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	CLIENT:	SRGE	SHEET: 1 of 19
	JOB:	REFERENCE BASIC DESIGN	1001056398 0010
	AREA:	BÚZIOS	
DP&T-SRGE	TITLE: <b>TEG REGENERATION SYSTEM PACKAGE</b>		NP-1 ESUP

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**TEG REGENERATION SYSTEM PACKAGE**

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## 1 INTRODUCTION

This specification covers the minimum requirements for design, engineering, materials, fabrication, inspection, testing, commissioning and pre-commissioning of the TEG REGENERATION SYSTEM PACKAGE to be supplied for REFERENCE BASIC DESIGN.

The TEG REGENERATION SYSTEM PACKAGE shall be provided with all necessary instruments to operate safely, adequately and without interruption in a offshore facility.

For process conditions information, see latest revision of I-FD-3010.1M-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001)

## 2 NORMATIVE REFERENCES AND DESIGN SPECIFICATIONS

The TEG REGENERATION SYSTEM PACKAGE shall comply with the requirements of this specification, data sheets, the rules, codes, standards and the project specifications as stated below and with those referred to herein.

### 2.1 CLASSIFICATION

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

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

### 2.2 CODES AND STANDARDS

2.2.1 The following codes and standards include provisions which, through reference in this text, constitute provisions of this specification. The latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below:

- |                      |   |
|----------------------|---|
| AWS D1.1             | - Structural Welding Code – Steel   |
| ASME B16.5           | - Pipe Flanges and Flanged Fittings   |
| ASME B31.3           | - Process Piping  |
| API 660              | - Shell and Tube Heat Exchangers for General Refinery Services  |
| API 12GDU            | - Specification for Glycol type Gas Dehydration Units   |
| API RP14E            | - Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems                                   |
| API RP 505           | - Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1, Zone 0, Zone 1 and Zone 2 |
| ASME BPVC sec. VIII: | - Rules for Construction of Pressure Vessels  |

- |                    |   |
|--------------------|---|
| ASME BPVC sec. IX: | - Qualification Standard for Welding, Brazing and Fusing Procedures   |
| ASME BPVC sec. V:  | - Nondestructive Examination  |
| IEC 60092-502      | - Electrical Installation in Ships – Tankers – Special Features   |
| IEC 61892-3        | - Mobile and Fixed Offshore Units – Electrical Installations – Equipment  |
| IEC 61892-6        | - Mobile and Fixed Offshore Units – Electrical Installations – Installation   |
| IEC 61892-7        | - Mobile and Fixed Offshore Units – Electrical Installations – Hazardous Areas  |
| TEMA               | - Mechanical Standards for Class “R” Heat Exchangers  |
| API 674            | - Positive Displacement Pumps – Reciprocating   |
| API 675            | - Positive Displacement Pumps - Controlled Volume for Petroleum, Chemical, and Gas Industry Services                            |
| API 676            | - Positive Displacement Pumps - Rotary  |
| ISO 15156          | - Petroleum and Natural Gas Industries: Materials for use in H <sub>2</sub> S containing environments in oil and gas production |

### 2.3 GOVERNMENTAL REGULATION

- |                        |   |
|------------------------|---|
| INMETRO Portaria n°179 | - Portaria n°179 – May 18th 2010                      |
| INMETRO Portaria n°89  | - Portaria n°89 – Feb 23rd 2012                       |
| NR 10                  | - Segurança em Instalações e Serviços em Eletricidade |
| NR-12                  | - Máquinas e Equipamentos                             |
| NR -13                 | - Caldeiras e Vasos de Pressão                        |
| NR-26                  | - Sinalização de Segurança                            |
| NR-37                  | - Segurança e Saúde em Plataformas de Petróleo        |

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

### 2.4 DESIGN SPECIFICATIONS

- |                               |  |
|-------------------------------|--|
| DR-ENGP-M-I-1.3               | - SAFETY ENGINEERING                                     |
| DR-ENGP-I-1.15                | - COLOR CODING   |
| I-DE-3010.1M-1200-942-P4X-002 | - GENERAL ARRANGEMENT                                    |
| I-DE-3010.1M-1227-944-P4X-001 | - TEG REGENERATION SYSTEM                                |
| I-DE-3010.1M-1233-944-P4X-001 | - GAS DEHYDRATION SYSTEM                                 |
| I-DE-3010.1M-1416-942-P4X-001 | - M06 – GAS DEHYDRATION AND HCDP – EQUIPMENT LAYOUT PLAN |

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-3010.00-1200-251-P4X-001	- BOLT MATERIALS
I-ET-3010.00-1200-431-P4X-501	- THERMAL INSULATION FOR MARITIME INSTALLATIONS
I-ET-3010.00-1200-510-P4X-001	- METALLIC TANKS DESIGN FOR TOPSIDE
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-3010.00-1200-955-P4X-001	- WELDING
I-ET-3010.00-1200-955-P4X-002	- REQUIREMENTS FOR WELDING INSPECTION
I-ET-3010.00-1200-956-P4X-002	- GENERAL PAINTING
I-ET-3010.00-1233-498-P4X-001	- ELECTRIC HEATER
I-ET-3010.00-5140-700-P4X-001	- LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.
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-3010.1M-1200-300-P4X-001	- NOISE CONTROL REQUIREMENTS FOR TOPSIDE
I-ET-3010.1M-1200-310-P4X-002	- POSITIVE DISPLACEMENT PUMPS SPECIFICATION FOR TOPSIDE.
I-ET-3010.1M-1200-451-P4X-001	- SHELL & TUBE HEAT EXCHANGER SPECIFICATION
I-ET-3010.1M-1200-940-P4X-002	- CORROSION MONITORING SYSTEM.
I-ET-3A36.00-1000-941-PPC-001_D	- METOCEAN DATA
I-FD-3010.1M-1227-560-P4X-001	- TEG REGENERATION SYSTEM PACKAGE (Z-1227001)
I-FD-3010.1M-1233-550-P4X-001	- GAS DEHYDRATION UNIT (T-1233001/V-T-1233001) – M06
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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### 2.5 CONFLICTING REQUIREMENTS

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.

## 3 DEFINITIONS AND ABBREVIATIONS

### 3.1 DEFINITIONS

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.

PURCHASER: The Company designated as such in the contract or in the purchase order.

PACKAGE UNIT or PACKAGE: An assembly of equipment supplied interconnected, tested and operating, requiring only the available utilities from the FPSO for full operation

### 3.2 ABBREVIATIONS

CRA	-	Corrosion Resistant Alloy
FAT:	-	Factory Acceptance Test
FPSO	-	Floating Production Storage and Offloading (vessel)
NDE:	-	Nondestructive Examination
P&ID:	-	Piping & Instrumentation Diagram

## 4 GENERAL FUNCTIONAL REQUIREMENTS

PACKAGER/MANUFACTURER shall be responsible for supplying complete and fully operative systems in accordance with the requirements of this specification, codes and standards referenced therein.

### 4.1 OPERATON ENVIROMENT

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

### 4.2 MOTION REQUIREMENTS

4.2.1 The necessary design data and information on motion requirements are given in the latest revision of I-RL-3010.1M-1350-960-P4X-009 - MOTION ANALYSIS.



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### 4.3 DESIGN CONDITONS

4.3.1 MANUFACTURER shall design the package for the full range of process conditions as specified in the document, Process Data Sheet: I-FD-3010.1M-1227-560-P4X-001 – TEG REGENERATION SYSTEM PACKAGE (Z-1227001).

### 4.4 PACKAGE LOCATION AND AREA CLASSIFICATION

4.4.1 The TEG REGENERATION SYSTEM PACKAGE (Z-1227001) shall be installed on the module M-06 as informed in I-DE-3010.1M-1200-942-P4X-002 - GENERAL ARRANGEMENT. For available space also see I-DE-3010.1M-1416-942-P4X-001 - M06 – GAS DEHYDRATION AND HCDP – EQUIPMENT LAYOUT PLAN.

4.4.2 All equipment shall be certified according area classification, see document I-DE-3010.1M-5400-94A-P4X-001 - AREA CLASSIFICATION – GENERAL

### 4.5 DESIGN LOADS

4.5.1 In addition to the Code described loads and loads due to vessel motion described in I-RL-3010.1M-1350-960-P4X-009 – MOTION ANALYSIS, the following design loads shall be considered where relevant:

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

### 4.6 DESIGN LIFETIME

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

### 4.7 NOISE

4.7.1 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.

### 4.8 CORROSION MONITORING

4.8.1 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.

## 5 PACKAGE SPECIFICATION

PURCHASER shall select a PACKAGER/MANUFACTURER considering a proven experience supplying this type of equipment/technology. PURCHASER shall submit the name of the PACKAGER/MANUFACTURER to PETROBRAS approval.

### 5.1 SCOPE OF SUPPLY

5.1.1 The TEG Regeneration Package shall be complete in all respect and the scope of supply shall include but not be limited to the following major equipment shown in Table 5.1:

**Table 5.1 - Package Scope**

EQUIPMENT	TAG NUMBER	QTY
TEG Flash Drum	V-Z-1227001-01	1
TEG Reboiler Drum	V-Z-1227001-02	1
TEG Surge Drum	V-Z-1227001-03	1
Primary TEG Cartridge Filters	FT-Z-1227001-01A/B	2
TEG Charcoal Filter	FT-Z-1227001-02	1
Secondary TEG Cartridge Filter	FT-Z-1227001-03	1
Hot Lean / Rich TEG Heat Exchanger	P-Z-1227001-01	1
Lean TEG Cooler	P-Z-1227001-02	1
Cold Lean / Rich TEG Heat Exchanger	P-Z-1227001-03	1
TEG Regeneration Unit Condenser	P-Z-1227001-04	1
TEG Regeneration Unit Reboiler	AQ-Z-1227001-01A/C	3
TEG Regeneration Unit Reboiler Panel	PN-AQ-Z-1227001-01A/C	3
TEG Regeneration Unit Stripper	T-Z-1227001-01	1
TEG Sparger Column	T-Z-1227001-02	1
TEG Circulation Pumps	B-Z-1227001-01A/B	2
Chemical injection package , including:		
- pH Control Injection Pump, air driven;	B-Z-1227001-02	1
- Foam Inhibitor Injection Pump, air driven;	B-Z-1227001-03	1
- Ph Control Storage Tank	TQ-Z-1227001-01	1
- Foam Inhibitor Storage Tank	TQ-Z-1227001-02	1

\*Note: pH Control Storage Tank and Foam Inhibitor Storage Tank: complete with level gauge, cleaning cover, drain, overflow, vent and fill connection.

5.1.2 For equipment specific requirements, refer to data sheet I-FD-3010.1M-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001).

### 5.2 PROCESS DESIGN

Process design and sizing of all equipment shall be in accordance with:

5.2.1 Datasheet: I-FD-3010.1M-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001);

5.2.2 P&IDs I-DE-3010.1M-1227-944-P4X-001 – TEG REGENERATION SYSTEM; I-DE-3010.1M-1233-944-P4X-001 - GAS DEHYDRATION SYSTEM.



- 5.2.3 For Gas Dehydration Unit information see latest revision of I-FD-3010.1M-1233-550-P4X-001 – GAS DEHYDRATION UNIT (T-1233001/V-T-1233001) – M06;
- 5.2.4 Latest revision of the following report document: I-RL-3010.1M-1200-940-P4X-001 - GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
- 5.2.5 Design shall also include:
- Definition of number, size and location of all process and instrument related nozzles;
  - Design and definition of all vessel internals and their appropriate locations;
  - Design and definition of internal support requirements for installing the internals in the vessels.
- 5.2.6 Lean TEG flow and stripping gas rates shall be continuously monitored. The TEG flow measurement shall be suitable for the pulsating flow (i.e. variable orifice meter is NOT permitted).
- 5.2.7 In the stripping gas supply line a manual throttling valve shall be provided downstream of PCV (Pressure Control Valve).
- 5.2.8 Internal baffles shall be installed to restrict liquid movement due to ship motion. For liquid supply to the stripping gas column, provisions shall be made to avoid alternate starving and flooding of the column caused by the same motion.
- 5.2.9 All relief valves shall be self draining to the process equipment. The relief valve assemblies shall include block valves with interlocking devices. The valves shall be operable at top of platform.
- 5.2.10 Vents and drains on heat exchanger may not be required if venting and draining can be done via other equipment. If vent and drain is provided on heat exchangers they shall have a valve and a blind connection.
- 5.2.11 There shall be continuous fall in the drain lines toward the terminal point. If required high and low pressure drains shall be routed separately.

### 5.3 MECHANICAL AND PIPING

- 5.3.1 Equipment and piping subjected to temperature of 60°C and above shall receive a personal protection system, by means of 316SS wire mesh / perforated plates. Alternatively, a thermally insulated may be applied. Equipment and piping in which heat conservation is necessary shall be thermal insulated. The thermal insulation shall be according latest revision of I-ET-3010.00-1200-431-P4X-501 – THERMAL INSULATION FOR MARITIME INSTALLATIONS
- 5.3.2 The design and assembly of all metallic process piping shall be according ASME B31.3 code.
- 5.3.3 All vessel internals shall be fabricated in CRA (Packing, weirs, baffles, skimming device, etc) and shall be compatible with fluid characteristics.
- 5.3.4 All major equipment shall be provided with lifting lugs.
- 5.3.5 Special attention shall be given to support and bracing of TEG Sparger Column (T-Z-1227001-01) to ensure that no movement occurs under the dynamic forces and loads.

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- 5.3.6 Socket welding is only permitted on low-pressure (non-process) piping sizes equal or less than 1½ inch. All piping above 1 ½ inch shall be butt-welded.
- 5.3.7 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.
- 5.3.8 All valves shall be positioned with the stem pointing upwards. They shall be located in such a way that the handwheel or actuator will not obstruct walkways and be easy accessible for operation and maintenance. Where hand operated valves are not easily operable, gear operated valves shall be used.
- 5.3.9 Valves, instruments, etc. elevated above 1.75 m above the floor, shall have access ladders or platform provided.
- 5.3.10 Sampling point / facilities shall be provided complete with necessary fittings and valves, and the design shall reflect nature of the fluids being sampled.
- 5.3.11 Heat exchanger piping shall not be supported on the shell and shall not hamper the removal of the tube bundle and shell /channel cover. A removable pipe spool may be required.
- 5.3.12 Piping shall be routed to allow access for maintenance. Removal of replacement of equipment shall be possible with a minimum dismantling of piping.
- 5.3.13 Piping at pumps shall be sufficiently flexible and adequately supported to prevent the equipment nozzle from being subjected to any stress that could disturb the alignment and internal clearance.
- 5.3.14 Piping systems shall not extend the operating floor.
- 5.3.15 All structural steel work including supports for equipment, ladders, walkways, platforms and drip trays shall be provided.
- 5.3.16 All other miscellaneous items and equipment which are required for the service and proper operation of the TEG Regeneration Package shall be included.
- 5.3.17 Studs, bolts, tightening bolts and nuts shall be according I-ET-3010.00-1200-251-P4X-001 – BOLT MATERIALS

#### **5.4 MATERIALS**

- 5.4.1 The material specification for the PACKAGE shall be according listed in Table 5.2.
- 5.4.2 . All materials shall comply with ISO 15156.
- 5.4.3 PACKAGER/MANUFACTURER may use the same, similar or better material than listed in Table 5.2. However, in all cases PACKAGER/MANUFACTURER shall submit the detailed material list, including all equipment and their components, for PETROBRAS approval prior to start the manufacture activities.
- 5.4.4 The corrosion allowance shall be defined during detailing by the PACKAGER/MANUFACTURER, but shall be not less than 1,6mm.

**Table 5.2 – Material Specification**

EQUIPMENT	MATERIAL
TEG Flash Drum (V-Z-1227001-01)	Carbon Steel + 3mm clad Inconel 625
TEG Reboiler Drum (V-Z-1227001-02)	Carbon Steel + 3mm clad Inconel 625
TEG Surge Drum (V-Z-1227001-03)	Carbon Steel + 3mm clad Inconel 625
Primary TEG Cartridge Filters (FT-Z-1227001-01 A/B)	Superduplex SS (UNS S32750)
TEG Charcoal Filter (FT-Z-1227001-02)	Superduplex SS (UNS S32750)
Secondary TEG Cartridge Filter (FT-Z-1227001-03)	Superduplex SS (UNS S32750)
Hot Lean / Rich TEG Heat Exchanger (P-Z-1227001-01)	Shell: Carbon Steel + Corrosion Allowance. Channel: Carbon Steel + 3mm clad Inconel 625 Tube: Inconel 625.
Lean TEG Cooler (P-Z-1227001-02)	Shell: Carbon Steel + Corrosion Allowance. Channel: Carbon Steel + Corrosion Allowance Tube: Carbon Steel.
Cold Lean / Rich TEG Heat Exchanger (P-Z-1227001-03)	Shell: Carbon Steel + Corrosion Allowance. Channel: Carbon Steel + 3mm clad Inconel 625 Tube: Inconel 625.
TEG Regeneration Unit Condenser (P-Z-1227001-04)	Shell: Carbon Steel + 3mm clad Inconel 625. Tube: Inconel 625.
TEG Regeneration Unit Reboiler and panel (AQ-Z-1227001-01A/C)	Shell: Carbon Steel + 3mm clad Inconel 625. Tube: Inconel 625.
TEG Regeneration Unit Stripper (T-Z-1227001-01)	Carbon Steel + 3mm clad Inconel 625
TEG Sparger Column (T-Z-1227001-02)	Carbon steel + Corrosion Allowance
TEG Circulation Pumps (B-Z-1227001-01A/B)	316SS
Chemical injection package:	
- pH Control Injection Pump, (B-Z-1227001-02)	316 SS
- Foam Inhibitor Injection Pump (B-Z-1227001-03)	316 SS
- Ph Control Storage Tank (TQ-Z-1227001-01)	316 SS
- Foam Inhibitor Storage Tank (TQ-Z-1227001-02)	316 SS

## 5.5 DESIGN AND FABRICATION

### 5.5.1 Heat Exchanger (Shell and Tube)

Shell and tube heat exchangers shall comply with the requirements of NR 13 (Brazilian Labor Ministry Safety Rules) and I-ET-3010.1M-1200-451-P4X-001 – SHELL & TUBE HEAT EXCHANGER SPECIFICATION.

### 5.5.2 Pumps

Pumps shall comply with the requirements I-ET-3010.1M-1200-310-P4X-002 – POSITIVE DISPLACEMENT PUMPS SPECIFICATION FOR TOPSIDE.

### 5.5.3 Metallic Tanks

All Tanks design shall comply with the requirements described in I-ET-3010.00-1200-510-P4X-001 – METALLIC TANKS DESIGN FOR TOPSIDE

### 5.5.4 Electric Heater

Electric Heater design and fabrication requirements shall comply with the latest revision of I-ET-3010.00-1233-498-P4X-001 – ELECTRIC HEATER

### 5.5.5 Pressure Vessel Design

All pressure vessels, columns and filters shall comply with the requirements of NR 13 (Brazilian Labor Ministry Safety Rules) and I-ET-3010.00-1200-540-P4X-001 – REQUIREMENTS FOR PRESSURE VESSELS DESIGN.

### 5.5.6 Pressure Vessels Fabrication

All pressure vessels, columns and filters shall comply with the requirements of I-ET-3010.00-1200-540-P4X-002 – REQUIREMENTS FOR PRESSURE VESSELS FABRICATION.

### 5.5.7 Welding

All pressure vessel, columns, filters and heat exchangers welds shall be according the requirements described in the latest revision of I-ET-3010.00-1200-955-P4X-001 – WELDING.

### 5.5.8 Welding Inspection

Welding inspection and NDEs shall be according the requirements described in the latest revision of I-ET-3010.00-1200-955-P4X-002 – REQUIREMENTS FOR WELDING INSPECTION.

\*Special requirements for pressure vessels - Any pressure vessel which is subjected to H<sub>2</sub>S service shall follow the requirements of ISO 15156 (Petroleum and Natural Gas Industries: Materials for use in H<sub>2</sub>S containing environments in oil and gas production).

## 5.6 SAFETY REQUIREMENTS

5.6.1 Maximum allowable pressure drop for pressure relief devices shall comply with API requirements.

5.6.2 Piping supports, instrument tappings, design pressures etc. shall be suitable for sustained operation under the pressure pulsations that occur if the bladders of pulsation dampeners fail.

5.6.3 For area classification see I-DE-3010.1M-5400-94A-P4X-001 – AREA CLASSIFICATION – GENERAL.

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

5.6.5 Electric Heater safety requirements shall be according specified in I-ET-3010.00-1233-498-P4X-001 – ELECTRIC HEATER

5.6.6 All safety signs and notices shall be in Portuguese language.



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## 5.7 INSTRUMENTATION

- 5.7.1 All instrumentation equipment and interface with FPSO automation and control design shall comply with I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGED UNITS.
- 5.7.2 For package automation type classification see I-ET-3010.1M-1200-800-P4X-014 – AUTOMATION INTERFACE OF PACKAGED UNITS.
- 5.7.3 All local instruments control valves, control, monitoring and safety protection instruments and devices for remote indication, control, alarms, protection and shut down etc. shall be included.
- 5.7.4 Automatic temperature control facilities shall be provided for the control of cooling medium flow.
- 5.7.5 Sampling point / facilities shall be provided complete with necessary fittings and valves for taking glycol samples.

## 5.8 ELECTRICAL

- 5.8.1 Low-voltage motors inside the package shall comply with latest revision of I-ET-3010.00-5140-712-P4X-001 – LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.
- 5.8.2 All electrical equipment and material shall fully comply with the document I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 5.8.3 Power lighting and grounding installations inside the package shall comply with requirements of I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.
- 5.8.4 Electrical requirements of thyristorized heaters shall be according I-ET-3010.00-1233-498-P4X-001 - ELECTRIC HEATER.
- 5.8.5 Two diagonally opposite earthing bosses shall be provided on each equipment item, which shall then be connected to the module during construction and assembly phase.

## 5.9 INSTALLATION REQUIREMENTS

- 5.9.1 All equipment shall be installed by MANUFACTURER over structural steel deck plate.
- 5.9.2 All piping terminations shall be flanged.
- 5.9.3 PACKAGER is requested to submit a layout plan limited to the module dimensions shown in the document I-DE-3010.1M-1416-942-P4X-001 – M06 – GAS DEHYDRATION AND HCDP – EQUIPMENT LAYOUT PLAN.
- 5.9.4 Only skids shall be provided with drip trays.
- 5.9.5 Equipment shall be arranged to allow safe and good personnel access for all operations and maintenance.



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### 5.10 PAINTING

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

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

## 6 NAMEPLATES

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

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

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

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

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

## 7 TAG NUMBERING

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.

For main item tag numbers, refer to I-FD-3010.1M-1227-560-P4X-001 – TEG REGENERATION PACKAGE (Z-1227001).

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



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## 8 CERTIFICATION REQUIREMENTS

### 8.1 CLASSIFICATION SOCIETY CERTIFICATION

- 8.1.1 For the entire TEG Regeneration Package, a Classification Society Certificate of compliance with Rules requirements shall be supplied.
- 8.1.2 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 Classification Society. Electrical equipment installed in external safe areas, that shall be kept operating during emergency shutdown ESD-3P and ESD-3T shall be certified for installation in hazardous areas Zone 1 Group IIA temperature T3.

### 8.2 MATERIAL CERTIFICATION

MANUFACTURER shall be responsible for obtaining all necessary certification of the equipment. 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.

## 9 INSPECTION, TESTING AND COMMISSIONING

### 9.1 GENERAL

- 9.1.1 MANUFACTURER is required to propose a program for inspection and testing of all supplied equipment for approval by PETROBRAS, prior to commencement of work in accordance with document schedule.
- 9.1.2 Unless otherwise stated, all inspections and tests shall be performed at the workshop of MANUFACTURER in the presence of PETROBRAS' representative and CLASS surveyor as applicable.
- 9.1.3 Inspections and tests are an integral part of the order which will not be considered complete until such inspections and tests have been carried out in full.
- 9.1.4 PETROBRAS shall issue an Inspection Release Certificate (IRC) after completion of these inspections and tests only.

### 9.2 INSPECTIONS

- 9.2.1 MANUFACTURER shall provide document schedules with the appropriate completion dates at the time drawings will be submitted for approval as indicated in the agreed document schedule.
- 9.2.2 PETROBRAS reserves the right to inspect all items at any time during fabrication to ensure that the material and workmanship are in accordance with this specification and all applicable documentation.
- 9.2.3 MANUFACTURER shall be responsible for compliance certificate carrying out all work examinations and test and be financially responsible for final inspection and testing which is necessary to ensure that such compliance are within the requirements of the Classification Society.

9.2.4 In addition to PETROBRAS inspection, equipment such as valves and fittings, etc. shall be subject to all classification authority and may range from a review of MANUFACTURER's quality manual to a physical survey of MANUFACTURER's and/or SUB- MANUFACTURER's shop or end products.

9.2.5 The inspector shall have the right to request inspections or examinations to ensure that the equipment complies with the relevant classification society requirements. In case examination reveals any shortcomings, MANUFACTURER shall bear the full cost of such inspection and replacement where necessary. Any repair shall first be approved by PETROBRAS. The subsequent examination necessary to ensure the satisfactory manufacture or the equipment in question will be at MANUFACTURER's cost.

9.2.6 Except as approved by PETROBRAS inspector, all equipment shall be presented for inspection in an unpainted state. MANUFACTURER shall provide notice to the inspector to witness the specified tests at least 2(two) weeks notice in advance for Brazilian MANUFACTURER/Sub-Suppliers and 3 (three) weeks for foreign MANUFACTURER/Sub-Suppliers.

### 9.3 TESTING

9.3.1 The following tests shall be included in MANUFACTURER's scope:

- Pumps running tests;
- Hydrotest of all vessels and pipes;
- Electrical continuity checks on all wiring and earthing;
- Functional checks on all instruments and valves;
- Heater and Thyristor panel tests

9.3.2 Hydrostatic testing shall be carried out in the presence of PETROBRAS inspectors and shall include all pressure vessels and heat exchangers and applicable pipe work.

9.3.3 All pumps shall be tested as per relevant codes (API 674, API 675 or API 676).

9.3.4 All piping systems and equipment shall be drained of water and dried after hydrostatic testing.

### 9.4 IMPACT TESTING

9.4.1 Charpy impact test shall be included, where applicable. MANUFACTURER shall verify the applicability as per code, taking into consideration the material thickness for each application and the minimum design temperature the material is subjected to.

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

### 9.5 NDE

9.5.1 Final NDEs, for acceptance purposes shall be carried out after completion of any post weld heat treatment (when applicable) and before the applications of painting, hydrostatic testing, etc.





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## 9.6 ELECTRICAL

9.6.1 The following testing shall be carried out in the presence of PETROBRAS inspectors and shall include:

- A MEGGER test for cables and electric motors shall be provided.
- Tests stated in the respective motors and power/control panel specifications.

## 9.7 PACKAGE INSPECTION

9.7.1 Unless waive by PETROBRAS, the following inspections and checks shall be witnessed by PETROBRAS inspector:

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

## 9.8 PACKAGE TEST

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

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

9.8.3 MANUFACTURER is to submit a FAT procedure with a test schedule covering all items within the scope of supply.

9.8.4 MANUFACTURER shall prepare a FAT procedure for the package and submit for PETROBRAS approval.

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



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

### 9.9 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

9.9.1 MANUFACTURER is responsible for assembly supervision of the equipments, including the assembly of components to be delivery loose (for exemple, some components of the pumps, like stuffing box; some vessels`internals, etc.).

9.9.2 MANUFACTURER 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**.

### 10 MANUFACTURER RESPONSIBILITY

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

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

- Technical responsibility for the entire scope of supply.
- Resolving all engineering questions and/or problems relating to design and manufacture.
- All coordination with manufacturers and collection of all details, drawings, calculations, and data to achieve optimum design and full submission of the documents requested in the specification.
- Providing details as requested of any sub-vendors relating to design and 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.
- MANUFACTURER's responsibility shall also include Commissioning & Training for operation.

Any exclusion and/or alternative to what is specified in this Technical Specification, including the use of the 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's 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 PREPARATION FOR SHIPMENT

### 11.1 MARKING

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

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

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

- Project Number
- Manufacturer's Name
- Purchase Order Number
- Minimum Breaking Load
- Item Number
- Classification Society Surveyor's Stamp

### 11.2 SHIPMENT PACKING

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

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

11.2.3 All carbon steel vessels, etc. shall be protected with corrosion inhibitor prior to shipment.

11.2.4 The package shall be protected from corrosion.

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

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

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

11.2.8 MANUFACTURER shall provide the procedures for unpacking, handling, installation, repacking, and long-term storage requirements. MANUFACTURER shall specify any limitations applicable to the transport and installation phase.