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	CLIENT: PETROBRAS	SHEET: 1 of 12
	PROGRAM: RIGID OFFSHORE PIPELINES	CC
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INDEX OF REVIEWS

REV.	DESCRIPTION AND/OR AFFECTED PAGES
0 A	ORIGINAL Sections 4, 8.7 and 14

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1 SCOPE

- 1.1 The scope of the present Specification cover, as per the Project requirements, the dewatering, MEG swabbing and Nitrogen purging operations and the analysis of the results.
- 1.2 This specification applies for dewatering, conditioning and nitrogen purging of offshore pipelines and their risers.
- 1.3 This specification applies for gas pipelines.

2 REFERENCES

- 2.1 DNVGL-ST-F101 - Submarine Pipeline Systems.
- 2.2 IGEM/TD/1: Edition 5:2008 – Appendix 9 Steel Pipelines and Associated Installations for High Pressure Gas Transmission – Methanol Swabbing.
- 2.3 DNVGL-RP-F115 – Pre-commissioning of submarine pipelines.

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions


- 3.1.1 CONTRACTOR: The company responsible for the dewatering, conditioning and nitrogen purging of subsea pipelines.
- 3.1.2 May: A course of action permissible within the limits of this specification (used when referring to CONTRACTOR).
- 3.1.3 Must not: Prohibited requirement (used when referring to CONTRACTOR).
- 3.1.4 Shall: Mandatory requirement (used when referring to CONTRACTOR).
- 3.1.5 Should: Preferred requirement (used when referring to CONTRACTOR)


3.2 Abbreviations

- 3.2.1 MEG: MONOETHYLENE GLYCOL
- 3.2.2 PLR - Pig Launcher and/or Receiver
- 3.2.3 R.B.C.: Rede Brasileira de Calibração

4 GENERAL

- 4.1 The submarine gas pipelines and their risers shall be dewatered, conditioned and nitrogen purged as soon as practicable after being advised by the Construction group that the pipelines and risers are hydrottested and approved. The hydrottested final condition of the pipelines shall be informed by the Construction Group.

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<p>4.2 The limits of the conditioning and nitrogen purging section shall be from PLR to PLR.</p> <p>4.3 A complete inventory of equipment and spares shall be available prior to start of operation. Main spares needed in case of breakdown of any equipment or instruments shall be available on site. A sketch with the lay out of equipment on vessel or on platform shall be supplied and the necessary area shall be informed.</p> <p>4.4 Equipment shall be suitable for offshore handling. All lifting and handling equipment and materials shall have valid certificates.</p> <p>4.5 Prior to be conditioned, the as-laid survey of the offshore pipeline shall be performed and completed to verify that the pipeline has been laid within the specifications of the alignment sheets, pipeline crossings, length and height of free spans, etc. Pipeline as-built survey shall be performed after the scope of this specification is completed.</p> <p>4.6 For offshore pipelines, when the pressure measuring device is normally located on the platform above mean sea level, a reduction in recorded pressure equivalent to the hydrostatic head between the mean sea level and location of the pressure measuring device is required. In case if the pressure measuring device is located on seabed level, the proper hydrostatic head of the pipeline shall be considered.</p> <p>4.7 For each operation, a Data Sheet shall be prepared indicating at least, the name of the line, the owner of the line, the main CONTRACTOR, the overall length of the pipeline, the detailed description of the pipeline section to be conditioned, the outside diameter, the steel grades, the various thickness(es), the design pressure, the test pressure, the volume of MEG to be injected, and the final delivery condition.</p> <p>4.8 This data sheet shall be attached to the operation procedures.</p> <p>4.9 Contractor shall provide procedures for the operations to PETROBRAS approval. No operation shall be started before approval of the procedures is obtained. The conditioning and nitrogen purging operations of pipelines and risers and associated accessories shall be approved and witnessed by PETROBRAS and Certify Authority.</p> <p>4.10 CONTRACTOR shall be responsible for disposal of all chemical products in accordance with the environmental regulations.</p> <p>4.11 CONTRACTOR shall provide all material required for dewatering, conditioning and nitrogen purging of the pipeline, including downlines, tanks, pigs, instruments, MEG, Nitrogen and any valves added to the line, which is being incorporated to allow for finishing the pipeline pre-commissioning as well as any equipment for MEG final disposal.</p> <p>4.12 During gas pipeline pre-commissioning operations with pressurized equipment on deck vessels, facilities shall be provided for remote operation of any valve or equipment to be operated under pressure, minimizing the exposure of people.</p>			


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5 DESIGN CONSIDERATIONS

- 5.1 The delivery condition for pipeline shall be in accordance with the project and it is defined in the project data sheet.
- 5.2 Dewatering, conditioning and nitrogen purging activities shall not be performed without a written approval of PETROBRAS.
- 5.3 Dewatering, conditioning and nitrogen purging activities shall not be performed without an approved previous procedure showing at least:
- 5.3.1 Dewatering, conditioning and nitrogen purging diagrams;
 - 5.3.2 Pipe specifications and manufacturer;
 - 5.3.3 MEG volume to be injected;
 - 5.3.4 Nitrogen pressure, volume and flowrate;
 - 5.3.5 Calculations for dewatering, MEG swabbing and nitrogen purging. This shall include but is not limited to pressure, volume and duration to achieve a minimum pig speed in compliance with reference [2.3], section 5.1.2.4 The minimum volume of MEG for each batch shall be defined in accordance with Ref. [2.2],
 - 5.3.6 Layout of equipment with dimensions;
 - 5.3.7 List of equipment with its description;
 - 5.3.8 Drawings of pigs;
 - 5.3.9 Schedule of activities;
 - 5.3.10 Test method description to achieve the required pipeline dryness condition and purging requirements;
- 5.4 The procedures shall include an isometric drawing showing all equipment and associated piping. This procedure shall be accompanied with a detailed description of all equipment and instrumentation.
- 5.5 All the calculations shall be presented in **MATHCAD** format including all steps of the calculation methodology.

6 DEWATERING OPERATIONS

- 6.1 Displacement of water shall be performed with nitrogen or dry air. The Dew Point of the air utilized to dry the pipeline shall be compatible with the Dew Point of the hydrocarbon gas, see pipeline data sheet.
- 6.2 The period from end of dewatering to start of drying shall be performed as soon as possible to prevent puddles forming at low points.

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<p>6.3 It is mandatory that a certified calibrated turbine flow meter be used during all operations. The certifying authority must be one approved by PETROBRAS. Certification is valid during 6 months.</p> <p>6.4 Volumes pumped into pipeline shall be controlled and registered during all operations. Estimative of pig losses shall be made to permit location of pig position at any time.</p> <p>6.5 When the water discharge into the sea is allowed by the environmental authority, the dewatering shall be done upwards through the output placed on the level, at least, 4 meters above the seabed. The discharge at sea level is not allowed.</p>			
<h2>7 MEG SWABBING OPERATIONS</h2>			
<p>7.1 The pig train swabbing operation consists of running into the pipeline batches of MEG to suppress the potential for hydrate formation after the dewatering operation by compressed dry air or nitrogen. The minimum volume of MEG for each batch (minimum of 2 batches) shall be defined by CONTRACTOR based on the Dew Point of the hydrocarbon gas, included in the data sheets. As a minimum Ref. [2.2] shall be adopted.</p> <p>7.2 It's not allowed to perform the MEG swabbing in the same pig train when compressed air is used. The interface MEG/pig/air is not permitted.</p> <p>7.3 The accuracy of the equipment to validate the MEG swabbing shall be in compliance with the range to be measured.</p> <p>7.4 Certified proof of accuracy of gauges and equipment shall be submitted prior to the start of the operation and be included in the final report. Maximum validity of certificates is six months.</p> <p>7.5 MEG samples shall be extracted from the last batch of MEG to be pigged out from the pipeline, in order to validate the drying operation. The chemical composition of the sample of MEG pigged out shall be compatible with the Dew Point of the hydrocarbon gas, see Data Sheets. CONTRACTOR shall establish, for PETROBRAS approval, the required MEG chemical composition after drying. As a minimum Ref. [2.2] shall be adopted.</p> <p>7.6 All operation shall be recorded and reported.</p> <p>7.7 All data shall be gathered and submitted to the PETROBRAS representative for analysis. The conclusion of MEG swabbing operations shall be in accordance with PETROBRAS representative decision.</p> <p>7.8 The acceptance criteria shall be in compliance with the pipeline design specification. MEG swabbing activity shall be approved by PETROBRAS before start nitrogen purging activity.</p> <p>7.9 The MEG swabbed pipeline shall be delivered with the necessary pressure to proceed the nitrogen purging operation.</p>			

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8 NITROGEN PURGING OPERATIONS


- 8.1 The nitrogen purging shall be applied to the gas pipeline, to ensure that hydrocarbon gas not come into contact with the air on commissioning.
- 8.2 The maximum percentage of oxygen shall be lower than 5%, volume, at the end of the purging operation. CONTRACTOR shall guarantee that this value is uniform along the pipeline.
- 8.3 The percentage of oxygen shall be measured, controlled and registered at the nitrogen inlet point during purging operations. This percentage shall be lower than 5%, volume.
- 8.4 At the end of nitrogen purging operations the percentage of oxygen shall be measured at the outlet point and shall be lower than 5%, volume.
- 8.5 CONTRACTOR shall deliver the pre-commissioned gas line with the internal pressure in accordance with the specified by the project or equal to the atmospheric pressure, if not specified.
- 8.6 Nitrogen packing is not acceptable.
- 8.7 After the operation of nitrogen purging the equipment valves shall be closed and the caps shall be installed in the PLETs in accordance with the project specification, if applicable. **Final nitrogen pressure shall be registered.**

9 IN-LINE EQUIPMENT DEWATERING OPERATIONS

- 9.1 After hydrotest the valves (in contact with the hydrotest fluid) of pipeline in-line equipment are in 50% closed position.
- 9.2 At the end of dewatering operation these valves shall be closed and the space between valve and test cap are to be filled with Meg-gel.
- 9.3 These valves in closed position shall be tested (with Meg-Gel) from the test cap. The test shall be performed with a pressure higher than the local water depth during 15 minutes. The acceptance criterion is no pressure decrease higher than 3% during 1 hour. The absolute test pressure (water depth pressure plus gage pressure applied by the ROV) shall be limited to the valve Rated Working Pressure (RWP).
- 9.4 In case of test failure the CONTRACTOR shall propose mitigation actions.
- 9.5 At the end of the test the space filled with Meg-Gel shall stay with pressure (pressure just higher than the water depth).

10 CONTINGENCY PROCEDURES

- 10.1 CONTRACTOR shall describe the possible contingency situations such as pig stuck, required purity of receiving MEG not achieved, required purity of nitrogen not achieved, equipment failure, bad weather, etc.

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10.2 CONTRACTOR shall present contingency procedures for each situation, when necessary, and provide the required equipment and operations.

11 EQUIPMENT AND MATERIALS

11.1 The following equipment and materials shall be provided as a minimum:

11.1.1 Downlines

11.1.2 Hoses

11.1.3 MEG and Nitrogen

11.1.4 Tanks

11.1.5 Oxygen meters

11.1.6 Densimeters

11.1.7 Gauges

11.1.8 PLRs

11.1.9 High sealing bi-directional pigs. The pigs shall be able to pass through the bends and the subsea equipment (PLETs, T, Y, derivations and reductions) in compliance with the design requirements.

11.1.10 Flowmeters and totalizers

11.1.11 Pig detection system including transmitters to be fitted on pigs and receivers on ROV.

11.1.12 Tanks for MEG collecting for final disposal

11.1.13 All necessary chemical products

11.1.14 Necessary equipment for the communication.


11.1.15 All rigging materials, containers, tanks, test cabin, temporary pipework, fittings, filters, spare parts, chemicals, hoses and necessary equipment and materials to perform the dewatering, conditioning and nitrogen purging operations.

12 OTHERS REQUIREMENTS FOR DEWATERING, CONDITIONING AND NITROGEN PURGING

12.1 The recording instrument shall be checked periodically through the operations period.

12.2 The pressure, flowrate and volume shall be properly monitored and registered periodically.

12.3 All equipment / instruments involved in measurement activities shall show calibration certificates issued by an agency accredited by R.B.C. – Brazilian Calibration Network or INMETRO. The calibration certificate validity time shall be at least 6 months.


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<p>12.4 The pigs shall be fitted with magnets for subsea detection with magnetic pig signaller with cradle to be assembled at each end of the pipeline, totaling 2 for all pre-commissioning operations. If CONTRACTOR propose another method for pig detection, this method shall be previously tested considering the pipeline features and approved for PETROBRAS. The test shall be previously discussed with PETROBRAS. Diverless operated pig launch/receivers shall be used in deep water operations.</p> <p>12.5 If the pipeline is internally coated, the pigs shall be specified in order to take it into account. The pigs shall not cause any damage to the internal coating. For instance, steel brushes and steel parts of pig in contact with the internal coating are not allowed.</p> <p>12.6 The operations shall start at a time to be agreed with PETROBRAS. The conditioning and nitrogen purging termination shall be agreed with PETROBRAS.</p> <p>12.7 Pressure shall be carefully released and the depressurization shall be regulated to ensure a moderate and constant reduction pressure at a rate not exceeding 3 bar/min.</p> <p>12.8 CONTRACTOR shall provide a mean to remove the plug of water between the isolation valve and the vertical hub of the PLETs and PLEMs, if applicable. Ports are acceptable only at the test cap. The MEG to fill the space between the isolation valve and the vertical hub shall be injected within a gel solution (MEG-Gel) to produce a product denser than the sea water.</p> <p>12.9 The gel to be used shall not react with ethanol. It shall also be stable over time and heat stable. CONTRACTOR shall perform tests in order to guarantee that the MEG Gel mixture will be chemically compatible with ethanol. The results of these tests shall be presented in a report with pictures and methodology.</p> <p>12.10 The MEG-Gel mixture shall be denser than seawater and the pH shall be equal to 7. The minimum flash point of the mixture shall be 100 °C.</p> <p>12.11 The chemical composition of the MEG-Gel mixture shall not contribute to hydrate formation.</p> <p>12.12 CONTRACTOR shall previous perform tests (trials), before offshore operations, to specify the viscosity of the MEG Gel mixture in order to guarantee the remotion of all seawater from the pipeline section. CONTRACTOR shall also provide this trial report. The report shall present, at least, the chemical composition, methodology, pictures, calculations, density, viscosity at filling conditions (subsea temperature), estimated time for filling operations regarding the specified flowrate of the device to be used in the filling operations, etc.</p> <p>12.13 The pipelines shall be left in accordance with specific project definitions and in compliance with the design requirements.</p>			

13 DISPOSAL OF FLUIDS

- 13.1 The hydrotest treated water (with dye or not) from the pipelines shall be disposed in such way that no harm is done to the surrounding environment.
- 13.2 Water disposal procedure with chemical, dye or not shall be approved by Brazilian Environmental Authorities.
- 13.3 It is not allowed to discharge MEG at sea. CONTRACTOR shall have to establish a procedure to collect the MEG for final disposal.

14 DOCUMENTATION

- 14.1 All observations shall be recorded on the appropriate forms stating clearly the event. Incomplete forms and absence of documentation should be a cause of a new operation.
- 14.2 CONTRACTOR shall supply, at least, the following documents:
 - 14.2.1 Pipeline and heads diagram and drawings;
 - 14.2.2 Pigs, pig trackers specification and drawings;
 - 14.2.3 Oxygen meters, densimeters and hygrometers specification;
 - 14.2.4 Pipeline dewatering procedure;
 - 14.2.5 Pipeline MEG swabbing procedure;
 - 14.2.6 Pipeline Nitrogen purging procedure;
 - 14.2.7 MEG-Gel trial reports;
 - 14.2.8 MEG-Gel filling procedure;
 - 14.2.9 Pressure recording instruments calibrations;
 - 14.2.10 Dewatering, conditioning and nitrogen purging diagram;
 - 14.2.11 Dry compressed air calculation, if applicable;
 - 14.2.12 MEG calculations;
 - 14.2.13 Nitrogen calculations;
 - 14.2.14 MEG evaluation and acceptance;
 - 14.2.15 Final oxygen content and acceptance criteria;
 - 14.2.16 Final nitrogen pressure and respective level of reference;

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<p>14.2.17 Records of failures, if applicable;</p> <p>14.2.18 Pipeline sketch showing location/position of all instrument and injection connections;</p> <p>14.2.19 Instruments certificates of accuracy;</p> <p>14.2.20 Calibration certificates for instruments and test equipment;</p> <p>14.2.21 Data sheets of products and additives specification, supplier and amounts injected;</p> <p>14.2.22 Material safety data sheets;</p> <p>14.2.23 Environmental Impact Assessment, regarding to disposal of chemicals;</p> <p>14.2.24 Drawings and layout of the equipment on board of the vessel or platform or on the beach;</p> <p>14.2.25 Schedule of all operations;</p> <p>14.2.26 Valve settings status;</p> <p>14.2.27 Drawings;</p> <p>14.2.28 Durations of dewatering and venting;</p> <p>14.2.29 Durations of MEG swabbing and nitrogen purging;</p> <p>14.2.30 Calculations demonstrating that equipment have adequate capacity to carry out the activities outlined in this specification;</p> <p>14.2.31 Data showing the estimated volume of air/nitrogen required for dewatering of the pipeline;</p> <p>14.2.32 Drawings giving details of proposed equipment including all instrumentation layouts and equipment settings;</p> <p>14.2.33 Drawings showing flowline elevation at pressure measurement points;</p> <p>14.2.34 Calculations demonstrating that equipment have surplus capacity to carry out the activities outlined in this specification;</p> <p>14.2.35 Data showing the estimated volume of MEG required for the conditioning and to be recovered;</p> <p>14.2.36 Data showing the estimated volume of nitrogen required for the purging;</p> <p>14.2.37 Estimated time calculations for pigs arrival;</p> <p>14.2.38 Estimated duration calculations for each operation;</p> <p>14.2.39 Functional Requirements to PLR and flexible downline and/or coil tubing;</p>			



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- 14.2.40 Specifications, dimensions and drawings of pigs;
- 14.2.41 All equipment specifications and datasheets;
- 14.2.42 Drawings giving equipment layouts including sizes and weights;
- 14.2.43 Pictures;
- 14.2.44 Final reports.