



PART-IV

SECTION-4A

SUBMARINE PIPELINES AND RISERS

(RIGID PIPELINE)

R.P. PUROHIT CE(C&M)		ROHIT PANT DGM(M)		SANJAY NARAIN DGM(C&M)	
R.K. GUPTA Dy.G.M.(C&M)	N.V.PAI Dy.G.M.(C&M)		B.P.MALIK Dy.G.M.(C&M)		K.P.VARGHESE Dy.G.M.(C&M)
PREPARED BY					
A.K.MISHRA Dy.G.M. (C&M)		D.R.KAMBLE GM (C&M)			
REVIEWED BY		APPROVED BY			
25	01.08.2016		5		
TOTAL NO. OF PAGES	DATE		REV.NO.		



SECTION-4A

SUBMARINE PIPELINES & RISERS (RIGID PIPELINE SYSTEM)

CONTENTS

- 4.1 GENERAL
- 4.2 SCOPE
- 4.3 DESIGN CRITERIA
- 4.4 DESIGN REVIEW
- 4.5 PIPELINE INSTALLATION
- 4.6 TIE-IN OPERATIONS
- 4.7 TESTING OF PIPELINE SYSTEM
- 4.8 POST-TEST PROCEDURE
- 4.9 POST- CONSTRUCTION SURVEY
- 4.10 CLEAN-UP
- 4.11 AS-BUILT PIPELINE SYSTEM REPORT



TABLES & APPENDICES
(PLACED AT ANNEXURE TO SECTION 4A)

TABLE 4.1A -	ENVIRONMENTAL PARAMETERS
TABLE 4.2A -	SUBMARINE PIPELINE DESIGNATION
APPENDIX A -	LIST OF DRAWINGS
APPENDIX B -	LIST OF SPECIFICATIONS
APPENDIX C -	JACKET DEFLECTIONS
APPENDIX D -	WAVE EXCEEDANCE TABLE
APPENDIX E -	PROJECT SPECIFIC REQUIREMENTS



4.1 GENERAL

- 4.1.1 Oil and Natural Gas Corporation Ltd. (ONGC) is planning for installation of a number of submarine pipelines.

Details/data of pipeline and riser system to be installed and platforms to be connected by these pipelines are given in field layout, Table 4.2 A (placed at Annexure to Section 4A) & other drawings including specifications.

This section includes the minimum requirements for the survey, design, engineering, material procurement, fabrication, transportation, installation, hook-up and testing/pre-commissioning of the submarine pipeline & risers covered within this Bid Package.

The final design of the pipeline & riser system shall be the sole responsibility of the CONTRACTOR. The CONTRACTOR shall ensure that the final design of the pipeline system complies fully with the design criteria and operating philosophy as presented in this Bid Package.

The CONTRACTOR shall also be responsible for the supply of material, fabrication, transportation, installation, hook-up, testing/pre-commissioning and making the entire pipeline system as described herein operational to the extent that they fulfill the intent of the system.

Company shall accept either of or a combination of S-lay or Reel-lay methods for laying of pipelines on overall cost economics.

- 4.1.2 As used in this specification, the following definitions shall apply:

COMPANY : Oil and Natural Gas Corporation Ltd

CONTRACTOR : Turnkey Contractor for the Project

- 4.1.3 CONTRACTOR shall obtain COMPANY's written approval for any deviations from the requirement of the bid specifications. This document is not intended to be all-inclusive and the use of the guidelines set forth does not relieve the CONTRACTOR of his responsibility in performing the work for its intended service.

Design/installation requirements shall be in accordance with Table 4.1A and 4.2A, drawings and specifications listed at Appendix A & B (placed at Annexure to Section 4A).



4.2 SCOPE

4.2.1 Requirements

This section includes the minimum indicative requirements for the design, detailed engineering, material supply, inspection, coating & wrapping, expediting & transportation to site, fabrication, installation as per approved drawings/procedures and testing/pre-commissioning of the submarine pipeline & riser system covered within this bid package.

4.2.2 Scope of Work

The scope of work to be performed by the CONTRACTOR shall be but not limited to the following:-

a) Pre-engineering and pre-construction surveys:

Carrying out seabed survey along the proposed routes, collection/ interpretation of survey results/data, selection and recommendation of final route (keeping the pipeline length and crossings as minimum and clearance with respect to jacket legs of existing well platforms as shown in relevant drawing) after finalizing departure and approach angles of pipelines at various platforms based on the survey carried out within the corridor or within additional corridor / area duly surveyed / investigated by CONTRACTOR and approved by the COMPANY. Pre-installation survey shall be carried out to ensure the installation in the designated slot/route with control during installation supervision.

The scope of work shall also include survey and inspection of jacket face to check the dimensions of existing members and to check the adequacy of space available for installation of risers and clamps. Interference or obstruction, if any, shall be identified by the CONTRACTOR.

The survey shall be carried out as per Spec. 2011.

b) Finalization of design data/basis for COMPANY's approval for carrying out design, detailed engineering, procurement, preparation of construction drawings and documents, installation and testing of pipelines/risers and other associated works. Finalization of design basis shall be done in accordance with Table 4.1A, & 4.2A (placed at Annexure to Section 4A) and design criteria, codes, standards and specifications contained in the bid package.

c) Design, detailed engineering of all submarine pipeline and riser system, including clamps, CP system, fittings, all tie-ins, pipeline crossings and free span corrections and anchoring etc., all complete in



accordance with approved design basis and requirements of this bid package. CONTRACTOR's scope shall also include furnishing of design reports, calculations and drawings etc. as per the requirement of bid package.

- d) Preparation of material requisition, purchase and supply, expediting, inspection, fabrication, testing and transportation of all materials to intermediate storage/plant locations and job site(s) including sea fastening , for successful execution of works at site.
- e) Supply and application of external corrosion protection coating as per Spec. no.2012A.
- f) Supply and application of internal corrosion protection coating for Water Injection Pipelines for 200mmm ND and above sizes. Bidder to submit the specifications for the same including the procedure for internal coating of field girth joint for Company's review and approval.
- g) Supply and application of concrete weight coating as per Spec. no. 2013 Rev.1 for S-Lay method only. In case of Reel Lay Method, only corrosion coating shall be provided and no concrete coating is required. For Reel Lay Method, additional wall thickness, if required, shall be worked out and provided for on-bottom stability and reeling/unreeling requirements of the pipeline in addition to the requirement covered for S-Lay Method given in table 4.2 A (placed at Annexure to Section 4A).
- h) Design, engineering, supply, installation and testing of sacrificial anode type cathodic protection system for all pipelines and risers. The cathodic protection system shall be as per scope of work, design criteria and specification No. FS 4002 enclosed in the bid package.
- i) Removal and cleaning of marine growth/fouling from jacket braces/members to facilitate installation and proper fit up of new riser clamps/brace clamps of additional member.
- j) Riser clamps and new structural members wherever required shall be designed, supplied, fabricated and installed by the CONTRACTOR. Riser clamps, wherever existing in the same location where the new riser clamps are to be installed, shall be replaced by new clamps by the CONTRACTOR after cutting existing clamps. Procedure for the same shall be approved by the COMPANY.

The location of risers shall be finalized during survey/detailed engineering.



All works incidental to installation of risers such as design and provision of additional/new members/braces wherever necessitated by detailed engineering, removal of interfering structures/members, boat landing, riser protector, barge bumper, anodes etc., and modifications thereof, if any, and reinstallation of the same as per original design conditions shall form part of CONTRACTOR's scope of work and cost of such works shall be deemed to be included in the price quoted by the CONTRACTOR. The removal/re-installation procedures of riser protector, boat landing, jacket anodes etc. to facilitate installation of risers shall be approved by the COMPANY.

- k) Providing & installing Monel sheathing on splash zone part of the riser as per Spec no.2015 Rev.1.
- l) Finalization and submission of installation procedures including analysis/calculations for safe installation of pipeline & risers, for Company's approval, as per the bid package requirement. Installation of all pipelines & risers as per Company's approved procedure including rectification of all unsupported spans to design permissible limit, pipeline crossings etc.

Both S-lay and Reel-lay methods are kept as alternative pipeline laying methods. Bidders are allowed to propose any of or a combination of the two methods. Company shall accept the above based on economic considerations.

- m) Testing of pipelines for possible buckling during installation by passing a 'gauging pig' through the entire pipeline and riser system. This must be done for each pipeline segment as per the requirement of the bid package in addition to the use of buckle detector during pipe laying.
- n) Cleaning and hydrostatic pressure testing of all installed submarine pipeline and riser system in accordance with the specification enclosed with the bid package.
- n) All pipelines including associated risers after hydrostatic testing, shall be left with treated seawater and hooked-up with the existing deck piping. Contractor shall supply minimum 4 Nos. of Dewatering/poly pigs of appropriate sizes for each segment, after hydrostatic testing. Commissioning shall be done by the Company for which necessary assistance required shall be provided by the Contractor.



- o) Carrying out post installation survey including C.P survey, all clean-up operations and preparation of as built drawings and documents as per bid package requirement.
- p) Each valve of 200 mm NB and above on pipeline laterals shall be provided with a hydraulic actuator. Further, for valves up to 150mm NB, valve vendor shall provide the valve operating torque values corresponding to valve pressure rating. In case, maximum hand wheel force required to operate the valve is within 35kgf, valve shall be operated manually. Further, in case for valves up to 150mm NB, maximum hand wheel force exceeds 35kgf, valve shall be provided with hydraulic actuator.
- q) All valves provided on idle laterals shall be kept in closed condition after completion of pigging and hydrotesting of pipeline with laterals.

4.2.3 CONTRACTOR's Responsibility

- a) Entire work(s) defined above shall be carried out by CONTRACTOR in accordance with the specifications, drawings and other requirements of the bid package, and instructions/directions of the COMPANY. Quality control shall be carried out as per the governing code(s) and Company's specification.
- b) Review and approval of CONTRACTOR's entire work(s) by COMPANY shall in no way relieve the CONTRACTOR of his sole responsibility for safe and efficient design, engineering, supply, installation and subsequent operation of all the pipeline(s)/riser(s) by COMPANY in accordance with applicable codes and standards for intended use of the pipeline(s) system.
- c) The CONTRACTOR is deemed to have recognized any restrictive features of the site(s) and/or specific requirements of the work and made due allowances for it in the work to be performed by him.
- d) The CONTRACTOR is cautioned to exercise extreme care and take necessary precautions to prevent damage to the existing offshore pipeline(s), riser(s), electrical and other cables, marine structures and/or jackets during execution of the entire works. It is CONTRACTOR's sole responsibility to obtain sufficient information on these existing facilities for safe and sound execution of the work. Entire cost of repair or replacement of these facilities damaged due to CONTRACTOR's negligence shall be to CONTRACTOR's account including any production loss to the owner/COMPANY thereof. COMPANY shall be the sole judge for deciding the same.



4.2.4 COMPANY's Responsibilities

COMPANY has provided available information on the existing pipelines and other facilities. It is the CONTRACTOR's responsibility to obtain relevant additional information on these existing facilities to allow safe and sound design and installation of the new pipelines and risers.

4.3 DESIGN CRITERIA

4.3.1 Design Parameters

The design of pipelines, risers, tie-ins, pipeline crossings and free span corrections shall follow the guidelines of Det Norske Veritas Rules for submarine pipeline system 1981 (DNV). The design and loading conditions and design criteria shall be as defined in Section 3 & 4 of the above rules. Constants and coefficients to be used for the design calculations can also be taken from these rules except as specified below:

- i) Maximum allowable steel stresses during installation. : 85% SMYS
loading condition "b" (SMYS-Specified Minimum Yield Strength).

During Hydrotest: : 90% SMYS

- ii) Zone-1
Maximum allowable steel stress during operation

Pipeline, load condition 'a' : 72% SMYS

Pipeline, load condition 'b' : 85% SMYS

- iii) Zone-2 (upto a distance of 12.2M from bottom end of the riser bend)

Load Condition 'a' : 50% SMYS

Load Condition 'b' : 67% SMYS

Von Mises Stress Hypothesis shall be used for determination of combined stresses in the riser/pipeline

- iv) Environmental Parameters



Table 4.1A (placed at Annexure to Section 4A) represents minimum environmental requirements.

- v) Pipeline sizes, design temperature/pressure etc. are presented in Table 4.2A (placed at Annexure to Section 4A).
- vi) The geo-technical data shall be collected by CONTRACTOR during surveys as per Spec. 2011 Rev.2. The soil data collected should be enough to determine strength and index properties required for engineering, areas prone to scour & instability.
- vii) Internal/External corrosion allowance as indicated in Table 4.2A (placed at Annexure to Section 4A) shall be used in pipeline & riser design.

4.3.2 Codes and Standards

The design, fabrication and installation of all pipe-lines and risers shall meet the requirements of Det Norske Veritas, "Rules for Submarine Pipeline System" 1981 (DNV). Additionally, latest edition of the following codes and standards shall be followed wherever applicable:

- | | |
|---------------|---|
| ANSI B31.4 | - Liquid Petroleum Transportation Piping Systems. |
| IP Part 6 | - Institute of Petroleum, Model code of safe Practice. |
| ANSI B31.8 | - Gas Transmission and Distribution Piping Systems. |
| API Std.1104 | - Standard for Welding Pipelines and Related Facilities. |
| API RP 1110 | - Recommended Practice for the Pressure Testing of Liquid Petroleum Lines. |
| API RP 1111 | - Recommended practice for design construction, operation and maintenance of offshore hydrocarbon pipeline. |
| United States | - Minimum Federal Safety Standards for Gas Lines.
Part 191,192
- Minimum Federal Safety Standards for Liquid Pipelines.
Part 195 |



- SIS 05-5900 - Swedish Standards Institution for Surface Preparation.
- DNV RPB-401 - Cathodic Protection System
- NACE Std. RP-06-75 - Recommended Practices : Control of Corrosion on Offshore Steel Pipelines.
- API RP 5L1 - Recommended practice for Rail – Road Transportation of Line pipe.
- API RP 2A - Recommended practice for planning, designing, construction of fixed offshore platforms.
- API RP 5L5 - Recommended practice for marine transportation of line pipe.
- DNV OS-F101 - Submarine pipeline systems.

ASTM Standards where applicable and all relevant specifications contained in the Bid Package.

Where conflicting statements exist between the different codes and standards, the most stringent regulations shall apply unless directed or agreed otherwise by the COMPANY.

4.3.3. Pipe diameters as indicated in Table 4.2A (placed at Annexure to Section 4A) are already decided and shall not be revised by the CONTRACTOR. The grade of pipe, wall thickness, thickness of corrosion protection coating & weight coating as given in Table 4.2A are the minimum requirement to be provided by the CONTRACTOR for S-Lay method only.

4.3.4 All calculation methods which bidder proposes to use in detail design, the installation procedures, testing procedure and marine equipment etc. proposed to be used shall be in sufficient details to allow the COMPANY to verify the design basis and technical suitability of bidder's proposal. If computer output is proposed, bidder shall furnish a brief description of the analytical methods employed in the programme and identify the basis and theory used. CONTRACTOR shall also perform detailed flexibility analysis for pipeline including checking spans for vortex shedding criteria.



4.3.5 PIPELINE DESIGN METHODS

4.3.5.1 Pipeline and related facilities shall be designed as per the requirements stated herein and complying with the requirements indicated in Table 4.1A & 4.2A (Annexure to Section 4A), drawings (enclosed elsewhere in the bid document) and specifications listed in Appendix A & B (placed at Annexure to Section 4A). The Contractor shall design the entire pipeline system in such way to ensure the piggability of pipelines from pig barrel to pig barrel.

4.3.5.2 Wall Thickness Design

Wall Thickness Analysis shall be carried out for installation, testing & operating conditions for selection of pipeline wall thickness. The pipeline wall thickness shall be checked for pressure containment (hoop stress) and against collapse due to external over-pressure.

In addition, local buckling (due to external over-pressure and combined effect of axial tension and bending), propagation buckling due to external over-pressure bar buckling and upheaval buckling shall be analyzed. Allowable out-of-roundness of the pipe to be used for the analysis, where applicable shall be 2%. The selected wall thickness shall comply the equivalent stress criteria considering thermal & curvature stresses etc. For thickness verification under operating condition, corroded thickness shall be used.

4.3.5.3 Stability Analysis

The stability requirements shall be evaluated by lateral and vertical stability analysis of the pipeline during installation, testing and operation. The lateral stability analysis shall include all environmental forces such as drag, inertia and lift as well as frictional resistance. The vertical stability analysis shall include pipe buoyancy, an assessment of soil liquefaction potential, trenching depth and backfill material requirements. The following design cases shall be considered:

- Pipe resting on the seabed
- Pipe in a Trench (if applicable)
- Pipe resting on seabed and stabilized by other means such as placing additional restraints e.g. grout bags etc.
- Pipe crossing with pipe resting on supports.

Unless otherwise specified by the COMPANY, the stability requirements shall primarily be met by increasing the submerged weight of the pipe. The required submerged weight shall as far as practicable be achieved by applying concrete weight coating to the pipe in case of conventional lay method or by providing additional wall thickness to the pipe in case of Reel Lay method.



The required submerged weight of the pipe for the stability analysis shall be determined for the following design conditions:

- Pipe empty during installation
- Pipe filled with product during operation.

On-bottom stability analysis shall be carried out considering the passive resistance of soil due to settlement of pipeline using Veritec RP E305/DNV RP F109/AGA level 2 such that the pipeline will not move from as installed position, apart from movements corresponding to permissible deformation, thermal expansion and limited amount of settlement after installation in line with the requirement of DNV 1981.

4.3.5.4 Expansion & Stress Analysis and Unsupported Span

Expansion analysis of pipeline shall be carried out in accordance with Design and Operating conditions, Temperature decay along the pipeline shall be calculated based on process design parameters.

The criteria for pipe stress analysis shall be to maintain all stresses during installation, testing and operation within the allowable limits set by Section 4.3.1 of this specification.

Operational stress limits specified for risers shall also be applied to Zone-II pipe upto a distance of 12.2 meter from the end of the riser bottom bend. The riser is defined as the portion extending from top of transition bend to the end of Zone-II pipe / end of expansion spool/ Tie-in spool (if any).

To keep pipeline stresses within the allowable limits, the unsupported spans shall not exceed certain maximum values. The static allowable spans shall be calculated for the following three pipeline conditions:

- Pipe empty after installation
- Pipe flooded during hydrostatic testing
- Pipe filled with product during operation.

In addition, the pipeline shall be designed to avoid excessive vibrations due to vortex shedding by limiting span lengths so that resonance does not occur. If this is not feasible, safety against fatigue failure shall be analyzed.

For each of the three pipeline conditions mentioned above, the shortest calculated span length shall be used as the maximum allowable span length.



In the event, the touch down length of proposed pipeline is less than one pipe length (12.2 mtrs.) between two consecutive free span corrections, then the entire configuration shall be treated as ONE free span correction.

4.3.5.5 Collapse and Buckling Analysis

Wall thickness shall be checked against collapse in addition to hoop stress.

Local buckling due to external over pressure, bending and propagation buckling due to external over-pressure shall also be analyzed. Allowable out-of-roundness of the pipe to be used for the analysis shall be 2 %.

4.3.5.6 Corrosion Protection

Pipeline external and internal corrosion protection shall be provided by corrosion protection coating. This external coating shall be as per the specification attached in Appendix B. Specification for internal coating (for Water Injection Pipelines) including coating of the field girth weld joint is to be submitted for Company's review and approval. The CONTRACTOR shall check the serviceability of such coating for the operating temperature and fluid characteristics of the pipeline.

4.3.5.7 Cathodic Protection

The cathodic protection of all pipelines shall be provided by Contractor in accordance with the attached specification No. FS 4002. As the Contractor is responsible for post-installation C.P. surveys and results of survey ensuring proper response of the system provided, Contractor shall inspect the installed anodes for appropriate mounting and electric connection.

4.3.5.8 Route and Profile

Utilizing the survey information, the CONTRACTOR shall finalize the pipeline alignment. The pipeline route shall be selected such that the pipeline follows a smooth seabed profile, and avoid, wherever possible, coral reefs, and soft or liquefied soils. Where it is not practical to avoid seabed irregularities, capable of causing significant stresses in the pipeline, stress levels shall be checked against the allowable stresses. In the event that the stress levels exceed the allowable limit, the pipeline profile shall be modified such that the stress levels are within the allowable limits. Unsupported pipeline spans shall not exceed the allowable limits calculated.

4.3.5.9 Offshore Pipeline Crossings

The crossings shall be designed, such that the existing or proposed pipeline shall not be over-stressed, either during installation, hydrotest or operation,



according to criteria mentioned in Section 4.3.1 and the resulting spans shall not exceed their allowable limits. The minimum clearance shall be subject to the COMPANY's approval and shall be based upon the predicted settlement of pipes and supports, size and type of supports and allowable span length.

The stability analysis of the pipeline and supports at the crossing shall be based on maximum wave heights/significant wave height at operating conditions.

On-bottom stability of the pipeline and supports including check for settlement of pipeline & supports based on soil bearing capacity, sliding and overturning of support.

The minimum factor of safety to be considered for support design shall be as follows :

- Factor of safety against settlement shall be considered as 2.0
- Factor of safety against sliding shall be considered as 1.5
- The eccentricity of the resultant force (against overturning) shall lie within middle third of the base of the support.

The newly installed pipeline should normally cross the existing line at an angle not less than 30 Degree. In case of any specific case involving restriction in maintenance of crossing angle as stipulated above, the same shall be reviewed by the COMPANY during detailed engineering review. CONTRACTOR shall design the supports for crossings considering the parameters given in Table 4.1A (placed at Annexure to Section 4A) and submit to the COMPANY for review and approval. Grout bag supports shall be provided to maintain physical separation of 350mm or more between the existing pipeline and the proposed pipeline for the life span of the proposed pipeline.

4.3.5.10 Pipelay analysis

The laying analysis shall be performed using the details of the proposed barge/laying method to confirm that pipelines can be laid with proposed barge and the design thickness without exceeding allowable stresses.

4.3.6 RISER DESIGN METHOD

The design of all pipeline & risers including the 12.2 meters horizontal length of Zone-II pipe shall be done in compliance with the code and standards specified in Section 4.3.2 and design parameters defined in Section 4.3.1.

4.3.6.1 Riser Location

The indicative location of risers for each submarine pipeline connecting the existing platforms are shown in the various drawings enclosed in the bid



package. These shall be finalized during pre-engineering survey / detailed engineering. For new platforms to be installed, the location of risers shall be finalized during detailed engineering. The risers shall be pre-installed within the confinement of the jacket at the new platforms. These risers shall have flanged connection at riser base.

4.3.6.2 Stress Control

The criteria for the riser stress analysis shall be to provide a safe and functional riser design. Stresses during installation, operation and testing shall not exceed the allowable limits as per Section 4.3.1. Expansion of pipelines and movement of jacket due to operational and environmental load shall be considered in the riser design.

For stress analysis of riser, the temperature decay along the pipeline shall be considered for thermal expansion of the pipeline based on process design parameters.

The Contractor shall endeavor to absorb in the riser any expansion/contraction in the pipeline or deflection of the platform caused by environmental and functional forces without the use of expansion loop by locating the first riser clamp as high as possible from the seabed or increasing the submerged weight of the pipe-line near the riser end, thus ensuring that the stresses in the riser are below the allowable limits and the loads transferred from the risers to the jacket are minimized. CONTRACTOR shall also perform a flexibility analysis.

4.3.6.3 Clamps and Location

Riser shall be supported by hanger flange and guided by non-frictional riser clamps attached to the platform. All new riser clamps shall be designed in accordance with the API RP 2A-WSD and provided as per approved Riser design reports.

The clamp spacing shall be such that the risers are safely supported and that calculated allowable spans are not exceeded. Number of clamps and their location shall be selected by the CONTRACTOR to prevent the riser from becoming over-stressed during design storm conditions while the pipeline remains in full operation. Spacing of riser clamps shall be based on risers withstanding storm conditions, temperature stresses and vortex shedding criteria given in Appendix-A to DNV rules for submarine pipeline system. Clamps shall be internally padded with 12mm thick neoprene bonded to the clamps steel surface by adhesion. However, contractor shall submit detailed procedure for company's approval. Where adjustable clamps are provided, electrical continuity for cathodic protection of clamps shall be provided between jacket and clamps. All bolting on the riser clamps shall utilize fully



tightened double nuts on each end of the struts. All nuts and bolts used for clamping the risers shall be XYLAN coated.

4.3.6.4 The internal and external corrosion allowance for the risers shall be considered in Design as per Table 4.2A (placed at Annexure to Section 4A).

4.3.6.5 **Coating of Risers and Bends**

- i) All risers, including bends, shall be coated and wrapped with the corrosion protective coating as described in the specification attached with the bid package, from the sea bed upto the splash zone.
- ii) All risers shall be coated with a concrete weight coating upto splash zone. The minimum thickness of concrete coating on risers shall be 30 mm. The field joint coating at the riser to pipeline connection and on risers shall follow the guidelines set for pipeline field joints.
- iii) Riser extending above the splash zone shall be painted in accordance with general specification 2005 "Protective Coating".
- iv) For splash zone (Portion extending from (-)2.0m w.r.t. Chart Datum upto (+) 5.5m or bottom of hanger flange "Monel Jacket" shall be applied. A 5mm thick monel sheet shall be welded to the riser pipe at top and bottom to form a tight jacket which should have facilities for future testing for tightness. At onshore yard, the monel jacket shall be checked for tightness by an air pressure test to 1.5 kg/cm². Installation tolerances and tolerances in surveyed water depth shall be considered for meeting the above requirements. Monel Sheathing shall meet the requirements of Clause 8.13 of Spec. No. 2015 Rev.1. All the welds shall be coated with epoxy/resin to prevent corrosion.

Specification and application procedure for splash zone protection shall be submitted by CONTRACTOR for approval by COMPANY.

4.3.6.6. **Riser Bend**

- i) Prefabricated shop pipe bends as described in the specification attached with the Bid package shall be used at the bottom and at the top of risers. Bends radius shall be at least 5 times the outside diameter of pipe and should be suitable for pigging with fault detection/intelligent pig.
- ii) Transition from one pipe wall thickness to another shall be by internal bevel not exceeding 1 to 4 taper.
- iii) Diagonal bracing shall be attached to the bottom riser bends by clamps during fabrication. These bracing shall be removed or a 600 mm



section cut out of the brace after riser installation is completed and clamps are tightened. The brace shall not be welded to the pipeline. The clamps shall be padded with 12 mm thick neoprene padding as per Clause 8.10 of specification No. 2015 Rev.1.

4.3.6.7 Cathodic Protection of Risers

Cathodic protection of risers shall be provided by Contractor to conform to enclosed Spec. No. FS 4002 and Electrical design criteria.
No insulating joints are envisaged on pipeline- riser system.

4.3.6.8 Hanger Flanges

All pipelines shall be provided with suitable hanger flanges for supporting the risers. The riser hanger flanges shall be designed, manufactured and installed by the CONTRACTOR as per relevant Codes and Standards. The material for hanger flanges shall meet the provisions of clause 5.7 of DNV, 1981 Rules for Submarine pipeline System.

CONTRACTOR shall perform detailed piping flexibility analysis for all risers and connected deck piping to determine the design loads.

The complete details, design, fabrication and installation of riser hanger flange shall be approved by the COMPANY.

4.3.7 In addition to the technical requirements and conditions stated herein above, specifications and drawings enclosed as Appendix - A & B shall be complied with for various works to be performed by the CONTRACTOR.

4.4 DESIGN REVIEW

4.4.1 Requirements

CONTRACTOR shall be required to present written substantiation of all proposed designs, installation, and testing procedures for approval by COMPANY. This shall be done thirty (30) days prior to the commencement of any phase of fabrication or installation. The work shall begin only after COMPANY approval has been obtained. The presentation may be in the form of one or more reports and shall contain the design calculations to substantiate CONTRACTOR's proposed materials and construction techniques. The report shall contain the design assumptions, design calculations, material specifications, and details of construction. Data included in the report shall be sufficient to show that all factors listed in section 4.3 have been considered. Calculations shall also be submitted for any other factor not listed in Section 4.3 but which are necessary to prove the validity of CONTRACTOR's design or proposed construction methods. CONTRACTOR shall furnish his document



schedule, indicating clearly sequencing of the documents. The following paragraphs cover the minimum requirements for the design document which includes:

- i) Reports
- ii) Drawings
- iii) Calculation Books.

The above mentioned items shall be a part of design documentation by the CONTRACTOR and shall be the property of the COMPANY.

4.4.1.1 **REPORTS**

The CONTRACTOR shall prepare the following reports as applicable:

- a) Pipeline Design Criteria Report
- b) Pipeline Design Report
- c) Riser Design Report
- d) Installation/Testing Method Report
- e) Specifications
- f) Cathodic Protection System design report.

a) **Pipeline Design Criteria Report**

Pipeline Design Criteria Report shall include the following items:

- Appraisal of Data (environmental, bathymetry, soils, etc.) submitted by the COMPANY and collected by CONTRACTOR after survey.
- Selection of the Pipeline Route and pipeline length.
- Pre-engineering, pre-construction and post-installation survey reports.

b) **The Pipeline Design Report shall include:**

- Pipeline wall thickness analysis
- Pipeline Lateral & Vertical Stability Analysis



- Pipeline Construction, Testing and Operating Stress Analysis.
- Pipe lay analysis
- Pipeline Buckle & Collapse Analysis
- Pipeline Unsupported Span Analysis
- Pipeline Crossing Stability and Stress Analysis
- Pipeline expansion analysis.
- Pipe Cathodic Protection Analysis
- Pipeline Fracture Analysis, if required

c) **The riser design reports shall include:**

- Riser Flexibility Analysis
- Riser Construction, Testing & Operating Stress Analysis.
- Clamp Loads
- Vortex shedding analysis
- Clamps and clamps spacing/allowable spans

d) **The Installation Methods Report shall include:**

- Offshore Pipeline Section
- Risers
- Hydrotest
- Spacing between existing & installed pipelines & method Contractor proposes to use ensure that related spacing is maintained.

e) **Specification for:**

i) Pipe

ii) Pipe Bends



- iii) Pipe Fittings & Flanges, if any
- iv) Riser Hanger Flange/Riser Clamps
- v) Knee Brace
- vi) Corrosion Protection Coating (internal & external)
- vii) Concrete weight coating
- viii) Field Joint Coating (internal & external)
- ix) Splash Zone Materials
- x) Pipeline Crossings
- xi) Tie-ins fittings
- xii) Cathodic Protection System
- xiii) Trenching and burial, if required

4.4.1.2 DRAWINGS

The CONTRACTOR shall prepare all the design drawings required to complete the design. The drawings shall include pipeline alignment drawings, schematics, lay-outs and isometrics, riser location and make up, riser clamps, tie-ins etc.

The drawings index shall be divided into the following major categories:

- Area Maps
- Pipeline Alignment Drawings
- Anode Installation drawings
- Pipeline Approach to and Departure from platforms
- Pipeline Crossings.
- Riser Elevation and Clamps spacing, riser makeup
- Clamps details



- Sketches and Illustrations.

A scale 1:5000 for the pipeline alignment sheets and a scale of 1:250 for the platform approach covering a distance of minimum 200 m shall be used unless otherwise specified by the COMPANY.

4.4.1.3 CALCULATION BOOKS

The calculation books shall include all calculations and computer analysis. The books shall have separate sections for pipelines and risers.

4.5 PIPELINE INSTALLATION

All works related to pipeline installation by S lay or Reel Lay method shall be performed in accordance with the specifications listed at Appendix B.

Rigid pipelines may be installed by “REEL LAY” method. In this method the pipes shall be welded together at the shore based yard. Also, corrosion coating has to be applied at the onshore yard. Next, welded pipes shall be spooled on to the pipe laying vessel’s reel (normally a D.P. vessel).

To initiate pipe lay, the end of pipe stalk shall be anchored, and the pipe-laying vessel then shall move along the pipeline route, unreeling pipes, as it shall advance.

Also, in this method, concrete weight coating cannot be applied, and hence on bottom stability may be achieved by increasing the wall thickness of the pipe, if required.

However, based on the brief methodology, mentioned above the Contractor shall furnish detailed methods/procedures at the time of bidding for Company’s evaluation.

For submarine pipeline to be laid by Reel Lay Method, pipe material & procedures, etc. shall comply to the requirements of Section 7H of DNV OS-F101 Offshore Standard for Submarine Pipeline Systems 2000 edition.

4.6 TIE-IN-OPERATIONS

4.6.1 Procedure

CONTRACTOR shall submit tie-in procedures for riser installation, connections to stub lines & laterals mechanical connections as applicable, to the COMPANY for approval.



4.6.2 The tie-in between pipeline and riser at the existing platforms shall be of welded connection, performed at the lay vessel and subsequently lowered. However, in case of new platforms the riser shall be pre-installed within the confinement of jacket. These risers shall have flanged connection (set of WN flange and Swivel flange) at riser base.

4.6.3 CONTRACTOR shall furnish the tie-in details to the COMPANY for approval. The following information shall be furnished as a minimum:

- i) Description and specification of components which will be introduced as permanent parts of the pipelines.
- ii) Calculation of stresses occurring during installation and operation.
- iii) Procedure specification covering all tie-in operations.
- iv) Description and specification of equipment and instruments to be used for the installation.
- v) Description and specification of methods of inspection and testing.

4.6.4 Other Tie-Ins

The tie-in between riser and deck piping shall be provided by welding.

4.7 HYDROSTATIC TESTING OF PIPELINE SYSTEM

Testing of pipeline & riser system shall be done as per the specification attached with bid package after completion of all installation works of pipelines, risers, crossing, operations and remedial works, if any. Before hydrostatic testing, the pipeline & riser shall be cleaned with a mechanical pig. Testing procedure and equipment shall be subject to Company's approval and shall include cleaning, gauging and hydrotesting of the pipeline & riser system. COMPANY's Representative must be present to witness all pipeline tests conducted by the CONTRACTOR. CONTRACTOR shall carry out hydrostatic test for a minimum continuous period of 24 hrs. after stabilization, all lines and risers to a test pressure of 1.25 times the design pressure given in Table 4.2A (placed at Annexure to Section 4A).

4.8 POST-TEST PROCEDURE

4.8.1 Following completion of the hydrostatic tests, all completed pipelines shall be left full of inhibited test water by CONTRACTOR, unless cleaning & purging is required by the COMPANY. CONTRACTOR will then make all above water tie-in-connections.



4.8.2 CONTRACTOR shall also remove all appurtenances that were installed to facilitate pigging & hydrotesting.

4.9 POST-CONSTRUCTION SURVEY

4.9.1 The CONTRACTOR shall carryout a survey of the installed pipeline system, with all necessary equipment, such as sub-bottom profiler, side scan sonar, echo sounder etc. for determining the extent of unsupported spans, damage etc.

4.9.2 Testing of Cathodic Protection System - Refer Section 3.5, Part-IV of the bid package.

4.9.3 Details of all subsea works, such as crossings, repair to pipeline system, supports to free spans. etc., shall also be Video recorded after carrying out the works and submitted to COMPANY for record.

4.10 CLEAN-UP

Any stakes, buoys, or temporary obstructions placed along the pipeline right of way in the water or on land, shall be removed by CONTRACTOR or COMPANY shall remove at CONTRACTOR's expense unless COMPANY specifically requests that they be left in place. Work spaces furnished to the CONTRACTOR by COMPANY shall be cleaned of all scrap and debris and restored to their original conditions.

CONTRACTOR shall remove all surplus materials from the work site and shall deliver such material belonging to COMPANY to the points designated by the COMPANY.

4.11 AS BUILT PIPELINE SYSTEM REPORT

4.11.1 On completion of hydrostatic testing, the CONTRACTOR shall prepare As built Drawings/Reports for all pipeline system. The COMPANY will specify the Coordinate system and scale to be used. Alignment details shall be obtained from plotted data taken during construction and post-construction surveys. All pertinent data such as pipeline appurtenances, fittings, crossings, unsupported spans, burial details, location of anodes, elevation of riser clamps, monel sheath, hanger flange etc. shall be accurately located on the "As Built Drawings".

4.11.2 The CONTRACTOR shall also prepare As Built Report which will include the following as a minimum:

- a) Pipeline installation record showing pipeline material, diameter, wall thickness, reference to pipe tally sheet numbers, length of such pipe, cumulative length, weld joint number, NDT results.



- b) Pipeline route/alignment maps at a scale of 1:5000 and Approaches to platform to a scale of 1:250 for 200 mtrs portion in vicinity of platform.
- c) Hydrostatic testing and pigging details.
- d) Riser Details showing riser makeup, pipe material, diameter, wall thickness, weld joint number, details of coating, riser bend diameter, wall thickness and radius, approach angle of pipe-line, locations/elevations of riser clamps, field joints, anodes, monel sheathing etc. exact placing, location and orientation of all risers installed shall be furnished on the "AS BUILT DRAWINGS".
- e) Location of Anodes, and post-installation potential measurement survey report.
- f) Spanning of pipelines, if any and remedial measures.
- g) Corrosion coating and concrete coating details for pipelines and risers.
- h) Details of field joints.
- i) Pipeline crossing details
- j) Pop-up Buoy details and locations.
- k) Other miscellaneous details, such as diary of events, list of video recordings, photo-graphic records etc.
- l) Table 4.2A (placed at Annexure to Section 4A) which shall be updated based on as build data and coordinates of originating/terminating platforms/stub end shall also be mentioned.

4.11.3 Six copies of the As Built Drawings and "As Built" Report and three copies of all photographic records and video recordings for each pipeline system shall be submitted to the COMPANY. Contractor shall also provide two copies on Compact Disc (CD) of all reports (in MS Office) and drawings in AUTOCAD 2000 or latest Version.