

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015												
			Rev. No.	1												
			Discipline:	PIPELINE												
			Page No.1 of 54													
<p><b>FUNCTIONAL SPECIFICATION</b></p> <p><b>FOR</b></p> <p><b>INSTALLATION OF SUBMARINE PIPELINE</b></p> <p><b>AND</b></p> <p><b>RELATED FACILITIES</b></p> <p><b>OIL AND NATURAL GAS CORPORATION LTD.</b></p> <p><b>INDIA</b></p>																
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FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:												
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003												


	OFFSHORE	FUNCTIONAL SPECIFICATION	SPEC. No.	2015
	DESIGN	FOR INSTALLATION OF	Rev. No.	1
	SECTION	SUBMARINE PIPELINES AND	Discipline:	PIPELINE
	RELATED FACILITIES	Page No.2 of 54		


## CONTENTS


SECTION	TITLE
1.0	SCOPE
2.0	REFERENCE CODES, STANDARDS AND SPECIFICATIONS
3.0	GENERAL
4.0	ENGINEERING REQUIREMENTS
5.0	CONSTRUCTION REQUIREMENTS
6.0	HANDLING, HAULING, STORAGE AND TRANSPORTATION
7.0	PIPELINE INSTALLATION
8.0	RISER INSTALLATION
9.0	PIPELINE CROSSINGS
10.0	PIPELINE FREE SPANS AND SUPPORTS
11.0	CATHODIC PROTECTION SURVEY
12.0	ON-LINE VALVES, LATERALS AND PLEM INSTALLATIONS
13.0	PIPING DESIGN AND FABRICATION REQUIREMENTS
14.0	CLEAN-UP, RESTORATION AND DISPOSAL OF SURPLUS MATERIALS
15.0	AS-BUILT DATA REQUIREMENTS
16.0	DOCUMENTATION
17.0	DAILY REPORTS
18.0	SUPPLY OF MATERIALS

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.3 of 54	
1.0 SCOPE				
1.1 This specification covers the minimum requirements for transportation, fabrication, installation and other associated works of submarine pipelines and riser systems transporting hydrocarbons in liquid/gaseous phase and injection water.				
1.2 This specification shall be read in conjunction with the requirements of all other 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 editions of the following Codes, Standards and specifications:				
a) DNV-1981 : Rules for Submarine Pipeline Systems				
b) ASME B 31.4 : Liquid Petroleum Transportation Piping Systems.				
c) ASME B 31.8 : Gas Transmission and Distribution Piping Systems.				
d) API 1104 : Standard for Welding Pipeline and Related Facilities				
e) API RP 1111 : Recommended Practice for Design Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines.				
f) API RP 5L1 : Recommended Practice for Rail-Road Transportation of Line Pipe				
g) API RP 515 : Recommended Practice for Marine Transportation of Line Pipe				
h) Part 195 : Code of Federal Regulations				
Title 49 : Minimum Federal Safety Standards for Gas Lines.				
FORMAT No. ODS/SOF/004B	Ref. PROCEDURE No. ODS/SOP/008 TO 015	ISSUE No. 01	REV. No. 01	REV. DATE: 15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.4 of 54	
<div>i) Part 192 : Code of Federal Regulations Title 49 : Minimum Federal Safety Standards for Gas Lines.</div> <div>j) IP Part 6 : Institute of Petroleum, Model Code of Safe Practice</div> <div>k) ASTM B-127 : Specification for Nickel Copper Alloy Plate, Sheet &amp; Strip</div> <div>l) ASTM D-2000 : Classification System for Rubber Products in Automotive Application.</div> <div>m) AWS 511E : American Welding Society Standard</div> <div>n) ASME Section IX : Boiler and Pressure Vessel Code</div> <div>o) BS 3072 : Specification for Nickel and Nickel Alloys</div> <div>p) SIS-055 900 : Swedish Standard – Pictorial Surface Preparation Standards for Painting Steel Surfaces.</div>				
<div>2.2 In case of conflict between the requirements of this specification and that of above referred codes, Standards and specification the requirement of this specification shall govern.</div>				
<div>3.0 GENERAL</div>				
<div>3.1 Contractor shall furnish and maintain all necessary barges, tugs, vessels, equipment, tools and tackles, materials, consumable, labour, inspection and monitoring services for the successful fabrication, installation and other associated operations of submarine pipeline system. All materials, equipment and vessels shall be subject to Company approval prior to their use.</div>				
<div>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. Prior to the commencement of work, the Contractor shall be</div>				
FORMAT No. ODS/SOF/004B	Ref. PROCEDURE No. ODS/SOP/008 TO 015	ISSUE No. 01	REV. No. 01	REV. DATE: 15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.5 of 54	
<p>deemed to be fully familiar with the site condition relating to sea bed, wind, waves, tides, currents, etc.</p> <p>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 pipeline installation and other, associated operations.</p> <p>3.4 Contractor shall consider the limiting weather, sea and current state in which the marine spreads can operate, whilst ensuring safety of the personnel, equipment, the Work and any other facilities in the working area and shall accordingly select equipment for the pipeline/riser installation and other associated operations to complete the Works within the schedule mentioned in the Contract.</p> <p>3.5 The Contractor shall acquaint himself and comply with all the applicable laws and statutory regulations of the Government Agencies having jurisdiction over the area of Work, while carrying out the pipeline/riser installation and other associated operations. All such laws and regulations enforced from time to time shall be binding upon the Contractor.</p> <p>3.6 Contractor shall take all necessary precautions to prevent damage to the existing facilities, during the installation and the associated operations .Contractor shall be responsible for any damage to the existing pipelines, its coatings and/or appurtenances, during the operations. The cost of repair of replacement of the existing facilities as a result of damage by Contractor’s operations shall be borne by the Contractor.</p> <p>3.7 Contractor shall provide full access to the Company Representative for monitoring of all Work areas during all phases of Work and shall also provide access to documentation related to the Work covered in the Contract.</p> <p>3.8 Contractor shall provide office, communication and accommodation facilities for specified number of Company personnel on-board the pipeline installation vessel, as well as personnel transport facilities as mentioned elsewhere in the Contract.</p> <p>3.9 In case any pipeline installation at shore approach is included in the work to be performed. Contractor shall provide round-the-clock transport facilities for the Company Representative between shore and the barge till the completion of the entire installation operation at the shore.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.6 of 54	

3.10

Contractor shall provide all diving services required to ascertain and confirm that the pipeline and appurtenances have been installed in accordance with the requirements of this specification.

3.11

Contractor shall carry out all works related to pipeline installation viz. trenching, back-filling, hydrostatic testing, etc. as applicable, as per relevant Company specification included in the Contract and the Company approved procedures.

4.0

ENGINEERING REQUIREMENTS

4.1

Procedures, drawings and calculations relevant to the pipeline/riser installation and other associated operations shall be prepared and submitted for Company approval, detailing all aspects of the installation operations.

4.2

Calculations

The Contractor shall calculate the stresses induced in the pipelines due to pipe laying, riser installation, Pipe Line end Manifold (PLEM) installation and other associated operations. The maximum allowable combined stress (calculated based on Von Mises Criteria) in the pipeline during installation shall be 85% of the specified minimum yield strength of the pipe material. The Contractor shall outline the method and basis of the calculations in the documents submitted for Company approval. In case any computer programs are proposed, Contractor shall furnish in his Bid, a brief description of the analytical methods employed in the program along with the basis and theory used. Failure to submit the required information may invalidate the Bid.

5.0

CONSTRUCTION REQUIREMENTS

5.1

Contractor shall investigate and select the lay barge positioning system taking into consideration:

-

Water depth

-

General installations and pipeline crossings

-

Sea bottom soil conditions


-


General environmental conditions

-

Laying tolerances

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.7 of 54	
<p>5.2 Contractor shall be responsible for laying the lines within 2 meters on either of the side of the pipeline route shown in the Company approved drawings for a distance of upto 1000 meters from the Platform/PLEM or other sub-sea installation. The tolerance for the rest of the area shall be <math>\pm 10</math> meters. However at shore approaches, the tolerance shall be <math>\pm 0.5</math> meters. Company reserves the right to seek realignment of the installed pipeline in case the above limits are not complied. Realignment if any shall be carried out by the Contractor to comply the above limits, at no extra cost to Company.</p> <p>5.3 At platform approaches where pipelines and pipeline appurtenances, etc., are existing, Contractor shall be responsible for laying the pipelines within the tolerances specified above without endangering the safety of the existing installations, taking into account the minimum possible barge clearances from the platform and constraints imposed by existing pipelines installations.</p> <p>5.4 Contractor shall continuously monitor sea-state and general meteorological conditions from the weather forecasting receiving facilities throughout the pipeline/riser installation and associated operations.</p> <p>5.5 Diver operations for crossing, unsupported spans, riser inspection and other underwater operations shall be monitored by close circuit television and underwater camera. Contractor shall make video tape recording of completed underwater work and permit Company Representative for TV viewing to enable monitoring of underwater works. Video tapes of such recording shall be submitted to the Company for record purposes. Recording shall be on VHS format tapes and shall be suitable for PAL Systems.</p> <p>5.6 Contractor shall carry out all works related to pipeline/riser installation and other associated operations, strictly in accordance with the requirements of this specification and the Company approved drawings and documents, without damaging the existing pipeline installations.</p> <p>5.7 Contractor shall not commence any work on installation of pipelines and associated facilities prior to the approval of the method/procedures by Company.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.8 of 54	

6.0

HANDLING, HAULING, STORAGE AND TRANSPORTATION

6.1

Contractor shall receive and take over against requisition all Company supplied materials from Company’s designated place(s) of delivery as defined in the Contact. The Contractor shall be totally responsible for all materials until the acceptances of the work by the Company.

6.2

In case Company supplied materials, Representatives of the Contractor and the Company shall jointly inspect all bare/coated pipes and other associated materials at the time of handing over. Contractor shall perform visual inspection and defects, if any noted, shall be recorded separately in the presence of Company Representative. The Contractor shall be entitled to extra compensation for repair and rectification of such defects in accordance with the procedures previously approved by the Company at the rates set forth in the Contract.

6.3

Damage to pipes which occur after the Contractor has taken delivery of Company supplied pipes such as dents, flats or damage to weld ends shall be cut of or removed and pipes rebevelled and repaired again as necessary the cost of this work, as well as that of the pipe lost in cutting and repair in excess of the wastage allowance shall be to the Contractor’s account. All such works shall be carried out after written approval of the Company Representative.


6.4


Contractor shall unload, load, stockpile and transport the bare and/or concrete coated pipes using suitable means and in a manner to avoid damages to pipe body and beveled ends and coating from designated place(s) of delivery to the work site(s). Contractor shall submit to Company for approval a detailed procedure/transportation scheme including necessary drawings of cargo barges for handling, hauling, storage and transportation prior to commencement of any handling operations. In general, pipes shall be transported in accordance with API RP 5L1 and API RP 5L5,


Contractor shall carry out a dynamic transportation analysis based on 1-year storm conditions mentioned elsewhere in the Contract, considering the proposed marine transportation scheme i.e. cargo barges and the securing arrangement and establish that the proposed transportation arrangement is safe and stable. The result of the such analysis shall be submitted to Company for approval, prior to undertaking the transportation of line pipe to the work site(s).

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003



	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.9 of 54	
6.5	Adequate strapping and padding shall be provided during handling. All pipe handling equipment shall be approved by Company prior to their use. All lifting equipment shall be of such a design so as to prevent damages to the line pipe or coating. Pipes shall not be allowed to bump against any other pipe or other objects. Rolling, skidding or dragging of pipes shall not be permitted. The pipe ends during handling and stacking shall be always protected with level protections.			
6.6	Coated line pipes shall be handled at all times with wide non-abrasive slings and belts or end hooks. End hooks shall have sufficient width and depth to fit the inside of the pipe and padded with soft material like rubber, Teflon or equivalent so as not to cause damages to bevel or pipe ends.			
6.7	Stacking of coated pipes shall be carried out in such a manner to prevent concrete coating from being damaged. Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes own weight does not cause damage to concrete coating. Contractor shall calculate based on the characteristics of the concrete used, the number of layers for stacking and submit the same to Company for approval.			
6.8	Truck, train and barge bolsters shall be at least 300 mm wide and well padded. When pipe is laid directly unto barge deck or the flat surfaces, these surfaces shall be clear of projecting bolt heads, uneven areas or loose hard substances such as rocks that could damage the pipe or coating. Suitable protections shall be provided in case of bold head projection.			
6.9	Stacks shall be suitably secured against falling and shall consist of pipe sections having the same diameter and wall thickness.			
6.10	If the Company Representative observes coating or pipe damage due to handling, Contractor shall review the handling procedure adopted and take corrective actions as required to the satisfaction of the Company Representative. Damaged pipes shall not be loaded until the repairs are done.			
6.11	Contractor shall be responsible for the load out, sea fastening and transportation to site of all materials necessary for installation and satisfactory completion of all pipeline installations.			
6.12	Contractor shall be solely responsible for scheduling the delivery, handling and hauling of appropriate materials to various intermediate and final locations as required by the activities enumerated in the Scope of Work			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.10 of 54	
forming part of the contract. Delays or lost time as a result of the Contractor's inability to schedule deliveries in time shall be to Contractor's account.				
7.0 PIPELINE INSTALLATION				
7.1 Survey Requirements				
7.1.1 Any information available with the Company regarding bathymetry, soil and other surveys carried out by other Agencies pertaining to the Work covered in the Contract are enclosed along with the Contract Document. Any additional survey required to carry out and complete the works in all respects shall be conducted by the Contractor at no extra cost to Company. All surveys shall comply the requirements stated in the relevant Company survey specifications included in the Contract, as and to the extent applicable.				
7.1.2 Pre-engineering survey				
Pre –engineering survey of the pipeline route/corridor, shore approach as well as the platform approach shall be carried out by the Contractor, in case the same is required to be performed by the Contractor as per the Contract.				
7.1.3 Pre-construction Survey				
Contractor shall carry out, in the laying season a pre-construction route survey to verify any omission and discrepancies relevant to the scope of work and to ascertain the changes if any from the pre-engineering to pre-installation period as well as collect data relevant to installation, if required. During pre-construction, the as laid position of any existing stub-ends and their extremities shall be identified and recorded.				
7.1.4 Post-construction Survey/As-built Survey				
Contractor shall carry out a survey of the installed pipeline system utilizing equipment viz. sub-bottom profiler, side scan sonar, echo-sounder, etc. to assess the extend of unsupported spans, damage to pipelines, depth of burial riser installation etc., and to collect the information for as-built documents. Details of all remedial works such as repair to pipeline system, rectification of pipeline alignment, supports to free spans, etc. shall also be recorded subsequent to the remedial works.				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.11 of 54	

7.2

**Barge Navigation/Offshore Positioning System**

For all works and activities related to the installation of pipelines/risers, the Contractor shall install a high resolution navigation system/radio positioning system with  $\pm$  23 meters accuracy, which shall be effective even during adverse visibility conditions and at night. Contractor shall have sufficient spare parts on-board to ensure a 24 hours a day positioning.

Contractor shall prepare and submit a survey positioning procedure including details of the barge navigation/positioning system with equipment and calibration procedures, station descriptions, etc. for Company review and approval.

7.3

**Anchor Handling Requirements**

7.3.1

Prior to start of the installation works, Contractor shall submit to Company for approval, an Anchor Handling Procedure including details of barge anchors, anchor lines, winches, anchor handling tugs and position control equipment; anchor tug positioning; anchor location, anchor dropping and testing for working tension; Anchor relocation procedure Precautionary and safety measures when installing anchors in the vicinity of the existing installations, anchor patterns proposed along the pipeline route, and near the platform location and/or other existing installations locations shall also be submitted for Company approval. In addition, Contractor shall also indicate the anchor cable configuration (catenary) for various water depths encountered along the pipeline route with the range of tension applicable for pipeline installation, to clearly establish that the minimum clearance requirements from the existing installations as mentioned in this specification are completed.

7.3.2

Anchors shall always be positioned at such a distance from the barge to ensure that, even with the maximum working tension, there shall never be any uplift force on the anchor.


7.3.3


Anchor position and time of relocation shall be regularly logged on-board the lay barge. Constant watch shall be kept on the anchors to detect any signs of slippage/dragging.

7.3.4

Radio positioning system shall be installed on-board the anchor handling tug to enable careful monitoring of the position of each anchor, before dropping, in respect of the actual position of the existing installations.

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.12 of 54	
7.3.5	In the event that an anchor/buoy is lost, the Company Representative on-board shall be immediately informed and the retrieval of the anchor/buoy shall then be arranged by the Contractor at the earliest and any delay on this account shall be to Contractor's account.			
7.3.6	<b>Anchoring near existing pipelines</b>			
7.3.6.1	While anchoring in the vicinity of the existing pipelines or installations, to safe-guard the installation from damage, special safety precautions shall be taken in respect of anchor handling and anchor positioning, which shall include as a minimum, the following;			
	<ul style="list-style-type: none"><li>- Anchor lines shall be laid such as to provide adequate clearance from existing structures</li><li>- No anchor shall be placed closer than 100 m from the existing pipeline/cable and the anchor location measured along the line of pull shall not be closer than 200 m to the pipeline/cable. Minimum distance of 50 m is acceptable to Company provided the anchor is not drawn towards the pipeline during tensioning of the anchor line.</li><li>- Any anchor crossing existing pipelines cables shall be decked on-board the anchor handling tug.</li></ul>			
7.3.6.2	Clearance between the anchor wires and the existing pipelines/pipeline appurtenances/cables			
	While performing the anchor handling maneuvers, the anchor wire shall not come in contact with any existing pipeline appurtenance/cable. The minimum vertical clearance between the wires and the pipelines/pipeline appurtenance/cable shall be 15 m. In case such clearance is not possible or impractical to achieve due to specific working conditions, then alternative arrangements viz., attachment of buoys with the anchoring wires at the crossing location, etc. shall be carried out.			
7.3.7	In case of pipe laying in the vicinity of shipping channel, the anchor pennant buoys shall be clearly visible (lighted at night) and the anchoring tugs shall maintain patrol around the lay spread to warn away any vessels in the vicinity.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.13 of 54	

7.4

**Field repairs to the damaged coating (Anti-corrosion and Concrete)**

7.4.1

Field repairs to damaged anti-corrosion and concrete coatings shall be accomplished with materials and methods, which are compatible with the parent coating, and provide a holiday free coating which are acceptable to the Company Representative.

7.4.2

If the concrete weight coating is damaged to the extent that it has become loose from the pipeline and is subject to spalling, it shall be repaired in accordance with the requirements of the Specification No. 2013.

7.4.3

If both concrete weight coating and anti-corrosion coating are damaged, the Contractor shall remove all weight coating material within 75 mm in all directions of the defects. This removal shall leave a hole tapering to the outside on a slope of around two parts vertical to one part horizontal. Contractor shall then remove all anti-corrosion coating within 50 mm of the defect. The defective area shall be wire brushed. Immediately following this, a primer compatible to that originally used with the anti-corrosion coating as mentioned in the Specification No. 2012 shall be applied. The remainder of the path shall be with Special Mastic Mix. Of quality approved by Company.

7.5

**Line-up and Welding**

7.5.1

**Care of Pipe**

Contractor shall inspect the internal surface of each joint of pipe to ensure that the pipe is free of visual defects/damage/cracks, pitting, dirt, rust and other foreign substances. Contractor shall thoroughly clean the inside of each joint of pipe, prior to aligning the pipe for welding into the pipeline. Contractor shall advise the Company immediately, should excessive corrosion or scaling be found inside any line pipe.


7.5.2

**Pipe defects and repairs**

It is Contractor’s responsibility to repair all internal and/or external defects. Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with the applicable Company material specifications included in the Contract.

Repair on line pipe shall be executed as specified in Company material specifications or ANSI B 31.8/ANSI B31.4/DNV whichever is more

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.14 of 54	

stringent. A record to all repairs is to be maintained by Contractor. This record provided with the pipe identification number shall be submitted to Company.

Dents, which contain a stress concentration such as scratch, gauge, arc burns or groove and dents located at the longitudinal weld shall be removed by cutting out the damaged portion of pipe as a cylinder.

Repair of damaged pipe ends by hammering is not allowed.

If due to cutting or repairs, the pipe identification number is removed, it shall be repainted immediately by the Contractor in the presence of Company Representative. In the event of line pipe supply by Company, Contractor shall be charged for any pipe length due to loss of identification number. No pipe without identification number shall be transported and/or welded into the pipeline.

**7.5.3 Cleaning of pipe ends**


Immediately prior to aligning pipe for waltzing, the beveled ends of each joint of pipe and the area immediately adjacent thereto (at least 25 mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign matter by use of power driven wire brushes, or by other methods approved by Company.

**7.5.4 Pipe Bevelling**


All damaged ends of pipe that are bent, cut or otherwise mutilated such that in the opinion of the Company, faulty alignment or unacceptable welding would result, shall be repaired or cut off and rebevelled to the correct angle with a beveling machine of a type approved by Company. No compensation shall be allowed for reason of such recutting or beveling, except when required because of the original bevel being damaged before the pipe is taken over by Contractor.

In case of line pipe supply by Company, the line pipes with bevels as mentioned in the relevant Company material specifications will be supplied to the Contractor. Rebevelling , if required, to suit the Contractor’s proposed welding procedure, shall be carried out by the Contractor at no extra cost to Company. Prior to rebevelling, if required, the Contractor shall prepare a sketch indicating the extent of wastage of line pipe envisaged for each end, and submit the same for Company approval. Wastages beyond

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.15 of 54	
the extent approved by the Company shall be charged to the Contractor at the rates finalised by the Company.				
7.5.5 Alignment of Pipe				
7.5.5.1 All pipe joints 8” NB and above shall be aligned with an internal pneumatic lineup clamp approved by Company, except for tie-in welds or other exceptional conditions acceptable to the Company, on which occasions an external line-up clamp may be used.				
7.5.5.2 All joints shall be aligned and welded with a uniform spacing. Hammers, if used, shall have bronze coated or other suitable head and shall be used in a manner as to avoid damage to the pipe.				
7.5.5.3.1 When joining pipe containing longitudinal weld seam, the longitudinal weld seam shall be in the upper quadrants of the pipe circumference. In addition, the longitudinal welds seams shall be offset at least 20 degrees from each other.				
7.5.6 Welding				
Pipeline welding, welding procedure and welder qualification, non destructive inspection and repair shall be carried out in accordance with the requirements of Company Welding Specification for Submarine Pipelines, included in the Contract.				
7.6 Anode Spacing				
Pipe joints with anodes shall be installed according to the spacing indicated in the Company approved drawings. Cares shall be taken so that the anodes, concrete and field joint coatings are not damaged while going through the stinger or over the rollers/supports.				
Special care shall be taken by the Contractor to ensure that the electrical bond from the anode bracelets to the pipe is not damaged during the handling and installation of the pipes. For this purpose, the anti-corrosion applied between the concrete coating and the anodes shall be checked for any damages. In case of any visible damage to the anti-corrosion coating, Contractor shall carry out the necessary remedial works without any extra cost to Company.				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003



	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.16 of 54	

7.7

Field Joint Coating

7.7.1

Field joint shall be provided with corrosion protection coating using either heat shrinkable wraparound sleeve or cold applied pipe wraps in accordance with the requirements of Specification No. 2014, included in the Contract Document.

7.7.2

In addition to the corrosion protection coating, the field joints shall be applied with in-fill coating using either mastic or polyurethane foam in accordance with the requirements of Specification No. 2014, included in the Contract Document.

7.8

Pipe Laying Operations

7.8.1

Company will obtain all necessary right of way easements from various Agencies having jurisdiction thereof. Contractor shall secure the necessary work permits for carrying out the works. Contractor shall adhere to said right of way and no changes in alignment shall be made by Contractor without prior written approval of Company. Company will advise the Contractor the right of way and permit provisions or conditions, and Contractor shall comply same and hold Company harmless of all claims, damages resulting from Contractor’s failures to observe such provisions or conditions. Damage resulting from Contractor’s negligence or failure to follow the designated routes shall be Contractor’s sole responsibility.

7.8.2

Pipeline and appurtenances shall be installed along the route and at locations indicated in the Company approved drawings. Placement accuracy shall be as mentioned in Section 5.0 of this specification.

7.8.3

Pipeline Installation Procedure Document


Contractor shall prepare and submit to Company for approval a Pipeline Installation Procedure Document, which shall include, as a minimum, the following:


a)


Pipe laying equipment description including plan and profile of lay barge, ramp orientation, pipe roller arrangement/location, line-up/welding repair/field joint coating station location, tensioner location and capacity, barge positioning systems and communication facilities: details of the pipeline to be handled.

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003



	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.17 of 54	
<p>b) Stinger description including dimension, cross section, length and roller arrangement/location.</p> <p>c) Pipe handling procedures including transportation, storage and pipe preparation.</p> <p>d) Welding, NDT, repair procedures</p> <p>e) Field joint coating procedure</p> <p>f) Pipe laying procedure including positioning control and start-up procedures.</p> <p>g) General laying procedure including positioning control and start-up procedures.</p> <p>h) Pipeline installation stress analysis including calculation of the stinger length, stinger angle or curvature and pipe tension required to restrict pipe stress levels within the allowable limits.</p> <p>i) Distance from the touch down point to the stern of the barge as well as the length of the pipe from the touch down point to the stern as a function of the tension and stinger angle in a graphical format, for all water depths encountered.</p> <p>j) Pipeline tension/configuration/stress monitoring and control details.</p> <p>k) General arrangements drawing of the buckle detector to be used.</p> <p>l) Umbilical installation procedure (if applicable) including the proposed umbilical route and the hook-up procedure to be adopted for connection with the valve actuator.</p> <p>m) Environmental conditions viz. maximum wave heights, wave period and current in which the laying can continue without damaging the pipeline.</p> <p>n) Proposed spacing between the existing and the installed pipeline and methods of maintaining the same.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.18 of 54	
7.8.4	Contractor shall install instrumentation including depth gauges on the pipelay stinger to continuously monitor the stinger configuration in order that the bending of the pipe is within the limits established in the installation stress analysis document.			
7.8.5	A buckle detector, as required by DNV Rules for Submarine Pipeline Systems 1981, shall be passed through the pipeline. The detector shall consist of a gauging plate positioned after the touch down point. If any buckle is detected it shall be repaired before continuing pipe laying operations. Aluminium gauging plate shall be used as a buckle detector.			
7.8.6	Contractor shall monitor continuously the tension exerted on the pipeline during all pipe laying operations, including abandonment and recovery by providing suitable instrumentation and ensure that the tension established in the stress analysis documents approved by the Company is achieved. Excessive tension shall not be applied. A daily record of tension and other parameters specified herein affecting pipeline stresses, recorded at regular intervals and during abnormal fluctuations or abandonment/recovery, shall be submitted to Company along with corresponding computed over bend and sag bend stresses.			
7.8.7	<b>Pipe Stress Control</b>  Stress in the pipeline shall be controlled during all phases of installation Contractor shall prepare and implement adequate procedures to control stress level in the pipe during laying such that the maximum permissible stress levels are not exceeded.  To limit bending in the over bend, the pipe support rollers on the barge and stinger or ramp must be accurately set at predetermined elevations such that support reactions and pipe bending loads are equally distributed. Contractor shall submit calculations of these positions and loads to Company as well as the proposed procedures for physical verification of these parameters during the laying operations.  Calculations and procedures shall account for the anticipated stinger deflection during laying operation due to environmental conditions, where appropriate. In case of a fixed ramp, Contractor shall indicate the proposed method for ensuring the pipe bending and pipe stresses are within the permissible limits.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.19 of 54	

7.8.8

Pipe Configuration Control

To ensure proper placement of the pipeline within the given alignment and control of the pipe curvature with acceptable limits, Contractor shall monitor the configuration of the suspended pipeline. Contractor shall submit a description of the means to monitor pipeline configuration and procedure for its use to Company prior to commencement of the installation works.

This shall consist of graphs and tables prepared specially for this work. In any event, the following items shall be included;

a)

Effect of pipe tension and tension variation on the pipe configuration as well as on pipe stresses.

b)

Effects of the most critical current and wave on the suspended pipeline.

Care shall be taken, to prevent the pipeline from jumping out the stinger during the laying operations.

Contractor shall propose a procedure to verify the actual dimensional configuration of the suspended pipe and location of the touch down point at regular intervals. The procedure shall also cover regular inspection of equipment such a tensioner and singer/ramp and indicate contingency plans in case of equipment failure. It is required that Contractor provide qualified engineering personnel on the lay vessel to conduct the aforesaid tasks, to interpret the results of calculations and measurements and to advise the vessel operating crew. All results of measurements and recordings shall be made available to Company.

7.8.9

Contractor shall provide suitable pulling/lowering head for the installation of the pipelines with stub ends. The lowering head shall be designed in such a way that the stub line can be dewatered and the stub end lifted at a future date by other Contractor while installing the remaining pipeline.

The lowering head shall include the following facilities as a minimum:


a)


Check plates for pulling

b)

Pig stopper and pig indicator

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
	DESIGN		Rev. No.	1
	SECTION		Discipline:	PIPELINE
	Page No.20 of 54			
<p>c) Ball valves and pipe fittings with blind flange for vent and drawing</p> <p>d) Barrel/pipe of sufficient length for holding the pig.</p> <p>7.8.10 Joint numbers, 150 mm high, are required on every joint laid. The numbers shall be painted on the upper quarter of the pipe so that divers can easily find each joint. Records shall be kept of the joint number with the corresponding pipe mill number, and the date when the joints has been welded and laid.</p> <p>7.8.11 Contractor shall maintain a record of the joint number and length of each joint as it is welded into the line. Contractor shall maintain a record of all of all cut-outs, joint ends cut off or pipe joints added and the amended length of the joint.</p> <p>7.8.12 Contractor shall comply with the tangent points of curves and the permissible bend radii mentioned in various Company approved drawings/documents.</p> <p>7.8.13 <b>Piggy back lines installation</b></p> <p>Where piggy back lines or umbilicals are to be located on the pipelines for installation as a bundle, then the piggy back lines/umbilicals shall be located at the top center of the mainline. Piggy back lines shall be strapped to the mainline by means of monel straps every 4 m all throughout the length of the line. Suitable spacers/guide supports shall be provided at every 2 m. Between the strap and the line as well as between the spacer and the line, a strip of 6 mm thick neoprene shall be provided to avoid any damage to the corrosion coating. Care shall be exercised to ensure the piggy back line/umbilical does not foul with the pipeline anodes.</p> <p>7.8.14 <b>Stub End Pipelines</b></p> <p>Incase the Contractor is required to tie-in to any existing stub-line, Contractor shall deploy divers and shall check the condition of the lay down heads and disconnect any shackles, slings, etc. Depending on the condition of the pipeline from pre-construction survey, a survey may be carried out by a ROV for 500 m length of the stub-ends, measured from the lay-down heads to identify any obstruction, which may hamper the recovery operations.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.21 of 54	

Contractor shall carry out hydrotest for a minimum period of six hours, unless otherwise specified and dewater the stub line prior to start of any lifting operations for tie-in. Contractor shall prepare and submit a procedure regarding the recovery of the stub end, including the details of hydrotest and dewatering of test water, etc. for Company approval.

**7.8.15 Emergency Flooding**

In case required by the Contractor’s design/procedure, whenever the pipe laying work is to be suspended due to weather conditions, the Contractor shall flood the pipeline with sea-water as per the Company approved procedures to stabilize the pipeline, provided stability calculations require flooding of the pipelines. The sea water used for flooding shall be filtered though a mechanical filter with a screen of size 50 mesh and treated with Company approved dosage of bactericide. During flooding operations, the Contractor shall monitor the water flow and pressure to ensure that it is within the safe limits established in the procedure previously approved by the Company.

Upon cessation of the conditions, and on obtaining the Company’s approval the pipeline shall be emptied by the Contractor before commencement of any operations.


**7.8.16** Any damage to the pipe weight coating during lifting, lowering, relocating or other installation operations shall be repaired by the Contractor at no extra cost to Company.


**7.8.17** Contractor shall provide diver or other sub sea inspection during the course of pipe laying operations to ensure that the suspended pipeline is within the limits of the calculated pipeline profile, the line is properly supported by the stinger, the line laid on the sea bottom is neither deformed in shape nor is the pipe coating damaged, and that the pipeline at the specified depth is continuously supported within the permissible limits indicated in the Company approved drawings/documents. Diver observation or other subsea inspection will also be required during pick-up and lay down of pipeline.

**7.9 Pipeline Installation at Platform Approaches**

**7.9.1** Platform approaches are considered to be within 500 m from the existing Platform/Platform Complex. Pipelines shall be laid in this zone as straight as possible with in the tolerances specified without endangering the safety of the existing pipelines and appurtenances, taking into account the minimum

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.22 of 54	
<p>possible barge clearances from the platform and constraints imposed by existing pipelines/installations. Diver controlled or ROV controlled operations shall be used if necessary, in congested areas to prevent laying over the existing lines/installations.</p>				
7.9.2	<p>Depending upon the location of the existing lines, approach angles of the pipelines to be laid, location of the riser to be installed, etc., Contractor shall decide the method of pipe laying in the Platform approaches i.e. either by initiating the pipe laying from the Platform end or by approaching the Platform from other end, lay down and side walking, unless specified otherwise. The proposed method shall be indicated in the Bid.</p>			
7.9.3	<p>If the pipelines to be installed in platform approaches are located in platform extremities where the pipeline installation near the platform, lifting and side walking the pipeline will not result in either damaging or endangering the safety of the existing installations, Contractor may adopt the lifting and side walking procedure after obtaining written approval from the Company. In case the pipelines to be installed are located at locations other than the platform extremities and Contractor proposes to install the pipeline by lifting and side walking procedure, Contractor shall propose suitable measures to establish that the proposed method does not damage/endanger the safety of the existing installations.</p>			
7.9.4	<p>In case pipe laying at Platform approaches initiate from the Platform end, it shall be done by making up the pipeline on board the lay barge and pulling to the sea bed. Tie-in back the snatch block to a jacket leg at the sea bed level or installing a Dead Man Anchor (DMA) shall be considered for this purpose.</p>			
7.9.5	<p>Diver survey shall be done near the platform to clearly identify the existing pipelines and the approaches for the new lines before and after completion of the pipeline installation.</p>			
7.9.6	<p>Contractor shall prepare and submit a Platform approach pipeline initiation procedure to Company including the following as a minimum :</p> <p>a) Method of pipeline installation at platform approaches along with schematic arrangement drawings including the details of the pipeline termination and abandonment, minimum possible barge clearances from the platform, lifting and side walking procedures, clearances from the existing installations, pipelines and appurtenances, if any.</p>			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.23 of 54	

b) Calculations for the pipeline stress during abandonment. Lifting and side walking.

c) Anchor pattern during pipeline laying at Platform approaches.

d) Diver inspection and survey of the Platform approaches prior to laying operations.

e) In case of pipeline initiation at Platform approaches, the following shall be furnished by the Contractor.

i) Calculation of the pulling load, stinger geometry and design of pulling head.

ii) Laying/start-up procedure including deployment of DMA/snatch block, Minimum length of pipe to be laid on the sea-bed prior to disconnection of hold back cable.

iii) Pipeline initiation schematic arrangement drawings with jacket tie-back system or with DMA arrangement including relative opposition of the barge, location of barge anchors.

iv) Details of equipment used including initiation head, pigs, sheave/snatch blocks, DMA, hold back cable etc.

v) Verification of the jacket legged for loads to be experienced during initiation (if applicable).


vi) Verification of holding capacity of DMA in the vicinity of the Jacket location (if applicable).

7.9.7


Installation of Expansion Loops


In case any expansion loops are required to be installed as per the Company approved drawings/documents, the Contractor shall install the same without any extra cost to Company. Contractor shall prepare a detailed installation procedure including all pertinent details of expansion loops installation and shall submit to Company for approval. Care shall be taken not to over stress the bend/loop during the installation. For this purpose necessary tie-bars/bracings shall be provided by the Contractor. Contractor shall also carry out a stress analysis considering the supporting arrangements to be


FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.24 of 54	
<p>adopted at the time of installation and submit the same to Company for approval.</p> <p>The pipes and bends forming a part of the expansion loop shall be provided with concrete coating as per the requirements of the Company approved drawings/documents.</p> <p><b>7.10 Pipeline Installation at Shore Approaches</b></p> <p><b>7.10.1</b> Pipeline installation at shore approaches shall be carried out either by pulling inshore through shore based winches or by fabricating the strings at the shore and pulling offshore through the barge winches depending upon the availability of the equipment and the availability of space at shore location unless specified otherwise. Contractor shall decide the method of installation at shore approaches in consultation with the Company.</p> <p><b>7.10.2</b> Pipeline shall be welded, radiographed, field joint coated as per the requirements mentioned elsewhere in the specification and the pipeline installation shall be carried out as per the Company approved procedures.</p> <p><b>7.10.3</b> Contractor shall prepare a detailed procedure, including all relevant calculations, drawings and sequence of operations to demonstrate the feasibility of the proposed methods for pipe laying methods for pipe laying at the shore approaches. Shore approach installation procedures shall be submitted to the Company for approval. The procedure shall include as a minimum the following:</p> <ul style="list-style-type: none"><li>a) Details of the proposed shore approach pipe laying spread including the marine and the land based equipment.</li><li>b) Plan, procedure and schedule for the pulling operations including details of the location with limits where the operation is to be performed.</li><li>c) Details of the sea bed preparation work including inspection methods and procedures.</li><li>d) Method of pulling along with the description of pulling equipment including capacity, instrumentation; and location of pulling equipment location and details of the hold back winch.</li><li>e) Sequence of operations of pulling including the installation of cables, attachment of cable with the pull head, etc.</li></ul>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003





	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.25 of 54	
<p>f) Length of pulling considered during the high/low water levels.</p> <p>g) Number of pull cables/ropes and capacity of sheaves proposed to be used.</p> <p>h) Estimated pulling force calculation including pipe/soil as well as cable soil friction coefficients; and selection of pulling winches/cables including factor of safety considered in selection of the pulling winches/cable as well as the reserve pulling capacity.</p> <p>i) Method of anchoring the winch along with winch anchor block calculations; Method of anchoring the barge.</p> <p>j) Calculation for designing of pulls head and verification procedure for the conditions expected during the pulling operations.</p> <p>k) Details of buoyancy tanks proposed to be provided along with the method of strapping with the pipe and the reserve capacity of the buoyancy tanks.</p> <p>l) Details of string make-up yard, launch way, rollers, etc. required.</p> <p>m) Details of safety measures to be adopted during pulling operations.</p> <p>n) Method, procedure, equipment and instrumentation of how the pulling operations will be monitored, and the stress limits of the pipelines are kept within established limits.</p> <p>o) Communication facilities proposed during the pulling between the shore and the barge.</p> <p>p) Contingency procedure to be adopted during pulling.</p> <p>q) Logistics of pulling and associated equipment installation.</p> <p>r) General arrangement drawings of the pulling plant.</p> <p>s) Pipeline profile/configuration for estimating the pulling force along with the proposed trench profile.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.26 of 54	
<p>t) Winch and other instrumentation calibration certificates not older than 3 months.</p> <p>7.10.4 Lateral forces on the pipeline due to current during pulling and increase in pull load due to sea bed slope at the shore approach shall be taken into account by the Contractor, while estimating the pulling force. Unless otherwise specified, the Contractor shall consider pipe-to-soil friction factor as 1.0 for estimating the pull force. All equipment including the winch, cable, sheaves, etc. used in the pulling operations shall have a factor of safety of minimum 1.5 to take care of the variations in the assumptions. Pulling equipment not meeting the above requirements shall not be used in the pulling operations. Company approval shall be obtained by the Contractor prior to mobilizing the pulling equipment. For this purpose the inspection certificates as well as the calibration certificates of the winch issued by the independent Inspection Agency shall be submitted to Company.</p> <p>7.10.5 In case of any soil bore hole data is available at the shore approach/beach location, the same shall be used for winch foundation calculation. In case no soil data is available, the Contractor shall carry out a soil investigation/bore hole to assess the properties of soil, for use in the winch foundation calculations.</p> <p>7.10.6 Buoyancy tanks may be strapped to the pipeline while pulling, to reduce the pulling load. In case buoyancy tanks are proposed, the pipeline shall be checked for stability under 1-Year storm conditions. Lightening of the pipeline beyond the 1-Year storm stability requirements is not permitted.</p> <p>7.10.7 Steel bands of 30 mm width shall be used for strapping the buoyancy tanks with the pipeline. Each buoyancy tanks shall be strapped with the pipeline with minimum of three such bands. In order to avoid damages to bands and subsequent release of buoyancy tanks while pulling the pipelines, the bottom quadrant of the pipeline shall not be wrapped with the bands. Bands shall be secured with the pipeline using Crawl plugs or other suitable means. Each buoyancy tank shall be provided with a rope hook at both ends, so that they can be connected with the adjacent tanks during pulling operations.</p> <p>7.10.8 In case circular steel drums are used as buoyancy tanks, wedges shall be provided between the tanks and the pipeline, in order prevent sliding of the tanks due to environmental actions during pulling. In case of polyurethane moulded floats are used, the bottom quarter shall be provided with a circular contour matching that of the diameter of the pipe to be pulled.</p>				
FORMAT No. ODS/SOF/004B	Ref. PROCEDURE No. ODS/SOP/008 TO 015	ISSUE No. 01	REV. No. 01	REV. DATE: 15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.27 of 54	
<p>7.10.9 Pulling head shall be suitable provided with buoyancy tanks during the pulling operations, so that the pulling head does not plough into the soil and lifting slightly off the sea bed during the pulling. Also in case the stinger is used during the pulling operations, it may not be possible to pull the pulling head along the stinger and therefore it may be necessary to deballast the stinger until the pulling head is clear and reaches sea bed before stinger is ballasted to support the pipeline.</p> <p>7.10.10 Prior to pulling operations, the Contractor shall submit a drawing clearly indicating the area required for pulling operations to Company for approval. Once the Company approval is given, the Contractor shall restrict himself within this area of operation only.</p> <p>7.10.11 At the time of pulling, the Contractor shall fence/cordon off the entire work site to prevent the entry of the unauthorized personnel. Provision shall be made for the installation of no-admittance signs to unauthorized personnel. Signs indicating the “Pulling in progress – Danger – Keep away” in English and the local language shall be placed at the work site.</p> <p>7.10.12 During the pulling operations, the barge anchor penant buoys shall be clearly visible (lighted at night) and the anchor tugs patrol around the barge to divert/caution the approaching fishing crafts, if any in the vicinity.</p> <p>7.10.13 Tide poles and current meters at appropriate location shall be installed and reading taken regularly by the Contractor during the pulling operations.</p> <p>7.10.14 Contractor shall use dynamometers during pulling operations for control and recording the loads transmitted through the pulling cables. In addition the each pulling winches shall also be provided with automatic recorders to record the load vs. the length of the pull data. Dynamometers and recorders shall be suitably placed for monitoring by Company Representative during the progress of the pulling operations. In case the actual pulling load exceeds the estimated pulling load, the pulling operations shall be suspended and Contractor shall investigate the reason for increase in the load. Remedial measures shall be carried out by the Contractor to the satisfaction of the Company Representative before continuing the pulling.</p> <p>7.10.15 Contractor shall maintain a pulling log-book and record the following during the pulling operations, viz.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.28 of 54	
<p>a) Date, time (start/finish) and duration of each pull</p> <p>b) Length of pull</p> <p>c) Buoyancy provided</p> <p>d) Tide levels and the current readings during the pulling</p> <p>e) Maximum and minimum load experienced during each pull</p> <p>f) Rate of pulling</p> <p>g) Interruption in pulling, if any along with the reasons for same.</p> <p>Such logs shall be submitted to Company Representative for information alongwith the charts of the automatic load recorders whenever requested or immediately upon completion of the pulling operations.</p> <p>7.10.16 Subsequent to completion of the pulling operations, the entire area at the shore/beach shall be restored to the original conditions to the complete satisfaction of the Company Representative and other Agencies having jurisdiction thereof. Winch foundation shall be dismantled subsequent to the completion of the pulling operations, unless otherwise specified.</p> <p>7.11 <b>Pipeline Abandonment and Recovery</b></p> <p>7.11.1 In case pipelines are to be abandoned during the pipe laying operations, either because of bad weather conditions or for any other reasons and subsequently recovered upon cessation of the conditions, the Contractor shall develop the Abandonment/recovery Procedures and submit the same for Company approval. The procedures shall be suitable for the Contractor's equipment and laying method and for the various water depths encountered along the pipeline route. The procedure shall include as a minimum the following:</p> <p>a) Stress analysis during the abandonment/recovery operations, for various water depths to be encountered along the pipeline route using the proposed lay barge equipment details.</p> <p>b) Drawings/schematic illustrations indicating the various stages of abandonment/recovery operation including the touch down point location.</p> <p>c) Description of the stepwise procedures and sequence of operations.</p> <p>d) Method proposed to verify the calculation result during the execution of the operations.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.29 of 54	
<p>e) A/R winch capacity</p> <p>f) Details of the lowering head as per para 7.8.9.</p> <p>8.0 RISER INSTALLATION</p> <p>8.1 The riser shall be installed in accordance with the Company approved procedures without damaging pipe and its coating.</p> <p>8.2 The tie-in between the pipeline and the riser shall be of welded construction, unless specified otherwise.</p> <p>8.3 Contractor shall prepare and submit a riser installation procedure to Company for approval. The procedure shall include, as a minimum, the following:</p> <p>a) Stress analysis of the riser during installation.</p> <p>b) Details of the equipment to be used for the riser installation.</p> <p>c) Drawings/schematic illustrations indicating the various stages of riser installation operation including pipe configuration during lifting/lowering.</p> <p>d) Descriptions of the stepwise procedures and sequence of operations for pipeline/riser tie-in and riser installation.</p> <p>e) Diving procedures and extent of diver inspection and measurements.</p> <p>f) Platform/jacket survey details to ascertain the riser/clamp locations, condition of clamps, presence of boat landing/riser protectors. Presence of jacket anodes at riser location etc.</p> <p>g) Procedure for installation of riser clamps</p> <p>h) Any contingency procedures envisaged during riser installation.</p> <p>8.4 Prior to start of the riser installation, survey of the pipe end shall be made to ensure that there are no obstructions to the lifting operations. The position of the pipeline on the sea bed shall be carefully determined.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.30 of 54	
8.5	Contractor shall carry out a survey to ascertain the riser clamp location, condition of clamps, presence of boat landing/riser protectors. Presence of jacket anodes at riser location, etc. prior to riser installation as a part of the pre-engineering survey. The survey for these shall be carried out using sector scan, diver inspection and video recording (PAL-VHS System). Video recording and other survey documents shall be submitted to Company for information and approval in case any modification is required to be carried out.			
8.6	In case the jacket anodes are fouling with the clamp locations, Contractor shall consider redesigning of the clamps to avoid anode removal. If jacket anodes removal is unavoidable during riser clamp installation, then these anodes shall be reinstalled in the nearest suitable location by the Contractor without any cost and time effect to Company. Number of anodes to be removed and reinstalled shall be finalised by the Contractor after the pre-construction survey of the existing platform, and shall be submitted to Company for approval.			
8.7	Anodes shall be installed to the risers as per the spacing indicated in the Company approved drawings.			
8.8	Diagonal bracing shall be attached to the bottom of riser bends by clamps during fabrication. These bracings shall be removed or a two foot section cut out of the brace after riser installation is completed and clamps are tightened.			
8.9	The risers shall be supported by hanger flanges and guided by non-frictional riser clamps. All bolting on the riser clamps shall utilize fully tightened double nuts on each end of the studs. Number of clamps and their location shall be as indicated in the Company approved drawings.			
8.10	Clamps shall generally comply the requirements indicated in the drawings enclosed in the Contract Document. Clamps shall be internally provided with 12 mm thick neoprene padding, vulcanized to the clamps steel surface. Where adjustable clamps are provided electrical continuity for cathodic protection of the clamps shall be provided between jacket and clamps. Neoprene material requirements as well as the fabrication requirements shall comply the following requirements.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.31 of 54	

8.10.1

**Material**

Neoprene shall conform to ASTM D-2000, Class “BC” as per line call out 3 BC 725 C12 G21K11Z or equivalent and shall comply all chemical and mechanical properties requirements of ASTM D-2000. Neoprene shall have sufficient water resistance that after kept in submerged condition in sea water for a period of two weeks at 23°C, it shall retain at least 95% of all the properties mentioned in ASTM D-2000. Neoprene shall be provided with certificates for the properties mentioned in ASTM D-2000 as well as certificate for water resistance.

8.10.2

All inside surface of the clamps shall be freed from pitting or any other material imperfections. The surface shall be degreased and sand blast cleaned to SA 2 ½ as per SIS 055900 prior to application of the neoprene sheathing.

8.10.3

Adhesive of Company approved quality shall be used to fix the neoprene to the steel surface, Lined clamps shall be closed using dummy pipes of appropriate diameter, bolts secured and the entire assembly put in an autoclave including the details of the material and application procedures proposed for the neoprene padding and shall obtain Company approval prior to start of vulcanizing operation. Thickness tolerance after vulcanizing shall be ± 5%.


In case Contractor proposes to affix the neoprene sheathing with the clamps using proven methods other than vulcanizing, details of the same shall be furnished to the Company along with relevant details of the past experience in similar subsea application wherein this method has been adopted and the test result of the as applied coating to establish that the proposed affixing scheme is equivalent or superior to the vulcanizing method. Upon review of such details Company may grant approval of the proposed method. In case sufficient details of the proposed affixing method along with the necessary back-up documents are not furnished. Company will have the right to either request for additional tests or to insist for vulcanizing.

8.11


Risers including bends shall be coated and wrapped with anti-corrosion coating and shall also be provided with a minimum thickness of 30 mm concrete coating, as per the specifications included in the Contract, from ocean floor upto the splash zone. The field joint at the riser to pipeline connection and on risers shall be coated as per the requirements of Specification No. 2014.


FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003





	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.32 of 54	
8.12	Risers extending above the splash zone shall be painted in accordance with Company General Specification No. 2005 “Protective Coating”.			
8.13	Splash Zone portion extending from – 2.0 w.r.t Datum upto bottom of hanger flange clamp, shall be applied with a 5 mm thick, monel sheathing. Monel sheet shall be welded to the riser pipe at the top and bottom to form a tight jacket which shall have facilities for future testing for tightness.			
	Material and fabrication requirements of monel sheathing shall comply the requirements given below:			
8.13.1	<b>Material</b>			
	Monel sheet conforming to ASTM B 127 of BS 3072 NA-13 or equivalent in annealed condition shall be used for sheathing purposes and the monel sheathing shall comply chemical and mechanical properties requirements of ASTM B 127/BS 3072 as applicable. Monel shall be provided with test certificates for all properties mentioned in ASTM B 127/BS 3072 as applicable. Monel sheet of 5 mm thickness shall be used for the sheathing purposes.			
8.13.2	Pipe surface where the monel sheathing to be applied shall be sand blast cleaned to SA 2 ½ as per SIS 055900. In addition the area where the welding is to be done shall be cleaned of all contaminants and then wiped down with a clean white cloth prior to welding. If necessary acetone or trichloroethylene shall be used to remove the traces of any contaminants.			
8.13.3	Monel sheathing shall be welded with the pipe either by using Tungsten Inert Gas (TIG) welding technique or by Shielded Metal Arc Welding (SMAW) process. In case of TIG welding, the filler metal shall be monel composition (AWS A-5.14, ER Ni Cu-7) for joining monel to monel, and nickel composition (ASW A-5.14, ER Ni-1) joining monel to carbon steel, or equivalent approved by Company. In case of SMAW welding, electrodes conforming to AWS A-5.11 E Ni Cu-7 shall be used. Contractor shall carryout welding procedure qualification in accordance with ASME Section IX and DNV and submit relevant documents to Company for approval prior to carrying out any monel welding operations.			
8.13.4	Monel sheets shall be rolled or formed in cold condition to suit the outer diameter of the steel pipe, and fitted unto the pipe. The monel sheet shall be fitted tightly around the pipe, with in place with a metal strapping. Tack welding on the pipe shall be done only on doubler plates positioned between			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003





	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.33 of 54	
<p>the pipe and the monel sheet. Any bulges, wrinkles, etc., in the monel sheet shall be worked out prior to welding. The total area covered by the monel sheathing shall be divided into two sections of approximately equal length as shown in Fig. No. 8.13.4. Each section shall have the provision for pressure testing. Monel to carbon steel welds shall be at the ends of the jacket and in the middle. All other welds shall be monel to monel.</p> <p>8.13.5 After each weld run, the welds shall be cleaned by hand grinding. To prevent damage to the monel cladding by weld spatter, the monel surfaces adjacent to the welds are to be coated with a temporary lime wash.</p> <p>8.13.6 All welds shall be checked over their full length by due penetrant examination. In addition all monel to carbon steel welds shall be radiographed to ensure no defects are in the welds.</p> <p>8.13.7 Final assembly i.e. monel to monel and monel to carbon steel welds shall be nitrogen and soap tested for a duration of 30 minutes at a pressure of 1.5 kg/cm<sup>2</sup> (g) to ensure leak free assembly.</p> <p>9.0 <b>PIPELINE CROSSINGS</b></p> <p>9.1 Pipeline crossings shall be so installed that they will not affect or danger the safety of the existing pipeline and its operation.</p> <p>9.2 In case of pipeline crossings, prior to pipe laying operation, Contractor shall provide a marker buoy at a point on the existing line where the proposed line will cross over it.</p> <p>A general layout of the existing pipelines and the proposed crossing locations are included in the Contract Document. It shall be the Contractor’s responsibility to conduct a detailed and accurate survey of the existing pipelines to determine their exact location and depth of the burial around the proposed crossing. The Contractor shall carry out the soil investigation as required at all pipeline crossing locations to determine the soil bearing capacity for support/grout bags.</p> <p>9.3 <b>Crossing Design</b></p> <p>9.3.1 Contractor shall design the pipeline crossing considering various information mentioned in the Contract Document and submit to Company for approval. General arrangement of pipeline at the crossing, shall be as</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.34 of 54	
<p>indicated in the relevant drawings included in the Contract. Pipeline crossings shall be designed to ensure on-bottom stability under the 100 year storm conditions. Crossing design calculations shall includes as a minimum the following:</p> <ul style="list-style-type: none"><li>- Stress in the pipeline at crossing location</li><li>- Calculations for settlement of support/stability of support, based on soil bearing capacity established during the soil investigation</li><li>- Check for the vortex shedding</li><li>- Support/grout bag details.</li></ul> <p>9.3.2 Pipeline crossing shall be designed to ensure that the induced stresses from combined functional and environmental loading conditions comply with the requirements of DNV Rules for Submarine Pipeline Systems, 1981 for both installation and operating conditions and the requirements mentioned in this specification.</p> <p>9.3.3 Approach angle of the pipeline being installed with respect to the existing line should not be less than 30°.</p> <p>9.3.4 Grout, bags/separators shall be provided to maintain a physical separation of 350 mm or more between the existing line and the proposed line for the life span of the proposed pipeline. Grout bags/separators shall be of sufficient length to ensure stability to remain under the pipeline during the operational life time of the pipeline.</p> <p>9.4 <b>Installation</b></p> <p>9.4.1 The installation of the pipeline crossing shall be executed in such a way that no shut down of the operating line is required.</p> <p>9.4.2 Crossing of the pipelines shall normally be at sufficient distance from the platforms to allow installation/maintenance and/or removal of newly installed or existing pipeline/riser without disturbing the crossing installation.</p> <p>9.5 <b>Material</b></p> <p>The grout filled support bags shall be able to withstand the marine environment, functional and operational forces of the pipeline for the life</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.35 of 54	
<p>span of the pipeline. The grout bags shall be constructed of a woven acrylic coated nylon or equivalent material. The details and the specifications of the material to be used for the crossings shall be submitted by the Contractor to Company for approval.</p> <p>Cement for the grout shall conform to Portland cement as per API Class G or equivalent. The grout shall have a compressive strength of 105 kg/cm<sup>2</sup> at 24 h and 422 kg/cm<sup>2</sup> at 28 days. The grout shall have a density of 1920 kg/m<sup>3</sup> ± 60 kg/m<sup>3</sup>.</p> <p><b>9.6 Free Spans</b></p> <p>The free spans of the exposed pipelines at the crossings shall also be supported by grout bags. The length of the free span between the two supports shall not exceed the limits as mentioned in the Company approved documents.</p> <p><b>9.7 Inspection</b></p> <p>The Contractor shall perform a detailed inspection of all the pipeline crossings and submit an inspection report and preliminary as-built survey report to the Company for approval. The inspection shall be done by the Contractor’s divers 12 hours after completion of the installation. This report shall also include the video tape recording and minimum of four good quality underwater photographs of the crossing and free span supports for each crossing. The Contractor shall submit to Company the procedure and the technique he proposes to use for such inspection for approval.</p> <p><b>10.0 PIPELINE FREE SPANS AND SUPPORTS</b></p> <p><b>10.1 Free Span Rectification</b></p> <p>Subsequent to completion of the pipeline installation and crossing installation, a complete survey shall be made to ensure that no spans in excess of the permissible span established in the Company approved documents exist. The survey shall be conducted using a side scan sonar, echo sounder and an ROV fitted with a video camera to define each span. The results of this survey shall be submitted to Company not later than one week after completion of such survey.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.36 of 54	
10.2	Free spans in excess of acceptable spans shall then be identified in consultation with Company Representative. The free spans shall then be rectified/corrected either by providing adequate supports consisting of grout bags underneath the pipe in hard soils or by suitably jetting and lowering the supporting points, in accordance with the procedures and methods approved by the Company. The grout bags shall meet the requirements mentioned in section 9.0 of this specification. In case any unacceptable span in pipeline which are proposed to be trenched at a later date, then the Contractor shall reduce the suspended span length by suitably jetting or other means .Checks shall be made upon completion of the span correction work by hydrographic surveys and diving inspections to ensure that the pipeline spans have been reduced to allowable limits as per Company approved documents. Company shall be kept fully informed during all phases of the span rectification work.			
10.3	Rectification of all spans greater than the maximum allowable lengths be completed to the satisfaction of the Company Representative before start of back filling works, if any and hydrostatic testing works.			
10.4	Installation of supports and/or protection, using approved grout bags or protective saddles, at specified locations shall be as per the procedure prepared and submitted by the Contractor and approved by the Company.			
11.0	<b>CATHODIC PROTECTION SURVEY</b>  Contractor shall carry out cathodic protection survey of the installed pipeline as per the relevant Company specifications included in the Contract document. Prior to carrying out the cathodic protection survey, the Contractor shall submit the relevant procedures as per the requirements of the specifications to Company for approval. Cathodic protection survey shall commence only after obtaining the Company approval.			
12.0	<b>ON-LINE VALVES, LATERALS AND PLEM INSTALALTION</b>			
12.1	<b>General</b>			
12.1.1	All piping/pipeline fabrication required for making up the on-line valve, lateral and PLEM assemblies shall be carried out in compliance with the requirements of section 13.0 of this specification.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.37 of 54	
12.1.2	Contractor shall install the on-line valves and laterals within $\pm$ 10 meters from the location shown in the Company approved drawings along the pipeline route. PLEM shall be installed as close to the lateral as possible, but within $\pm$ 2 m of the approved location.			
12.1.3	Care shall be exercised by the Contractor during the installation to avoid damage to the pipeline, coating and appurtenances being installed.			
12.2	<b>Design</b>			
12.2.1	Contractor shall design the complete on-line, lateral PLEM assemblies including piping, supports, structures as required alongwith the protective cages for the complete and effective functioning of the system, taking into account the scheme indicated in the Process and Instrumentation Diagram included in the Contract. PLEM – lateral hook-up scheme shall be designed taking into account the details of the existing facilities included in the Contract as well as the details obtained during the pre-engineering survey.			
12.2.2	On-line valve, lateral and PLEM assemblies shall be designed to ensure that the induced stresses form combined functional and environmental loading conditions comply with the requirements on DNV Rules for Submarine Pipeline Systems, 1981 for both installation and operating conditions and the requirements mentioned in this specification. The assemblies shall be designed to withstand the 100 year storm conditions, mentioned in the Contract.			
12.2.3	The on-line valve, lateral and PLEM system shall be suitable for operation in sub-sea at the water depths and environmental conditions indicated in the Contract Document and shall be designed for a life span of not less than 30 years.			
12.2.4	All connections shall be by welding except for future tie in for which flanged end shall be provided, unless otherwise specified.			
12.2.5	On-line valve/lateral assembly shall be designed for installation on sea bed with uniform support. Contractor shall check the soil bearing capacity of the soil at the location and shall design the lateral/on-line valve assembly against any future settlement. In case no soil data is available, Contractor shall carry out soil investigation at the location of laterals/on-line valves at no extra cost to Company. Even in case the pipelines are required to be buried, lateral/on-line valve assembly shall be configured to rest on the sea bed.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.38 of 54	

12.2.6

On-line valves including ball/check valves, laterals and PLEM assemblies shall be provided with a protective cage to protect the installation from external damage due to falling objects. The protective cage shall be designed such that the operation of the valves are not impeded and necessary access is available for the diver intervention. Protective cage to be installed on the lateral (branch connection for future hook-up) is possible without restoring to cutting of the protective cages.

12.2.7

Cathodic protection of the PLEM assembly supports, structures and the protective cages of the on-line valve, lateral and PLEM assemblies shall be designed as per the relevant specifications included in the Contract by suitably providing sacrificial anodes. Contractor shall submit the detailed design, material, manufacturer and reference list to Company for prior approval.

12.2.8

PLEM Structure and Piles

PLEM support structure and piles shall be designed to resist the maximum loads imposed on the PLEM system during 100 year storm conditions and for operational load conditions.

PLEM structure shall be provided with minimum four piles and shall be designed for existing soil conditions in that location. For this purpose, Contractor shall carry out soil investigation at this location if there is no data available. It shall be designed with a minimum load factor of 23 under 100 year storm conditions.


Design of the structures and PLEM piles shall be carried out as per the relevant specifications enclosed in the Contract.

12.3

Materials

Materials for various components used in the fabrication of on-line valves, laterals and PLEM assemblies shall suitable for the service and sub-sea environments indicated in the Contract and shall strictly conform to the relevant Company Material Specifications for the Submarine Pipeline included in the Contract.

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.39 of 54	

12.4

**Painting**

On-line valves, lateral and PLEM assemblies including protective cages of the on-line valves, laterals and PLEM shall be suitably coated with coal tar epoxy coating and anti-fouling paint, suitable for long term sub-sea service. Contractor shall prepare and submit details of the coating and paining scheme suitable for the prevailing conditions for Company approval.

12.5

**Marking**

Stainless steel plate nor other materials with embossed letter and radiant paints for long term sub-sea service indicating the designation of the on-line valve/lateral/PLEM assembly shall be welded with the protective cage, so as to enable easy location and identification by divers.

12.6

**Installation**

12.6.1

Contractor shall prepare and submit a procedure to be adopted during the assembly installation including schematic arrangement. Procedure shall include functional testing of valves prior to installation on barge.

12.6.2

**On-Line Valve/Lateral Assemblies**

12.6.2.1

Contractor shall carry out a stress analysis of the pipeline during installation of lateral/on-line valves considering the loads and bending moment capabilities of the valve and shall ensure that the stress levels and the bending moment on valves are not exceeded. Floats may be attached during installation in case additional buoyancy is required in the calculations.

12.6.2.2


Ball valves, check valves and lateral assemblies shall be installed in such a way that they are as close to vertical as possible/Care shall be exercised to prevent the valves/laterals assemblies from experiencing any torsion during the installation. Suitable checks shall be carried out while the assemblies are passing through the stinger.

12.6.2.3


Shims/protection shield/wooden packing shall be provided in such a way that while passing through the barge stinger, the assembly does not get damaged.

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003



	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.40 of 54	
12.6.3	<b>PLEM</b>			
12.6.3.1	It shall be the responsibility of the Contractor to locate the existing lateral connections by conducting detailed and accurate underwater surveys to establish the relevant details required for the design and installation of PLEM tie-in.			
12.6.3.2	Contractor shall remove any debris, fishing nets, etc. around the area of the lateral before making the PLEM hook-up. Contractor shall ensure that the internal surface of the prefabricated PLEM assemblies is clean of all loose sand, materials, weld spatter etc. prior to installation.			
12.6.3.3	The pipeline to PLEM connection shall normally be welded unless otherwise indicated as flanged in the Company approved drawings.			
12.6.3.4	Contractor shall check whether the existing valves on the laterals are in open or closed position. If required the valve shall be closed prior to removal of blind flange for PLEM hook-up.			
12.6.3.5	The Contractor shall adopt suitable PLEM installation procedures to comply the stress limits as mentioned elsewhere in this specification.			
12.6.3.6	Pile supports required shall be installed subsequent to installation of the PLEM assembly.			
12.7	Contractor shall be responsible to make the valves functional, subsequent to installation of these assemblies and shall demonstrate the same to the Company Representative by suitably opening and closing the valves. For actuated valves, the opening and closing shall be demonstrated by use of portable nitrogen cylinders by divers. The demonstration shall be video recorded and submitted to the Company Representative.			
12.8	For valves operated through umbilicals, Contractor shall demonstrate the valve function by operating the Hydraulic Power Unit (HPU).			
12.9	<b>Testing</b>			
	After installation, these assemblies shall be hydrostatically tested along with the connected pipeline, complying the requirements of the Specification No. 2022. Prior to installation, on-line valve, lateral and PLEM assemblies shall be hydrostatically pre-tested in compliance with the requirement of clause 13.6 of this specification.			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003



	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.41 of 54	

13.0

PIPING DESIGN AND FABRICATION REQUIREMENTS

13.1

All piping shall be designed, fabricated and inspected as per the Company approved procedure, documents drawings and in compliance with the applicable codes and standards mentioned in this specification.

13.2

Piping Design

13.2.1

All piping drawings including lay-outs and isometrics shall be prepared in compliance with the requirements of the specification and submitted to Company for approval prior to fabrication. Only after obtaining Company approval, the fabrication shall begin.

13.2.2

All design calculations for thermal expansion/flexibility etc. shall be made in accordance with the relevant code requirement and submitted to Company for approval.

13.2.3

Piping and equipment shall be adequately supported for weight of piping water full, attached unsupported components, and any other applicable forces. Care shall be taken that these supports are adequate to prevent excessive stress, loads or moments in either the piping or nozzle of the equipment to which it is connected.

13.2.4

Adequate space shall be provided in order to provide diver access to valves and equipment during regular operation and maintenance of the system.

13.3


Piping Fabrication


13.3.1


Dimensional Tolerances


Contractor shall be responsible for working to the exact dimensions as per the approved drawings. Dimensional tolerances to be adopted during the fabrication works shall generally comply the requirements stated in the referred codes and standards. In addition dimensional tolerance for finished fabricated piping shall comply the following requirements. These tolerances shall apply approval drawings. Dimensional tolerances to be adopted during the fabrication works shall generally comply the requirements stated in the referred codes and standards. In addition dimensional tolerance for finished fabricated piping shall comply the following requirements. These tolerances shall apply to in-line items and connections for other lines:

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.42 of 54	
<p>a) General dimensional tolerance such as face to face end to end and center to center shall be <math>\pm 3</math> mm.</p> <p>b) Inclination tolerance of flange face from true alignment in any direction shall be 0.8 mm.</p> <p>c) Displacement tolerance of branch connection from the indicated location shall be <math>\pm 1.6</math> mm. When multiple branches are involved, the displacement of the branches shall not exceed 3 mm from a common point.</p> <p>d) Rotation of flange bolt holes shall not exceed 1.6 mm.</p> <p>13.3.2 On-line valve, lateral and PLEM assemblies shall be fabricated as per the Company approved drawings. It is Contractor’s responsibility to have the units completely assembled, tested and made fully functional.</p> <p>13.3.3 Branch connections shall be provided in accordance with the branch connection details indicated in the relevant Company Material Specification for Submarine Pipeline included in the Contract.</p> <p>13.3.4 Valves with flow arrows shall be installed according to the normal flow in the pipeline. During welding, the valves shall be in fully open position. In addition, Manufacturer’s instructions shall be strictly adopted in entirety. Care shall be taken to avoid entry of sand particles, etc. in to the valve body, seals etc. during transportation, storage, assembly and installation.</p> <p>13.3.5 All valves shall be handled using equipment and methods to avoid impact. In particular, the equipment and tools for lifting and handling shall never be done through hand wheel, valve stem, flange joints and other parts which may suffer damage and handling shall be done only through the lifting lugs provided on the valves.</p> <p>13.3.6 Contractor shall ensure that the piping assemblies are not in strain or highly stressed prior to the final bolting or welding.</p> <p>13.3.7 <b>Flanged Connections</b></p> <p>13.3.7.1 Contractor shall ensure that all flange faces are parallel and centered according to standard practice, prior to final bolting. Contractor shall not use bolting. Contractor shall not use bolting forces as means for attaining alignment. Gasket complying the requirements of Company Material</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.43 of 54	
<p>Specification for Submarine Pipelines shall be installed between the flanges at each joint.</p> <p>13.3.7.2 Bolts shall be tightened in diagonal sequence and shall be centered with equal amounts of thread visible on both sides. Bolts shall be uniformly tightened to produce a leak-proof joint. Bolts that yield during tightening shall be removed and discarded. It is mandatory that a torque wrench be used for bolt tightening.</p> <p>13.3.7.3 Flange bolt holes shall straddle the established horizontal and vertical center lines of the pipe, unless other orientation is required as per the Company approved drawings.</p> <p>13.3.8 <b>Welded Connections</b></p> <p>13.3.8.1 All welding and welding procedure qualification and NDT shall be performed in accordance with the Company specification included in the Contact. Welding procedure shall be established and qualified in the presence of the Company Representative. Documentation of the welding procedure shall be prepared and submitted by the Contractor to Company for approval prior to beginning of welding.</p> <p>13.3.8.2 All welds shall be 100% radiographically examined. For fillet welds where carrying out radiography is not possible, magnetic particle test or dye penetrant test shall be carried on 100% of such weld joint.</p> <p>13.3.8.3 Where the ends of the piping components being welded have unequal thicknesses, the edge preparation shall be carried out as per ANSI B31.8 /ANSI B 31.4 as applicable.</p> <p>13.3.8.4 Back-up rings shall not be used during welding.</p> <p>13.4 <b>Inspection</b></p> <p>All piping work shall be subjected to inspection by Company at any time during fabrication. Contractor shall furnish to Company detailed work program sufficient in advance in order to enable Company to arrange for inspection.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No. <b>2015</b>	
			Rev. No. <b>1</b>	
			Discipline: <b>PIPELINE</b>	
			Page No.44 of 54	
13.5	<b>Cleaning</b>		<p>Contractor shall ensure that all equipment and piping are thoroughly swabbed clean of all dust, refuse, weld –spatter, scale or any potentially detachable matter by suitable mechanical means prior to the tie-in or final welding/bolting.</p>	
13.6	<b>Testing</b>		<p>On-line valve, lateral and PLEM assemblies shall be hydrostatically tested after pre-fabrication in the yard for a minimum duration of 6 hours, with the test pressure equal to that of the pipeline hydrotest pressure.</p> <p>After successful completion of hydrostatic testing, the entire assembly shall be dewatered and dried using compressed air. Hydrotest records shall be submitted to Company for approval.</p>	
14.0	<b>CLEAN-UP, RESTORATION AND DISPOSAL OF SURPLUS MATERAILS</b>			
14.1	<b>Clean-up</b>		<p>During pipeline installation Contractor shall not discard at any point along the pipeline routes, the construction materials, scrap or other objects. Any stacks, buoys or temporary obstructions placed along the pipeline right of way in the water or on land shall be removed at Contractor's expense unless Company specifically requests that they be left in place.</p>	
14.2	<b>Restoration</b>		<p>Work space furnished to the Contractor shall be cleaned of all scrap and debris and restored to such stable and usable condition as may be reasonably consistent with the condition of the right of way prior to laying of the pipeline. Contractor shall restore the original shoreline contours and conditions to the satisfaction of the Company and Governmental Agencies having jurisdiction over the area.</p>	
14.3	<b>Surplus Materials</b>		<p>All surplus materials supplied by Company shall be collected by the Contractor and delivered to Company's warehouse as mentioned elsewhere</p>	
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.45 of 54	

in the Contract. Contractor shall keep a record of all materials returned to Company and shall submit the same for Company information.

14.4      **Disposal**

All surplus and defective materials supplied by Contractor and all trash, refuse and spoiled material shall not be disposed off from the vessels into the surrounding water but shall be collected and disposed off by Contractor in a manner satisfactory to Company.

The right of way at shore approaches shall be cleared of all rubbish, broken skids, empty cans, cardboard, sacks, stumps, trash and leftover construction material.

Surplus soil can only be removed from the work area after authorization by Company Representative.


All loose stones and rock exposed by the construction operations and scattered over the right of way or adjacent grounds shall be removed by the Contractor and be transported to a location considered suitable by the Authorities having jurisdiction, for satisfactory disposal.


15.0      **AS-BUILT DATA REQUIREMENTS**


15.1      On completion of hydrostatic testing, the Contractor shall prepare “As Built Drawings and Reports for all pipeline systems. It shall be the responsibility of Contractor to carry out an accurate survey of the installed pipelines and to provide detailed “As Built” alignment drawings to include any departure from the specified alignment, details of unsupported span, etc. within four weeks after completion of construction. For this purpose the already approved drawings by Company shall be used for incorporating the as-built data. As-built data shall be collected by carrying out a geophysical survey of the installed pipeline subsequent to the completion of the pipeline installation, using echo sounder, side scan sonar, sub bottom profiler etc. Preparation and submission of new as-built drawings is not acceptable to Company, in case “Issued for Construction” drawings already exist.

15.2      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, location of laterals/on-line valves/PLEMS, elevation of


FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.46 of 54	
<p>riser clamps, monel sheathing details hanger flange and insulting joint details etc. shall be accurately located on the “As-built” drawings. Exact placement, location and orientation of all risers, lateral, stub ends, mechanical connectors, flanges, etc. shall also be indicated on the “As-built” drawings.</p>				
15.3	<p>Contractor shall provide divers and saturation diving facilities as required to inspect and verify the areas where the pipeline/appurtenances are installed on the sea bed viz. On-line valves locations, lateral locations, PLEM locations, expansion loop locations etc. All diver operations shall be monitored by close circuit TV and underwater cameras. Contractor shall make video-tape recordings of underwater surveys performed by divers.</p>			
15.4	<p>The Contractor shall also prepare an “As –Built” Report including the following as a minimum.</p> <p>a) Pipeline installation record indicating pipeline material, diameter, wall thickness, reference to pipe tally sheet numbers, length of such pipe, cumulative length, weld joint number, NDT results.</p> <p>b) Pipeline alignment/route maps with 1:5000 scale, approaches to platforms with 1:500 scale, piping drawings for laterals, on-line valves assemblies, pipeline end manifolds with 1:33 1/3 scale.</p> <p>c) Burial details along the pipeline route including the Platform approaches and shore approaches.</p> <p>d) Riser detail drawings showing riser make-up, pipe material, diameter, wall thickness, weld joint number, details of coating, riser bend radius and angle, approach angle to platform, location/elevation of riser clamps, field joints, anodes, monel sheathing, splash zone extent and protection, etc.</p> <p>e) Location of anodes, and post-installation potential measurement survey report.</p> <p>f) Location and details of stub-ends/lowering heads.</p> <p>g) Location and details of laterals, on-line valves, PLEMS, expansion loops, etc.</p>			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.47 of 54	
<p>h) Spanning of pipelines, if any and remedial measures undertaken.</p> <p>i) Corrosion and concrete coating details for the pipelines and risers.</p> <p>j) Details of field joints</p> <p>k) Pipeline crossing details including the grout bag/support details.</p> <p>l) Other miscellaneous details, such as diary of events, list of video tape recordings, photographic records, etc.</p> <p>m) Details of the expansion loop installed, if applicable.</p> <p>Six copies of the “As-built” drawings, reports and all video tape recordings for each pipeline system shall be submitted to the Company. In addition two sets of electronic copies on CD of all as-built drawings shall be submitted to Company.</p> <p>15.5 In addition to the above, the Contractor shall obtain the Project Data base formats from the Company and suitably fill the same with the relevant data of the project carried out.</p> <p>15.6 Contractors shall also furnish to Company the line wise statistical details of the lay rate, weld repairs (no. of joints as well as the length of repair), barge down time due to weather as well as mechanical break-down, etc. as a part of the as-built documentations.</p> <p>16.0 <b>DOCUMENTATION</b></p> <p>16.1 At the time of bidding, the Contractor shall furnish the technical documents including the following as a minimum:</p> <p>a) Description of the complete marine laying spread, including diving and other underwater system suitable for maximum and minimum water depths involved in the scope of work.</p> <p>b) Brief description of the proposed laying methods, welding methods, welding and tie-in procedures including welding inspection and repair procedures.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.48 of 54	
<p>c) All geometrical characteristics and data of pipe laying equipment with sufficient details as per the Fig. No. 16.1, in order to enable the Company to verify all calculations and analysis on the proposed pipe laying system.</p> <p>d) Positioning system to be used to ensure that the pipeline is installed along the designated route along with the accuracy of positioning.</p> <p>e) Complete list of manpower, tools and equipment proposed to be used.</p> <p>f) Description of equipment and procedures used for the pipeline repair in case of any buckle.</p> <p>g) List of possible suppliers, sub-contractors along with relative supply, activity or work to be sub-contracted and summary of previous references of similar activities in the last five years.</p> <p>h) General organization or work, spread, supplies and transport.</p> <p>i) Calculations and technical report on proposed laying procedures showing the stress level conditions as well as the configuration, which are anticipated in the pipeline during laying operations. In particular, the Contractor shall calculate the main laying parameters referring to the most severe condition in order to assess the capability of the pipe laying equipment (mainly the tensioning device and winch).</p> <p>j) Post-construction survey method to establish and prepare ‘as-laid/as-built’ drawings upon completion of construction.</p> <p>k) Expected line wise rate of laying (km/day) for each pipeline.</p> <p>l) Details of the complete proposed shore approach pipe laying spread (if applicable) including the marine and land based equipment.</p> <p>m) Proposed direction of pipe laying for each pipeline.</p> <p>n) Proposed method of pipe laying at shore approaches.</p> <p>o) Details of the proposed cathodic protection surveys.</p> <p>p) Details of the computer programs proposed to be used for the various analyses.</p>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

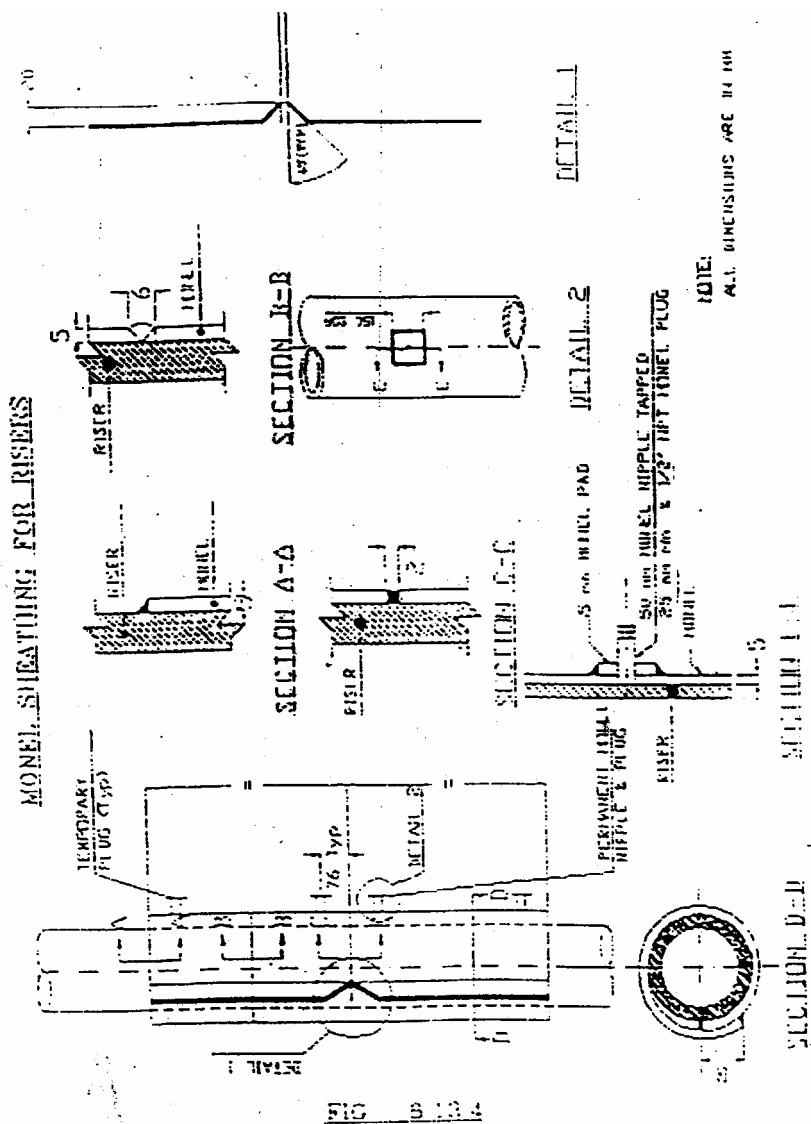


	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015										
			Rev. No.	1										
			Discipline:	PIPELINE										
			Page No.49 of 54											
<p>q) Reference list of similar installation works carried out by the Contractor using the proposed marine spread, including all relevant details viz. Project, Year, Client, Location, Size, Service, Water depth, Concrete coating thickness, Average lay rate per day attained, etc. in the fast five years.</p>														
16.2	Contractor shall prepare and submit for Company approval, six copies of the following documents in sufficient details as enumerated herein below, at least eight, weeks before commencement of respective works at the site:													
16.2.1	<b>Procedures</b>													
	<p>a) Pre-engineering survey, if applicable</p> <p>b) Pre-construction survey</p> <p>c) Welding and welder qualification procedures</p> <p>d) Survey Positioning Procedure</p> <p>e) Pipeline Installation Procedure</p> <p>f) Riser Installation Procedure</p> <p>g) On-line valves, Lateral Assembly, PLEM Installation and Expansion Loop Installation Procedures (as applicable).</p> <p>h) Anchor handling procedure and Anchor pattern to be adopted in the vicinity of the existing installations.</p> <p>i) Diving procedures.</p> <p>j) Method of pipeline repair in case of dry buckle/wet buckle.</p> <p>k) Abandonment/Recovery procedures to be adopted in case of contingencies.</p> <p>l) Procedure to ensure the spacing between the pipelines, in case of parallel lines.</p> <p>m) Survey procedure to establish and prepare ‘as-laid/as-build’ drawings upon completion of installation.</p> <p>n) Cathodic protection survey procedures.</p>													
<table><tr><td>FORMAT No.</td><td>Ref. PROCEDURE No.</td><td>ISSUE No.</td><td>REV. No.</td><td>REV. DATE:</td></tr><tr><td>ODS/SOF/004B</td><td>ODS/SOP/008 TO 015</td><td>01</td><td>01</td><td>15/10/2003</td></tr></table>					FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:	ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:										
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003										

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.50 of 54	
<div>o) Umbilical installation procedure (if applicable)</div> <div>p) Trenching and back-filling procedure (if applicable)</div> <div>q) Hydrostatic testing procedure (if applicable).</div> <div>16.2.2 Calculations</div> <div>a) Pipeline stress analysis during installation.</div> <div>b) Riser stress analysis during installation.</div> <div>c) On-line valves, lateral assemblies and PLEM stress and stability analysis.</div> <div>d) Abandonment/recovery stress analysis</div> <div>e) Stress analysis of pipeline crossing</div> <div>f) Stress analysis for the free spans/free span calculation</div> <div>g) Transportation analysis</div> <div>16.2.3 Design Documents</div> <div>a) Design of the pipeline crossings</div> <div>b) Design of PLEM, on-line valves and lateral assemblies.</div> <div>c) Umbilical route and stability analysis (if applicable)</div> <div>d) Design of cathodic protection of PLEM and protective cages for on-line valves, lateral and PLEMS assemblies (as applicable).</div> <div>16.2.4 Material Details</div> <div>a) Details of all materials to be furnished by Contractor including the following as a minimum:</div>				
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
	DESIGN		Rev. No.	1
	SECTION		Discipline:	PIPELINE
	Page No.51 of 54			
<ul style="list-style-type: none"><li>- Complete technical documentation of the material including catalogs, test certificates, drawings etc. for various proposed Manufacturers/Vendors.</li><li>- Reference of list of previous similar supplies in the past five years.</li><li>- Any other documents specially listed in the Company Material Specifications for Submarine Pipelines.</li></ul>				
17.0	<b>DAILY REPORTS</b>  Daily progress reports on laying operations shall be given to the Company Representative on-board and communicated to the Company's office onshore on a daily basis. This shall include as a minimum the following: <ul style="list-style-type: none"><li>- Designation of the pipeline section being laid.</li><li>- Barge location/co-ordinates along with chainage</li><li>- Number of joints laid in the last 24 hrs.</li><li>- No. of weld repair, and barge time lost in weld repair</li><li>- Quality of field joint coating operations.</li><li>- Weather status</li><li>- Any other relevant details</li></ul>			
18.0	<b>SUPPLY OF MATERIALS</b>  Contractor shall be responsible for supply of all materials (other than those supplied by Company as free issue materials to Contractor) and consumable required for completion of works in all respects, in compliance with the requirements of this specification.  All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant applicable Company Materials Specifications and shall include, as a minimum, the following:			
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

	OFFSHORE DESIGN SECTION	FUNCTIONAL SPECIFICATION FOR INSTALLATION OF SUBMARINE PIPELINES AND RELATED FACILITIES	SPEC. No.	2015
			Rev. No.	1
			Discipline:	PIPELINE
			Page No.52 of 54	
<p>a) Welding electrodes and all other consumables.</p> <p>b) All materials and equipment for coating field joints and repairing damaged yard applied coating.</p> <p>c) All pipe supports, hanger flanges, clamps, etc. necessary for the installation of the pipeline.</p> <p>d) All support bags and spacers for the pipeline crossings and free spans.</p> <p>e) Any other material required to complete the works in all respect.</p>				
FORMAT No. ODS/SOF/004B	Ref. PROCEDURE No. ODS/SOP/008 TO 015	ISSUE No. 01	REV. No. 01	REV. DATE: 15/10/2003



FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004B	ODS/SOP/008 TO 015	01	01	15/10/2003

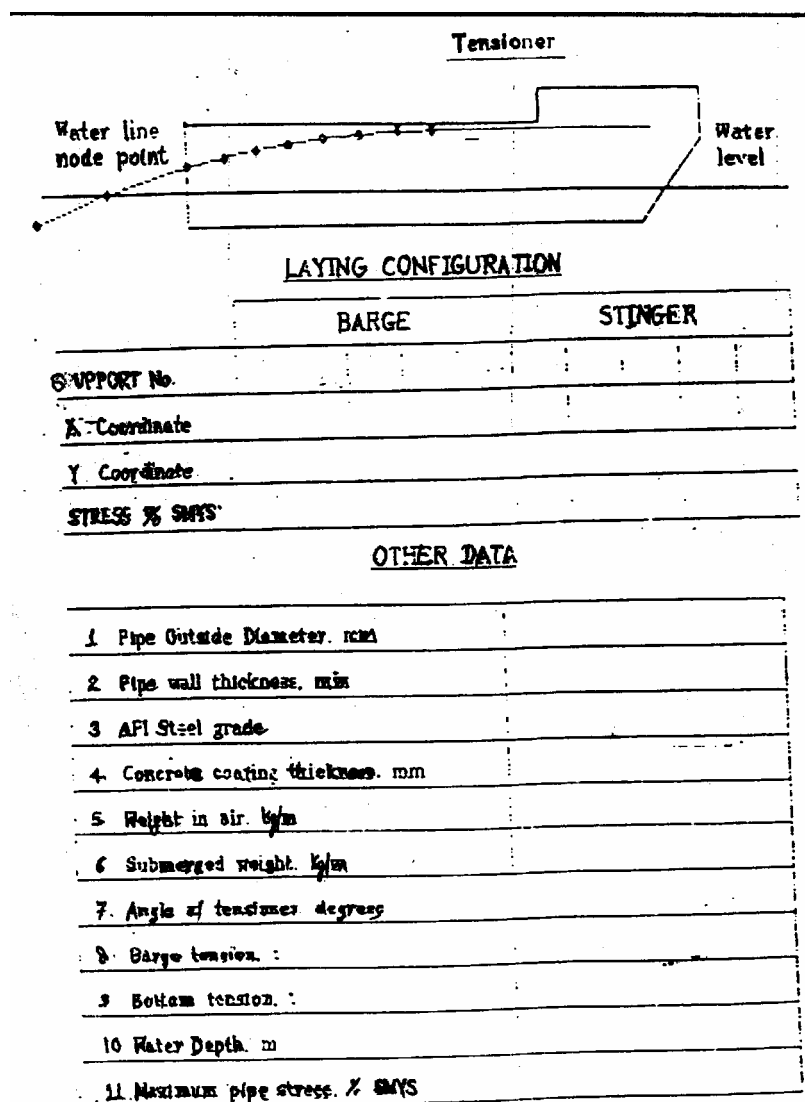


FIG - 16.1