SPECIFICATION

FOR

TRENCHING AND BACKFILLING OF SUBMARINE PIPELINES

OIL AND NATURAL GAS CORPORATION LTD.

INDIA

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1.0 **SCOPE**

1.1 This Specification covers the minimum requirements for trenching works of submarine pipelines. This Specification also covers the minimum requirements for backfilling of submarine pipelines, where specific backfilling is required.

1.2 This specification shall be read in conjunction with the requirements of all specifications and documents included in the Contract

2.0 **REFERENCE CODES, STANDARDS AND SPECIFICATIONS**

2.1 Reference has been made in this specification to the latest edit of the following Codes, Standards and Specifications:

a. ANSI B 31.4 - Liquid Petroleum Transportation Piping System

b. ANSI B 31.8 - Gas Transmission and Distribution Piping Systems

c. Part 195, Title 49 - Code of Federal Regulations, Minimum Federal - Safety Standards for Gas Lines

d. IP Part 6 - Institute of Petroleum, Model Code of Safe Practice

e. DNV-1981 - Det Norske Veritas – Rules for Submarine Pipelines

2.2 In case of conflict between the requirements of this specification and that of the above referred codes, standards and specifications, the requirement of this specification shall govern.

3.0 **GENERAL**

3.1 Contractor shall furnish all the required materials, equipments, vessels, inspection and monitoring services for the successful trenching and backfilling operations. All

materials, equipments and vessels shall be subject to company approval prior to their use.

3.2 Contractor shall fully familiarize himself with all aspects of the environmental information available for the area in which the work is to be carried out. Prior to the commencement of work, the Contractor shall be deemed to be fully familiar with the site conditions relating to seabed, wind, wave; tides, currents, etc

3.3 Contractor shall also fully familiarize himself' with the location and depth of all existing facilities and obstructions, including wrecks, boulders, pipelines, cables, structures, etc. which may affect the trenching/backfilling operations.

3.4 Contractor shall consider the limiting weather, sea and current state in which the trenching/backfilling spread can operate, whilst ensuring safety and integrity of the personnel, equipment, the work and any other facilities in the working area and shall accordingly select equipments for trenching / backfilling operations to complete the works within the schedule mentioned in the Contract

3.5 Contractor shall comply with the statutory requirements of the Government Agencies having jurisdiction over the area of work, while carrying out trenching/ backfilling and other associated operations.

3.6 Contractor shall perform all anchor handling operations in accordance with the requirements mentioned in Company Specification No. 2015

3.7 Contractor shall take all necessary precautions to prevent damage to the existing facilities, during the trenching/backfilling operations. Contractor shall be responsible for any damage to the installed pipelines, its coatings and or appurtenances, due to the trenching/backfilling operations. The repair or replacement of the existing facilities as a result of damage by trenching/backfilling operations shall be borne by the Contractor.

3.8 Contractor shall provide full access to the Company Representative of all work areas during all phases of work and shall also provide access to documentation related to the work covered in the Contract.

3.9 Contractor shall be responsible for the stability and sage working loads of all temporary facilities erected in connection with the trenching operations. The design and construction of all temporary facilities shall be subject to the prior approval of the Company.

3.10 Contractor shall provide office, communication and accommodation facilities for specified number of Company personnel onboard the trenching/backfilling vessels, as mentioned elsewhere in the Contract.

4.0 ENGINEERNG REQUIREMENTS:

4.1 Procedures, drawings and calculations relevant to the trenching and backfilling operations including details of all aspects of the trenching operations shall be prepared and submitted to Company for approval.

4.2 Calculations

4.2.1 The contractor shall calculate the stresses induced in the pipelines due to trenching operations and deployment and recovery of the trenching equipment. In addition the stress analysis of the pipeline sections installed in a curve while trenching shall also be carried out. The maximum allowable combined stress in the pipeline during trenching shall be 85 % of the specified yield strength of the pipe material. The Contractor shall outline the method and basis of the calculations. In case any computer programs are proposed, Contractor shall furnish a brief description of the analytical methods employed in the program alongwith the basis and theory used.

4.2.2 The calculations shall take into account soil conditions, trenching speed, trench depth, water depth, seabed slope, tow line force, pipeline curvature and any other

significant variables. The Contractor shall also calculate the forces and stresses induced in the pipeline by the trenching equipment rollers and supports, if applicable, and calculate the limiting safe side and support roller reaction forces for the range of variables to be encountered. The effect of currents on the trenching equipment and thus on the pipelines, shall be included in the calculations.

4.2.3 The limiting allowable tide and support roller reaction forces calculated shall ensure that the concrete coating is not damaged by the trenching operations.

4.3 **Trenching/ backfilling procedure manual**

The Contractor shall submit to Company a trenching / backfilling procedure manual including details of all materials, equipment and procedures, etc but not limited to the following to demonstrate the feasibility of the proposed trenching backfilling methods and other operations described in this specification

a. Complete details of the proposed trenching backfilling spreads including:

- Principal dimensions
- Mooring system, winch and anchor details
- Equipments (pumps, airlifts, conveyers or other and methods for disposing of spoil)
- Trenching machine tow winch details, if applicable
- Accommodation and services onboard
- Monitoring instruments and methods
- Survey equipments and communicator system available onboard
- Floating lines, disposal hose pipes alongwith the method of anchoring (if applicable)

- Expected capacity of the trenching / backfilling spread per day alongwith individual capacity of all equipments
- Details of the survey vessel

b. Plan, procedure and schedule for the trenching, backfilling if applicable and other operations including details of the locations with limits where these operations are to he performed.

c. Detailed pipeline stress analysis for the condition before, during and after the trenching, backfilling and other operations as mentioned in clause 4.2 of this specification.

d. Details of seabed preparation work in terms of its scope, extent, locations and procedures

e. Details of pre-post-trenching work including details of trenching direction, method of trenching, trench size, configuration and profile, disposal of spoil/excavated material, sand padding and safety precautions.

f. Details of backfilling works (if applicable) including method of back-filling, direction of backfilling, configuration and profile of backfill source, gradation and specific gravity of backfill, etc. procedure for backfill material handling and haulage.

g. Monitoring, controlling and inspection methods, procedures, equipments and instrumentation of trenching/ backfilling operations to ensure the safe stress limits of the pipelines. This shall include hut not limited to, graphs, tables and calculation methods planned for use at site.

h. Details of diving inspections and hydrographic surveys along with the frequency of such operations.

i. Details of the procedure to rectify insufficient trench depth.

j. Details of the procedure to rectify insufficient trench depth.

k. Procedures and details for the storage, handling and use of explosives and blasting procedures (if applicable) as per the requirements of clause 6.6.8 of this specification

l. Details of safety measures proposed to prevent damage to the existing facilities structures and pipelines during the trenching backfilling operations

Upon approval by Company, any change in the procedure shall be notified to company whose approval in writing of all changes shall be obtained prior to start of trenching and backfilling operations

4.4 If a modified trenching spread or method is proposed the Contractor shall present all design calculations demonstrating that the machine is appropriate for the work, alongwith the results of all field trials. Additionally, the Contractor shall demonstrate, prior to deployment to the Company Representative's satisfaction by field trials in the area of the work that the proposed procedures and equipment ensure safe and successful trenching operations.

5.0 CONSTRUCTION REQUIREMENTS

5.1 In general pre -trenching shall be carried out in the shore approach/shallow water zone and post-trenching shall he carried out in the off-shore zone, unless specified otherwise. Limited and extent shall he as defined elsewhere in the Contract

5.2 Contractor shall set up and maintain quality assurance inspection systems to ensure that all requirements of this specification are complied with.

5.3 While carrying out pre-trenching/ backfilling operations, the Contractor shall comply with the following tolerance limits:

- The trench alignment shall not vary more than ±1 m from the alignment shown in the company approved drawings.
- Trench depth and resulting trench profile shall not vary from the depth and profile shown in the approved drawings. In case of over excavation of trench, the resulting trench profile shall comply the permissible elastic bending radius of the pipeline. Trench profile less than the permissible elastic bending radius of the pipeline is not acceptable.
- Bottom width of the trench shall not vary more than ±200 mm from that shown in the Company approved drawings.
- Where backfilling is proposed, the backfill shall not extend beyond the seabed level by more than 300 mm unless specified otherwise or unless established through soil settlement calculations. In any case, the backfilling shall not be lower than the adjoining seabed levels.

5.4 The Contractor shall be responsible for the cost of excessive trenching beyond the tolerances specified as well s consequent backfilling required.

6.0 TRENCHING OPERATIONS

6.1 Contractor shall follow the Company approved procedures as mentioned in clause 4.3 of this specification for the trenching and other associated operations.

6.2 Contractor shall carry out trenching strictly to alignment profile and levels as indicated in the approved drawings.

6.3 Excavation shall be carried out and trench shall be maintained in all types of soil including coral, shell, soft and hard rock. Trench shall be cut to a grade that will provide a firm, uniform and continuous support for the pipe.

6.4 The Contractor shall perform hydrographic survey and diving inspection as required immediately on mobilization to site, to check and verify that the

equipments proposed arc suitable for the soil conditions encountered along the route.

6.5 **Survey Requirements**

Contractor shall carry out hydrographic surveys during the trenching /back filling operations at various stages of work as mentioned below:-

In case of pre-trenching:

a. Pre trenching survey prior to any pre-trenching operations.

b. Post pre-trenching survey prior to pipeline installation for trench acceptance.

c. Additional post pre- trenching survey in case of any rectification measures required to be carried subsequent to post pre-trenching operations.

In case of post-trenching

a. Pre- post trenching survey in case of significant delay in start of post trenching after pipeline installation.

b. Final as-built Survey upon completion of post trenching operations for post-trenching acceptance.

6.6 **Pre-trenching:**

6.6.1 Prior to commencement of the trenching works, Contractor shall carry out a pre-trench survey in the presence of the Company Representative, to locate establish the position of any debris which could pose problems to trenching operations. Pre-trenching survey shall be performed from a dedicated survey vessel using a surface positioning system, towed fish side-scan sonar and echo sounder.

Diver survey shall also be carried out at locations where the crossings or debris are established during the pre-trenching survey.

After the pre-trenching survey has been performed, any necessary intervention work shall be carried out by the Contractor, to enable the start of pre- trenching operations.

6.6.2 The pre-trenching works in shore approach / shallow water zone shall be performed using conventional marine trenching methods. Drilling, blasting and or other means may be used of the site and environmental conditions so dictate. Contractor shall ensure safety of nearby structures, if any during the operations.

6.6.3 In case more than one pipeline is to he installed as a part of the Contract. Contractor shall excavate a single trench to accommodate all the pipelines currently being laid, unless otherwise specified. Width of the trench shall be decided in consultation with Company.

6.6.4 Contractor shall ensure that the trench is stable under the environmental conditions that are likely to prevail at the site. Contractor may choose to stabilize the slopes of the trench by sheet piling or other measures, if required.

6.6.5. If the tolerances specified for the trench are exceeded, Contractor shall take remedial measures after obtaining the approval from the Company.

6.6.6. In case any filling of trenches of siltation is expected, Contractor shall estimate the extent of trench filling considering all conditions existing at site. For this purpose, pit excavation may be carried out at a any suitable location along the pipeline route. Contractor should carry out the required maintenance dredging to maintain the trench satisfactorily until the pipeline installation. Alternatively the Contractor rnay carry out additional excavation to a depth acceptable to Company.

6.6.7 Spoil from any trench operation shall he placed at a location and in a manner acceptable to Company and Government Agencies having jurisdiction over the marine areas, unless otherwise specified elsewhere in the Contract.

6 6.8 **Blasting**

6.6.8. In case drilling and blasting is to be carried out for trenching, Contractor shall carry out the blasting as a part of work. The Contractor shall acquaint himself and comply with as the applicable laws and regulations concerning storing, handling and the use of explosives. All such laws and regulations enforced from time to time shall be binding upon the Contractor.

6.6.8.2 Contractor shall submit to Company a detailed blasting procedure including the details regarding method of blasting, details of drilling and blasting marine spread alongwith the instrument/equipments proposed for monitoring blasting activities, materials such as explosives, detonators. etc to be used, blasting pattern, vibration control, storage of explosives estimated and schedule for blasting operations etc.

6.6.8.3 Contractor shall obtain necessary permits for storage and use of explosives and comply with the laws, rules and regulations of the respective Governmental agencies having jurisdiction thereof.

6.6.8.4. No blasting will be allowed without prior and due notice given by Contractor to Company and the other concerned Governmental Agencies.

6.6.8.5 Every possible precaution shall be taken to prevent injurious and damages to existing installations and persons during blasting operations Contractor shall employ only such workmen who are experienced in the type of work to be performed to supervise and handle and use the explosives.

6.6.8.6 Ground vibration due to blasting near the existing structures, pipelines and other facilities shall he continuously monitored using certified instruments to be provided by the Contractor and approved by Company and the peak particle velocity shall not exceed 50 mm/s.

6.68.7 Blasting operations shall be carried out during fixed hours of the day, which shall have the approval of the Company. The hours once fixed shall not be altered without prior written approval of thee Company.

6.6.8.8 The site of blasting operations shall be prominently demarcated by marker buoys. A constant vigil shall be kept by support vessels or patrol boats to warn vessels approaching the area to keep clear.

6.6.8.9 Company reserves the right to refuse blasting where possible danger exists to the existing installations. In such locations, other methods of excavating the hard soil shall he proposed by the Contractor and approved by the Company.

6.6.9 Padding shall be provided in rocky, coral and other hard unevenly trenched areas. A padding of 200 mm of sand shall be provided in the entire width of the trench, prior to the installation of the pipeline.

6.6.10 If a layer of sand or other defined material is specified in selected location prior to the installation of the pipeline, this specified padding shall be installed in accordance with the requirements this specification

6.6.11 At transition zones between hard and soft soil trench shall he profiled in such a manner as shown in the approved drawings to ensure that the pipe line is not over stressed. Trench profile shall be such that the minimum cover requirements in soft soil is complied and the transition cover shall be in the rocky or hard seabed.

6.6.12 After completion of the trench, Contractor shall carry out a hydrographic survey and diving inspection to verify that the trench profile and levels shown on approved drawings have been achieved and that the trench is ready to receive the pipeline. Surveys shall be carried only in the presence of Company Representative. Trench shall be free of any debris or rock material which could impair pipeline installation work.

The Contractor shall carry out any additional excavation or take such corrective measures as shall be necessary in the opinion of the Company Representative to ensure that the trench achieves the correct alignment profile. Fresh sounding shall be taken following the corrective measures to ensure the propriety of the corrective measures.

6.7. **Post – trenching**:

6.7.1 During all post-trenching operations the Contractor shall employ all necessary equipment and methods sufficient to ensure that the required trenching is carried out within the tolerances specified without causing damage to thee pipeline, concrete/corrosion coating, anodes or other facilities.

6 7.2 In the off-shore zone, the pipeline shall be lowered to the specified level by the Contractor, normally by post-trenching method, unless otherwise specified in the Contract. Contractor may propose to use jetting, plowing, mechanical trench cutting or other pro methods for the trenching operation.

6.7.3 Post trenching/burial of the pipelines shall start as close as possible from the risers considering the safety of the adjacent existing pipelines while using the burial sled.

6.7.4 In case drilling and blasting is resorted for trench excavation on at certain trench locations, this shall be carried out prior to post trenching operations.

6.7.5. Trenching machine shall be fitted with instrumentation and sensors connected to load cells on the machine to measure and record continuously under all circumstances all vertical and horizontal forces exerted on the pipeline by the trenching machine.

6.7.6 All monitoring instruments and equipment shall be calibrated and equipment prepared prior to mobilization of the spreads from Contractor's work base to allow the Company to inspect the spreads and review the calibration results. Company reserves the right to witness the calibration of instruments and equipments.

Contractor shall give timely notice to the Company of the period for calibration and allow the Company to witness. All calibration reports shall be onboard the vessels at all times and made available to the Company Representative whenever requested.

6 7.7 Facilities for the continuous monitoring of the trenching machine operations by video or sector scan or other means duly approved by Company shall be provided.

6.7.8 All instrument monitors and recorders shall he in a location accessible to the Company Representative. The records collected during the operation shall be presented to Company Representative as a part of the as-built documentation.

6.7.9 Contractor shall carry out pre post-trench survey in the presence of the Company Representative in case of significant time delay between the pipeline installation and the post-trenching activities or the post-trenching operations are postponed to the next working season, to determine any changes in the pipeline seabed in the zone required to be post-trenched from the post-lay survey results. This survey shall be carried out from a dedicated survey vessel using a surface positioning system, towed fish side-scan sonar and echo sounder.

Diver survey shall also be carried out at locations where the crossings or debris are established during the pre-trenching survey.

After the survey has been performed, any necessary intervention work shall be carried out by the Contractor, and make the line ready for post trenching operations.

6.7.10 The trenching machine shall be run along the pipelines a sufficient number of times to lower the pipeline to the required level while maintaining stress levels within the allowable limits. At each end of' the trench and on deployment and recovery of the trenching machine, the trench shall be profiled back to the natural seabed so as to ensure the pipeline is not over stressed.

6.7.11 Check shall be made at regular intervals as the work progresses to ensure free spans in excess of permissible values do not occur.

6.7.12 The Contractor shall monitor and control picture curvature within acceptable limits by implementing the Company approved procedures.

6.7.13. During the trenching operations, the Contractor's divers or ROV shall periodically (at least twice a day) report on the operation of trenching machine to the on-board company Representative. This report shall include - Condition of the pipe, coating, anodes and field joints:

-Depth and profile of trench

- Soil being dredged

- Pipe profile relative to the natural seabed in format of the machine to two joints past the touch down point.

- Any video survey / sector scan survey or other means as a back – up, as and when requested by Company.

6.7.14. The Contractor shall collect and evaluate the following data, on a continuous basis to ensure that the post-trenching operation is proceeding safely and satisfactorily.

- Current velocity and direction at/ or near the location of the trencher (applicable only for neutrally buoyant trenchers)

- Towing force on trenching device (if applicable)

- Load levels on pipeline during trenching and installation (recovery of trenching device (if applicable).

- Pressure and volume of water and air supply to trenching device (if applicable)

.- Loads on mechanical excavator (if applicable).

6.7.15 The contractor shall provide qualified engineering personnel on the post-trenching barge to interpret the results of measurements and calculations and to advise operating crew for safe and satisfactory post-trenching work.

6.7.16. Upon completion of the trenching operation a final hydrographic survey at locations shall be performed in the presence of Company Representative, to obtain the following information

- Pipeline route.

- Pipeline location in trench

-Pipeline burial depth.

-Extent of pipeline crossings and untrenched sections at the crossings, risers and laterals location.

The survey vessel used for the pre-trenching operations shall be used for carrying out post-trenching survey as well. Additionally, under water television inspection shall be made and recorded on video tapes

(VHS PAL) with spoken commentary during all the stages of the post-trenching operations and submitted to the Company. Alternatively, sector scan or other means shall also be used for inspection underwater and records submitted to the Company.

6.8. **Trenching with combination of pre-trenching and post trenching**.

6.8.1. Where trenching is proposed to be carried out with combination of pre and post trenching the requirements of clause 6.6 for pre trenching and 6.7 for post trenching shall be complied during the works.

6.8.2. In case post-trenching is proposed to be carried out in a pre-trenched installation, the Contractor shall ensure that the width of the trench is adequate for the proposed

post-trenching equipments. Any increase in width of' the trench will be to Contractor's account.

6.8.3 Prior to Start of post-trenching operations, Contractor shall carry out survey of the installed pipeline in the trench to ascertain the position of the pipeline within the trench, and establish to the satisfaction of the Company Representative that the post-trenching machine can operate without any problems within the trench. In case any rectification measures required, the same shall be carried out by the Contractor prior to start of the works.

6.9 TRENCHING IN AREAS ABOVE MEAN HIGHWATER SPRING (MHWS)

6.9.1. Contractor shall excavate the pipeline trench on the beach beyond MHWS, by adopting the procedures approved by Company, taking into account the permissible curvature of the pipeline. Any grading and clearing required shall be carried out.

6.9.2. Trench shall be cut to a grade that will provide a firm uniform and Continuous support for the pipe.

6.9.3. In case of rock or hard Soil areas, trenching may be done by blasting method, with the prior approval of the Company. Procedure for blasting shall be in compliance with the requirements of clause 6.6.8 of this specification. At the time of blasting, the area shall be suitably cordoned off to pre cut entry of any unauthorized persons. Adequate safety measures shall be taken by the Contractor and necessary warning signs and flags shall be installed.

6.9.4 The trench shall be excavated to a minimum width so as to provide on both sides of the installed pipeline, a clearance as indicated in the job standards drawings as to a depth sufficient to provide the minimum cover of atleast 1.0 metre. Minimum depth of cover shall be measured from the top of the pipe concrete weight coating

to the top of' the undisturbed surface of the soil or top of the graded working strip. Fill material shall not be considered to add to the depth of the cover.

6.9.5 In rock, coral and other hard unevenly trenched areas, sand padding shall be provided. Company will decide the extent of trench padding that will be required. The thickness of the compacted padding shall not he less than 200mm in those areas that are to be padded. The trench shall be at least 200 mm deeper than otherwise required, and evenly and sufficiently padded to keep the pipe when in place at least 200mm above bottom excavated trench.

6.9.6 In case padding is provided in the sloping trench, Contractor shall provide barriers or other protection to prevent the padding material from being washed away. Methods of protection shall have a prior approval of the Company. Barriers or protection shall not come in way of pulling operations.

6.9.7 Contractor shall keep the trench in food condition until the pipe is laid, and no claim is to be made to the Company by reason of its caving either before or after pipe is laid. All sheet piling, jacks or other materials that may be necessary to shore the trench in order to prevent caving are to be furnished and dismantled by the Contractor.

6 9.8 Contractor shall dewater if necessary, using well point system or other suitable systems, shore or do what else might be required to excavate the trench in accordance with these specifications at no extra cost to company.

7.0 BACKFILLING OPERATION

7.1 Where backfilling is specified as a requirement, the backfilling shall be carried out after pipeline installation and span correction and normally before hydro testing, with approved backfill materials. Back filling if required shall be done only after obtaining Company approval. Extent of backfilling shall be as per the Company approved drawings.

7 2 Contractor shall follow the Company approved back filling procedures as mentioned in Clause 4.3 of this specification .The Contractor shall ensure that the pipeline is not damaged or moved and that no vertical and or lateral loads are exerted on the installed pipeline. Backfilling by uncontrolled dropping from the sea surface is not permitted.

7.3 Sand bedding layer, provided for hard sea bed material areas shall be installed with great care to the required / specified thickness so that no projections of the underlying hard sea bed material protrude through the sand layer before pipeline installation.

7.4 The Contractor shall place an adequate quantity of backfill material to cater for losses

during installation and future settlement of the backfill.

7.5 The backfill material shall contain no extraneous material and /or hard lumps of soil which could damage the pipe and or leave void in the backfilled trench. No stones or coral greater than 50 mm cube shall be permitted for backfilling around the pipe. Rock or coral of size. > 25 cm cube may be used as backfill material in the top 50 cm in areas of rock. Coral or hard soil.

7.6. The Contractor shall monitor and inspect by means of' hydrographic surveys and diving inspection the placement of various layers of the backfill material to the desired thickness, levels, profiles and slopes as per the approved drawing, during various stages of the work.

7.7 Upon completion of the backfilling, Contractor shall carry out the hydrographic survey in the presence of the Company Representative to establish the extent of backfilling as per the approved drawings has been achieved. Details of the survey shall be submitted to Company for approval. In case of any corrective measures at

locations, Contractor shall carry out the necessary filling as required and carry out additional survey to establish the same.

7.8 In case any rock dumping is specified, Contractor shall carry out the dumping operations strictly as per the arrangement and size of rocks shown in the Company approved drawings over the specified areas prior to carrying out such rock dumping operations, Contractor shall submit to Company for approval, a procedure detailing out the method old dumping and source, gradation and size of the along with equipments etc. used in the operations. Such operations shall start only after approval of Company.

7.9 Backfilling in areas above Mean Water Spring

7 9.1 Contractor shall carry out the backfilling in the beach areas above MHWS by adopting the procedures approved by the Company.

7.9.2 Backfilling shall not be done until the pipe and appurtenances have the proper fit and the pipe is following thee ditch profile at the required depth that will provide the required cover. Backfilling shall be done only after obtaining company approval. If any backfilling is done without company's approval, Company will have the right to require removal of the backfill for examination and the cost of such uncovering and refilling shall be borne by the Contractor.

7.9.3 Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the Company, so as to provide a natural anchorage for the pipeline. If immediate backfilling is not possible, a covering of at least 200 mm of earth, free of rock and hard lumps shall be placed over and around the pipe.

7.9.4 The backfill material shall contain no extraneous material and or hard lumps of soil which could damage the pipe and or its coating or leave void in the backfilled trench

.After the initial backfill has been placed into the trench to a level slightly above the surrounding ground Contractor shall compact the backfill material.

7.9.5. The surplus material shall be neatly crowned directly over the trench and the adjacent excavated areas on both sides of the trench, to such a height which will provide adequately for future settlement of the trench backfill during the maintenance period and thereafter.

7.9.6 Rock, lumps of hard soil or like materials shall not be backfilled directly onto the pipe unless padding is provided. Where rock, lumps of hard soil or like material are encountered at the time of' trench excavation, sufficient earth, sand or select backfilling materials shall be placed around and over the pipe to form a protective cushion extending at least to a height of 200 mm above the top of the pipe. Select backfill materials for padding that are acceptable to Company shall bee soil sand clay or other materials containing no gravel, rock or lumps of hard soil.

7.9.7 Backfilling shall he carried out at the high ambient temperature.

8.0 REPAIRS

8.1 Contractor shall exercise care in handling the pipelines, Anodes and take precautionary measures to prevent damage to the same .However, if the damage should occur, the decision to repair or replace the damaged portion shall be at the sole discretion of the Company.

8.2 The repairs shall be done in accordance with the procedures prepared by the Contractor and approved by the company. Repairs to the pipelines/anodes and/or its coatings being installed or existing facilities shall be handled by the Contractor at his own cost Complete hydrostatic testing of the repaired pipelines, risers, and /or tie-in may be required by the Company at its sole discretion.

8.3 The Contractor shall keep the Company fully informed through all stages of the repair or replacement work.

8.4 If at any time the instrumentation or video pictures or sector scan, etc. indicate that damage to the pipeline may have occurred, the Contractor shall interrupt the operations and perform a diver or ROV video surrey of the suspect area. The cause of any damage shall be investigated and rectified prior to restarting the operations.

8.5 In case of anode damage, the Contractor shall check the electrical continuity of the anode with the pipelines using a Company approved method. Should two or more anodes in sequence be rendered non-functional by the contractors operation, then the Contractor shall fit new anodes to Company approved method.

9.0 CLEAN-UP

The Contractor shall, remove all debris and obstructions exposed by construction operations and restore the construction rights-of-way and all sites used for construction activities as per the requirements of the Company or the responsible Marine Authority.

The Contractor shall restore the original shoreline contours and conditions to the satisfaction of the Company and relevant government agencies having jurisdiction over the areas.

10.0 AS-BUILT DATA

The Contractor shall submit to the Company all as-built data of the completed trenching, backfilling and other operations including all data gathered during the operations specified herein, the format with details previously agreed with the Company. The As-built data shall be submitted within four weeks of the completion of the entire job.

11.0 DOCUMENTATION

At the time of bidding, the following documents shall he submitted by the Contractor.

a. Complete details of the proposed marine trenching and backfilling (if applicable) spreads viz. dredgers, barges, survey vessels and other trenching equipment etc including the following information:

- Principal dimensions
- Mooring system
- Accommodation and services on board
- Survey equipments availability
- Details of floating lines, disposal hose
- Pipes along with the method of anchoring.
- - Monitoring instruments details

b. Plan, procedure/brief methodology and schedule for the trenching back filling and other operations including details of the locations with limits where these operations are to be performed with respect to the pipeline.

c. Rate of trenching and backfilling the proposed spread is capable of and the number of passes envisaged to achieve the required burial depth.

d. Previous reference list of the projects wherein the proposed trenching and backfilling spreads have been deployed alongwith the details viz. project name, diameter, water depth, average and maximum rate of trenching and backfilling achieved, depth of burial, type of soil excavated and the backfill material to provide evidence that the selected trenching and backfilling spread is suitable for all soil conditions encountered along the pipeline route

11.2 Contractor shall repair and submit for Company approval, eight week prior to commencement of trenching and backfilling operations, at least six copies of trenching and backfilling achieved procedure manual in compliance with the requirements of clause 4.3 of this specification, including drawings and relevant calculations.

11.3 Progressively with the status of work, Contractor shall submit the following documents, in sequence, for Company approval. Finally after completion of trenching and backfilling operations, the final approved documents shall be submitted for Company's record.

11.4 a Pre-trenching survey report.

b Post-trench survey Report presenting all data recorded during the survey operations, including the interpretations

c. As-built pipeline profile along with the pipeline cover available through out the pipeline route.

d. Data/recordings collected through the Instrument monitors and recorders during the post-trenching.

e. Post backfill survey report presenting all data collected recorded during survey operations, including the diver inspections.

12.0 DAILY REPORTS

Daily progress reports on trenching /backfilling operations shall be given to the Company Representative onboard and communicated to the Company's office onshore on a daily basis. This shall include as a minimum the following:

- Date and location.
- Log of activities.
- Type of soil being trenched.

- Length of pre/ post trenching or backfilling (if applicable) achieved in the last 24 h and cumulative length of pre/post trenching or back filling (if applicable) along with the change

- Any equipment failure and summary of any repairs made to the equipment.

- Volume of soil excavated back filled in the last 24 h.

- Outline of any other problems encountered.