings are taken at every joint (normally on each road length).

When the bit penetrates the surface at the exit point, the pilot hole is complete.

7.2.2. Ream and Pull Back

After the completion of pilot hole, depending on the drilled cuttings and actual soil encountered during the pilot hole, combinations of Cutters /Reamers will be used to enlarge the hole.

The Cutter / Reamer will be fixed to the drill string will be rotated and pulled/pushed through the pilot hole. The cutter will cut through the hole with the cutting action of bentonite pumped through the drill string. On completion of first pass other Reamer (sizes may vary as per actual condition) shall be used to enlarge the hole. Cleaning passes as required shall be done depending on the soil conditions encountered. It is to be noted that the passes mentioned in the schedule are tentative and might change as per the soil conditions encountered as per the pilot hole logs. It will be decided at the site to use various combination of down hole tools as per the requirement by the Driller. Also, the sizes of Reamers/Cutters and sequences to use these can be vary as per actual site conditions.

Once the cutting passes are complete a non-rotating swivel will be attached to the pull head to pipeline section to prevent torsional stress on the pipeline. The drill string is aligned with the product pipe. An overhead bend will be formed by lifting the product pipe to the correct height to allow smooth entry in the borehole. As the pipeline section is drawn towards the drill rig the pipeline section will be adequately cradled with rolling cradles (IUM) to facilitate a stress-free line-up with the pre-reamed hole. Product pipe shall be placed on rollers to minimize the friction during pulling.

Bentonite will be pumped during pullback. Bentonite slurry and returns from the drilled hole shall be disposed-off in safe manner as per agreed procedure. Bentonite to be used does not contain any constituents hazardous to the environment. During drilling process check shall be maintained to check the viscosity. Mixing of mud shall be controlled as per the soil conditions in countered. Upon reaching rig side, the final reamer and pull back swivel are removed and the pulling head is attached for pulling the product pipe. After completion of pull back, the rig down shall be done and the equipment is demobilized after dearing/cleaning the work area.

To minimize heaving during pull back, the pullback rate shall be determined which maximizes the removal of soil cuttings and minimize compaction of the ground surrounding the bore hole. The pullback rate shall also minimize over cutting of the bore hole. During back reaming operation to ensure excessive voids are not created resulting in post installation settlement.

Drilling mud pressure in the fore hole should not exceed that which can be supported by the overburden to prevent heaving or a hydraulic fracturing of the soil. Allowing for a sufficient cover depth does this.

The pipeline must be sealed at either end with a cap or a plug to prevent water, drilling fluids and other foreign materials from entering the pipe as it is being pulled back.

In order to prevent over stressing of the pipeline during pullback a weak link or breakaway-pulling head, may be used between the swirl and the leading end of the pipe

7.2.3. Drilling Accuracy

The instrument used to survey the pilot hole during drilling is magnetic and therefore subject to some inaccuracy. Additionally, some deviation from the designed drilled

path may be experienced due to soil reaction. Therefore, we generally anticipate a deviation in actual versus designed pilot hole course of $\pm 0.5\%$ of the horizontal and vertical directions drilled length. The error, when it is unacceptable, can be largely eliminated by re drilling after "punch out" in the right of way limits. Best drilling standards shall be followed to minimize the deflection as per the client's requirements.

Performance of the down hole survey system is monitored during drilling by diagnostic system which confirms the suitability of the transmitted signal. Additionally, the accuracy of the surveyed hole can be determined by comparing the actual exit point with the anticipated exit point. Any error measured in this manner is then distributed linearly over the entire length of the pilot hole to produce an accurate as built survey. Reaming Operation shall start immediately after completion of pilot hole without any delay.

7.2.4. Bentonite Disposal Scheme

Bentonite slurry and returns from the drilled hole shall be disposed-off as per approved procedure. Bentonite to be used does not contain any constituents hazardous to the environment.

8. QUALITY AND INSPECTION PLAN

CONTRACTOR will maintain Quality Assurance program for its Horizontal Directional Drilling Activities based on the three major components of the technology. These three components and the guidelines for Quality Assurance are detailed below as follows:

8.1. Guidance System

An electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2-feet horizontally on either side of the borehole.

The **CONTRACTOR** shall supply all components and materials to install, operate, and maintain the guidance system.

The Guidance System shall be of a proven type, and shall be set up and operated by personnel trained and experienced with the system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

When access to a location directly above the borehole alignment is not possible, or when borehole depth exceed 30 meters, a computerized survey system is utilized. This survey system allows for real time readings measured from a steering device located in the tip of the drill bit. Real time readings are produced and generated back to a lap top computer operated in the control room. A qualified steering tool technician operates this survey equipment and assures that the drilled alignment is consistent with the proposed profile provided in the engineering and design data. Quality Assurance is maintained by plotting on the approved design profile the actual horizontal and vertical alignment taken at each road length intervals. The steering tool

technician is responsible for this Quality Assurance activity. This activity is conducted during pilot hole drilling/installation.

8.2. Pilot and Reaming Operation

The Drilling Superintendent is responsible for the Quality Assurance activities associated with the pre-ream operations. Pre-reaming refers to the process where in the borehole is enlarged in a step-wise progression to enable the installation of the carrier pipeline. It is the Driller's responsibility to assure proper drilling mud viscosity's, to ensure that the cuttings are being removed from the drilled hole, and that a proper mud cake is lining the interior of the hole walls. It is also the Drillers responsibility to monitor the torque and pullback forces being exerted by the drill rig during pre-reaming operations. Although a specific standard does not exist, the Drillers past experience and knowledge is the basis for adjusting drilling mud viscosity as well as monitoring rig torque and pullback forces.

8.3. Pipe line Installation Operations

Once the drilled hole has been enlarged and is ready to accept the pipe string, pullback operations commence. Pullback operations refer to the process wherein the pipe string is installed in the drilled hole utilizing the cranes/side booms and pipe rollers to assure proper alignment and entry angle into the hole. It is the Driller's responsibility to ensure proper quantity of cranes/side booms and pipe rollers are maintained and on the job site to complete this operation. The entry angle is calculated and included as part of this engineering and design package. It is the Driller's responsibility to assure that this entry angle is maintained during pullback operations. Once the pipeline has been successfully pulled into the drilled hole, the pull head is removed from the pipe string.

After pulling the pipeline across the drilled crossing, **CONTRACTOR** shall cut the extended portion of the pipeline at the entry and exit points. Thereafter, the drilled portion of the pipeline shall be cut at suitable location/depth and extended on either bank as per direction of EIC.

The drill rig will be demobilized and the job site secured. These activities are also a part of the Quality Assurance responsibilities of the Driller.

9. INSPECTION AND TESTING

CONTRACTOR will maintain the Inspection and Testing procedure for the HDD works at site as mentioned below:

9.1. Daily Maintenance

Daily maintenance of equipment is the most important and essential part of our Inspection and testing procedure. It is very important for site superintendent to maintain all the drilling equipment in best of maintenance with the Mechanic crew. Depending upon the drilling hours per machine, oil and filters maintenance is done. Care is taken to maintain the inventory of spares and tools required keeping the equipment in good running condition.

9.2. Bentonite Inspection and Testing

Quality check is maintained during drilling operation by checking viscosity and yielding power. Mud man maintains the record of Bentonite being used and the quality of the Bentonite. Also, the returns of cuttings are checked to keep track of soil being encountered and to check the same with the soil investigation data.

9.3. Profile Inspection

Profile to be drilled is maintained and checked by state-of-the-art steering tool system that gives a driller the actual path being followed at every joint of pipe. The steering

system gives the driller the information of drilling bit or jet in reference to ground level in terms of depth, azimuth and inclination.

10. SPECIAL INSTRUCTIONS

For access route to the working strip the **CONTRACTOR** will be responsible to negotiate with the relevant Owner, tenant or authorities. Any deemed compensation will be borne by the Bidder.

CONTRACTOR proponent shall have to preserve top soil dug and shall be restored to original condition on completion of the work wherever required / as required.

CONTRACTOR shall construct the pipeline and other infrastructure by adopting safety measures as per the standards & specification laid down by the concerned agencies from time to time. All the safety and personnel protection measures shall be properly provided to meet any mishap / hazard / during operation and HDD method.

CONTRACTOR proponent is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.

On completion of all temporary work structures, surplus materials and wastes shall be suitably disposed off.

11. DOCUMENTATION

The **CONTRACTOR** will supply with his tender the different documents listed here below.

- A description of the major drilling equipment as
 - Drill rig specification
 - Maximum dynamic torque
 - Pull back capacity
 - Drilling fluid trailer tank specification
 - Control cab
 - Pipe racks
 - Positioning system
 - Drilling head
 - Ancillary equipment
 - Safety features
- A complete description of the directional drilling working method as:
 - The positioning record system and procedure
 - Drilling of the pilot hole and wash over pipe.
 - Reaming operation (type and size of the reamer)
 - Mix compound of the Bentonite mud.
 - Soil cuttings/Bentonite mud separation and treatment process and reuse of the Bentonite.
 - Pipelines pull back operation.
 - Alignment and positioning of the pipe string.
 - Rollers support used. The support will be designed so as not to damage the pipe, pipe surface or coatings.
 - Detail drawing showing the theoretical profile, the final design profile, the position of the pipe string (with support arrangement) before pull back operation
 - The method intends to use for controlling the protection of pipeline to minimize wear and tear of outer surface
 - The method intends to use for verification of the pipeline final profile after the pull-back operations.

- Documents to be supplied by the contractor before and during the execution of the HDD and after his completion

Before and during the HDD execution

- Before the pull-back operation the **CONTRACTOR** will submit for approval to the Owner the final profile of the HDD including any deflection of the drilling head. The **CONTRACTOR** can start the pull-back operation only after the Owner approval.
- This document submitted by **CONTRACTOR** needs to demonstrate that after completion (operating condition) and under internal pressure (MOP and test pressure), soil load and Pneumatic load the section of the pipeline will not have a radius of curvature smaller than those permitted by the design.
- The document shall also indicate the pulling force on the pipe at the beginning, during and at the end of the process and the rate of progress of the pipe.
- During the different execution phases of the HDD the **CONTRACTOR** will record all the information regarding the different operations which includes, among others:
- The measurements of mud pressure, mud flow rate, pulling force, X-Y-Z of the drill head recorded during drilling and any other relevant statistics.
- Stand-off during operations and the reasons thereof

During drilling operation (per drill pipe element)

- The maximum force applied (push/pull/torque);
- Time duration for assembling 2 elements;
- The drilling head position in X-Y-Z- co-ordinates;
- Deviation compared to the required position;
- The proposed corrective measures.

During drill pipe pull-back (per drill pipe element)

- Pull-back duration per element
Maximum pulling force per element.
- An alignment sheet with length profile of the pipeline (scale 1/500) showing the location of each weld joint and their X-Y-Z co-ordinates.
- An official certificate concerning the discharge of the drilling operations tailings approved by the relevant Authorities.
- Pipeline installation is broadly categorized in this section. After the HDD execution
- After completions of the HDD the **CONTRACTOR** will transmit to the Owner the horizontal drilling operation record of the relevant activities which includes.
- Concerning the drilling mud
- Quantity of mud used;
- Mud pressure (at the drilling)
- The density of the drilling fluid and soil cuttings;
- The localization of storage site for the waste from the drilling operation and the measures taken to comply with environmental constraints.

12. AS-BUILT RECORDS

CONTRACTOR shall keep detailed and accurate records of all activities associated with the HDD process.

As Built plans are submitted in AutoCAD format and in paper form. HDD construction records and As Built plans shall include the following:

- HDD tracking data and operator logs including following
The type of tracking equipment used

The length and depth of the HDD installation,
Additional information that may include steering adjustments and other
equipment performance parameters;

- As Built plans shall be derived from the tracking data and operator logs. At a minimum, the drawings shall Indicate
Horizontal and vertical HDD alignment,
Existing utility horizontal locations and depths at all exposed or potholed
locations and existing utility horizontal locations where indicated with field
locates.
- As-Built documentation containing all documents (drawings, design
calculations, welding log etc.)

As-Built documents shall maximize the use of CAD, computer database (Access and
Excel) and digital records in such a way to allow later integration in a "Geographical
Information System" (GIS).

All equipment shall be duly traced with reference to initial supplier Identification
Reference (ID) — Equipment details, log book, Certificates etc.