

	<b>TECHNICAL SPECIFICATION</b>	Nº: I-ET-3010.2D-5331-587-P4X-001
	CLIENT: AGUP	SHEET: 1 of 24
	JOB: HIGH CAPACITY FPSO - GAS EXPORTATION ALL ELECTRIC	
	AREA: ATAPU 2 AND SÉPIA 2	-
SRGE	TITLE: <b>HYDROCYCLONES (CI-5331001A/E)</b>	INTERNAL ESUP

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FORM OWNED TO PETROBRAS N-0381 REV. L



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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 HYDROCYCLONES (CI-5331001A/E).

The requirements herein listed apply to all players which will perform any activity related to the scope of this unit, including manufacturers, packagers, main contractor, subcontractors, 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, the SELLER shall follow all the requirements of Exhibit I (SCOPE OF SUPPLY), as well as Exhibit III (DIRECTIVES FOR ENGINEERING EXECUTION), Exhibit IV (DIRECTIVES FOR CONSTRUCTION AND ASSEMBLY), Exhibit V (DIRECTIVES FOR PROCUREMENT), Exhibit VI (DIRECTIVES FOR PLANNING AND CONTROL), Exhibit VII (DIRECTIVES FOR QUALITY MANAGEMENT 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 to submit to Classification Society the documentation in compliance with stated Rules.
- 2.1.3 Classification Society rules may only be waived upon 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 that, through reference in this text, constitute provisions of this specification. The latest issue of the references shall be used unless otherwise agreed.
- 2.2.2 Other recognized international standard may be used, whether they meet or exceed the requirements of the standards referenced below. Formal approval from BUYER and from the Classification Society is also required.

- |            |  |
|------------|--|
| API RP 14C | - Recommended Practice for Analysis, Design, Installation and Testing of Safety Systems for Offshore Production Facilities |
| API RP 14E | - Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems                          |

API RP 14J	- Recommended practice for design and Hazard Analysis for Offshore Production Facilities
API RP 14FZ	- Recommended Practice for Design, Installation and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities For Unclassified And Class 1, Zone 0,1 And 2 Locations
API RP 520	- Sizing, Selection and Installation of Pressure Relieving Devices – All Parts
API STD 521	- Pressure-relieving and Depressuring Systems
ASME B16.5	- Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard
ASME B16.47	- Large Diameter Steel Flanges: NPS 26 through NPS 60
ASME B31.3	- Process Piping
ASME BPVC V	- Boiler and Pressure Vessel Code. Non-destructive Examination
ASME BPVC VIII	- Div.1 and Div. 2. Boiler and Pressure Vessel Code. Rules for Construction of Pressure Vessels
ASME BPVC IX	- Boiler and Pressure Vessel Code - Qualification Standard for Welding, Brazing and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
AWS D1.1	- Structural Welding Code – Steel
IEC 60079 (all parts)	- Explosive Atmospheres
IEC 60092-502	- Electrical Installations in Ships – Part 502 – Tankers – Special Features
IEC 61892 (all parts)	- Mobile and fixed offshore units – Electrical installations
ISO 13702	- Control and Mitigation of Fires and Explosions on Offshore Production Installations
ISO 15156	- Materials for use in H2S containing environments in Oil and Gas Production – All Parts
ISO 21457	- Materials selection and corrosion control for oil and gas production systems

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**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.

NR-10	Brazilian Regulatory Standard - Safety in Electrical Facilities and Services
NR-12	Brazilian Regulatory Standard – Safety Working with Machineries and Equipment.
NR-13	Brazilian Regulatory Standard - Boilers, Pressure Vessels, Pipes and Metallic Storage Tanks
NR-17	Brazilian Regulatory Standard - Ergonomics
NR-26	Brazilian Regulatory Standard - Safety Signaling
NR-37	Brazilian Regulatory Standard - Safety and Health in Petroleum Platforms
CONAMA	National Environment Council – Resolution 393 / 2007
IBAMA	Brazilian IBAMA environmental regulations concerning the discharge of all types of effluents
INMETRO	INMETRO Resolution nº 115, March 21st 2022, and its annexes

**2.4 DESIGN SPECIFICATIONS**

DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE

DR-ENGP-I-1.15 – COLOR CODING

I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS

I-ET-3A26.00-1000-941-PPC-001\_F – METOCEAN DATA – UNITS AND PRODUCTION SYSTEMS – SANTOS BASIN CENTRAL CLUSTER REGION

I-ET-3A36.00-1000-941-PPC-001\_F – METOCEAN DATA – PRODUCTION SYSTEM AND UNITS – NOTHERN SANTOS BASIN PRE-SALT FIELDS

I-RL-3010.2D-1350-960-P4X-002 – MOTION ANALYSIS

I-DE-3010.2D-1200-942-P4X-002 – GENERAL ARRANGEMENT

I-DE-3010.2D-1421-942-P4X-002 – M-10B – PRODUCED WATER TREATMENT AND TEST SEPARATOR – EQUIPMENT LAYOUT PLAN

I-DE-3010.2D-1200-94A-P4X-001 – AREA CLASSIFICATION - GENERAL

I-ET-3000.00-5400-98G-P4X-001 – EXPLOSION STUDY

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I-ET-3010.00-1200-300-P4X-001 – NOISE AND VIBRATION CONTROL REQUIREMENTS

I-FD-3010.2D-5331-587-P4X-001 – HYDROCYCLONES (CI-5331001A/E)

I-DE-3010.2D-5331-944-P4X-002 – HYDROCYCLONES

I-DE-3010.2D-5331-943-P4X-001 – UTILITY FLOW DIAGRAM PRODUCED WATER SYSTEM

I-ET-3010.2D-1200-200-P4X-001 – PIPING SPECIFICATION FOR TOPSIDE

I-ET-3010.2D-1200-200-P4X-005 – MINIMUM REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT

I-ET-3010.2D-1200-200-P4X-006 – REQUIREMENTS FOR PIPING STRESS ANALYSIS

I-ET-3010.2D-1200-200-P4X-004 – REQUIREMENTS FOR PIPING SUPPORT

I-ET-3010.00-1200-200-P4X-115 – REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING

I-ET-3010.00-1200-431-P4X-001 – THERMAL INSULATION FOR MARITIME INSTALLATIONS

I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS

I-ET-3010.00-1200-200-P4X-116 – REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT

I-DE-3010.00-1400-140-P4X-004 – GENERAL NOTES FOR TOPSIDES STRUCTURES

I-ET-3010.2D-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN

I-ET-3010.00-1200-540-P4X-001 – REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION

I-ET-3010.00-1200-751-P4X-001 - ANODES SPECIFICATION FOR MECHANICAL EQUIPMENT

I-ET-3010.2D-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES

I-MD-3010.2D-1200-947-P4X-003 - DESCRIPTIVE MEMORANDUM – SAFETY

I-FD-3010.2D-5400-947-P4X-001 - SAFETY DATA SHEET - TOPSIDE

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I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING

I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS

I-ET-3010.2D-1200-800-P4X-014 – AUTOMATION INTERFACE OF PACKAGED UNITS

I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS

I-ET-3010.00-5140-712-P4X-001 – LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS

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

I-ET-3010.00-5140-741-P4X-004 – SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS

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

I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.

I-ET-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE

I-DE-3010.00-5140-797-P4X-002 – ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS

I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST

I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM

I-MD-3010.00-5510-760-PPT-001 - GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN

I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING

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I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN

I-ET-3010.00-1200-970-P4X-003 - REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION

I-ET-3010.00-1200-972-P4X-006 - REQUIREMENTS FOR MANUFACTURING SURVEY INSPECTION

I-ET-3010.00-1200-978-P4X-005 - REQUIREMENTS FOR MATERIALS TRACEABILITY

I-ET-3010.00-1200-970-P4X-013 - COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS

I-ET-3010.00-1200-955-P4X-001 – WELDING

I-ET-3010.00-1200-970-P4X-004 - NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS

## 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

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

## 4 GENERAL REQUIREMENTS

### 4.1 OPERATION ENVIRONMENT

4.1.1 The equipment supplied shall be suitable for the environment and range of ambient condition defined in the following documents: for SEPIA field see I-ET-3A26.00-1000-941-PPC-001\_F – METOCEAN DATA – UNITS AND PRODUCTION SYSTEMS – SANTOS BASIN CENTRAL CLUSTER REGION; for ATAPU field see I-ET-3A36.00-1000-941-PPC-001\_F – METOCEAN DATA – PRODUCTION SYSTEM AND UNITS – NOTHERN SANTOS BASIN PRE-SALT FIELDS.

### 4.2 MOTION REQUIREMENTS

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

### 4.3 EQUIPMENT LOCATION AND AREA CLASSIFICATION

4.3.1 Hydrocyclones (CI-5331001A/E) shall be installed on module M-10B as informed in I-DE-3010.2D-1200-942-P4X-002 – GENERAL ARRANGEMENT.

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

### 4.4 DESIGN LOADS

4.4.1 In addition to the loads required by the International Standards and loads due to FPSO motion described in I-RL-3010.2D-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 (see 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 SELLER shall design and fabricate the equipment for a minimum lifetime of 30 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 GENERAL

5.1.1 SELLER shall select manufacturers considering a proven experience supplying this type of equipment/technology. SELLER shall submit manufacturers names to BUYER approval.

5.1.2 SELLER shall provide the complete engineering package including: design, fabrication, inspection, testing, certification and preparation for shipment of the Hydrocyclones. The package shall include drawings showing dimensions, weights, instrumentation and any additional information.

### 5.2 PROCESS DESIGN

5.2.1 SELLER shall design and size the equipment for the full range of process conditions as specified in the following documents:

- A. Process Data Sheet I-FD-3010.2D-5331-587-P4X-001 – HYDROCYCLONES (CI-5331001A/E);
- B. Piping and Instrument Diagram: I-DE-3010.2D-5331-944-P4X-002 – HYDROCYCLONES ;
- C. Flow Diagram: I-DE-3010.2D-5331-943-P4X-001 – UTILITY FLOW DIAGRAM PRODUCED WATER SYSTEM.

5.2.2 Design shall also include:

- Definition of number, size and location of all nozzles related to the process and instruments in the battery limits of the package (refer to the I-DE-3010.2D-5331-944-P4X-002 – HYDROCYCLONES ).
- Design and configuration of the vessels or manifold arrangement;
- Design and definition of the vessel internals and their appropriate locations, as applicable;
- Design of vessel internals supporting.

5.2.3 Quotation shall include the following data:

- Liquid handling capacity;
- Oil handling capacity (m<sup>3</sup>/h);
- Oil removal efficiency (%);
- Allowable pressure drop;
- Any other relevant operating/ design data.

### 5.3 ARRANGEMENT

5.3.1 SELLER is requested to submit a layout plan limited to the module dimensions shown in the document I-DE-3010.2D-1421-942-P4X-002 – M-10B – PRODUCED WATER TREATMENT AND TEST SEPARATOR – EQUIPMENT LAYOUT PLAN



## 5.4 MECHANICAL AND PIPING

- 5.4.1 Horizontal vessels or manifolds shall comply with ASME BPVC Sec VIII Div 1.
- 5.4.2 All pressure vessels shall be in accordance with I-ET-3010.00-1200-540-P4X-001 REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION.
- 5.4.3 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.
- 5.4.4 Liquid shall be automatically removed using a level control valve.
- 5.4.5 Vessels shall be provided with baffle plate at normal liquid level with vertical orientation to minimize incomplete wetting.
- 5.4.6 Vessels shall have removable internals suitably sized in sections, to pass through manway.
- 5.4.7 SELLER shall follow the technical specification I-ET-3010.2D-1200-200-P4X-001 – PIPING SPECIFICATION FOR TOPSIDE. Alternative piping specifications shall be submitted to BUYER for approval
- 5.4.8 All piping shall be routed and terminated with flanges at the package limit.
- 5.4.9 Piping shall be designed so that the specified nozzle loadings are not exceeded.
- 5.4.10 Flange ratings shall be in accordance with ASME B16.5 or ASME B16.47.
- 5.4.11 All process, utility and drainage piping, pipe supports, and valves shall be provided;
- 5.4.12 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-3010.2D-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.
- 5.4.13 Piping stress analysis shall be performed according to I-ET-3010.2D-1200-200-P4X-006 – REQUIREMENTS FOR PIPING STRESS ANALYSIS.
- 5.4.14 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.
- 5.4.15 Piping shall be routed to allow access for maintenance. Removal or replacement of equipment shall be possible with a minimum dismantling of piping.
- 5.4.16 Piping systems shall not extend over the operating floor.
- 5.4.17 All valves shall be positioned with the stem pointing upwards and located in such a way that the handwheel or actuator will not obstruct walkways and will be easily accessible for operation and maintenance. Where hand operated valves are not

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easily operable, gear operated valves shall be used.

- 5.4.18 The use of concentric type butterfly valves and straight-through diaphragm valves with open body (open body tubular diaphragm valves) is not permitted.
- 5.4.19 The use of elastomeric throttle valves exposed to UV radiation is not allowed.
- 5.4.20 Sampling points/ facilities shall be provided, complete with necessary fittings and valves, and the design shall be proper for the fluids being sampled.
- 5.4.21 Utility hose stations shall be installed throughout the package on strategic places for maintenance and cleaning purposes.
- 5.4.22 All major equipment shall be provided with lifting lugs.
- 5.4.23 Equipment and piping subjected to a 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 the latest revision of I-ET-3010.00-1200-431-P4X-001 – THERMAL INSULATION FOR MARITIME INSTALLATIONS.
- 5.4.24 All fasteners (studs, bolts, tightening bolts, and nuts) shall be according to I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS.
- 5.4.25 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.
- 5.4.26 SELLER shall provide a design book with all piping detailed design documentation, which must 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.

**5.5 MATERIAL SELECTION AND CERTIFICATION**

- 5.5.1 The SELLER is responsible for the materials selection considering the philosophy detailed at I-ET-3010.2D-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN, suitable to the operational condition shown in the process data sheet I-FD-3010.2D-5331-587-P4X-001 – HYDROCYCLONES (CI-5331001A/E).
- 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.

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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 STRUCTURES**

5.6.1 SELLER shall follow the requirements of I-DE-3010.00-1400-140-P4X-004 – GENERAL NOTES FOR TOPSIDES STRUCTURES.

5.6.2 All structure design and execution shall follow AWS D1.1 – Structural Welding Code – Steel.

5.6.3 All equipment shall be installed over structural steel deck plate. If installation by others, it shall be according to SELLER's instructions and supervision.

5.6.4 SELLER shall provide all structural steel work including main structural skid, support frames, supports for equipment, ladders, walkways, platforms, grating and drip trays.

5.6.5 SELLER shall design and construct a steel structural skid to accommodate the equipment within the SELLER scope of supply.

5.6.6 All structural steel works including support frames, supports for equipment, grating and drip pan, shall be provided.

5.6.7 Bolts, nuts and washers for use in structural constructions shall follow I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS.

**5.7 ERGONOMIC 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-3010.2D-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 walkways and be easily accessible for operation and maintenance, according to I-ET-3010.2D-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 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.

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

5.8.3 Mandatory safety items as established in DR-ENGP-M-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-3010.2D-1200-947-P4X-003 - DESCRIPTIVE MEMORANDUM – SAFETY, and I-FD-3010.2D-5400-947-P4X-001 - SAFETY DATA SHEET - TOPSIDE.

5.8.5 HAZOP and PHA shall be performed according to DR-ENGP-M-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 Maximum allowable pressure drop for pressure relief devices shall comply with API requirements.

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

5.8.9 The use of fittings in pipes with flammable liquids between FPSO decks and the plant shall be minimized so as to reduce the risk of pool fire.

5.8.10 The use of fittings in gas lines shall be minimized.

5.8.11 Any SDV (Shutdown Valve) shall be installed in places where they will not be affected by fire originating in other areas.

5.8.12 Instrumentation cables for emergency consumers shall have two different routings. The definition of the routes shall consider that a fire risk scenario shall not reach both of them simultaneously. The routing of such cables shall be as far as possible from fire risky areas. As an alternative to the use of two different routes, a fire-resistant cable can be used.



## 5.9 INSTRUMENTATION

- 5.9.1 The Package shall be provided with all necessary instruments and devices to operate safely, adequately and without interruption in a tropical marine environment.
- 5.9.2 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.
- 5.9.3 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.
- 5.9.4 For package automation type classification and additional interfaces see I-ET-3010.2D-1200-800-P4X-014 – AUTOMATION INTERFACE OF PACKAGED UNITS.

## 5.10 ELECTRICAL

- 5.10.1 For electrical equipment and material requirements, power supply definition and related subjects SELLER shall comply with the requirements of I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS, which will in turn guide on the use of other specific applicable electrical design specifications.
- 5.10.2 Equipment, accessories, piping and structures shall be grounded according to requirements of IEC 61892-6 and IEC 60092-502. For installations in hazardous area, the grounding requirements of IEC 61892-7 shall also be complied with. Earthing bosses shall be provided according to I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS.

## 5.11 TELECOMMUNICATIONS

- 5.11.1 Design of PAGA equipment shall fulfill the requirements, including standards and documents referred herein as well as referenced data sheets. PAGA installations and interfaces shall comply with requirements of:
- 5.11.2 I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM
- 5.11.3 I-MD-3010.00-5510-760-PPT-001 - GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN
- 5.11.4 I-ET-3010.2D-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES
- 5.11.5 Package shall be delivered with PAGA horns and cables installed and tested based on detail design done by SELLER.
- 5.11.6 SELLER shall be responsible for the design, supplying, installation and integration of the PAGA System items of its package, complying with all applicable requirements

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described in I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM for the entire system.

- 5.11.7 Since the PAGA network inside package to be designed is part of the entire system that is scope of SELLER detail design, SELLER shall ask BUYER any specific characteristics of the system, as well as the approval of the sound calculation memory and detailed design, to assure fully interoperability.
- 5.11.8 The acoustic horns and cables shall be designed by SELLER in 02 (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.
- 5.11.9 SELLER shall be responsible for commissioning the PAGA network inside the package of its own scope of supply before the lifting of the package, when the system will be accepted by BUYER.
- 5.11.10 SELLER shall supply all needed facilities to test the PAGA network inside package before lifting.
- 5.11.11 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 detail design, if required.
- 5.11.12 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: This section is only applicable for equipment that is built on a skid:

- 5.12.1.1 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.
- 5.12.1.2 All equipment shall be installed by SELLER over structural steel deck plate in position shown in I-DE-3010.2D-1421-942-P4X-002 – M-10B – PRODUCED WATER TREATMENT AND TEST SEPARATOR – EQUIPMENT LAYOUT PLAN.
- 5.12.1.3 All piping terminations shall be flanged.
- 5.12.1.4 The set of equipment and their skids must be designed, arranged and assembled in such a way to allow the safe personnel access, operation, and maintenance.
- 5.12.1.5 Lifting facilities shall enable lifting of the equipment with crane as a single point

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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 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.

5.12.1.6 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).

5.12.1.7 Lifting beams, spreader bars, slings, shackles, etc. are within SELLER's scope of supply.

5.12.1.8 Drip trays with drain connections shall be provided underneath equipment where significant spillage is likely to occur.

5.12.1.9 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.

5.12.1.10 Skid shall have two diagonally opposed earthing bars.

#### 5.12.2 Maintenance Lifting Beams

5.12.2.1 All required maintenance lifting beams, complete with the necessary hoisting and lifting gear, shall be provided to facilitate safe and easy maintenance.

5.12.2.2 Lifting beams, spreader bars, slings, shackles, all necessary hoisting and lifting gear are within SELLER's scope of supply.

5.12.2.3 All lifting beams shall overhang by at least 1.2 m into agreed lay-down areas.

5.12.2.4 The deflection of the maintenance crane/hoisting beams shall not exceed 1/500 of the span length.

5.12.2.5 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 to 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 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:

- A. Petróleo Brasileiro S.A. – PETROBRAS;
- B. Purchase order number;
- C. Manufacturer and year of build;
- D. Tag number;
- E. Service;
- F. Serial number;
- G. Main data for design, operation and testing (Power, Pressure, Volume, Temperature, Rotation, Flow rate), where applicable;
- H. Specific requirements;
- I. Installation identification;
- J. Driver power rating and speed, where applicable;
- K. Design code;
- L. Empty, operation and test weight;
- M. 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, telecommunication, mechanical and piping items, including valves, shall be in accordance with the latest revision of I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

7.1.2 For main item tag numbers, refer to I-FD-3010.2D-5331-587-P4X-001 – HYDROCYCLONES (CI-5331001A/E).

7.1.3 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 the 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.

8.2.2 All electrical and telecommunication equipment, 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, complying with I-DE-3010.2D-1200-94A-P4X-001 - AREA CLASSIFICATION – GENERAL, unless they are automatically de-energized in case of confirmed gas in equipment area, as defined in IEC 61892-7.

## 9 REPAIR

### 9.1 GENERAL

9.1.1 Welding repairs and heat treatments must be recorded and submitted for BUYER's approval.

## 10 INSPECTION, TESTING AND COMMISSIONING

### 10.1 GENERAL

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. ITP shall be issued for the equipment that are part of the Unit.

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 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 data book.

10.1.4 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.

10.1.5 Testing shall be witnessed by BUYER's inspector and shall include, at least:

- Hydrostatic test (vessels, valves);
- Running test (actuators);
- Review of calibration certificate (PSVs).

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ESUP**10.2 PERSONNEL QUALIFICATION AND CERTIFICATION**

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

**10.3 QUALITY AND INSPECTION**

10.3.1 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.

10.3.2 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.

10.3.3 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.

10.3.4 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.

10.3.5 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.

10.3.6 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 2 (two) weeks in advance for Brazilian manufacturer and 3 (three) weeks for foreign manufacturer.

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

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

**10.4 WELDING AND WELDING INSPECTION**

10.4.1 All equipment, structures, valves and piping welds shall be according to the requirements stated in I-ET-3010.00-1200-955-P4X-001 – WELDING.

10.4.2 Welding shall be carried out with procedures and welders qualified in accordance with

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Design Code and additional requirements stated in contractual technical specifications. Welding shall not be performed before qualified welding procedures specification have been approved.

10.4.3 Intermittent fillet welds are not permitted.

10.4.4 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 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.

**10.5 NON DESTRUCTIVE TEST**

10.5.1 NDT shall be according to the respective design Code and I-ET-3010.00-1200-970-P4X-004 - NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS

10.5.2 Final NDTs, for acceptance purposes shall be carried out after completion of any post weld heat treatment (when applicable) and prior to paint application, hydrostatic testing, etc.

**10.6 PACKAGE INSPECTION**

10.6.1 BUYER inspector shall witness the following inspections and checks:

- A. Verification of equipment construction materials (vessels, hydrocyclones, 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;
  - Location and orientation of equipment and instrument

**10.7 PACKAGE TEST**

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

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

10.7.3 SELLER shall submit a FAT procedure for the package with a test schedule covering all items within the scope of supply package and submit for BUYER approval.

10.7.4 The following factory test are included in SELLER scope:

- Hydrotest of all vessels and pipes;
- Electrical continuity checks on all wiring and earthing;
- Functional checks on all instruments and valves.
- Holiday detector testing for coating.

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

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

10.7.7 Preservation to be applied shall be as detailed in I-ET-3010.00-1200-200-P4X-115 – REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING.

10.7.8 FAT will be witnessed by BUYER representatives. SELLER shall advise BUYER of the test schedule at least 2 (two) weeks for Brazilian manufacturers /Sub-Suppliers and 3 (three) weeks for foreign manufacturers/Sub-Suppliers before the planned test dates. SELLER shall invite CLASS surveyor for FAT.

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

## 10.8 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

10.8.1 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.).

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

10.8.3 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.

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



## 11 SELLER RESPONSIBILITY

### 11.1 GENERAL

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

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

- A. Technical responsibility for the entire scope of supply;
- B. Resolving all engineering questions and/or problems relating to design and manufacture;
- C. 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;
- D. Providing details as requested of any sub-vendors relating to design and manufacture;
- E. To submit to the certifying authority the documentation as described in the latest edition of their rules for equipment on offshore facilities;
- F. If installation at site is included, the presence of supervision will be required;
- G. SELLER's responsibility shall also include Commissioning & Training for operation;
- H. Pre-Commissioning;
- I. Attend HAZOP meetings arranged by BUYER and update the design with its recommendations..

11.1.3 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.

## 12 PREPARATION FOR SHIPMENT

### 12.1 MARKING

12.1.1 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 component.

12.1.2 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.

12.1.3 As a minimum, the following identification shall be provided:

- Project Number
- Manufacturer's name
- Purchase Order Number
- Shipping Weight
- Item Number

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- Classification Society surveyor's stamp

**12.2 SHIPMENT PACKING**

12.2.1 The equipment shall be supplied tested, flushed and preserved.

12.2.2 Shipment packing preparation of the equipment shall be suitable for 24 months of outdoor storage from time of shipment.

12.2.3 All open ends of tubes on the equipment shall be treated and closed off by plastic caps and taped. Small bore threaded connections shall be taped over.

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

12.2.5 The package shall be protected from corrosion.

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

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

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

12.2.9 SELLER shall submit the packing design to BUYER for approval.

12.2.10 SELLER shall pack the equipment in accordance with the packaging requirements of the country which the equipment is being shipped to.

12.2.11 SELLER shall provide the procedures for unpacking, handling and installation, as well as repacking and long-term storage requirements.

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