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PRELIMINARY

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1 INTRODUCTION

This Technical Specification covers the minimum requirements for the design, engineering, materials, fabrication, inspection, testing, commissioning and pre-commissioning of the SULPHATE REMOVAL UNIT (UT-1251002) to be installed on PETROBRAS FPSO (Module M-11).

The SULPHATE REMOVAL UNIT shall be provided with all necessary instruments for safe, efficient and uninterrupted operation in a tropical marine environment.

The SULPHATE REMOVAL UNIT is composed by:

- SRU CLEANING SYSTEM HEATER (AQ-UT-1251002-A/B)
- SULPHATE REMOVAL BOOSTER PUMP (B-UT-1251002-01A/C)
- MEMBRANE CLEANING PUMP (B-UT-1251002-02A/B)
- SRU CLEANING SYSTEM FILTER (FT-UT-1251002-A/B)
- SRU CLEANING TANK (TQ-UT-1251002-A/B)
- CHEMICAL DOSING SYSTEM OF SRU (UQ-UT-1251002)
- SULPHATE REMOVAL UNIT CONTROL PANEL (PN-UT-1251002)

2 NORMATIVE REFERENCES

All equipment shall comply with the requirements of this technical specification and references stated below.

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

2.1 CLASSIFICATION


PACKAGER/ MANUFACTURER shall perform the work in accordance with the requirements of Classification Society.

PACKAGER/ MANUFACTURER is responsible for submitting to the Classification Society all documentation in compliance with stated Rules.

2.2 CODES AND STANDARDS

The latest editions of the following codes and standards shall be used as design guidelines:

API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API 613	Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services
API 614	Lubrication, Shaft-Sealing, and Oil-Control Systems and Auxiliaries
API 670	Machinery Protection Systems
API 671	Special-Purpose Couplings for Petroleum, Chemical and Gas Industry Services
API RP 14E	Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems
API RP 14FZ	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Zone 0, Zone 1 and Zone 2 Locations

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API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2		
API STD 520 Part I & II	Sizing, Selection and Installation of Pressure Relieving Devices		
API RP 545	Recommended Practice for Lightning Protection of Aboveground Storage Tanks for Flammable or Combustible Liquids		
ASME B16.5	Pipe Flanges and Flanged Fittings		
ASME B31.3	Process Piping		
ASME BPVC SECTION IX	Qualification Standard for Welding, Brazing, and fuzing procedures		
ASME BPVC SECTION VIII	Rules for construction of pressure vessels		
ASME BPVC SECTION X	Fiber-Reinforced Plastic Pressure Vessels		
HIS	Hydraulic Institute Standard		
IEC 60092-502	Electrical Installation in Ships – Part 502: Tankers - Special Features		
IEC 61892-6	Mobile and Fixed Offshore Units – Electrical Installations – Part 6: Installation		
IEC 61892-7	Mobile and Fixed Offshore Units – Electrical installations – Part 7: Hazardous areas		
IEC 60034	Rotating Electrical Machines		
INMETRO	Resolution 179, May 18-2010 and its annexes, and Resolution 270, June 21-2100		
ISO 14692	Glass-Reinforced Plastics Piping		
2.3	GOVERNMENTAL REGULATION		
NR 10	Segurança em Instalações e Serviços em Eletricidade (<i>Safety in Electrical Facilities and Services</i>)		
NR 13	Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento (<i>Boilers, Pressure Vessels, Piping and Metallic Storage Tanks</i>)		
NR 26	Sinalização de Segurança (<i>Safety Signaling</i>)		
NR-37	Segurança e Saúde em Plataformas de Petróleo Plataformas e Instalações de Apoio (<i>Safety and Health in Oil Platforms</i>)		
INMETRO	Portaria nº 179, May 18th 2010		
INMETRO	Portaria nº 89, Feb 23rd 2012		
Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein.			
2.4	REFERENCE DOCUMENTS		
DR-ENGP-1.3	SAFETY ENGINEERING		
DR-ENGP-I-1.15	COLOR CODING		
I-DE-3010.1M-1251-944-P4X-001	SULPHATE REMOVAL UNIT (P&ID)		
I-DE-3010.1M-5111-943-P4X-001	UTILITY FLOW DIAGRAM - SEA WATER SYSTEM		
I-DE-3010.1M-1200-942-P4X-002	GENERAL ARRANGEMENT		



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I-DE-3010.1M-1422-942-P4X-001	M-11 - WATER INJECTION AND SULPHATE REMOVAL - EQUIPMENT LAYOUT PLAN
I-DE-3010.00-5140-700-P4X-001	POWER INSTALLATION TYPICAL DETAILS
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS
I-DE-3010.00-5140-797-P4X-001	ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM
I-DE-3010.1M-5400-94A-P4X-001	AREA CLASSIFICATION – GENERAL
I-ET-3000.00-1200-940-P4X-001	TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
I-ET-3010.00-5400-947-P4X-008	ESCAPE ROUTE
I-ET-3010.00-1200-251-P4X-001	BOLT MATERIALS
I-ET-3010.1M-1200-300-P4X-001	NOISE CONTROL REQUIREMENTS FOR TOPSIDE
I-ET-3010.00-1200-431-P4X-001	THERMAL INSULATION FOR MARITIME INSTALLATIONS
I-ET-3010.00-1200-540-P4X-001	REQUIREMENTS FOR PRESSURE VESSELS DESIGN
I-ET-3010.00-1200-540-P4X-002	REQUIREMENTS FOR PRESSURE VESSELS FABRICATION
I-ET-3010.00-1200-800-P4X-002	AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGED UNITS
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
I-ET-3010.1M-1200-940-P4X-002	CORROSION MONITORING SYSTEM
I-ET-3010.00-5140-700-P4X-002	SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-005	REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS
I-ET-3010.00-5140-712-P4X-001	LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
I-ET-3010.00-5140-712-P4X-002	MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
I-ET-3010.00-5140-741-P4X-003	POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS
I-ET-3010.00-5140-797-P4X-001	ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
I-ET-3010.1M-1200-800-P4X-014	AUTOMATION INTERFACE OF PACKAGED UNITS
I-ET-3A36.00-1000-941-PPC-001_D	METOCEAN DATA
I-FD-3010.1M-1251-560-P4X-001	SULPHATE REMOVAL UNIT (UT-1251002) - M-11
I-RL-3010.1M-1200-940-P4X-001	GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-RL-3010.1M-1350-960-P4X-009	MOTION ANALYSIS

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3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

- May: Indicates a course of action that is permissible within the limits of the standard (a permission).
- Shall: An absolute requirement which shall be strictly followed in order to conform with the standard.
- Packager: Company responsible for the project, assembly, construction, fabrication, test and furnishing of the Package.
- Manufacturer: Company responsible for the fabrication of equipment or components internal to the Package.
- Package Unit or Package: An assembly of equipment supplied interconnected, tested and operating, requiring only the available utilities from the FPSO for full operation.
- Purchaser: The Company designated as such in the contract or purchase order.


3.2 ABBREVIATIONS

- CS: Classification Society
- ESD: Emergency Shutdown
- CUI : Corrosion under Insulation
- FPSO: Floating Production Storage and Offloading (vessel)
- GRP Glass Reinforced Plastic
- HMI: Human-Machine Interface
- ITR: Inspection and Test Report
- SDI: Silt Density Index
- SDV: Shut Down Valve
- SS: Stainless Steel
- TBD: To be defined
- UCP: Unit Control Panel

4 SCOPE OF SUPPLY

PACKAGER supply shall include, but not necessarily be limited to, the following:

- A complete engineering package including design, fabrication, inspection, testing, certification and preparation for shipment of the Sulphate Removal Unit. The package shall include drawings with dimensions, weights, instrumentation and electrical connections and any additional information.
- Membrane package including membrane pressure vessels and membrane elements, high pressure feed pumps with electric motors, couplings, guards and baseplates, cartridge filters, instrumentation and controls.
- Membrane cleaning package including mixing tank (if required, 2 x 100 %), pumps with electric motor (2 x 100%), heaters (complete with heater panel, flexible or hard piped connections) and mixer (if required).
- Injection water chemical injection system including pumps, tanks and instrumentation etc.
- Pressure safety relief valves or bursting discs as required.
- Vibration monitoring devices on high pressure feed pumps.
- Sea Water Sampling.
- Complete control, automation and protection system including all hardware and software for the package, installed in the UCP(s).
- Structural skid(s) with platforms, ladders and handrails for access, operation and maintenance.

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- Materials certificates and electrical certificates.
- Testing and inspection of the equipment in accordance with the PACKAGER Quality Plan:
 - Witnessed pressure testing of pressurized items.
 - Witnessed testing of all rotating equipment.
 - Witnessed performance testing of the complete unit including function testing of all instruments and controls.
 - Performance test of the complete unit may be done offshore local.
- Tagging of all individual items of equipment and instruments.

PACKAGER/ MANUFACTURER tender shall list the respective subcontractors for the following major items:

Sulphate Removal Booster Pump	B-UT-1251002-01A/C
Membrane Cleaning Pump	B-UT-1251002-02A/B
SRU Cleaning System Filter	FT-UT-1251002-A/B
SRU Cleaning Tank	TQ-UT-1251002-A/B
Chemical Dosing Tanks	TQ-UQ-UT-1251002-01/02/03
SRU Cleaning System Heater	AQ-UT-1251002-A/B
Chemical Metering Pumps	B-UQ-UT-1251002-01/02/03A/B
Chemical Dosing System of SRU	UQ-UT-1251002
Sulphate Removal Unit Control Panel	PN-UT-1251002
Sulphate Removal Unit Cleaning System Heater Panel	PN-AQ-UT-1251002-A/B
Nanofiltration (Sulphate Reduction Membranes)	TBD
Membrane Pressure Vessels	TBD
Free Chlorine Analyzers	TBD
Brine Metering System	TBD

All equipment, including sub-orders, shall be of “field proven” design and well within the manufacturer’s actual experience. For PETROBRAS, “field proven” equipment is defined as having a Reference List with at least 3 (three) operating equipment (of similar capacity) installed in offshore production units.

Deviations from field proven design may only be accepted for equipment which is part of research or development programs. In this case, their use shall be formally approved by PETROBRAS program coordinator.

5 GENERAL TECHNICAL REQUIREMENTS

5.1 OPERATION ENVIRONMENT

The equipment shall be suitable for the environment and range of ambient conditions, including, atmospheric pressure, relative humidity, rainfall, dry-bulb air temperature (see *Note*), characteristic monthly values and wind motions defined in I-ET-3A36.00-1000-941-PPC-001 – METOCEAN DATA.


Note: For dry bulb air temperature of electrical equipment, use the most critical conditions, among those defined by Classification Society and the specific equipment documentation.

5.2 DESIGN CONDITIONS

PACKAGER/ MANUFACTURER shall design the equipment for operation at any point on the head x flow curve within PETROBRAS defined operational limits, as specified in the Process Data Sheet I-FD-3010.1M-1251-560-P4X-001 – SULPHATE REMOVAL UNIT (UT-1251002) – M-11. Package design shall comply with I-DE-3010.1M-1251-944-P4X-001 – SULPHATE REMOVAL UNIT.

For utilities see I-RL-3010.1M-1200-940-P4X-001 – GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

For additional information and package interfaces also refer to the Utility Flow Diagram and Piping & Instrument Diagram listed in item 2.4.

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5.2.1 Injection Water Coarse Filters

Coarse Filters shall be automatic backflushing type, and supplied complete with motor, gearbox, automatic backwash valve, control panel, all necessary instrumentation (including pressure differential indicator transmitter), NR13 certification and NR13 nameplates.

The Coarse Filter shall be made of Carbon Steel (SA-516 Gr.70) with internal coating according to I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING, and internals in Super duplex (SA-240 UNS S32750 or UNS S32760).

The arrangement and size of the coarse filters shall be determined by PACKAGER/ MANUFACTURER based on the process data sheet, seawater supply quality and treated seawater specification.

5.2.2 Fine Filtration System (Cartridge Filters)

Replaceable cartridge filters, to be installed downstream the coarse filters, shall be supplied complete, each vessel with pressure differential indicator transmitter, NR13 certification and NR13 nameplates.

Filter shall be made of carbon steel (SA-516 Gr.70) with internal coating according to I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING, and internals in super duplex (SA-240 UNS S32750 or UNS S32760).

The final quantity of filters shall be determined prior to order placement, and their performance shall meet the minimum membrane inlet conditions as per membrane manufacturer's recommendations. Arrangement and size of cartridge filters shall be determined by PACKAGER/ MANUFACTURER based on the seawater supply quality and the treated seawater specification.

Cartridge housing shall preferably be designed to accept both conventional and spear end filter types.

Sampling points shall be fitted upstream and downstream the filters for SDI analysis.

Local pressure gauge(s) shall be provided on the filters to ensure safety prior to opening the filter covers.

5.2.3 Pumps

Centrifugal pumps shall be designed and manufactured according to API 610, and supplied complete with electric motors. Pump material shall be Super Duplex according to API 610 table H class D2.

The pumps shall feed and pressurize the membrane banks at safe flowrates and pressures, compatible with the membranes.

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.

5.2.4 Membrane Banks

PACKAGER/ MANUFACTURER is free to propose the most cost-effective arrangement of the membrane banks able to meet the allocated module space and specified desulphated seawater quality and flowrate. Consideration shall also be given to providing a high availability for the unit.


Each bank shall be provided with a differential pressure indicator-transmitter with differential pressure alarm. Each train of banks shall be protected against backflow with a discharge check valve. Vacuum protection shall be accomplished with a vacuum relief valve or bursting disc between the check valve and membrane banks. Final banks quantity and arrangement shall be agreed upon prior to order placement.

Membrane elements shall be selected for long life performance. The membrane banks shall be provided with sampling facilities to monitor the membranes performance during operation.

Membrane vessels shall be made of GRP or Super Duplex, depending on the pressure limits. They shall be manufactured and tested as per ASME X/ ASME VIII – Div. 1 respectively, and comply with NR 13 requirements.

5.2.5 Membrane Cleaning Package

A complete membrane cleaning package located adjacent to the membrane units shall be provided, with rigid piping (or hoses, if not practicable) for cleaning each membrane bank after isolation. The package will consist of GRP tank, electric heater(s), filter(s), pump(s) and all required accessories.

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PACKAGER/ MANUFACTURER shall define the expected cleaning frequency, water flowrate, and type and flowrate of chemicals required for each cleaning cycle.

5.2.6 Chemical Injection Package

PACKAGER/ MANUFACTURER shall define the concentrations, volumes and types of chemicals to be used and shall comment on the suitability of PETROBRAS proposed arrangement.

The package shall include all required injection pumps with motors, tanks, instrumentation, piping to the skid edge, valves and controls, drip trays with drain piping.

5.2.7 Lubricating Oil System (if Applicable)

To be supplied in accordance with the PACKAGER/ MANUFACTURER's standard proven system. All lube oil piping and oil wetted parts shall be in 316L SS. A single on-skid lube oil system for the gearbox and pump is preferred.

5.2.8 Gearbox (if Applicable)

Gearboxes shall generally conform to the requirements of API 613 standard. Any exception thereto shall be submitted to PURCHASER approval. Gearbox shall be designed so that no external loads be imposed on the gearbox by other equipment.

5.2.9 Couplings

Couplings shall be flexible disc-type with stainless steel discs as defined by API 671. Coupling guards shall be in non-sparking material (brass).

5.3 EQUIPMENT LOCATION AND LAYOUT CONSIDERATIONS

The Sulphate Removal Unit will be installed on module M-11. The total volume occupied by the unit shall not exceed the available space according to I-DE-3010.1M-1422-942-P4X-001 - M-11 - WATER INJECTION AND SULPHATE REMOVAL - EQUIPMENT LAYOUT PLAN.

5.4 DESIGN LOADS

In addition to Code described loads and loads due to vessel motions defined in I-RL-3010.1M-1350-960-P4X-009 - MOTION ANALYSIS, the following loads must be considered where relevant:

- Equipment transportation and erection loads;
- Nozzle loads;
- Thermal loads;
- Wind loads (wind data in I-ET-3A36.00-1000-941-PPC-001_D – METOCEAN DATA);
- Weight loads.

5.5 CORROSION MONITORING AND DESIGN LIFETIME

PACKAGER/MANUFACTURER shall verify the need for corrosion monitoring within the package and submit verification to PETROBRAS for approval. Refer to I-ET-3010.1M-1200-940-P4X-002 - CORROSION MONITORING SYSTEM.

PACKAGER/ MANUFACTURER shall design and fabricate the complete equipment for a minimum service life of 25 years.


5.6 NOISE

Noise control analysis is a mandatory item to be carried out, according to I-ET-3010.1M-1200-300-P4X-001 - NOISE CONTROL REQUIREMENTS FOR TOPSIDE.

5.7 MECHANICAL AND PIPING

The Sulphate Removal Unit, including all ancillary equipment, shall be assembled to the maximum extent possible, aligned and pre-checked at the MANUFACTURER's shop, allowing shipment to the installation site with minimal fieldwork.

All interconnecting piping shall comply with the requirements of ASME B31.3.

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All skid piping within the limits of supply shall be fabricated and terminated at the baseplate edge by means of valves and/or flanges and blind flanges according to ASME B16.5.

The flanges shall be flush with the transverse ends of the skid having a uniform B.O.P. (Bottom of Pipe) at an elevation as low as practical. This shall be shown on PACKAGER/ MANUFACTURER's P&ID's and General Arrangement drawings. All tubing for the off-skid interfaces shall be terminated at the skid by means of compression fitting valves.

All piping shall be rigidly supported for service and shipment, supports on the module plates shall not be accepted without under-deck stiffening. Supporting and installation shall allow piping removal without disturbing structural members.

All drain lines shall be routed through the deck to a common drain header, which shall be terminated in one flange at the skid edge 300 mm below the pancake level, for connection to PETROBRAS overboard drain system. Drain lines shall have a continuous slope towards the end point, with no low spots. Drain line connections into the drain header shall enter from the top. All drain lines shall be rigid pipes fitted with means to prevent vacuum build-up.

Fabricated branch welded connections (fittings, couplings etc.) shall be directly joined to the header with full penetration welds, where applicable.

After fabrication completion, all fabricated pipe spools shall be internally and externally cleaned to remove all loose scale, weld spatter, sand and any other foreign matter.

PACKAGER shall check and approve all piping with respect to stresses, vibration and piping layout. Anchor points shall be provided at skid edge.

Equipment and piping subject to temperatures > 60°C, or which require heat conservation, shall be thermally insulated according to I-ET-3010.00-1200-431-P4X-001 – THERMAL INSULATION FOR MARITIME INSTALLATIONS.

5.8 PRESSURE VESSELS DESIGN AND FABRICATION

All pressure vessels shall be designed and fabricated according to I-ET-3010.00-1200-540-P4X-001 – REQUIREMENTS FOR PRESSURE VESSELS DESIGN and I-ET-3010.00-1200-540-P4X-002 – REQUIREMENTS FOR PRESSURE VESSELS FABRICATION.

All pressure vessels shall comply with the requirements of NR 13 – Brazilian Ministry of Labor.

The facing and holes of all nozzle flanges shall be in accordance with ASME B16.5 or B16.47 standard.

Each vessel shall have its own support and may not be supported by piping, even in case of small vessels.

To avoid corrosion under insulation (CUI), only non-hygroscopic insulation material shall be selected for personal protection.

5.9 INSTRUMENTATION AND CONTROL

The Sulphate Removal Unit shall be provided with all necessary instruments and controls to operate safely, adequately and without interruption in a tropical marine environment.


This Package is classified in document I-ET-3010.1M-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS. The package requirements are according to I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGED UNITS.

The UCP (Sulphate Removal Unit Control Panel – PN-UT-1251002) shall be installed in the M-17 which is a non-hazardous area.

5.10 ELECTRICAL

Electrical equipment and material shall comply with I-ET-3010.00-5140-700-P4X-002– SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

Electrical installations within the package shall meet the requirements of I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS, I-DE-3010.00-

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5140-700-P4X-001 - POWER INSTALLATION TYPICAL DETAILS and I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS.

Electrical motors shall comply with 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.

Package motors shall be fed by the FPSO panels. PN-UT-1251002 shall be connected to the FPSO panels by hardwired cables for CONTROL (on/ off) and monitoring (status) of the motors.

The Sulphate Removal Unit Cleaning System Heater Panels (PN-AQ-UT-1251001A/B) for electrical heaters shall comply with I-ET-3010.00-5140-741-P4X-003 – POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS.

Electrical controls shall comply with I-ET-3010.00-5140-700-P4X-005 – REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.

The electrical interfaces of the package shall comply with I-DE-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM and I-ET-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

5.11 SKID DETAILS

This section is only applicable for skid mounted equipment. 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.

Lifting facilities shall permit the equipment to be lifted by 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 centre of gravity coincides approximately with the geometrical centre of the skid. When lifting the skids, complete with all equipment mounted, beam deflection shall not exceed 1/400 L.

The skid shall resist all sling forces, including both horizontal and vertical components of the applied sling angle (sling angles shall be between 50° and 90° degrees with the horizontal plane)

The floor shall be made of plate material with a raised on-slip tread. Drip trays with drain connections shall be provided underneath equipment where seriously spillage is likely to occur.

The skid shall be welded to the supporting structures. Welds underneath skid beams shall be ground flush. Welding shall be carried out with procedures and operators qualified as per ASME section IX. Welding shall not be performed before qualified welding procedure etc. is approved. Intermittent fillet welds are not permitted.

Skid shall have 2 diagonally opposed earthing bosses.

5.12 MAINTENANCE LIFTING BEAMS

All necessary maintenance lifting beams, complete with hoist and lifting gear, shall be provided to enable safe and easy maintenance.

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

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


All beams and lifting gear shall be subject to witnessed load testing by PETROBRAS and CS representatives.

A spreader beam to lift up the vacuum pumps shall be provided.

5.13 PAINTING

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

Vessel and filters shall be internally coated according to I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.

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Color code shall meet DR-ENGP-I-1.15 - COLOR CODING.

5.14 SAFETY

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

The use of couplings in gas lines shall be minimized.

Escape routes shall be designed as per DR-ENGP-1.3 - SAFETY ENGINEERING and as per I-ET-3010.00-5400-947-P4X-008 - ESCAPE ROUTE.

5.15 NAMEPLATES, TAGGING AND SAFETY SIGNS

MANUFACTURER shall attach SS 316 nameplates on each item of equipment in an accessible location, fastened with corrosion resistant pins, in Portuguese.

Nameplates for vessels shall be according to I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN.

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

- Service;
- Tag number;
- Manufacturer and year of build;
- Manufacturer's serial number;
- Main data for design, operation and testing (Power, Pressure, Volume, Temperature, Rotation, Flow rate), where applicable;
- Driver power rating and speed, where applicable;
- Design code;
- Empty, operation and test weight.
- Specific requirements;

Tagging of all instruments, electrical, mechanical and piping items, including valves, shall be in accordance with latest revision of I-ET-3000.00-1200-940-P4X-001 - TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN. The main items shall have individual tag numbers as dictated by PETROBRAS.

All safety signs shall be in Portuguese.

6 CERTIFICATION REQUIREMENTS

6.1 MATERIAL CERTIFICATION


In order to ensure that the materials of construction are in accordance with data sheets, all certificates shall contain the following information:

- Name of manufacturer
- Purchase order number and issue date
- Identification number of certificate and issue date
- Material specification(s)
- Material charge, batch or heat number
- Mechanical properties recorded from test results
- Nondestructive Testing method and results
- Heat treatment procedure

6.2 GENERAL CERTIFICATION

PACKAGER/ MANUFACTURER shall be responsible for obtaining all required certification of the equipment.

PACKAGER/ MANUFACTURER, through the independent certifying authority shall supply all certificates related to the materials, inspections, tests and qualification activities detailed in the approved Quality Plan.

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All electrical equipment shall be certified, according to I-DE-3010.1M-5400-94A-P4X-001 – AREA CLASSIFICATION – GENERAL. All materials and equipment proper to be used in hazardous areas, shall have conformity certificates complying with INMETRO Portaria nº 179, May 18th 2010 and its annexes and Portaria nº 89, Feb 23rd 2012 and shall be approved by CS. Electrical equipment installed in external safe areas, that shall be kept operating during emergency shutdown ESD-3P and ESD-3T shall be certified for installation in hazardous areas Zone 1 Group IIA temperature T3.

7 MATERIALS

7.1 GENERAL

The repair and defects in pressure-containing castings by peening or burning-in or by impregnation with other compounds is not allowed.

Repair by welding or by plugging shall be undertaken only when permitted by the material specification and shall only be applied with the procedures specified.

After weld repair, castings shall be heat treated, if specified in the material specification. A major weld repair shall always be followed by heat treatment.

Details of all major weld repairs and the heat treatment shall be recorded and reported to PETROBRAS.

For bolt materials apply the requirements of I-ET-3010.00-1200-251-P4X-001 – BOLT MATERIALS. The use of asbestos or materials containing asbestos is prohibited.

8 INSPECTION, TESTING AND COMMISSIONING


PACKAGER shall submit an Inspection and Test Plan (ITP) with the bid. PETROBRAS shall identify all the required witnessed inspections and tests on a marked up copy of the ITP. PETROBRAS reserves the right to inspect the package equipment anytime during fabrication to ensure that material and workmanship are in accordance with this specification. PACKAGER shall ensure that all the witnessed inspection and test requirements by the CS are met and due notice is given. The notification period for such inspections shall be mutually agreed upon during the kick-off meeting.

PACKAGER shall be responsible for compliance certificate carrying out all work examinations and tests, and shall be financially responsible for final inspection and testing which is necessary to ensure such compliance within the requirements of the CS.

8.1 INSPECTIONS AND TESTS

Unless waived by PETROBRAS, as a minimum the following inspections and tests shall be witnessed by PETROBRAS surveyor:

- Verification of the equipment, piping and fittings for conformity with the construction materials and fabrication requirements of the specification;
- A visual check noting:
 - That the thickness of pressure retaining parts meets or exceeds the quoted design thickness;
 - Any repairs;
 - Internal coating is complete (dry-film thickness as quoted);
 - General appearance, materials, workmanship and finish standard are acceptable;
- Dimensional check;
- Inspection by radiographic, dye penetrant, magnetic particles, ultrasonic inspection of welds of the pressure retaining parts of vessels;
- Hydrostatic test of all pressure vessels;
- Approval of relieve valve settings and their testing after setting;
- All instrumentation, control panels, electrical and ancillary equipment shall be built, checked, tested and function tested prior to installation as defined in the specification;
- Review of ITR's.

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8.2 FACTORY ACCEPTANCE TESTING (FAT)

PACKAGER/ MANUFACTURER shall prepare an FAT procedure covering all items within the scope of supply and submit it to PETROBRAS for approval. The FAT will be witnessed by PETROBRAS and PACKAGER shall invite CS representatives.

A full function test of completed package shall be performed. The satisfactory operation of all indicators, selectors and controllers shall be demonstrated. The correct operation of all controllers, alarm and failure protection equipment and indicators shall be demonstrated and if necessary failure simulations.

8.3 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

PACKAGER is responsible for assembly supervision of the equipment, including assembly of components delivered loose (for example, some components of the pumps, such as stuffing box; vessel internals etc.).

PACKAGER is responsible for pre-commissioning and commissioning supervision of the equipment/ system.

Final acceptance will be on satisfactory completion of commissioning tests as specified by PETROBRAS.

9 PREPARATION FOR SHIPMENT

9.1 MARKING

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

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

As a minimum, the following identification shall be provided:

- Project Number
- Manufacturer's name
- Purchase Order Number
- Shipping Weight
- Item Number
- Classification Society surveyor's stamp

9.2 SHIPMENT PACKING


The equipment shall be supplied tested, flushed and preserved. The preparation shall make the equipment suitable for 24 months outdoor storage from the time of shipment.

Equipment and accessories must be protected from corrosion. All open ends of pipes shall be treated and closed off by plastic caps and taped. Small bore threaded connections shall be taped over. All carbon steel vessels and parts shall be protected with corrosion inhibitor. All crates and boxes shall contain sufficient moisture absorbing agent to avoid condensation.

Vulnerable instruments shall be removed and packed separately for shipment. Transportation bracing/support shall be used where necessary and shall be clearly identified as temporary.

PACKAGER shall submit the packing design to PETROBRAS for approval. PACKAGER shall pack the equipment in accordance with the packaging requirements of the country which the equipment is being shipped to.

PACKAGER shall provide the procedures for unpacking, handling and installation, as well as repacking and long-term storage requirements. PACKAGER shall specify any limitations applicable to the transportation and installation phase.

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10 PACKAGER/ MANUFACTURER RESPONSIBILITY


PACKAGER shall assume sole contractual and total engineering responsibility for the package equipment. PACKAGER responsibility shall 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 manufacturing.
- 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 manufacturing.
- 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).
- Pre-Commissioning, Commissioning & Training Operations.

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

The Deviation List mentioned above shall contain, at least, for each requirement that the PACKAGER/ MANUFACTURER intends to change:

- The document description, code and section that contain the requirement;
- The reason for deviation, and the costs, schedule and technical benefits/ impacts of the change;
- The PACKAGER/ MANUFACTURER proposal.

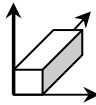
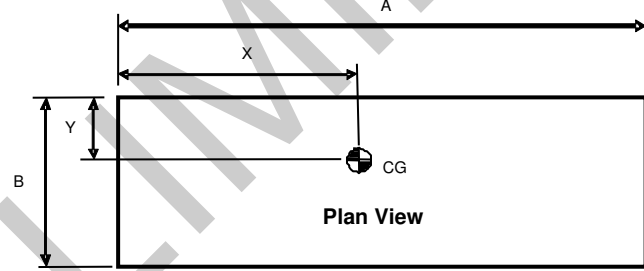
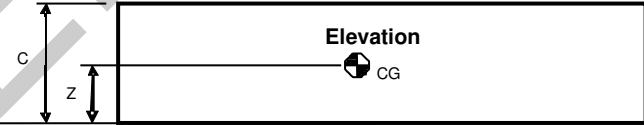
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11 WEIGHT CONTROL

PACKAGER shall fill in the following attachment.

1	APPLICABLE TO: <input checked="" type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS BUILT		
2	FOR: EB-E&P	UNIT / MODULE:	_____
3	SITE: CESSÃO ONEROSA	SERVICE:	_____
4	No REQ / TAG: _____	MANUFACTURER:	_____
5	MODEL: _____	VENDOR:	_____
6	SIZE / TYPE: _____	MAIN EQUIPMENT:	_____
7	SERIAL No. _____	MANUFACTURER No:	_____

WEIGHT DATA			
9 DATA STATUS: <input type="checkbox"/> ESTIMATED <input type="checkbox"/> CALCULATED <input type="checkbox"/> WEIGHTED			
10	EQUIPMENT WEIGHT:	ACCURACY:	_____
11	DRY:	_____ kg ± _____ %	REMARKS: _____ _____ _____
12	OPERATING (NORMAL):	_____ kg ± _____ %	
13	OPERATING (MAXIMUM):	_____ kg ± _____ %	
14	TEST:	_____ kg ± _____ %	
15	MAX MAINTENANCE	_____ kg ± _____ %	
16	_____	_____ kg ± _____ %	

DIMENSIONS DATA			
19 DATA STATUS: <input type="checkbox"/> ESTIMATED <input type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED			
20 SKETCH:			
		 <p style="text-align: center;">Plan View</p>	
		 <p style="text-align: center;">Elevation</p>	Level Top of support
37	OVERALL DIMENSIONS:	DRY DIMENSIONS:	OPERATING DIMENSIONS: MAINTENANCE DIMENSIONS:
38	A: _____ mm	X: _____ mm	X: _____ mm _____ : _____ mm
39	B: _____ mm	Y: _____ mm	Y: _____ mm _____ : _____ mm
40	C: _____ mm	Z: _____ mm	Z: _____ mm _____ : _____ mm

NOTES	
General:	
<ul style="list-style-type: none"> Vendor shall fill in all blank spaces in the weight control data sheet (fields and check boxes). All missing information will be considered as not applicable or not according to vendor's proposal. Vendor shall fill in data sheets for main and auxiliary equipment, furnished separately or on different skids. If necessary, manufacturer shall produce additional copies of the weight control data sheet. 	
Weight data:	
<ul style="list-style-type: none"> Accuracy of weight figures shall be ± 10% in the proposal phase. After placing of the purchase order, the accuracy shall be refined to ± 3%. 	
Dimensional data:	
<ul style="list-style-type: none"> Manufacturer shall indicate equipment orientation. Any variation in center of gravity from dry to operating mode shall be noted. Manufacturer shall indicate with dashed lines on sketch and respective dimensions on the information table all maintenance areas required for assembly and disassembly of equipment. Accuracy of dimensions shall be ± 10% in the proposal phase. After placing of the purchase order, the accuracy shall be refined to ± 3%. 	