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INDEX OF REVISIONS									
REV.	DESCRIPTION AND/OR REVISED SHEETS								
0	ORIGINAL ISSUE								
A	REVISED WHERE INDICATED								
B	REVISED WHERE INDICATED								
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	MAR/25/21	SEP/20/22	DEC/14/22						
DESIGN	EEA	EEA	EEA						
EXECUTION	CJH4	HXG3	HXG3						
CHECK	U3B9	CJH4	CJH4						
APPROVAL	U32N	U32N	U32N						
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1 SCOPE

This specification covers the minimum requirements for design and assembly of corrosion monitoring systems to be used in offshore oil production units.

2 NORMATIVE REFERENCES

All equipment shall comply with the requirements of this technical specification and references stated herein. All equipment parts and details not complying with any of these requirements shall be informed on a "Deviation List". Otherwise, they will be considered as "Agreed", and so required.

As a general guideline, in case of conflicting requirements between this technical specification and other cited references, the most stringent shall prevail. If necessary, the SELLER may revert to BUYER for clarification.

2.1 CLASSIFICATION

- 2.1.1 SELLER shall perform the work in accordance with the requirements of Classification Society.
- 2.1.2 SELLER is responsible for submitting to the Classification Society all documentation in compliance with stated Rules.

2.2 CODES AND STANDARDS

- 2.2.1 The latest editions of the following codes and standards shall be used as design guidelines.

Table 1: Codes and Standards

API RP-505	- Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2
ASME B31.3	- Process Piping
IEC-60092-502	- Electrical Installations in Ships
IEC-61892-7	- Mobile and Fixed Offshore Units - Electrical Installations.
IEC 61892-6	- Mobile and Fixed Offshore Units – Electrical Installations – Installation
ISO 12944-2	- Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments
ISO 21457	- Petroleum, petrochemical, and natural gas industries - Materials selection and corrosion control for oil and gas production systems
ISO 15156	- Petroleum, petrochemical, and natural gas industries — Materials for use in H2S-containing environments in oil and gas production
NACE SP 0775	- Preparation, Installation, Analysis, and Interpretation of Corrosion Coupons in Oilfield Operations



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2.3 GOVERNMENT REGULATION

2.3.1 Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein.


Table 2: Brazilian Regulatory Standard and Government Regulation

NR-10	Brazilian Regulatory Standard - Safety in Electrical Facilities and Services
NR-13	Brazilian Regulatory Standard - Boilers, Pressure Vessels, Pipes and Metallic Storage Tanks
NR-17	Brazilian Regulatory Standard – Ergonomic
NR-26	Brazilian Regulatory Standard - Safety Signaling
NR-37	Brazilian Regulatory Standard Safety and Health in Petroleum Platforms
IBAMA	Brazilian IBAMA environmental regulations concerning the discharge of all types of effluents
INMETRO	INMETRO Resolution nº 115, March 21 st 2022

2.4 DESIGN SPECIFICATIONS

Table 3: Design Specifications

DR-ENGP-M-I-1.3	- SAFETY ENGINEERING GUIDELINE
DR-ENGP-I-1.15	- COLOR CODING
I-ET-3000.00-1200-940-P4X-001	- TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
I-ET-3010.00-1200-940-P4X-002	- GENERAL TECHNICAL TERMS
I-ET-3010.00-1200-955-P4X-001	- WELDING
I-ET-3010.00-1200-800-P4X-002	- AUTOMATION, CONTROL, AND INSTRUMENTATION ON PACKAGE UNITS
I-ET-3010.00-1200-956-P4X-002	- GENERAL PAINTING
I-ET-3010.00-1200-970-P4X-004	NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS
I-ET-3010.00-1200-859-P4X-001	- AUTOMATION REQUIREMENTS FOR CORROSION MONITORING SYSTEM (CMS)
I-ET-3010.00-1200-200-P4X-001	- MINIMUM REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT
I-ET-3010.00-1200-200-P4X-115	- REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING

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Note: Specific Documents to be supplied by BUYER
PROCESS DATASHEET
GENERAL ARRANGEMENT
GENERAL AREA CLASSIFICATION
PIPING SPECIFICATION

2.5 CONFLICTING REQUIREMENTS

- 2.5.1 In case of conflicting information between this Specification (ET) and other specific BUYER document (data sheet), the specific BUYER document shall prevail.
- 2.5.2 In all cases of conflict between this specification and applicable documents listed herein, the more stringent requirements shall prevail. In such cases, SELLER shall inform BUYER of the conflict and seek clarification.

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

- 3.1.1 All Terms and definitions are established in the latest revision of I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS.


3.2 ABBREVIATIONS

CLASS	-	Classification Society
CMS	-	Corrosion Monitoring System
ER	-	Electric Resistance Probe
FAT	-	Factory Acceptance Test
FSM	-	Field Signature Measurement
FPSO	-	Floating Production Storage and Offloading
HAZOP	-	Hazard and Operability Study
ITP	-	Inspection and Test Plans
LPR	-	Linear Polarization Resistance Probe
NDT	-	Non-Destructive Test
PHA	-	Process Hazards Analyses
SAT	-	Site Acceptance Test

4 GENERAL REQUIREMENTS

4.1 DESIGN REQUIREMENTS

- 4.1.1 All components of the corrosion monitoring systems shall be suitable for marine environment according to class CX of ISO 12944 Part 2, and compatible with process fluids to be monitored.

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4.1.2 Online monitoring shall have a Corrosion Monitoring System (CMS) connected to the Automation and Process Control System of the Offshore Unit and all the data must be available through an industry-standard open communication protocol.

4.1.3 Control system, electrical installation, consoles, and software shall follow requirements of I-ET-3010.00-1200-859-P4X-001 - AUTOMATION REQUIREMENTS FOR CORROSION MONITORING SYSTEM (CMS) in addition with requirements set herein.

4.2 LOCATION OF CORROSION MONITORING POINTS:

4.2.1 Monitoring points shall be installed at bottom of pipe (at 6 o'clock position) on a horizontal and straight segment as illustrated in Figure 2.

4.2.2 The monitoring points of water systems with monophasic flow may be installed in any pipe position and direction (vertical or horizontal).

4.2.3 The monitoring points shall be located at a minimum distance of 5 times pipe nominal diameter away from any pipe accessory which can induce turbulence (such as bends, branches, valves instruments, or any other appurtenance) as illustrated in Figure 1.

4.2.4 The corrosion monitoring points shall be installed downstream of corrosion inhibitors injection points.

4.2.5 Corrosion monitoring points in pipe sections hanging over the sea area is not allowed.

4.3 PAINTING

4.3.1 Paint system for external coating shall be according to I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

4.3.2 Color code shall comply with DR-ENGP-I-1.15 - COLOR CODING.

5 REQUIREMENTS FOR INTRUSIVE TECHNIQUES

5.1 GENERAL REQUIREMENTS

5.1.1 Design pressure of the components shall be equal or greater than the pressure rate of listed fittings in the pipe SPEC to be installed.


5.1.2 The following equipment's shall be delivered as loose item and include as part of the corrosion monitoring system.

5.1.2.1 One retrieval tool kit with a service valve for in-service pressurized operation. The retrieval equipment shall be compatible with all access fitting assemblies delivered.

5.1.2.2 One handheld collector for manual data collection of online monitoring system.

5.1.3 Project design shall select either a mechanical or a hydraulic type of access fittings assemblies. The use of both systems within one Offshore Unit design is not permitted.

5.1.4 The corrosion monitoring system and the access fittings should be from only one supplier. Different suppliers may be accepted if proven that devices from both suppliers are compatible and interchangeable. In this case the prior approval of **BUYER** is required.

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5.2 ACCESS FITTING

- 5.2.1 The access fitting shall be design according to ASME B31.3 and also shall follow the requirements stated in pipe specification of the project [document supplied by BUYER].
- 5.2.2 Welding of access fitting to the run pipe shall follow the requirements of I-ET-3010.00-1200-955-P4X-001 - WELDING.
- 5.2.3 Welding shall be carried out with procedures and welders qualified in accordance with Design Code and additional requirements stated in contractual technical specifications. Welding shall not be performed before qualified welding procedures specification have been approved.
- 5.2.4 Welding inspection shall be according to the Design Code and additional requirements stated in the contractual technical specification I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING.
- 5.2.5 Buttwelded end access fittings shall be welded to a reducing Tee or a Weldolet as defined by run pipe to branch size table according to piping specification of the project [document supplied by BUYER].
- 5.2.6 Run pipes above or equal NPS 6 shall have flareweld end access fitting directly welded to run pipe.
- 5.2.7 Run pipes below NPS 6 shall have buttwelded end access fittings welded to a reducing Tee at the run pipe.
- 5.2.8 Socket welded, intermittent fillet welds, flanged or threaded connections to run pipe are not permitted.
- 5.2.9 Access Fitting shall be welded during pipe spool fabrication at pipe shop facilities.
- 5.2.10 Preparation and installation of access fitting shall follow Manufacturer's procedure.
- 5.2.11 It is recommended to cut a small hole before welding and make a final cutting hole sized to the internals after the welding of access fitting assuring the removal of excess weld and burrs.
- 5.2.12 Final cut can be done with a reamer or with drill of a hot tap machine, care shall be taken no to damage internal threads of the access fitting.
- 5.2.13 Access Fitting shall be temporarily plugged with pressure rate suitable to withstand hydrotest.
- 5.2.14 External protective cover to avoid damage during spool handling and installation shall be provided to each access fitting.
- 5.2.15 NDT shall be according to the Design Code and I-ET-3010.00-1200-970-P4X-004 NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS.
- 5.2.16 Final NDTs, for acceptance purposes shall be performed after completion of any post weld heat treatment (when applicable) and prior to paint application, hydrostatic testing, etc.

5.3 MATERIALS SPECIFICATION

- 5.3.1 The access fittings material shall be the same as components of the run pipe specification.
- 5.3.2 Internal components, such as plugs, probes, and coupon holders, shall be in a corrosion resistant material under the operating conditions and process fluids involved, and conform to

the specific technical requirements of standards and design. The **SELLER** is the responsible for the materials specification for those internal parts.

- 5.3.3 **SELLER** shall be responsible for obtaining all necessary certification of the equipment, work, and materials.
- 5.3.4 **SELLER** through the independent certifying authority shall supply all certificates related to the materials, inspections, tests, and qualification activities detailed in the approved Quality Plan.

5.4 CLEARANCE AND ERGONOMY

- 5.4.1 Monitoring point location shall have enough clearance for installation of retrieval kit with service valve. For pipes under NPS 16 at least a clearance of 350 mm radius and 2000 mm length shall be set up around the monitoring point location as shown in Figure 1 and Figure 2. For NPS 16 above the manufacturer shall be consulted for proper installation requirements. The clearance of 2000 mm is applicable only to intrusive techniques. For non-intrusive techniques the minimum distance required shall be based on **SELLER** experience and the value shall be approved by **BUYER**.
- 5.4.2 Monitoring points shall have access by ladders and platforms. For installations heights up to 3,5 m it may be acceptable temporary ladders and scaffolding arrangement when permanent access installation is not feasible.

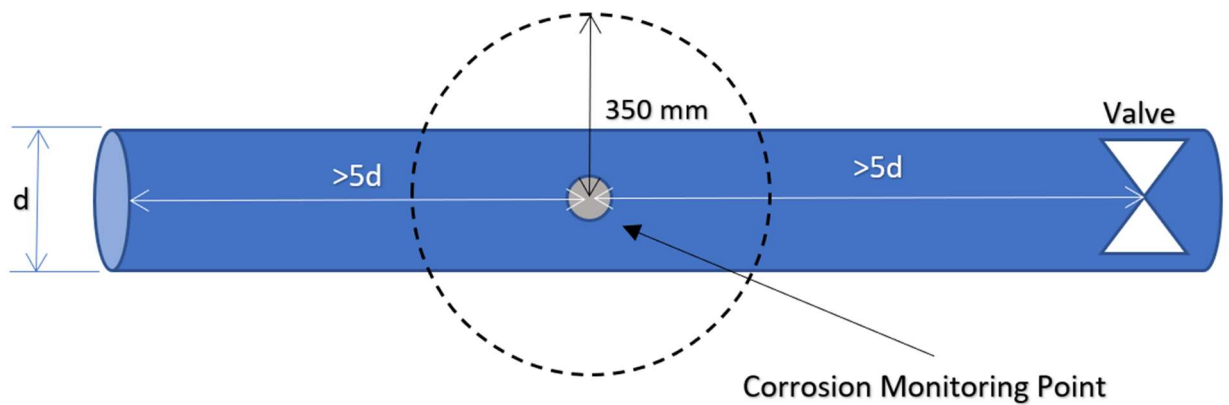


Figure 1 – Top View

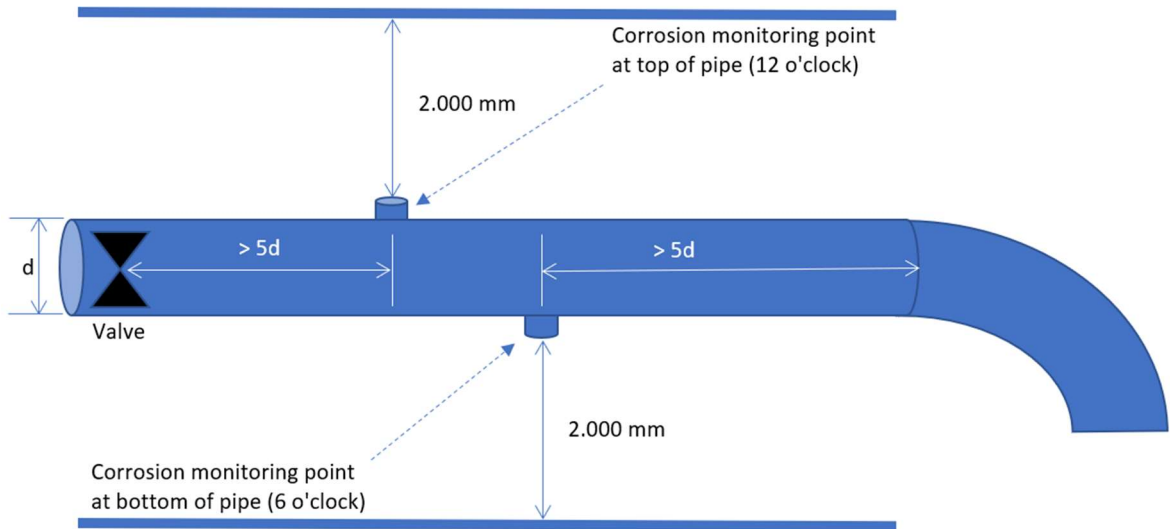


Figure 2 – Side View

5.5 TYPES OF WEIGHT LOSS CORROSION COUPONS

5.5.1 The types of weight loss corrosion coupons that shall be used will be defined by the **BUYER** and specified in the project-specific corrosion monitoring data sheet. Typically, the most common types of coupons specified are flush disc, multiple disc, strip (pair) and ladder strip (pair) as exemplified in Figure 3.

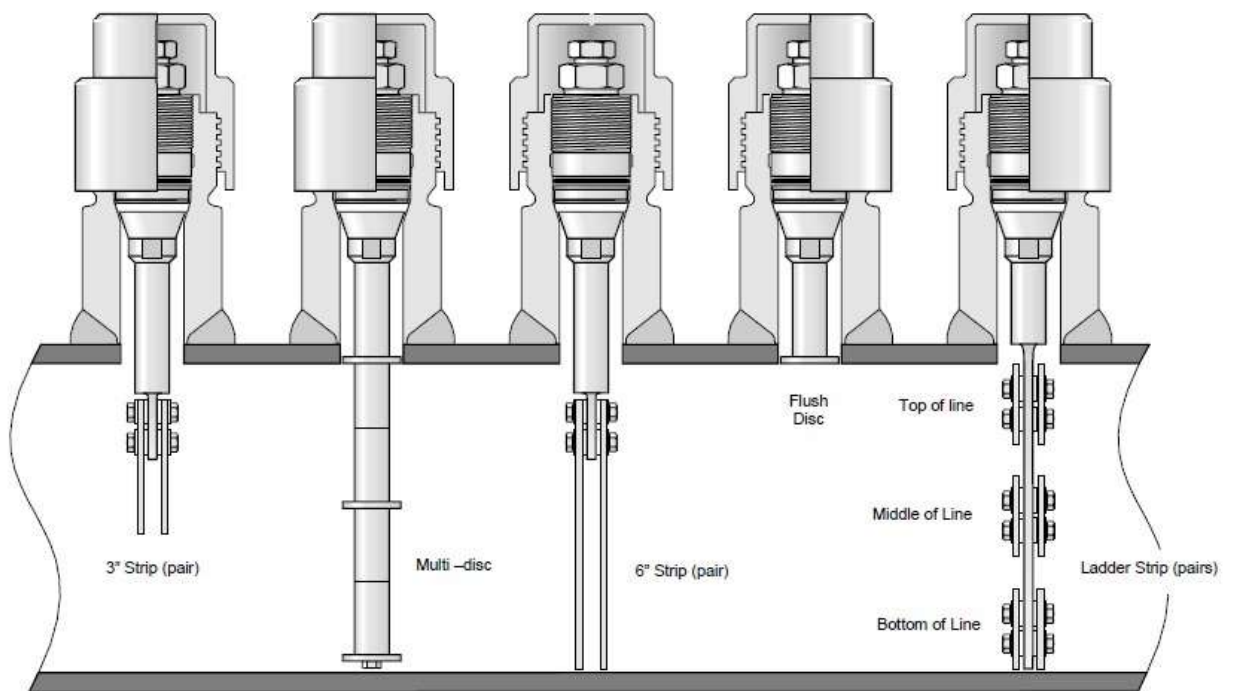



Figure 3: Common types of weight loss corrosion coupons

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5.6 WEIGHT LOSS COUPON HOLDERS FOR SOLID PLUG:


- 5.6.1 There are basically three types of coupon holders: fixed length (pipe plug) and adjustable length (retractable and retrievable coupon holder).
- 5.6.2 Adjustable coupon holder for flush disc type coupon shall be supplied for water systems with provision for pigging.
- 5.6.3 For water systems may be supplied either strip type coupon holder or flush disc type coupon.
- 5.6.4 Oil and gas systems shall be supplied adjustable coupon holder for flush disc type coupon, fixed length is acceptable, and the defined length shall be calculated as a function of the pipe diameter and desired monitoring position.
- 5.6.5 Adjustable or fixed coupon holder length shall be calculated for each piping diameter and thickness.
- 5.6.6 In high pressure systems, retrievable type coupon holders shall be used.

5.7 ELECTRICAL RESISTANCE (ER) AND LINEAR POLARIZATION RESISTANCE (LPR) PROBES FOR HOLLOW PLUG:

- 5.7.1 The ER and LPR probes shall be provided with a system that allows continuous monitoring of the corrosion rate linked to the Corrosion Monitoring Panel according to I-ET-3010.00-1200-859-P4X-001 - AUTOMATION REQUIREMENTS FOR CORROSION MONITORING SYSTEM (CMS).
- 5.7.2 Pigging pipe system shall use flush disc mounted type element with fixed length probe. Fixed length probe shall be selected in accordance with the pipe diameter and thickness.
- 5.7.3 Linear Polarization Resistance (LPR) probes shall be of fixed length with two-electrode system or three-electrode system.

6 REQUIREMENTS FOR NON-INTRUSIVE CORROSION MONITORING DEVICES

- 6.1.1 Non-intrusive corrosion monitoring devices shall be able to determine corrosion rates and mass loss due to corrosion or erosion in a pipe.
- 6.1.2 Devices shall be either Electrical Field Signature Measurement, Guided Waves or Ultrasonic Measurement. Other types of devices may be acceptable under previous approval of BUYER.
- 6.1.3 Transducers or sensing pins shall be installed externally to pipe wall following manufacture installation procedure.

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6.1.3.1 For punctual measurement: A sensing pins spot welded or transducers installed externally to the pipeline over the point to be monitored.

6.1.3.2 For section measurement: An array of sensing pins (spot welded) or transducers installed externally to the pipeline over the section to be monitored.

6.1.4 Cabling from transducers and sensing pins shall be organized and wrapped along the pipe in accordance with manufacturer installation procedure.

6.1.5 When required temperature standardization, a external thermal insulation and / or mechanical protection shall be provided in places where the sensing pins, transducers and the reference plate are installed.

6.1.6 A reference metal plate obtained from the pipe shall be provided when required by the measurement method.


6.1.7 The use of section measurement device as an alternative for punctual measurement device is acceptable.

6.1.8 Requirements for automation system, data collection device, analyzer and software shall follow I-ET-3010.00-1200-859-P4X-001 - AUTOMATION REQUIREMENTS FOR CORROSION MONITORING SYSTEM (CMS).

7 SCOPE OF SUPPLY AND SERVICES

7.1.1 The scope of supply includes, but is not limited to:

- a) Executive procedures of installation and commissioning;
- b) Datasheets of equipment;
- c) Material certificates;
- d) Welding documentation;
- e) Drawings for each equipment;
- f) Installation drawings including general arrangement, electrical diagrams, wiring diagrams, cable list, material list, equipment list;
- g) Supply of equipment, materials and accessories required to carry out the construction, installation and pre-operation of the system, as well as spare parts required for two years of operation;
- h) FAT of automation systems;
- i) Installation and commissioning of the corrosion monitoring system;
- j) Supply of operational manual, inspection, and maintenance;
- k) Execution of training, including the topics related to non-intrusive techniques, real time monitoring, the software; And
- l) Warranty.

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8 CERTIFICATIONS REQUIREMENTS

8.1 CLASSIFICATION SOCIETY CERTIFICATION

- 8.1.1 SELLER shall provide a CLASS Certificate of Compliance to the corrosion monitoring system, when required, for comments and its approval.
- 8.1.2 In order to obtain the Certificate of Compliance all related CLASS activities and CLASS technical requirements are within the SELLER scope of work, as well as all cost associated with it.

8.2 HAZARDOUS AREAS CERTIFICATION

- 8.2.1 All materials and equipment proper to be used in hazardous areas, shall have conformity certificates complying with INMETRO Resolution nº 115, March 21st 2022 and its annexes, and shall be approved by Classification Society. Electrical equipment installed in external safe areas, that shall be kept operating during emergency shutdown ESD-3P and ESD-3T shall be certified for installation in hazardous areas Zone 2 Group IIA temperature T3.


9 TAGS AND SAFETY SIGNALING

- 9.1.1 When applicable, tagging of all instrumentation, electrical, mechanical, and piping items, including valves, shall be in accordance with latest revision of I-ET-3000.00-1200-940-P4X-001 - TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.
- 9.1.2 The main items shall have individual tag numbers as dictated by BUYER. The actual tag numbers will be advised to the SELLER after award.
- 9.1.3 Tags shall be supplied with the number and description in English, unless otherwise stated in the project data sheets.
- 9.1.4 Tag numbers for remaining ancillary equipment shall be given after Purchase Order placement.
- 9.1.5 All safety signs and notices shall be in Portuguese language.

10 INSPECTION, TESTING AND COMISSIONING

10.1 INSPECTION

- 10.1.1 SELLER is required to propose a program for inspection and testing of all supplied equipment for approval by BUYER, prior to commencement of work in accordance with document schedule. Inspection and Test Plans (ITP) shall be issued for each item that are part of the Corrosion Monitoring System (CMS).
- 10.1.2 Unless otherwise stated, all inspections and tests shall be performed at the workshop of SELLER in the presence of BUYER representative and CLASS surveyor as applicable
- 10.1.3 BUYER shall identify all the required witnessed inspections on a marked up copy of the ITP.
- 10.1.4 BUYER reserve the right to inspect the equipment anytime during fabrication and assembly to ensure that material and workmanship are in accordance with this specification.

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10.1.5 SELLER shall ensure that all the witnessed inspection requirements by the classification society are met, and due notice is given.

10.1.6 The notification period for such inspections shall be mutually agreed upon during the kick-off meeting.

10.1.7 The following inspections and checks may be witnessed by BUYER:

- a. Verification of the construction materials of the equipment for conformity with the requirements of the specification;
- b. Verification that piping and fittings are conform with specification of materials and fabrication;
- c. Inspection by radiographic, dye penetrant, magnetic particles, ultrasonic inspection of welds of the pressure retaining parts;
- d. A visual check noting:
 - That the thickness of pressure retaining parts meets or exceeds the quoted design thickness;
 - Any repairs;
 - General appearance, materials, workmanship, and finish standard are acceptable;
- e. Dimensional check;
- f. Alignment check to be demonstrated;
- g. All instrumentation, control panels and ancillary equipment shall be built checked, tested and function tested prior to installation as defined in the specification.

10.2 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

10.2.1 SELLER is responsible for assembly supervision of the equipment/system, including assembly of components delivered loose (for example, vessel internals etc.).

10.2.2 SELLER is responsible for pre-commissioning and commissioning supervision of the equipment/ system. Final acceptance will be on satisfactory completion of commissioning tests as specified by BUYER.

10.3 FIELD SERVICES

10.3.1 SELLER shall carry out verification of assembly, configuration and operation accompaniment of system and Site Acceptance Test (SAT).

10.3.2 SELLER shall carry out training on the installed corrosion monitoring system. The theoretical training content may be taught remotely, and practical training shall be carried out in person and on board the installation. Alternatively, SELLER may suggest carrying out the practical training at the supplier's own facilities, in Brazil, where users will be able to have access to all tools installed on board the installation. The time of theoretical and practical training can be defined by the supplier based on its own experience.

10.3.3 The services shall be executed by 1 (one) technical specialist of the system manufacturer.

NOTE: All costs of transport, lodging and alimentation until the work local are in the scope of manufacturer of the system.

10.4 WARRANTY

10.4.1 SELLER shall give warranty for all components, even for equipment or device furnished by others, up to 24 (twenty four) months from delivery or for 12 (twelve) month operation.



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- 10.4.2 This warranty shall cover fabrication or installation problems, as well as any service included in the scope of supply.
- 10.4.3 Furnisher shall warranty the supply of spare parts, at least, for up to 10 (ten) years after the acceptance test date, and technical assistance at installation site performed by qualified and certified maintenance staff, when requested.
- 10.4.4 During warranty period, any defective part shall be changed for a new one, within one week, after the problem report by **BUYER**.