

	TECHNICAL SPECIFICATION		N°: I-ET-3010.2Q-1223-560-P4X-001			
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	PROGRAM: BASIC DESIGN – REVIT I					
	AREA: MARLIM LESTE E SUL			ESUP		
TITLE: CLEAN IN PLACE UNIT (UT-1223001)			INTERNAL			
INDEX OF REVISION						
REV.	DESCRIPTION AND/OR REVISED SHEETS					
0	ORIGINAL					
A	REVISED WHERE INDICATED					
B	REVISED WHERE INDICATED					
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E
DATE	24/04/24	05/06/24	JUL/09/24			
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1 OBJECTIVE

This Technical Specification covers the minimum requirements for design, engineering, materials, fabrication, inspection, testing, commissioning, and pre-commissioning of the CLEAN IN PLACE UNIT (UT-1223001).

The CLEANING IN PLACE UNIT (CIP) shall be provided with all necessary instruments to operate safely, adequately and without interruption in an offshore facility. The cleaning in place shall be used in order to perform descaling of heat exchangers at the FPSO, as well as some control valves in oil and produced water treatment systems.

The requirements herein listed are applicable to all players performing such related activities within the scope of this unit, including manufacturers, packagers, suppliers, sub suppliers, integrators, constructors, and all technical personnel involved. Within the scope of this document, they are all referred to as being a SELLER.

In addition to the requirements of this technical specification, SELLER shall follow all the requirements of the Exhibit I (SCOPE OF SUPPLY), as well as Exhibit III (DIRECTIVES FOR PRODUCT DEVELOPMENT), Exhibit IV (DIRECTIVES FOR PRODUCT FABRICATION), Exhibit V (DIRECTIVES FOR ACQUISITIONS), Exhibit VI (DIRECTIVES FOR PLANNING AND CONTROL), Exhibit VII (DIRECTIVES FOR QUALITY ASSURANCE SYSTEM) and Exhibit VIII (DIRECTIVES FOR COMMISSIONING PROCESS).

2 NORMATIVE REFERENCES AND DESIGN SPECIFICATIONS

2.1 CLASSIFICATION SOCIETY

2.1.1 SELLER shall perform the work in accordance with the requirements of the Classification Society.

2.1.2 SELLER is responsible for submitting to the Classification Society the documentation in compliance with stated Rules.

2.1.3 Classification Society rules may only be waived upon the formal approval from the Classification Society itself and from BUYER.

2.2 CODES AND STANDARDS

2.2.1 The following codes and standards include provisions which, through reference in this text, constitute provisions of this specification. The latest issue of the references shall be followed unless otherwise agreed.

2.2.2 Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below. Formal approval from BUYER and from Classification Society is also required.


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Table 1: Codes and Standards


ASME B16.5	-	Pipe Flanges and Flanged Fittings
ASME B31.3	-	Process Piping
ASME BPCV VIII Div. 1	-	Rules for Construction of Pressure Vessels
AWS D1.1	-	Structural Welding Code – Steel
DOT-3A	-	Specification for Seamless Steel Transportable Pressure Receptacles
DOT-3AA	-	Specification for Seamless Steel Transportable Pressure Receptacles
IEC 60079 (all parts)	-	Explosive Atmospheres
IEC 61892 (all parts)	-	Mobile and fixed offshore units – Electrical installations
IEC 61260	-	Electroacoustics-Octave Band and Fractional-Octave-Band Filters
IEC 61672 1/2	-	Electroacoustics-Sound Level Meters
ISO 9809 (all parts)	-	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes
ISO 15156	-	Materials for Use in H2S-Containing Environments in Oil and Gas Production – Part 1, 2, and 3
ISO 21457	-	Materials selection and corrosion control for oil and gas production systems

2.3 GOVERNMENT REGULATION

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-12	-	Brazilian Regulatory Standard - Safety in the Work of Machinery and Equipment
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 Signing
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


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2.4 DESIGN SPECIFICATIONS


Table 3: Design Specifications

DR-ENGP-I-1.15	- COLOR CODING
DR-ENGP-M-I-1.3	- SAFETY ENGINEERING GUIDELINE
I-FD-3010.2Q-1223-560-P4X-008	CLEANING IN PLACE UNIT (UT-1223001)
I-DE-3010.00-1400-140-P4X-004	- GENERAL NOTES FOR TOPSIDES STRUCTURES
I-DE-3010.00-5140-797-P4X-002	- ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS
I-DE-3010.00-5140-700-P4X-003	- GROUNDING INSTALLATION TYPICAL DETAILS
I-DE-3010.2Q-1200-94A-P4X-001	- AREA CLASSIFICATION – GENERAL
I-DE-3010.2Q-1421-942-P4X-003	- M10C – OIL PROCESSING - EQUIPMENT LAYOUT PLAN
I-MD-3010.2Q-1200-947-P4X-003	- DESCRIPTIVE MEMORANDUM – SAFETY
I-FD-3010.2Q-5400-947-P4X-001	- SAFETY DATA SHEET - TOPSIDE
I-ET-3000.00-1000-941-PPC-001_F	- METEOCEAN DATA
I-ET-3010.2Q-1400-140-P4X-001	- TOPSIDES STRUCTURAL REQUIREMENTS
I-ET-3010.00-1200-200-P4X-003	- DESIGN, CONSTRUCTION AND ASSEMBLY OF FRP PIPING
I-ET-3010.00-1200-200-P4X-115	- REQUIREMENTS FOR PIPING FABRICATION, ASSEMBLY AND COMMISSIONING
I-ET-3010.00-1200-200-P4X-116	- REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT
I-ET-3010.00-1200-251-P4X-001	- REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-300-P4X-001	- NOISE AND VIBRATION CONTROL REQUIREMENTS
I-ET-3010.00-1200-310-P4X-001	- API 610 CENTRIFUGAL PUMPS SPECIFICATION
I-ET-3010.00-1200-310-P4X-002	- POSITIVE DISPLACEMENT PUMPS SPECIFICATION
I-ET-3010.00-1200-310-P4X-003	- NON-API 610 CENTRIFUGAL PUMPS SPECIFICATION
I-ET-3010.00-1200-431-P4X-001	- THERMAL INSULATION FOR MARITIME INSTALLATIONS
I-ET-3010.00-1200-500-P4X-001	- NON-METALLIC TANKS AND PRESSURE VESSELS DESIGN
I-ET-3010.00-1200-540-P4X-001	- REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION

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<p>I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL, AND INSTRUMENTATION ON PACKAGE UNITS</p> <p>I-ET-3010.2Q-1200-800-P4X-005 - FIELD INSTRUMENTATION</p> <p>I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS</p> <p>I-ET-3000.00-1200-940-P4X-001 - TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN</p> <p>I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS</p> <p>I-ET-3010.00-1200-955-P4X-001 - WELDING</p> <p>I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING</p> <p>I-ET-3010.00-1200-970-P4X-003 - REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION</p> <p>I-ET-3010.00-1200-970-P4X-004 - NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS</p> <p>I-ET-3010.00-1200-970-P4X-013 - COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS</p> <p>I-ET-3010.00-1200-972-P4X-006 - REQUIREMENTS FOR MANUFACTURING SURVEY INSPECTION</p> <p>I-ET-3010.00-1200-978-P4X-005 - REQUIREMENTS FOR MATERIALS TRACEABILITY</p> <p>I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-712-P4X-002 - MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS</p> <p>I-ET-3010.00-5140-741-P4X-003 - POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS.</p>			

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- I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
- I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
- I-ET-3000.00-5400-98G-P4X-001 - EXPLOSION STUDY
- I-ET-3010.00-5400-947-P4X-002 - SAFETY SIGNALLING
- I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM
- I-ET-3010.2Q-1200-200-P4X-001 - PIPING SPECIFICATION FOR TOPSIDES
- I-ET-3010.2Q-1200-200-P4X-004 - REQUIREMENTS FOR PIPING SUPPORT
- I-ET-3010.2Q-1200-200-P4X-005 - REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT
- I-ET-3010.2Q-1200-200-P4X-006 - REQUIREMENTS FOR PIPING FLEXIBILITY AND STRESS ANALYSIS
- I-ET-3010.2Q-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS
- I-ET-3010.2Q-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN
- I-ET-3010.00-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES
- I-MD-3010.00-5510-760-PPT-001 - GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN
- I-RL-3010.2Q-1200-940-P4X-001 - GENERAL SPECIFICATIONS FOR AVAILABLE UTILITIES
- I-RL-3010.2Q-1350-960-P4X-002 - MOTION ANALYSIS
- I-ET-3010.00-1200-588-P4X-001 - SAMPLE CONNECTIONS.
- I-RL-3010.2Q-1200-940-P4X-002 - UTILITY CONSUMPTION SUMMARY
- I-RL-3010.2Q-1200-940-P4X-003 - DRAINAGE SYSTEM GUIDELINES
- I-RL-3010.2Q-1200-940-P4X -005 - RELIEF AND BLOWDOWN REPORT
- I-DE-3010.2Q-1223-943-P4X-001 - OIL COLLECTING AND SEPARATION
- I-DE-3010.2Q-1223-944-P4X-005 - INTERSTAGE HEATER A/C
- I-DE-3010.2Q-1223-944-P4X-006 - INTERSTAGE HEATER D/F
- I-DE-3010.2Q-1223-944-P4X-012 - OIL/OIL PRE HEATER A/D
- I-DE-3010.2Q-1223-944-P4X-013 - PRODUCTION HEATER A/C

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- I-DE-3010.2Q-1223-944-P4X-014 - PRODUCTION HEATER A/C
- I-DE-3010.2Q-1223-944-P4X-026 - TEST HEATER / TEST SEPARATOR
- I-DE-3010.2Q-1223-944-P4X-029 - UT-1223001 CIP

2.5 CONFLICTING REQUIREMENTS

2.5.1 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.

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

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

3.2 ABBREVIATIONS

- CIP - Cleaning-In-Place
- CLASS - Classification Society
- FAT - Factory Acceptance Test
- FPSO - Floating Production Storage and Offloading
- HAZOP - Hazard and Operability Study
- ITP - Inspection and Test Plans
- NDT - Non-Destructive Test
- PAGA - Public Address and General Alarm
- PHA - Process Hazards Analyses

4 GENERAL REQUIREMENTS

4.1 OPERATION ENVIRONMENT


4.1.1 The equipment supplied shall be suitable for the environment and the range of ambient conditions defined in I-ET-3000.00-1000-941-PPC-001_F - METOCEAN DATA .

4.2 MOTION REQUIREMENTS

4.2.1 The necessary design data and information on motion requirements are given in I-RL-3010.2Q-1350-960-P4X-002 - MOTION ANALYSIS.

4.3 PACKAGE LOCATION AND AREA CLASSIFICATION

4.3.1 The cleaning in place unit (UT-1223001) shall be installed on module M-10C as informed in I-DE-3010.2Q-1421-942-P4X-003 - M10C – OIL PROCESSING - EQUIPMENT LAYOUT PLAN.

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4.3.2 For area classification see I-DE-3010.2Q-1200-94A-P4X-001 - AREA CLASSIFICATION – GENERAL

4.4 DESIGN LOADS

4.4.1 In addition to the Code described loads and loads due to vessel motion described in I-RL-3010.2Q-1350-960-P4X-002 - MOTION ANALYSIS, the following design loads shall be considered whenever applicable:

- Equipment transportation and erection loads.
- Nozzle loads.
- Thermal loads.
- Wind loads in METOCEAN DATA.
- Weight loads.
- Blast loads (according to I-ET-3000.00-5400-98G-P4X-001 – EXPLOSION STUDY)

4.5 DESIGN LIFETIME

4.5.1 The SELLER shall design and manufacture the complete equipment of the package for a minimum useful life of 25 years.

4.6 NOISE AND VIBRATION

4.6.1 Noise and vibration control concerning human exposure shall be performed according to I-ET-3010.00-1200-300-P4X-001 - NOISE AND VIBRATION CONTROL REQUIREMENTS.

5 PACKAGE SPECIFICATION

5.1 SCOPE OF SUPPLY

5.1.1 The SELLER shall select a sub supplier considering a proven experience supplying this type of equipment/technology. SELLER shall submit the name of the sub supplier to BUYER approval.


5.1.2 The Cleaning in place Unit (UT-1223001) shall be complete in all respect and the scope of supply and shall include, but not be limited, to the major equipment described in the document I-FD-3010.2Q-1223-560-P4X-008 - CLEANING IN PLACE UNIT (UT-1223001)

5.1.3 All piping, accessories, overpressure and depressurizing devices, vent, drainage and utility connections, valves, instruments, control loops and devices, other equipment and other connections to the package (including all piping and accessories to connect the package to the process plant located outside that are indispensable to the correct CIP operation, performance and maintenance shall be foreseen inside scope of supply.

5.2 PROCESS DESIGN

5.2.1 SELLER shall design and size the equipment of package for the full range of process conditions as specified in the Process Data Sheet I-FD-3010.2Q-1223-560-P4X-008 CLEANING IN PLACE UNIT (UT-1223001).

5.2.2 In order to design the CIP system, it shall be considered the fluid physical properties at operating temperature (e.g.: viscosity, specific gravity, vapor pressure, specific heat, thermal

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conductivity, etc.) from:

- a) 0.1 wt% Caustic Soda solution;
- b) 2.0 wt% hydrochloric acid solution;
- c) 2.0 wt% Oxalic acid.

5.2.3 Design shall also include the definition of number, size and location of all process and instrument related nozzles of Cleaning in Place Unit (UT-1223001).

5.2.4 The interconnecting lines for utilities shall be considered in the detailed design.

5.2.5 The piping outside the package shall follow the same piping specification as the interconnect piping in accordance with I-ET-3010.2Q-1200-200-P4X-001 - PIPING SPECIFICATION FOR TOPSIDES. In the piping within CIP unit, the packager is responsible for material selection.

5.2.6 Detailed design shall provide compatible accessories for transfer operation from laydown area to transfer CIP pump and from pump to CIP tank.

5.2.7 Pumps

5.2.8 The pumps shall feed and pressurize the exchangers and control valves at safe flowrates and pressures, compatible with the equipment and accessories. Each pump shall be provided with discharge check-valve and suction and discharge stop valves, plus all necessary controls, drainage piping and valve facilities. For pressures above 20 bar g, double block and bleed stop valves are required.

5.2.9 CIP Tanks

5.2.10 The tank shall have a conical bottom (5° angle) to facilitate the removal of solids without the need to open the tank. The tank shall be constructed with: Lifting Lugs and Clips for Ladder, Platforms and Pipes.

5.2.11 The tank shall be in non-metallic material adequate for the fluids being handle, including contamination with process fluid during the recirculation process.

5.2.12 Equipment nozzles used for instruments or standpipe connections shall not be positioned on the bottom of the tank due to clogging possibility.


5.2.13 Control and Safety instruments' process connection nozzles shall have the same height (elevation). A TIT shall be installed at the tank.

5.2.14 Monitoring of mixing tank level and temperature (consider redundancy in readings) shall be considered as well as a sample point for pH monitoring. The sample point shall be according to I-ET-3010.00-1200-588-P4X-001- SAMPLE CONNECTIONS.

5.3 MECHANICAL AND PIPING

5.3.1 All piping shall have valves (on/off valves) and/or flanges and blind flanges (ASME B16.5/B16.47) at the end of unit limits.

5.3.2 SELLER shall define a piping specification adequate for the chemical product being handled.

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The piping specifications shall be submitted to BUYER for approval.

5.3.3 The spec of the piping included in the scope of supply must be compatible with the pressure spec of piping from outside the scope of supply, otherwise overpressure protection devices (e.g.: pressure safety valves, pressure control valves) must be foreseen inside scope of supply by Manufacturer/Packager.

5.3.4 FRP piping shall follow the requirements stated in I-ET-3010.00-1200-200-P4X-003 - DESIGN, CONSTRUCTION AND ASSEMBLY OF FRP PIPING.

5.3.5 Piping stress analysis shall be performed according to I-ET-3010.2Q-1200-200-P4X-006 - REQUIREMENTS FOR PIPING FLEXIBILITY AND STRESS ANALYSIS.

5.3.6 All piping shall be properly supported considering the service loads, shipment, results of pipe flexibility analysis studies and transportation loads. Piping supports shall be in accordance with I-ET-3010.2Q-1200-200-P4X-004 - REQUIREMENTS FOR PIPING SUPPORT. Supports applied directly to the module base plates shall not be performed without prior under deck stiffening. The supporting and installation shall enable piping removal without disturbing structural members.

5.3.7 Socket welding connections in lieu of butt-welding connections are only permitted for piping sizes equal or less than 1½ inch NPS (Nominal Pipe Size). All piping above 1½ inch shall be butt-welded.

5.3.8 The use of concentric type butterfly valves and straight-through diaphragm valves with open body (open body tubular diaphragm valves) is not allowed.

5.3.9 Sampling point / facilities shall be provided complete with necessary fittings and valves, and the design should reflect nature of the fluids being sampled.

5.3.10 Utility hose stations shall be installed throughout the package on strategic places for maintenance and cleaning purposes.


5.3.11 The design, assembly and commissioning of all process piping shall be according to ASME B31.3 code, I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION, ASSEMBLY AND COMMISSIONING and I-ET-3010.2Q-1200-200-P4X-005 - REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT.

5.3.12 All structural supports including main structural skid, support frames, supports for equipment, ladders, walkways, platforms, grating and drip trays shall be provided.

5.3.13 All other miscellaneous items and equipment which are required for the service and operation of the Cleaning in place unit shall be included.

5.3.14 Equipment and piping subjected to temperature of 60°C and above shall receive a personal protection system, by means of stainless steel 316 wire mesh / perforated plates. Alternatively, a thermal insulation may be applied. Equipment and piping in which heat conservation is necessary shall be thermal insulated. The thermal insulation shall be according to latest revision of I-ET-3010.00-1200-431-P4X-001 - THERMAL INSULATION FOR MARITIME INSTALLATIONS.

5.3.15 All fasteners (stud bolts, tightening bolts, and nuts) shall be according to I-ET-3010.00-1200-

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251-P4X-001 - REQUIREMENTS FOR BOLTING MATERIALS.

5.3.16 Bolted joints within the package shall be assembled and managed as established in I-ET-3010.00-1200-200-P4X-116 - REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT.

5.3.17 SELLER shall provide a design book with all piping detailed design documentation, which shall include but not be limited, to the following documents: isometrics, piping plan, support detail drawings, stress analysis report (with native program file), list of supports, valve list, special item list, document list, stress analysis list, tie-in list, welding procedures, strainers datasheet, and piping elements datasheet.

5.4 STRUCTURES

5.4.1 The structure and their foundations shall be designed according to CLASS rules and all requirements and conditions indicated in I-ET-3010.2Q-1400-140-P4X-001 - TOPSIDES STRUCTURAL REQUIREMENTS

5.4.2 All materials used for SKID/PACKAGE structure shall met the CLASS rules and specifications indicated in I-DE-3010.00-1400-140-P4X-004 - GENERAL NOTES FOR TOPSIDES STRUCTURES.

5.5 MATERIAL SELECTION AND CERTIFICATION

5.5.1 The SELLER is responsible for the materials selection considering the BUYER philosophy detailed at I-ET-3010.2Q-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN, and the operational condition and process data stated at process datasheet.

5.5.2 In all cases, SELLER shall submit the detailed material selection report, including all piping, equipment, and their components, for BUYER approval prior to manufacturing activities.


5.5.3 SELLER shall be responsible for obtaining all necessary certification of the equipment, work, and materials.

5.5.4 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.

5.6 DESIGN AND FABRICATION

5.6.1 **Pump:** Pumps shall comply with the requirements I-ET-3010.00-1200-310-P4X-001 - API 610 CENTRIFUGAL PUMPS SPECIFICATION, I-ET-3010.00-1200-310-P4X-002 - POSITIVE DISPLACEMENT PUMPS SPECIFICATION or I-ET-3010.00-1200-310-P4X-003 - NON-API 610 CENTRIFUGAL PUMPS SPECIFICATION. For pumps up to 7.5 kW, working with non-flammable and non-hazardous service, vendor may use its own specification, i.e., SELLER may indicate the equipment design code and any additional technical requirements. In this case SELLER shall demonstrate that field proven requirements for the PACKAGE are fulfilled, and it shall be approved by BUYER previously during the package technical proposal. Material selection shall still be performed as per ISO 21457.

5.6.2 **Pressure Vessel:** All metallic pressure vessels, columns and filters shall be designed in accordance with ASME BPCV VIII and comply with the requirements of last revision of Brazilian

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Regulatory Standard NR-13 (Boilers, Pressure Vessels, Pipes and Metallic Storage Tanks) and I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION. If the scope of supply includes any transportable pressure vessels, connected with process plant or platform installations, these items shall be within the scope of Brazilian Regulatory Standard NR-13. Furthermore, transportable containers shall be designed, constructed, inspected, and installed in accordance with the requirements addressed by a specific rule of transportable equipment, such as ISO 9809, DOT-3A or DOT-3AA.

5.6.3 **Electric Heater:** Heater materials shall be resistant to all chemicals to be used in the CIP unit Heater and shall follow the requirements of I-ET-3010.2Q-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN. The equipment shall be an immersion tank flanged heater, with a maintenance area which allows its entire extraction for replacement. The terminal box shall be suitable for the marine atmosphere.

5.6.4 Heat exchangers shall comply with:

- a) The requirements of last revision of Brazilian Regulatory Standard NR-13 - I-ET-3010.00-1200-970-P4X-013- COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS;
- b) I-ET-3010.00-1200-451-P4X-001 - REQUIREMENTS FOR SHELL AND TUBE HEAT EXCHANGER DESIGN AND FABRICATION.

5.6.5 **Non-Metallic Tank and Pressure Vessel:** Non-metallic tanks and non-metallic pressure vessels shall comply with the requirements of I-ET-3010.00-1200-500-P4X-001- NON-METALLIC TANKS AND PRESSURE VESSELS DESIGN.

5.7 ERGONOMICS REQUIREMENTS


5.7.1 The package shall be arranged such to allow safe and good personnel access for all operation and maintenance activities and in accordance with I-ET-3010.00-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES.

5.7.2 SELLER shall prepare detailed assembly, disassembly, and maintenance procedures, describing the use of all involved handling devices and including all required preventive and corrective maintenance tasks. SELLER shall inform the need for disassembling any component or equipment to facilitate access for maintenance. Suitable maintenance routes shall be provided to remove the main components and auxiliaries, avoiding interference with structures, piping, cabling, electric conduits and supports, equipment etc. This plan shall be submitted to BUYER for approval.

5.7.3 All valves shall be positioned with the stem pointing upwards. They shall be located in such a way that the hand wheel or actuator will not obstruct escape routes, walkways and be easily accessible for operation and maintenance, according to I-ET-3010.00-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES. Where hand operated valves are not easily operable, gear operated valves shall be used.

5.7.4 Ladders and platform shall be provided to access operational devices, e.g., valves, instruments, manways, etc., whether located in an elevation greater than 1.75 m over the module base plate.

5.7.5 The level gauges shall be installed in such position that the level indicated in receiver will be

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easily seen. All level gauges shall have flanged connections, which can be isolated, and be complete with vent and drain, valves and connection, to facilitate the maintenance tasks.

5.8 SAFETY REQUIREMENTS

5.8.1 Pressure relief system and devices shall comply with the requirements of API STD 521. Maximum allowable pressure drop for pressure relief devices shall comply with API requirements.

5.8.2 For area classification see I-DE-3010.2Q-1200-94A-P4X-001 - AREA CLASSIFICATION – GENERAL.

5.8.3 Mandatory safety items, as established in DR-ENGP-M-I-1.3 - SAFETY ENGINEERING GUIDELINE, are to be considered complementary requirements, to the pertinent extent. In case of items in conflict with this document, BUYER shall be consulted.

5.8.4 Safety design additional requirements see I-MD-3010.2Q-1200-947-P4X-003 – DESCRIPTIVE MEMORANDUM - SAFETY, and I-FD-3010.2Q-5400-947-P4X-001 – SAFETY DATA SHEET - TOPSIDES.

5.8.5 HAZOP and PHA shall be performed according to DR-ENGP-M-I-1.3 - SAFETY ENGINEERING GUIDELINE.

5.8.6 Double block & bleed arrangements are required for isolation of equipment in piping classes of 300# and above.

5.8.7 All safety signs and notices shall be in Portuguese language according to I-ET-3010.00-5400-947-P4X-002 - SAFETY SIGNALLING.

5.9 INSTRUMENTATION

5.9.1 All instrumentation equipment and interface with FPSO automation and control design shall comply with I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL, AND INSTRUMENTATION ON PACKAGE UNITS.

5.9.2 For package automation type classification and additional interfaces see I-ET-3010.2Q-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS.


5.9.3 All control, monitoring and safety protection instruments, instrumented valves, devices and associated accessories (such as, but not limited to, tubings, thermowells, etc) for remote indication, control, alarms, protection and shut down, etc. shall be included.

5.9.4 Automatic temperature control facilities shall be provided for the control of cooling medium flow.

5.10 ELECTRICAL

5.10.1 All materials and equipment proper to be used in hazardous areas shall have conformity certificates complying with the latest revision of IEC-60079 and all its parts; PORTARIA INMETRO Nº 115 (March 21st, 2022); and shall be approved by Classification Society.

5.10.2 Electrical equipment installed in external safe areas, that shall be kept operating during

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emergency shutdown ESD-3P and ESD-3T shall be certified for installation in hazardous areas Zone 2 (EPL Gc) Group IIA temperature T3, unless they are automatically disconnected if there is gas in the equipment area, according to IEC 61892-1.

5.10.3 Low-voltage and Medium-voltage motors inside the package shall comply with latest revision of I-ET-3010.00-5140-712-P4X-001 – LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS and I-ET-3010.00-5140-712-P4X-002 – MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.

5.10.4 All electrical equipment and material shall fully comply with the document I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS, I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS, I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and, I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

5.10.5 Heater panels shall comply with I-ET-3010.00-5140-741-P4X-003 - POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS.

5.10.6 Power lighting and grounding installations inside the package shall comply with requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS, I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS and, I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS.

5.10.7 Interfaces of the Package with Electrical System shall comply with I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-DE-3010.00-5140-797-P4X-002 - ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS

5.11 TELECOMMUNICATIONS REQUIREMENTS


5.11.1 Design of PAGA equipment shall fulfill the requirements, including standards and documents referred herein as well as referenced on project data sheets and system technical specification. PAGA installations and interfaces shall comply with requirements of:

- a) I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM
- b) I-MD-3010.00-5510-760-PPT-001 - GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN
- c) I-ET-3010.00-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES

5.11.2 Package shall be delivered with PAGA horns and cables installed and tested based on detail design done by SELLER.

5.11.3 SELLER shall be responsible for the design, supplying, installation and integration of the Public Address and General Alarm System (PAGA) items of its package, complying with all applicable requirements described in I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM for the entire system.

5.11.4 Since the PAGA network inside package to be designed is part of the entire system that is

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scope of SELLER detailed design, SELLER shall ask the BUYER any specific characteristics of the system, as well as the approval of the sound calculation memories and detailed design, to assure fully interoperability.

5.11.5 The acoustic horns and cables shall be designed by SELLER in two different and independent groups A and B. Each of these groups shall be ended inside a proper interface box to be installed at the edge of the package, in accordance with the classifications zone and groups established by IEC / ABNT and SELLER.

5.11.6 SELLER shall be responsible for commissioning the PAGA network inside package of its own scope of supply before the lifting of the package, when the system will be accepted by BUYER.

5.11.7 SELLER shall supply all needed facilities to test the PAGA network inside package before lifting.

5.11.8 Wherever there are closed areas in package module, they shall also be covered by UHF, LTE and WLAN systems. So, SELLER shall make available MCT (Multi cable and pipe transit) for cables entrance and internal fixing supports for internal UHF and LTE antennas and their RF cables and industrial access points with their fiber optic cable and electrical cable. Such equipment and cables will be delivered by SELLER according to its detailed design, if required.


5.11.9 Since the UHF Active Repeater, LTE and WLAN Systems are part of complete systems scope of SELLER, SELLER shall ask the BUYER any specific characteristics of infrastructure required and detailed design to assure interoperability and functionality inside closed areas of packages module.

5.12 INSTALLATION REQUIREMENTS

5.12.1 SKID DETAILS

5.12.1.1 This section is only applicable for equipment that is built on a skid.

- a) The skid shall be designed to accommodate the entire equipment within the scope of supply. The skid shall be of rigid construction, which will not distort during hoisting, operation and shipment and shall withstand all moments and forces due to the vessel motion.
- a) All piping terminations shall be flanged.
- b) The set of equipment and its skid shall be designed, arranged, and assembled in such a way as to allow safe access for personnel for all operations and maintenance tasks (mechanical, electrical, painting, insulation, etc.).
- c) Lifting facilities shall enable lifting of the equipment with crane as a single point lift for transportation and installation. The design and manufacture of the lifting lugs shall be certified. The arrangement of equipment, piping and superstructure shall be such that the

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center of gravity coincides approximately with the geometrical center of the skid when lifting the skids, complete with all equipment mounted, beam deflection shall not exceed 1/400 L.

- d) The skid shall resist all sling forces, including both horizontal and vertical components of the applied sling angle (sling angles shall be within between 50 and 90° with the horizontal plane).
- e) Lifting beams, spreader bars, slings, shackles, etc. are within SELLER's scope of supply.
- f) Drip trays with drain connections shall be provided underneath equipment where significant spillage is likely to occur.
- g) The skid shall be welded to the supporting structures. Skid floor shall be made of plate material with a raised on-slip tread. Welds underneath skid beams shall be ground flush. Skid shall have two diagonally opposed earthing bars.

5.12.2 MAINTENANCE LIFTING BEAMS

- a) All required maintenance lifting beams, complete with the necessary hoisting and lifting gear, shall be provided to facilitate safe and easy maintenance.
- b) All lifting beams shall overhang by at least 1.2 m into agreed lay-down areas.
- c) The deflection of the maintenance crane/hoisting beams shall not exceed 1/500 of the span length.
- d) All beams and lifting gear shall be subject to load testing, witnessed by BUYER representative and CLASS.

5.13 PAINTING

5.13.1 Painting requirements shall be according I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

5.13.2 Color code adopted shall be in accordance with DR-ENGP-I-1.15 - COLOR CODING.


6 NAMEPLATES

6.1 GENERAL

6.1.1 SELLER shall attach corrosion resistant stainless-steel type 316 nameplates on each item of equipment in an accessible location, fastened with corrosion resistant stainless-steel type 316 pins, and in Portuguese language.

6.1.2 For pressure vessels, columns and filters the nameplates shall be according to I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION.

6.1.3 For the other equipment, the nameplates shall include, as a minimum, the following information:

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- Petróleo Brasileiro S.A. – PETROBRAS;
- Purchase order number.
- Manufacturer and year of build.
- Tag number.
- Service.
- Serial number.
- Main data for design, operation, and testing (Power, Pressure, Volume, Temperature, Rotation, Flow rate), where applicable.
- Specific requirements.
- Installation identification.
- Driver power rating and speed, where applicable.
- Design code.
- Empty weight.
- NR-13 information (if applicable).

6.1.4 Valves, instruments, and orifices shall be tagged with the applicable number only.

7 TAG NUMBERING

7.1 GENERAL

7.1.1 Tagging of all instruments, electrical, telecommunications, 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.

7.1.2 Tag numbers for remaining ancillary equipment shall be given after purchase order placement.

8 CERTIFICATION REQUIREMENTS


8.1 CLASSIFICATION SOCIETY CERTIFICATION

8.1.1 SELLER shall provide a CLASS Certificate of Compliance for the entire Unit.

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 the latest revision of IEC-60079 and all its parts; PORTARIA INMETRO Nº 115 (March 21st, 2022); and shall be approved by CLASS.

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9 INSPECTION, TESTING AND COMMISSIONING

9.1 GENERAL

9.1.1 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 equipment that are part of the Unit.

9.1.2 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.

9.1.3 Inspections and tests are an integral part of the order which will not be considered complete until such inspections and tests have been carried out in full and recorded in an inspection report that shall be part of the data-book.

9.1.4 BUYER shall issue an Inspection Release Certificate (IRC) only after completion of all required inspections and tests and after the manufacturing data-books have been issued and approved.

9.2 PERSONNEL QUALIFICATION AND CERTIFICATION

9.2.1 Personnel qualification and certification shall be in accordance with I-ET-3010.00-1200-970-P4X-003 - REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION.

9.3 QUALITY AND INSPECTION

9.3.1 SELLER shall provide documented schedules with the estimated completion dates. These schedules shall be issued by the same time the drawings are submitted for approval, as indicated in the agreed document schedule.


9.3.2 BUYER reserves the right to inspect all items at any time during fabrication to ensure that the materials and workmanship are in accordance with this specification and all applicable documentation.

9.3.3 SELLER is responsible for the overall compliance of the Unit when it comes to the CLASS requirements, including certificates, work examinations and tests, as well as final inspection activities and shipment.

9.3.4 In addition to BUYER inspection, equipment such as valves and fittings, etc. shall be subject to all CLASS authority and may range from a review of SELLER's quality manual to a physical survey of SELLER's shop or end products.

9.3.5 The CLASS inspector shall have the right to request inspections or examinations to ensure that the equipment complies with the relevant CLASS requirements. If examination reveals any deficiencies, SELLER shall bear the full cost of repair or replacement when necessary. Any repair work shall be approved by BUYER. The subsequent examination necessary to ensure the satisfactory manufacture of the equipment in question will be on behalf of the SELLER.

9.3.6 Except if approved by BUYER inspector, all equipment shall be presented for inspection in an unpainted state. SELLER shall provide notice to the inspector to witness the specified tests at least

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2 (two) weeks in advance for Brazilian MANUFACTURER and 3 (three) weeks for foreign MANUFACTURER.

9.3.7 Manufacturing Survey Inspection shall be performed according to I-ET-3010.00-1200-972-P4X-006 - REQUIREMENTS FOR MANUFACTURING SURVEY INSPECTION.

9.3.8 Traceability of material shall comply with I-ET-3010.00-1200-978-P4X-005 - REQUIREMENTS FOR MATERIALS TRACEABILITY.

9.3.9 Equipment, piping, and accessories under scope of NR-13 shall comply with I-ET-3010.00-1200-970-P4X-013 - COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS.

9.4 WELDING AND WELDING INSPECTION

9.4.1 All equipment (such as pressure vessels, filters, tanks, heat exchangers, pump, turbomachinery etc.), structures, valves and piping weldments shall be according to the requirements stated in I-ET-3010.00-1200-955-P4X-001 - WELDING.

9.4.2 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.

9.4.3 Intermittent fillet welds are not permitted.

9.4.4 Welding inspection shall be according to the Design Code and additional requirements stated in the contractual technical specification, such as I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION, ASSEMBLY AND COMMISSIONING I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION, I-DE-3010.00-1400-140-P4X-004 - GENERAL NOTES FOR TOPSIDES STRUCTURES, etc.

9.5 NDT

9.5.1 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.

9.5.2 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.

9.6 TESTING


9.6.1 The following tests shall be included in SELLER's scope:

- a) Pressure test (usually hydrostatic) of all vessels, heat exchangers, tanks, and piping/valves.
- b) Electrical insulation and continuity checks on all wiring and earthing.
- c) Functional checks on all instruments and valves.

9.6.2 Hydrostatic testing shall be carried out in the presence of BUYER inspectors and shall include all pressure vessels, heat exchangers and applicable piping/valves.

9.6.3 All piping systems and equipment shall be drained and dried after hydrostatic testing.

9.6.4 Preservation to be applied shall be as detailed in I-ET-3010.00-1200-200-P4X-115 -

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REQUIREMENTS FOR PIPING FABRICATION, ASSEMBLY AND COMMISSIONING.

9.7 ELECTRICAL

9.7.1 The following testing shall be performed in the presence of BUYER inspectors and shall include:

- a) Insulation (MEGGER) test for cables, electric motors and electrical panels shall be provided.
- b) Tests stated in the respective motors and power/control panel specifications.

9.8 PACKAGE INSPECTION

9.8.1 Unless waived by BUYER, the following inspections and checks shall be witnessed by BUYER inspector:

- a) Verification of equipment construction materials (vessels, heat exchangers, pumps, etc.) for conformity with the specification requirements.
- b) Verification of piping, fittings and valves conform to specification of materials and fabrication.
- c) Reports for all NDT performed on the pressure retaining parts (radiographic, dye penetrant, magnetic particles, and ultrasonic inspection).
- d) Approval of the relief valve settings and witness of their testing after setting.
- e) Review of Inspection and Test Records.
- f) A visual check noting:
 - That the thickness of the pressure retaining parts meets or exceeds the quoted design thickness.
 - Any repairs.
 - Dry-film thickness of applied coatings.
 - The general appearances, materials, workmanship, and standard of finish.
 - Dimensional check.
 - Alignment to be demonstrated.

9.9 PACKAGE TEST

9.9.1 A full function test of completed package shall be performed. The satisfactory operation of all indicators, selectors and controllers shall be demonstrated.

9.9.2 The correct operation of all controllers, alarm and fault protection equipment and indicators shall be demonstrated and if necessary, fault simulations.


9.9.3 SELLER shall submit a FAT procedure with a test schedule covering all items within the scope of supply.

9.9.4 SELLER shall prepare a FAT procedure for the package and submit for BUYER approval.

9.9.5 FAT will be witnessed by BUYER representatives. SELLER shall invite CLASS surveyor for FAT. The advance notice for tests schedule shall be forwarded to BUYER within the deadline stated in EXHIBIT V - DIRECTIVES FOR ACQUISITIONS.

9.9.6 Acceptance of the FAT will not be considered as the final acceptance test of the package.

9.10 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

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9.10.1 SELLER is responsible for assembly supervision of the equipment, including the assembly of components to be delivery as loose parts (for example, some components of the pumps, like stuffing box; some internals of pressure vessels, etc.).

9.10.2 SELLER is responsible for pre-commissioning and commissioning supervision of the equipment/system. SELLER shall submit pre-commissioning and commissioning tests procedures for BUYER approval. Final acceptance shall be on satisfactory completion of commissioning tests as specified by BUYER.

9.10.3 An Initial Service Safety Inspection shall be performed on the piping and on the static equipment of the Unit (pressure vessels, heat exchangers, and so on) once the Unit itself has been erected to its final location.

9.10.4 Requirements of I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION, ASSEMBLY AND COMMISSIONING shall be attended.

10 SELLER RESPONSIBILITY

10.1 GENERAL

10.1.1 SELLER shall assume sole contractual and total engineering responsibility for the package equipment.

10.1.2 SELLER's responsibility shall also include, but is not limited to:


- Technical responsibility for the entire scope of supply.
- Resolving all engineering questions and/or problems relating to design and manufacture.
- All coordination with manufacturers and collection of all details, drawings, calculations, and data to achieve optimum design and full submission of the documents requested in the specification.
- Providing details as requested of any sub-vendors relating to design and manufacture.
- To submit to the certifying authority the documentation as described in the latest edition of their rules for equipment on offshore facilities.
- Installation at site by others, however, presence of supervision will be required.
- SELLER's responsibility shall also include Commissioning & Training for operation.
- Pre-Commissioning.
- Attend HAZOP meetings arranged by BUYER and update the design with its recommendations.

10.1.3 Any exclusion and/or alternative to what is specified in this Technical Specification, including the use of the SELLER's standard and exclusive technology, shall be presented in a Deviation List, subject to BUYER acceptance during the clarification phase, preceding the proposal presentation. Otherwise, the requirements herein will be considered as "Agreed", and so required.

11 PREPARATION FOR SHIPMENT

11.1 MARKING

11.1.1 All items supplied to this specification shall be adequately marked for identification against a certificate or relevant test documentation. Marking shall be such that it will not damage or impair the

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component.

11.1.2 Items that cannot be identified shall be rejected. Rejected items may be re-certified by carrying out all relevant testing, with prior approval of BUYER.

11.2 SHIPMENT PACKING

11.2.1 SELLER shall provide suitable outdoor storage packing, if planning to store this equipment in an outdoor area, taking into consideration access for heating elements control/monitoring.

11.2.2 All open ends of tubes on the equipment shall be treated and closed off by plastic caps and taped. Small bore threaded connections, as cables entrances, shall be temporary plugged.

11.2.3 All carbon steel vessels, stainless steel instruments/piping/tubing, etc. shall be protected with corrosion inhibitor prior to shipment.

11.2.4 The package shall be protected from corrosion.

11.2.5 Vulnerable instruments shall be removed and packed separately for shipment.

11.2.6 Transportation bracing/support shall be used where necessary and shall be clearly identified as temporary.

11.2.7 All crates and boxes will contain sufficient moisture absorbing agent to avoid condensation.

11.2.8 SELLER shall specify any limitations applicable to the transport and installation phase.