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	JOB:	REFERENCE BASIC DESIGN	1001056398 0010
	AREA:	BÚZIOS	
DP&T-SRGE	TITLE:	<b>VACUUM DEAERATION UNIT</b>	NP-1
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PRELIMINARY

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## 1 INTRODUCTION

This Technical Specification covers the minimum requirements for design, engineering, materials, fabrication, inspection, testing, commissioning and pre-commissioning of the VACUUM DEAERATION UNIT (UT-1251003) to be installed on PETROBRAS FPSO (Module M-11).

The VACUUM DEAERATION UNIT (UT-1251003) shall be provided with all necessary instruments for safe, efficient and uninterrupted operation in a tropical marine environment.

The Vacuum Deaeration Unit is composed by:

- VACUUM DEAERATOR COLUMN (D-UT-1251003)
- VACUUM SYSTEM (Z-UT-1251003)

## 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. Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below:

API 681	Liquid Ring Vacuum Pumps and Compressors for Petroleum, Chemical and Gas Industry Services
API RP 14E	Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems
API STD 520 Part I & II	Sizing, selection and installation of pressure relieving devices in refineries
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B31.3	Process Piping
ASME BPVC Section VIII	Rules for Constructions of Pressure Vessels;
ASME BPVC IX	Qualification Standard for Welding, Brazing and Fusing Procedures
ASME BVPC X	Fiber-Reinforced Plastic Vessels
IEC 60034	Rotating Electrical Machines
IEC 60092-502	Electrical Installation in Ships – Tankers Special Features
IEC 61892-6	Mobile and Fixed Offshore Units – Electrical Installations – Installation
IEC 61892-7	Mobile and Fixed Offshore Units – Electrical installations – Hazardous areas
ISO 14692	Glass-Reinforced Plastic Piping

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**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, Tubulação e Tanques Metálicos de Armazenamento (Boilers, Pressure Vessels, Piping and Metallic Storage Tanks)
NR 26	Sinalização de Segurança (Safety Signaling)
NR-37	Segurança e Saúde em Plataformas de Petróleo (Safety and Health in Oil Platforms)
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-M-I-1.3	SAFETY ENGINEERING
DR-ENGP-I-1.15	COLOR CODING
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-3010.1M-1200-942-P4X-002	GENERAL ARRANGEMENT
I-DE-3010.1M-1422-942-P4X-001	M-11 - WATER INJECTION AND SULPHATE REMOVAL - EQUIPMENT LAYOUT PLAN
I-DE-3010.1M-1251-944-P4X-002	VACUUM DEAERATION UNIT (P&ID)
I-DE-3010.1M-5111-943-P4X-001	UTILITY FLOW DIAGRAM - SEA WATER SYSTEM
I-ET-3000.00-1200-940-P4X-001	TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.
I-ET-3010.00-1200-251-P4X-001	BOLT MATERIALS
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-3010.1M-1200-800-P4X-014	AUTOMATION INTERFACE OF PACKAGED UNITS
I-ET-3010.00-1200-956-P4X-001	QUALIFICATION TESTS FOR PAINT SYSTEMS
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
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-3010.00-5140-712-P4X-001	LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
I-ET-3010.1M-1200-300-P4X-001	NOISE CONTROL REQUIREMENTS FOR TOPSIDE
I-ET-3010.1M-1200-940-P4X-002	CORROSION MONITORING SYSTEM
I-ET-3A36.00-1000-941-P4X-001_D	METOCEAN DATA
I-FD-3010.1M-1251-560-P4X-002	VACUUM DEAERATION UNIT (UT-1251003) - MAIN DECK
I-FD-3010.1M-1251-565-P4X-001	VACUUM DEAERATOR COLUMN (D-UT-1251003) - MAIN DECK
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: is defined as the responsible for project, assembly, construction, fabrication, test and furnishing of the Package.
- Manufacturer: is defined as the responsible by fabrication of equipment or components internal to the Package.
- 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
- CUI : Corrosion under Insulation
- FPSO: Floating Production Storage and Offloading (vessel)
- GRP Glass Reinforced Plastic
- HMI: Human-Machine Interface
- P&ID: Piping & Instrumentation Diagram
- SS: Stainless Steel
- UCP: Unit Control Panel

### 4 SCOPE OF SUPPLY

PACKAGER/ MANUFACTURER shall be responsible for supplying complete and fully operative systems according to I-DE-3010.1M-1251-944-P4X-002 - VACUUM DEAERATION UNIT, I-FD-3010.1M-1251-560-P4X-002 – VACUUM DEAERATION UNIT (UT-1251003) – MAIN DECK, and I-FD-3010.1M-1251-565-P4X-001 - VACUUM DEAERATOR COLUMN (D-UT-1251003) – MAIN DECK and the requirements of this specification.

PACKAGER/ MANUFACTURER scope of 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 Vacuum Deaerator Column (D-UT-1251003) with its supports and internals and the complete skid mounted Vacuum System (Z-UT-1251003), with all necessary instrumentation, isolating and regulating valves as required. The package documentation shall include drawings with dimensions, weights, instrumentation and electrical connections and all required information.
- Vacuum System (Z-UT-1251003) including:
  - a) 1 x 100% Atmospheric Air Ejector.
  - b) 2 x 100% Liquid Ring Vacuum Pumps (including Electric Motors), to be sized for 120% of the required flow rate.
  - c) 1 x 100% Discharge Separator Tank.
  - d) 1 x 100% Vacuum System Control Panel (PN-Z-UT-1251003).
  - e) Structural Skid.
  - f) Piping for interconnection between Vacuum System Equipment.
- Vacuum pumps shall be provided with spacer couplings, including non-sparking coupling guards.
- The vacuum liquid ring pumps shall be supplied in accordance with API 681.

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- Discharge separator tank stiffeners shall be internal where necessary.
- Vacuum Deaerator Column (D-UT-1251003) including vessel internals, instrumentation, support, ladders and platforms for operation and maintenance. The column shall be designed and fabricated in compliance with ASME Sec. VIII Div. 1 and protected from damage or rupture by use of over-pressure devices, pressure safety relief valves or bursting discs as required.
- The deaerator column shall be provided with lifting trunnions, attached by full penetration welds. Lifting lugs shall be designed for a total load of 1.5 times the lifted weight.
- Vacuum System Control Panel (PN-Z-UT-1251003), supplied loose to be installed on FPSO module.
- Sampling facilities.
- Control and Protection system suitable for location in a safe area, complete with HMI.
- Complete control and protection system including all hardware and software for the package, to be installed in the UCP.
- All material and equipment certificates (including electrical).
- Testing and inspection throughout the manufacturing process, in accordance with the PACKAGER/MANUFACTURER's 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 locally done offshore.
- Tagging of all individual items of equipment and instruments.
- Lifting beams, spreader bars, slings, shackles etc. as required for package transportation and installation.

All equipment, including sub-orders, shall be of "field proven" design and well within the PACKAGER/MANUFACTURER's experience.

"Field proven" equipment is defined by PETROBRAS as having a Reference List with at least 3 (three) operating equipment (of similar capacity) installed in offshore production units.

Deviations from the "field proven" design criterion may be accepted only for equipment, which is part of research or development programs, in which 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\_D – METOCEAN DATA.


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

### 5.2 DESIGN CONDITIONS

PACKAGER/ MANUFACTURER shall design the equipment for the process conditions as specified in the Process Data Sheets I-FD-3010.1M-1251-565-P4X-001 – VACUUM DEAERATOR COLUMN (D-UT-1251003) – MAIN DECK and I-FD-3010.1M-1251-560-P4X-002 – VACUUM DEAERATION UNIT (UT-1251003) – MAIN DECK, considering all design conditions and performance criteria.

Package design shall comply with I-DE-3010.1M-1251-944-P4X-002 – VACUUM DEAERATION UNIT.

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

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

### 5.3 EQUIPMENT LOCATION AND LAYOUT CONSIDERATIONS

The VACUUM DEAERATION UNIT will be installed on module M-11, and the Vacuum System Control Panel (PN-Z-UT-1251003) will be installed on module M-17. For more details, see I-DE-3010.1M-1200-942-P4X-002 – GENERAL ARRANGEMENT.

The total volume occupied by the VACUUM DEAERATION 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.

Safe and adequate ladders and platforms shall be installed for access to all operation and maintenance areas (e.g. valves, instruments etc.) located higher than 1.75 m above the skid base plate.

Valves shall preferably be positioned with their stem pointing upwards, located in such way that the hand wheel or stem will not obstruct walkways. Where hand operated valves are not easily operable, gear operated valves shall be used.

Sufficient withdrawal spaces and clearances shall be provided for all removable vessel/ pipe internals. Lifting facilities provided by PACKAGER/ MANUFACTURER shall be in place to allow temporary removal of the filter tops for maintenance and filter change out, and general maintenance duties on all equipment within the package limits.

### 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. MANUFACTURER/ PACKAGER shall fill in the attached Forms I and II and submit them to PETROBRAS approval.


### 5.7 MECHANICAL AND PIPING

The Vacuum Deaeration 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.

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.

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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 Labor Ministry Rules.

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 shall 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 Vacuum Deaeration Unit (UT-1251003) shall be provided with all necessary instruments and controls shown on I-DE-3010.1M-1251-944-P4X-002 - VACUUM DEAERATION UNIT, in order to meet the requirements listed on I-FD-3010.1M-1251-560-P4X-002 – VACUUM DEAERATION UNIT (UT-1251003) – MAIN DECK and I-FD-3010.1M-1251-565-P4X-001 - VACUUM DEAERATOR COLUMN (D-UT-1251003) – MAIN DECK.

The Vacuum Deaerator Column (D-UT-1251003) and the Vacuum System (Z-UT-1251003) shall be delivered with all instrumentation 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 (Vacuum System Control Panel PN-Z-UT-1251003) shall be installed in the Topside AEPR (Automation & Electrical Panel Room), which is a non-hazardous area. The panel shall be capable of carrying out interlocking, process automation and start-up, shutdown, normal operation and safety procedures.

#### 5.10 ELECTRICAL

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

Electrical motors shall comply with requirements of I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.



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

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.

Package motors shall be fed by the FPSO panels. PN-Z-UT-1251003 shall be connected to the FPSO panels by hardwired cables for CONTROL (on/ off) and monitoring (status) of the motors.

### 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 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.

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.


Deaerator column shall be internally coated according to I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.

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

### 5.14 SAFETY

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

The use of couplings in gas lines shall be minimized.

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### 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.

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.

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## 7 MATERIALS

The quotation shall describe a complete list of the materials of the main parts as well as required inspection. All materials shall be corrosion resistant for the intended service.

Materials of construction for the Vacuum Deaerator Column shall be carbon steel with internal coating in accordance with I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

Materials for deaerator column internals shall be SS 316, polypropylene (PP) or glass fiber reinforced plastic (GRP).

Internal distribution piping material shall be Carbon Steel internally coated with Polyethylene.

The materials of construction for the liquid ring pumps and the ejectors shall be 25% Cr duplex.

Separator tank shall be made of GRP.

PACKAGER/ MANUFACTURER may offer materials of construction other than those specified, but these shall be quoted separately as an alternative.

For the pressure-containing parts of equipment and main components, PACKAGER/ MANUFACTURER shall confirm the specified mechanical properties and chemical composition of the materials used for the equipment by means of appropriate certificates as defined in this specification.

Materials for supporting lugs, skirts, baffles and similar non-pressure parts welded to the vessel shall be compatible with the material which they are attached to.

Impact testing shall be as per material specifications and codes. Guaranteed values are not acceptable; impact testing shall show the actual results.

For bolt material apply the requirements of I-ET-3010.00-1200-251-P4X-001 – BOLT MATERIALS.

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

PACKAGER/ MANUFACTURER shall be responsible for the review of all repair welds to ensure that they are properly heat treated and non destructively examined, and in compliance with the applicable qualified procedure.

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.

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:

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- 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.

## 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 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.


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
- CS 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.

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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.

## 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: _____ UNIT / MODULE: _____
3	SITE: _____ SERVICE: _____
4	No REQ / TAG: _____ MANUFACTURER: _____
5	MODEL: _____ VENDOR: _____
6	SIZE / TYPE: _____ MAIN EQUIPMENT: _____
7	SERIAL No. _____ MANUFACTURER No: _____

**WEIGHT DATA**

9 DATA STATUS:  ESTIMATED  CALCULATED  WEIGHTED

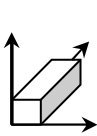
10 EQUIPMENT WEIGHT: \_\_\_\_\_ ACCURACY: \_\_\_\_\_

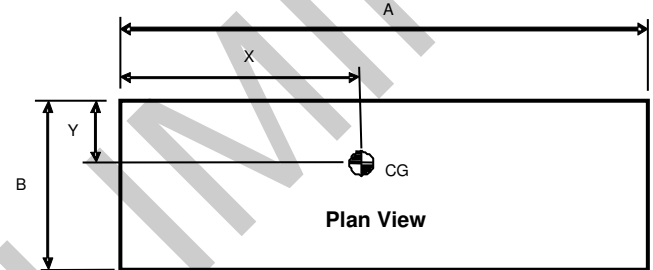
11	DRY:	_____ kg	± _____ %	<b>REMARKS:</b> _____ _____ _____
12	OPERATING (NORMAL):	_____ kg	± _____ %	
13	OPERATING (MAXIMUM):	_____ kg	± _____ %	
14	TEST:	_____ kg	± _____ %	
15	MAX MAINTENANCE	_____ kg	± _____ %	
16	_____	_____ kg	± _____ %	_____

**DIMENSIONS DATA**

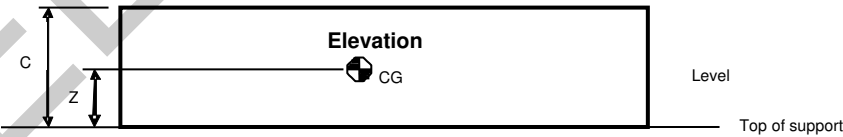
19 DATA STATUS:  ESTIMATED  CALCULATED  MEASURED

20 SKETCH:





**Plan View**



**Elevation**

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:**
- 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:**
- 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:**
- 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%.