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SUMMARY

1 OBJECTIVE

This Technical Specification covers the minimum requirements for design, engineering, materials, fabrication, inspection, testing, commissioning, and pre-commissioning of the TEG REGENERATION PACKAGE (Z-1227001).

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

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

In addition to the requirements of this technical specification, SELLER shall follow all the requirements of the Exhibit I (SCOPE OF SUPPLY), as well as Exhibit III (DIRECTIVES FOR ENGINEERING EXECUTION), Exhibit IV (DIRECTIVES FOR CONSTRUCTION AND ASSEMBLY), Exhibit V (DIRECTIVES FOR PROCUREMENT), Exhibit VI (DIRECTIVES FOR PLANNING AND CONTROL), Exhibit VII (DIRECTIVES FOR QUALITY MANAGEMENT SYSTEM) and Exhibit VIII (DIRECTIVES FOR COMMISSIONING PROCESS).

2 NORMATIVE REFERENCES AND DESIGN SPECIFICATIONS

2.1 CLASSIFICATION SOCIETY

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

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

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

2.2 CODES AND STANDARDS

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

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

Table 1: Codes and Standards

AISC ASD	Steel Construction Manual
API 12GDU	Specification for Glycol type Gas Dehydration Units
API RP 14C	Analysis, Design, Installation and Testing of Safety Systems for Offshore Production Facilities
API RP 14E	Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems
API RP 14J	Recommended practice for Design and Hazards Analysis for Offshore Production Facilities
API RP 14FZ	Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1 and Zone 2 Locations
API RP 505	Classification of locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2
API STD 520	Sizing, Selection and Installation of Pressure Relieving Devices Part I and II
API STD 521	Pressure Relieving and Depressuring Systems
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API 670	Machinery Protection Systems
API 671	Special-purpose Couplings for Petroleum, Chemical, and Gas Industry Services
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
API 681	Liquid Ring Vacuum Pumps and Compressors for Petroleum, Chemical, and Gas Industry Services
API 682	Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.47	Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard
ASME B31.3	Process Piping

ASME BPVC II	Part A, B, C and D. Boiler and Pressure Vessel Code - Materials
ASME BPVC V	Boiler and Pressure Vessel Code – Non-Destructive Examination
ASME BPVC VIII	Div.1 and Div. 2. Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels
ASME BPVC IX	Qualification Standard for welding, brazing, and fusing procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators
AWS D1.1	Structural Welding Code – Steel
DOT-3A	Specification for Seamless Steel Transportable Pressure Receptacles
DOT-3AA	Specification for Seamless Steel Transportable Pressure Receptacles
IEC 60079 (all parts)	Explosive Atmospheres
IEC 61892 (all parts)	Mobile and fixed offshore units – Electrical installations
IEC 61672 (all parts)	Electroacoustics-Sound Level Meters
ISO 9809 (all parts)	Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes
ISO 13702	Control and mitigation of fires and explosions on offshore production installations
ISO 15156 (all parts)	Materials for Use in H_2S-Containing Environments in Oil and Gas Production
ISO 21457	Materials selection and corrosion control for oil and gas production systems
ISA 75.07	Control Valve Noise Measurement and Prediction

2.3 GOVERNMENT REGULATION

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

Table 2: Brazilian Regulatory Standard and Government Regulation

NR-10	- Brazilian Regulatory Standard - Safety in Electrical Facilities and Services
NR-12	- Brazilian Regulatory Standard – Safety in the Work of Machinery and Equipment
NR-13	- Brazilian Regulatory Standard - Boilers, Pressure Vessels, Pipes and Metallic Storage Tanks
NR-17	- Brazilian Regulatory Standard - Ergonomics

NR-26	- Brazilian Regulatory Standard - Safety Signaling
NR-37	- Brazilian Regulatory Standard - Safety and Health in Petroleum Platforms
IBAMA	- Brazilian IBAMA environmental regulations concerning the discharge of all types of effluents
INMETRO	- INMETRO Resolution nº 115, March 21st 2022

2.4 DESIGN SPECIFICATIONS

Table 3: Design Specifications

DR-ENGP-I-1.15	- COLOR CODING
DR-ENGP-M-I-1.3	- SAFETY ENGINEERING GUIDELINE
I-DE-3010.00-1400-140-P4X-004	- GENERAL NOTES FOR TOPSIDES STRUCTURES
I-DE-3010.00-5140-797-P4X-002	- ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS
I-DE-3010.00-5140-700-P4X-003	- GROUNDING INSTALLATION TYPICAL DETAILS
I-DE-3010.2Q-1200-942-P4X-002	- GENERAL ARRANGEMENT
I-DE-3010.2Q-1200-94A-P4X-001	- AREA CLASSIFICATION – GENERAL
I-DE-3010.2Q-1227-944-P4X-001	- TEG REGENERATION SYSTEM
I-DE-3010.2Q-1233-944-P4X-003	- TEG CONTACTOR
I-DE-3010.2Q-1416-942-P4X-001	- M06 – GAS DEHYDRATION AND FUEL GAS – EQUIPMENT LAYOUT PLAN
I-DE-3010.2Q-5111-943-P4X-001	- UTILITY FLOW DIAGRAM SEA WATER SYSTEM
I-ET-3000.00-1000-941-PPC-001_F	- METOCEAN DATA
I-ET-3000.00-1200-940-P4X-001	- TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
I-ET-3000.00-1350-94P-P4X-002	- DIGITAL ENGINEERING TECHNICAL REQUIREMENTS FOR DETAILED DESIGN
I-ET-3000.00-5400-98G-P4X-001	– EXPLOSION STUDY
I-ET-3010.00-1200-200-P4X-003	- DESIGN, CONSTRUCTION AND ASSEMBLY OF FRP PIPING
I-ET-3010.00-1200-200-P4X-115	- REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING
I-ET-3010.00-1200-200-P4X-116	- REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT
I-ET-3010.00-1200-251-P4X-001	- REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-300-P4X-001	- NOISE AND VIBRATION CONTROL REQUIREMENTS
I-ET-3010.00-1200-310-P4X-001	- API 610 CENTRIFUGAL PUMPS SPECIFICATION

I-ET-3010.00-1200-310-P4X-002	- POSITIVE DISPLACEMENT PUMPS SPECIFICATION
I-ET-3010.00-1200-310-P4X-003	- NON-API 610 CENTRIFUGAL PUMPS SPECIFICATION
I-ET-3010.00-1200-431-P4X-001	- THERMAL INSULATION FOR MARITIME INSTALLATIONS
I-ET-3010.00-1200-451-P4X-001	- REQUIREMENTS FOR SHELL AND TUBE HEAT EXCHANGER DESIGN AND FABRICATION
I-ET-3010.00-1200-498-P4X-002	- ELECTRIC PROCESS HEATERS
I-ET-3010.00-1200-500-P4X-001	- NON-METALLIC TANKS AND PRESSURE VESSELS DESIGN
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 AND FABRICATION
I-ET-3010.00-1200-751-P4X-001	- ANODES SPECIFICATION FOR MECHANICAL EQUIPMENT
I-ET-3010.00-1200-800-P4X-002	- AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS
I-ET-3010.00-1200-940-P4X-002	- GENERAL TECHNICAL TERMS
I-ET-3010.00-1200-940-P4X-005	- CHEMICAL INJECTION POINTS
I-ET-3010.00-1200-955-P4X-001	- WELDING
I-ET-3010.00-1200-956-P4X-002	- GENERAL PAINTING
I-ET-3010.00-1200-970-P4X-003	- REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION
I-ET-3010.00-1200-970-P4X-004	- NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS
I-ET-3010.00-1200-970-P4X-013	- COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS
I-ET-3010.00-1200-972-P4X-006	- REQUIREMENTS FOR MANUFACTURING SURVEY INSPECTION
I-ET-3010.00-1200-978-P4X-005	- REQUIREMENTS FOR MATERIALS TRACEABILITY
I-ET-3010.00-5140-700-P4X-001	- SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-002	- SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-003	- ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-007	- SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-009	- GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-712-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-3010.00-5140-741-P4X-004	- SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
I-ET-3010.00-5140-797-P4X-001	- ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
I-ET-3010.00-5400-947-P4X-002	- SAFETY SIGNALLING
I-ET-3010.00-5500-854-P4X-001	- MACHINERY MONITORING SYSTEM (MMS)
I-ET-3010.00-5518-767-PPT-002	- TOPSIDES PUBLIC ADDRESS SYSTEM
I-ET-3010.00-5520-888-P4X-001	- AUTOMATION PANELS
I-ET-3010.2Q-1200-200-P4X-001	- PIPING SPECIFICATION FOR TOPSIDES
I-ET-3010.2Q-1200-200-P4X-004	- REQUIREMENTS FOR PIPING SUPPORT
I-ET-3010.2Q-1200-200-P4X-005	- REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT
I-ET-3010.2Q-1200-200-P4X-006	- REQUIREMENTS FOR PIPING FLEXIBILITY AND STRESS ANALYSIS
I-ET-3010.2Q-1200-800-P4X-014	- AUTOMATION INTERFACE OF PACKAGED UNITS
I-ET-3010.2Q-1200-940-P4X-001	- MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN
I-ET-3010.2Q-1400-140-P4X-001	- TOPSIDES STRUCTURAL REQUIREMENTS
I-ET-3010.2Q-1400-196-P4X-001	- ERGONOMICS REQUIREMENTS FOR TOPSIDES
I-ET-3010.2Q-5266-630-P4X-001	- TOPSIDES MECHANICAL HANDLING PROCEDURES
I-FD-3010.2Q-5400-947-P4X-001	- SAFETY DATA SHEET - TOPSIDES
I-FD-3010.2Q-1227-560-P4X-001	- TEG REGENERATION SYSTEM PACKAGE (Z-1227001)
I-FD-3010.2Q-1233-550-P4X-001	- GAS DEHYDRATION UNIT (T-1233001, V-T-1233001)
I-FD-3010.2Q-5400-947-P4X-001	- SAFETY DATA SHEET - TOPSIDES
I-LI-3010.00-5140-797-P4X-001	- ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST
I-MD-3010.00-5510-760-PPT-001	- GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN
I-MD-3010.2Q-1200-947-P4X-003	- DESCRIPTIVE MEMORANDUM – SAFETY
I-MD-3010.2Q-1200-970-P4X-001	- COMISSIONING DESCRIPTIVE MEMORANDUM
I-RL-3010.2Q-1200-940-P4X-001	- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-RL-3010.2Q-1350-960-P4X-002	- MOTION ANALYSIS

2.5 CONFLICTING REQUIREMENTS

2.5.1 In case of conflicting requirements between this technical specification and other cited references, the most stringent shall prevail. If necessary, the SELLER may revert to BUYER for clarification.

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

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

3.2 ABBREVIATIONS

CLASS	-	Classification Society
CIP	-	Clean In Place
CRA	-	Corrosion Resistant Alloy
CS	-	Carbon Steel
EPCI	-	Engineering, Procurement, Construction and Installation
FAT	-	Factory Acceptance Test
FPSO	-	Floating Production Storage and Offloading
FRP	-	Fiber Reinforced Plastic
GRP	-	Glass Reinforced Plastics
HAZOP	-	Hazard and Operability Study
ITP	-	Inspection and Test Plans
MMS	-	Machinery Monitoring System
MPS	-	Machinery Protection System
NDT	-	Non-Destructive Test
PAGA	-	Public Address and General Alarm
PHA	-	Process Hazards Analysis
TEG	-	Triethylene Glycol

4 PACKAGE REQUIREMENTS

4.1 SCOPE OF SUPPLY

4.1.1 The SELLER shall select a sub supplier considering a proven experience supplying TEG REGENERATION PACKAGE technology. SELLER shall submit the name of the sub supplier to BUYER approval.

4.1.2 The TEG REGENERATION PACKAGE (Z-1227001) shall be complete in all respect and the scope of supply shall include but not be limited to the major equipment described in the document I-FD-3010.2Q-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001).

4.2 PROCESS DESIGN

4.2.1 SELLER shall design and size the equipment of package for the full range of process conditions as specified in:

- I-FD-3010.2Q-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001);
- I-DE-3010.2Q-1227-944-P4X-001 - TEG REGENERATION SYSTEM.

4.2.2 For GAS DEHYDRATION UNIT information, see I-FD-3010.2Q-1233-550-P4X-001 - GAS DEHYDRATION UNIT (T-1233001, V-T-1233001)I-DE-3010.2Q-1227-944-P4X-001 - and I-DE-3010.2Q-1233-944-P4X-003 - TEG CONTACTOR.

4.2.3 Design shall also include the definition of number, size and location of all process and instrument related nozzles of TEG REGENERATION PACKAGE (Z-1227001) at the battery limits (refer to the I-DE-3010.2Q-1227-944-P4X-001 - TEG REGENERATION SYSTEM).

4.2.4 In the stripping gas supply line, a manual throttling valve shall be provided downstream of PCV (Pressure Control Valve).

4.2.5 Vessels 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.

4.2.6 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.

4.2.7 If vent and drain is provided on heat exchangers, they shall have a valve and a blind connection.

4.2.8 There shall be continuous fall in the drain lines toward the terminal point. If required high and low pressure drains shall be routed separately.

4.3 OPERATION ENVIRONMENT

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

4.4 MOTION REQUIREMENTS

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

4.5 PACKAGE LOCATION AND AREA CLASSIFICATION

4.5.1 The TEG REGENERATION PACKAGE (Z-1227001) shall be installed on module M-06 as informed in I-DE-3010.2Q-1200-942-P4X-002 - GENERAL ARRANGEMENT. For available space, also see I-DE-3010.2Q-1416-942-P4X-001 - M06 – GAS DEHYDRATION AND FUEL GAS – EQUIPMENT LAYOUT PLAN.

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

4.6 DESIGN LOADS

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

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

4.7 DESIGN LIFETIME

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

4.8 NOISE AND VIBRATION

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

4.9 ELECTRONIC MODEL

4.9.1 VENDOR shall develop full 3D model according to the requirements stated in I-ET-3000.00-1350-94P-P4X-002 - DIGITAL ENGINEERING TECHNICAL REQUIREMENTS FOR DETAILED DESIGN.

4.9.2 The 3D model shall include valve categorization according to I-ET-3010.2Q-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES. Manually operated valves shall have type of handle, direction and height from floor as 3D model attributes.

4.10 PIPING

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

4.10.2 Piping specification (specs) and valves shall follow the technical specification I-ET-3010.2Q-1200-200-P4X-001 - PIPING SPECIFICATION FOR TOPSIDES. Alternative piping specifications and valves shall be submitted to BUYER for approval.

4.10.3 Piping layout shall observe the requirements presented on I-ET-3010.2Q-1200-200-P4X-005 - REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT.

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

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

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

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

4.10.8 The use of elastomeric throttle valves exposed to UV radiation is not allowed.

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

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

4.10.11 The design, assembly and commissioning of all process piping shall be according to

- ASME B31.3,
- I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING.
- I-ET-3010.2Q-1200-200-P4X-005 - REQUIREMENTS FOR PIPING MECHANICAL DESIGN AND LAYOUT.

4.10.12 Whenever flexible lines are applied anti whip safety cable shall be foreseen to prevent injury in case of hose disconnection.

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

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

4.10.15 All other miscellaneous items and equipment which are required for the service and proper operation of the TEG Regeneration Package shall be included.

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

4.11 THERMAL INSULATION

4.11.1 The thermal insulation shall be according to latest revision of I-ET-3010.00-1200-431-P4X-001 - THERMAL INSULATION FOR MARITIME INSTALLATIONS.

4.12 BOLTS AND NUTS

4.12.1 All fasteners (stud bolts, tightening bolts and nuts) shall be according to I-ET-3010.00-1200-251-P4X-001- REQUIREMENTS FOR BOLTING MATERIALS.

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

4.13 PAINTING

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

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

4.14 STRUCTURES

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

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

4.15 TEG REGENERATION GAS RECOVERY UNIT (UC-Z-1227001)

4.15.1 Compressor shall comply with the requirements I-FD-3010.2Q-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001)

4.15.2 The TEG Regeneration Gas Recovery Unit (UC-Z-1227001) shall be supplied as complete compressor package, in compliance with the provisions of this document and its

attachments, all applicable codes, standards, regulations and Classification Society requirements.

4.15.2.1 Complete package means one (1) train of main equipment (Liquid ring compressors and electric motors) and all auxiliary equipment integrated for perfect functioning of the required service (accessories, machinery protection system, oil system, etc.).

4.15.3 CONTRACTOR shall include in scope of supply:

4.15.3.1 List of required documents as minimum:

- Cross-Sectional Drawings and Part Numbers
- Torsional Critical Speed Analysis;
- Lateral Critical Speed Analysis Report;
- Report Mechanical Running Test Logs;
- Performance Curves;
- Certified Hydrostatic Test Data;
- Data Sheets (Proposal / As-Built);
- Cause x Effect Matrix, Ladder Block, Control Narratives, Logic (including Start-Up, Alarm and Shutdown) and Loop Diagrams;
- P&ID Drawings and Schematics including, as a minimum: Steam, Seal Gas, Electrical Power, Fuel, Water, Lubrication and Process Fluid System;
- Technical Data Manual: Hardware and Software Manuals, Application Program, Communication Drivers, Drawings); Instrumentation Cable List with Complete Specification; Electronic Cards Schematic Drawings with Connections;
- Recommended Alarm (Alert) and Shutdown (Danger) Set-Points
- Field Acceptance Test and Site Acceptance Test Procedures.

4.15.3.2 Ring liquid recirculation pump and driver (To be confirmed by manufacture).

4.15.3.3 All spares required for complete testing, NR-13 for tests (if applicable), start-up, commissioning field and for one year assisted operation. CONTRACTOR shall also provide compulsory sets specified by Classification Society and those necessary to comply with NR-13 requirement.

4.15.3.4 Special tools for main & auxiliary equipment maintenance (field maintenance).

4.15.3.5 A spare part list to cover two years of operation shall be provided, including the prices of each part, delivery time, and the layout and sectional drawings indicating the location of the parts with tag / reference identifications.

4.15.3.6 Packing, coating, anticorrosive protection and preservation.

4.15.3.7 All safety equipment and systems such as emergency shutdown valves, pressure safety valves, etc. within compressor skid limits.

4.15.3.8 Technical documents and drawings, including data-book, installation, operating and maintenance manuals.

4.15.4 CONSTRUCTION FEATURES

4.15.4.1 Original Equipment Manufacturer (OEM) shall assume full unit responsibility for the complete compressor package, including the driver and all ancillaries.

4.15.4.2 The TEG Regeneration Gas Recovery Compressor Unit shall operate over wide ranges, usually within narrow suction pressure bands. The TEG Regeneration Gas Recovery Compressor shall be equipped with compressor recycle valve. Suction pressure is maintained by pressure control of a recycle valve, with additional loading and unloading of the compressors when limits of valve opening/closing or suction

pressure are reached. Usually, the controls are set up to sequentially load and unload the compressor.

4.15.4.3 The interconnecting pipework between auxiliary skid and the main baseplate shall be provided by OEM. The pipes arrangement shall avoid the accumulation of liquid (siphon). Drainage shall occur in all lower parts of the piping.

4.15.4.4 CONTRACTOR shall submit to OWNER main equipment coupling data sheet according to API 671.

4.15.4.5 All coupling guards (including those for auxiliary equipment) shall be rigid, fully enclosed, in non-sparking material and solely fitted to equipment baseplates, not fastened. Safety coupling guards (without feet) are also acceptable. In case of failure, guards shall be able to retain broken parts, for personnel protection. Coupling guards shall be designed to allow removal without disassembling the coupling and shall be constructed so that routine inspections are performed by means of strobe light, with the equipment running.

4.15.4.6 Compressor shall be fitted with double mechanical cartridge type seals. The seal system shall be a pressurized seal barrier system according to API standard 682, Plan 53-B. Each of the mechanical seal packages shall consist of the following main components as minimum:

- Pressure control valve to maintain correct pressure in the seal system;
- Bladder-type accumulator, with barrier fluid;
- Pressure transmitter with high, low and low-low alarms;
- Temperature indicator;
- Air Finned Cooler;
- Manual valves and check valve.

4.15.4.7 Driver, driven machine, transmission, seal panel and local panel shall be mounted on a single baseplate. Other auxiliaries shall be mounted on the same baseplate (preferable) or provided with their own skid. CONTRACTOR shall submit layout to OWNER comments and approval.

4.15.4.8 CONTRACTOR shall provide electrically driven lifting / handling devices and external structure components enabling assembly, disassembly and removal all components inside the package (compressor, electric motor, rotor, etc.), including internal parts such as compressor rotor and electric motor rotor with adequate and certified capacity to handle maximum maintenance weight and / or dimensions. Lifting and handling devices shall be according to I-ET-3010.2Q-5266-630-P4X-001 - TOPSIDES MECHANICAL HANDLING PROCEDURES.

4.15.5 FIELD PROVEN DESIGN REQUIREMENTS

4.15.5.1 All package components, including sub-orders, shall be of proven design and fully within the CONTRACTOR's actual experience.

4.15.5.2 A "field proven" equipment is defined herein as having a Reference List with at least 3 (three) operating packages of similar capacity, installed on offshore production units. Undersized equipment, unproven designs or prototypes (including parts) with no previous service on offshore installations is not acceptable. For TEG Regeneration Gas Recovery Unit, a minimum of 25,000 hours continuous operation under similar operating conditions shall be demonstrated for, at least, 4 machines of the same model and same size to meet data sheet operating conditions required.

4.15.5.3 Deviations from the above defined "field proven design" requirement may be accepted only for equipment which is part of research or development programs. In this case, their use shall be formally submitted to OWNER for approval.

4.16 MATERIAL SELECTION AND CERTIFICATION

4.16.1 The SELLER is responsible for the materials selection considering the philosophy detailed at I-ET-3010.2Q-1200-940-P4X-001 - MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN, stated in ISO 21457 and the operational condition and process data stated at I-FD-3010.2Q-1227-560-P4X-001- TEG REGENERATION SYSTEM PACKAGE (Z-1227001).

4.16.2 In all cases, SELLER shall submit the detailed material selection report as per stated in ISO 21457, including all piping, equipment, and their components, for BUYER approval prior to manufacturing activities.

4.16.3 All materials that are exposed to hydrocarbons containing hydrogen sulphide shall follow the requirements of ISO 15156 for sour service.

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

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

4.16.6 The corrosion allowance shall be defined during detailing by the CONTRACTOR, but shall be not less than 1,6mm.

4.16.7 All vessel internals shall be fabricated in CRA (Packing, weirs, baffles, skimming device, etc) and shall be compatible with fluid characteristics.

4.16.8 CONTRACTOR may use the same, similar or better material than listed in Table 4 below. However, in all cases CONTRACTOR shall submit the detailed material list, including all equipment and their components, for OWNER approval prior to start the procurement for manufacture activities.

Table 4: Minimum material grade for TEG equipment unit

EQUIPMENT	MATERIAL
TEG Flash Drum (V-Z-1227001-01)	CS + 3mm clad Inconel 625
TEG Reboiler Drum (V-Z-1227001-02)	CS + 3mm clad Inconel 625
TEG Surge Drum (V-Z-1227001-03)	CS + 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: CS + Corrosion Allowance. Channel: CS + 3mm clad Inconel 625 Tube: Inconel 625.
Lean TEG Cooler (P-Z-1227001-02)	Shell: CS + Corrosion Allowance. Channel: CS + Corrosion Allowance Tube: CS
Cold Lean / Rich TEG Heat Exchanger (P-Z-1227001-03)	Shell: CS + Corrosion Allowance. Channel: CS + 3mm clad Inconel 625 Tube: Inconel 625.

TEG Regeneration Unit Condenser (P-Z-1227001-04)	Shell: CS + 3mm clad Inconel 625. Tube: Inconel 625.
TEG Regeneration Unit Reboiler (AQ-Z-1227001-01A/C)	Shell: CS + 3mm clad Inconel 625. Tube: Inconel 625.
TEG Regeneration Unit Stripper (T-Z-1227001-01)	CS + 3mm clad Inconel 625
TEG Sparger Column (T-Z-1227001-02)	CS + Corrosion Allowance
TEG Gas Recovery Unit (UC-Z-1227001)	316SS
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

4.17 PUMPS

4.17.1 Pumps shall comply with the requirements of:

- I-ET-3010.00-1200-310-P4X-001 SPECIFICATION. - API 610 CENTRIFUGAL PUMPS
- I-ET-3010.00-1200-310-P4X-002 SPECIFICATION; or - POSITIVE DISPLACEMENT PUMPS
- I-ET-3010.00-1200-310-P4X-003 SPECIFICATION. - NON-API 610 CENTRIFUGAL PUMPS

4.17.2 For pumps up to 7.5 kW, working with non-flammable and non-hazardous service, vendor may use its own specification, i.e., no specific design code will be applicable, provided that field proven requirements for the PACKAGE are fulfilled and if approved by BUYER previously during the package technical proposal. Material selection shall still be performed as per ISO 21457.

4.18 PRESSURE VESSELS

4.18.1 All pressure vessels, columns and filters shall comply with:

- The requirements of last revision of Brazilian Regulatory Standard NR-13;
- I-ET-3010.00-1200-970-P4X-013 - COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS; and
- I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION.
- If the scope of supply includes any transportable pressure vessels, connected with process plant or platform installations, these items shall be within the scope of NR-13 regulation. Furthermore, transportable containers shall be designed, constructed, inspected and installed in accordance with the requirements addressed by a specific rule of transportable equipment, such as ISO 9809, DOT-3A or DOT-3AA.

4.18.2 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.

4.19 HEAT EXCHANGERS

4.19.1 Heat exchangers shall comply with:

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

4.20 ELECTRIC HEATER

4.20.1 Electric Heaters shall comply with the requirements of I-ET-3010.00-1200-498-P4X-002 - ELECTRIC PROCESS HEATER and I-FD-3010.2Q-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001)

4.21 NON-METALLIC TANK AND PRESSURE VESSEL

4.21.1 Non-metallic tanks and non-metallic pressure vessels shall comply with the requirements of I-ET-3010.00-1200-500-P4X-001- NON-METALLIC TANKS AND PRESSURE VESSELS DESIGN.

4.22 METALLIC TANK

4.22.1 Metallic tanks shall comply with the requirements of I-ET-3010.00-1200-510-P4X-001 - METALLIC TANKS DESIGN FOR TOPSIDE

4.23 WELDING AND WELDING INSPECTION

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

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

4.23.3 Intermittent fillet welds are not permitted.

4.23.4 Welding inspection shall be according to the Design Code and additional requirements stated in the contractual technical specification, such as:

- I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING,
- I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION,
- I-DE-3010.00-1400-140-P4X-004 - GENERAL NOTES FOR TOPSIDES STRUCTURES, etc.

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

4.24 NON DESTRUCTIVE TESTING – NDT

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

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

4.25 ERGONOMICS REQUIREMENTS

4.25.1 The package shall be arranged such to allow safe and good personnel access for all operation and maintenance activities and in accordance with I-ET-3010.2Q-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES.

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

4.25.3 All valves shall be positioned with the stem pointing upwards. They shall be located in such a way that the hand wheel or actuator will not obstruct escape routes, walkways and be easily accessible for operation and maintenance, according to I-ET-3010.2Q-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES. Where hand operated valves are not easily operable, gear operated valves shall be used.

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

4.25.5 The level gauges shall be installed in such position that the level indicated in receiver will be easily seen. All level gauges shall have flanged connections, which can be isolated, and be complete with vent and drain, valves and connection, to facilitate the maintenance tasks.

4.26 SAFETY REQUIREMENTS

4.26.1 Pressure relief system and devices shall comply with the requirements of API STD 521.

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

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

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

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

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

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

4.26.8 Electric Heater safety requirements shall be according specified in I-ET-3010.00-1200-498-P4X-002 - ELECTRIC PROCESS HEATER.

4.27 INSTRUMENTATION

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

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

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

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

4.27.5 Package Unit Control Panel shall fully comply with requirements of I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS.

4.27.6 For TEG Regeneration Gas Recovery Compressor Unit, Machinery Protection System (MPS) shall be according to the API 670 latest revision.

4.27.7 All vibration and temperature protection systems shall be according to Original Equipment Manufacturer (OEM) standards and API 670 compliant.

4.27.8 All signals from MPS monitoring cards shall be available to send data to MMS (Machinery Monitoring System), according to the requirements described in the specification I-ET-3010.00-5500-854-P4X-001- MACHINERY MONITORING SYSTEM (MMS).

4.28 ELECTRICAL

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

4.28.2 Electrical apparatus installed in non-hazardous (safe) external (open) areas, expected to operate during emergency shutdown ESD-3P or ESD-3T, shall, as a minimum, be certified for installation in hazardous areas Zone 2 (EPL Gc) Group IIA temperature T3, unless they are automatically de-energized in case of confirmed gas in equipment area, according to IEC 61892-1.

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

4.28.4 All electrical equipment and material shall fully comply with:

- I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS,
- I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS
- I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS; and
- I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

4.28.5 Electrical requirements of thyristorized heaters shall be according I-ET-3010.00-1200-498-P4X-002 - ELECTRIC PROCESS HEATER. Heater panels shall comply with I-ET-3010.00-5140-741-P4X-003- POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS.

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

4.28.7 Interfaces of the Package with Electrical System shall comply with I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE, I-DE-3010.00-5140-797-P4X-002 - ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS and I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST

4.29 TELECOMMUNICATIONS REQUIREMENTS

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

a. I-ET-3010.00-5518-767-PPT-002 - TOPSIDES PUBLIC ADDRESS SYSTEM.
b. I-MD-3010.00-5510-760-PPT-001 - GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN.
c. I-ET-3010.2Q-1400-196-P4X-001 - ERGONOMICS REQUIREMENTS FOR TOPSIDES

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

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

4.29.4 Since the PAGA network inside package to be designed by SELLER is part of the entire system that is scope of SELLER detail design, SELLER shall ask BUYER any specific

characteristics of the system, as well as the approval of the sound calculation memories and detailed design, to assure fully interoperability.

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

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

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

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

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

4.30 INSTALLATION REQUIREMENTS

4.30.1 SKID DETAILS

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

4.30.1.2 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.

4.30.1.3 All equipment shall be installed by SELLER over structural steel deck plate in position shown in I-DE-3010.2Q-1416-942-P4X-001 - M06 – GAS DEHYDRATION AND FUEL GAS – EQUIPMENT LAYOUT PLAN.

4.30.1.4 All piping terminations shall be flanged.

4.30.1.5 The set of equipment and its skid must be designed, arranged and assembled in such a way as to allow safe access for personnel for all operations and maintenance tasks (mechanical, electrical, painting, insulation, etc.).

4.30.1.6 Lifting facilities shall enable lifting of the equipment with crane as a single point lift for transportation and installation. The design and manufacture of the lifting lugs shall be certified. The arrangement of equipment, piping and superstructure shall be such that the 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.

4.30.1.7 The skid shall resist all sling forces, including both horizontal and vertical components

of the applied sling angle (sling angles shall be within between 50 and 90º with the horizontal plane).

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

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

4.30.1.10 The skid shall be welded to the supporting structures. Skid floor shall be made of plate material with a raised on-slip tread. Welds underneath skid beams shall be ground flush. Skid shall have two diagonally opposed earthing bars.

4.30.2 MAINTENANCE LIFTING BEAMS

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

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

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

4.30.2.4 All beams and lifting gear shall be subject to load testing, witnessed by BUYER representative and CLASS.

4.31 NAMEPLATES

4.31.1 SELLER shall install in all package equipment nameplate made of stainless steel 316 in an accessible location, fastened with corrosion resistant stainless-steel type 316 pins, and in Portuguese language.

4.31.2 For pressure vessels, columns and filters the nameplates shall be according to I-ET-3010.00-1200-540-P4X-001- REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION. For heat exchangers I-ET-3010.00-1200-451-P4X-001 - REQUIREMENTS FOR SHELL AND TUBE HEAT EXCHANGER DESIGN AND FABRICATION.

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

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

- Design code.
- Empty weight.
- NR-13 information (if applicable).

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

4.32 TAG NUMBERING

4.32.1 Tagging of all instruments, electrical, telecommunications, mechanical and piping items, including valves, shall be in accordance with latest revision of I-ET-3000.00-1200-940-P4X-001 - TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

4.32.2 For main item tag numbers, refer to I-FD-3010.2Q-1227-560-P4X-001 - TEG REGENERATION SYSTEM PACKAGE (Z-1227001).

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

5 CERTIFICATION REQUIREMENTS

5.1 CLASSIFICATION SOCIETY CERTIFICATION

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

5.1.2 In order to obtain the Certificate of Compliance all related CLASS activities and CLASS technical requirements are within the SELLER scope of work, as well as all cost associated with it.

5.2 HAZARDOUS AREAS CERTIFICATION

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

6 INSPECTION, TESTING AND COMMISSIONING

6.1 GENERAL

6.1.1 SELLER is required to propose a program for inspection and testing of all supplied equipment for approval by BUYER, prior to commencement of work in accordance with document schedule. Inspection and Test Plans (ITP) shall be issued for each equipment that are part of the Unit.

6.1.2 Unless otherwise stated, all inspections and tests shall be performed at the workshop of SELLER in the presence of BUYER representative and CLASS surveyor as applicable.

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

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

6.2 PERSONNEL QUALIFICATION AND CERTIFICATION

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

6.3 QUALITY AND INSPECTION

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

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

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

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

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

6.3.6 Except if approved by BUYER inspector, all equipment shall be presented for inspection in an unpainted state. SELLER shall provide notice to the inspector to witness the specified tests at least 2 (two) weeks in advance for Brazilian MANUFACTURER and 3 (three) weeks for foreign MANUFACTURER.

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

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

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

6.4 TESTING

6.4.1 The following tests shall be included in SELLER's scope and shall be performed in the presence of BUYER inspectors:

a) Pressure test (usually hydrostatic) of all vessels, heat exchangers, tanks and piping/valves.

b) Electrical insulation and continuity checks on all wiring and earthing.

c) Insulation (MEGGER) test for cables and electric motors shall be provided.

d) Tests stated in the respective motors and power/control panel specifications.

e) Functional checks on all instruments and valves.

f) Pumps running tests

g) Heater and Thyristor panel tests

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

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

6.4.4 Preservation to be applied shall follow the requirements of I-ET-3010.00-1200-200-P4X-115 - REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING.

6.4.5 The TEG Regeneration Gas Recovery Compressor shall be tested as per API 681 latest edition including:

6.4.5.1 Additional requirements for Hydrostatic test (HT)

- No vises or clamping devices shall be used for pressing of nozzle flanges.
- PTFE tape or thread compounds shall not be used to prevent leakage of threaded plugs and connections.

6.4.5.2 Performance Test (PT)

- PT shall be performed on each unit according to API STD 681.
- The performance test procedure shall be agreed with OWNER.

6.4.5.3 Mechanical Running Test (MRT)

- MRT shall be performed on each unit according to API STD 681.
- The MRT procedure shall be agreed with OWNER.

6.4.5.4 Shipyard Acceptance Test (SYAT)

- Shipyard Acceptance Test (SYAT) is an onshore acceptance test to be performed during the commissioning phase. The requirements of this test are presented in I-MD-3010.2Q-1200-970-94X-001.

6.4.5.5 Site Acceptance Test (SAT)

- Site Acceptance Test (SAT) is an offshore acceptance test to be performed when the motocompressor is able to operate after all commissioning is complete and not pending.
- SAT shall be performed according to “Annex A” (Rotating Equipment Reliability Test).
- CONTRACTOR shall provide all facilities, support and technical assistance for SAT. CONTRACTOR and OEM is responsible for any repairs required during the SAT that are not caused by factors external to the motocompressor system.
- The SAT procedure shall be agreed with OWNER.

6.5 PACKAGE INSPECTION

6.5.1 BUYER Inspector shall witness the following inspections and checks:

- Verification of equipment construction materials (vessels, heat exchangers, pumps, etc.) for conformity with the specification requirements.

- Verification of piping, fittings and valves conform to specification of materials and fabrication.
- Reports for all NDT performed on the pressure retaining parts (radiographic, dye penetrant, magnetic particles, and ultrasonic inspection).
- 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 of applied coatings.
  - The general appearances, materials, workmanship, and standard of finish.
  - Dimensional check.
  - Alignment to be demonstrated.

6.6 PACKAGE TEST

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

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

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

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

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

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

6.7 ASSEMBLY ASSISTANCE AND COMMISSIONING REQUIREMENTS

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

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

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

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

6.7.5 SELLER shall comply with the requirements of I-MD-3010.2Q-1200-970-P4X-001 – COMISSIONING DESCRIPTIVE MEMORANDUM.

7 SELLER RESPONSIBILITY

7.1 GENERAL

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

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

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

7.1.3 Any exclusion and/or alternative to that specified in this Technical Specification, including the use of the SELLER's standard and exclusive technology, shall be presented in a Deviation List, subject to the BUYER's acceptance during the clarification phase, prior to the submission of the proposal. Otherwise, the requirements contained herein will be considered as "Agreed" and therefore required.

8 PREPARATION FOR SHIPMENT

8.1 MARKING

8.1.1 All items supplied 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.

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

8.2 SHIPMENT PACKING

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

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

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

8.2.4 The package shall be protected from corrosion.

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

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

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

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

ANNEX A – ROTATING EQUIPMENT RELIABILITY TEST (TURBOMACHINERY UNITS)

The reliability test is intended to demonstrate that turbomachinery unit overcomes the premature failures (“burn in phase”) and provide a reliable operation condition within useful life.

For such evaluation, the reliability test shall be performed for each turbomachinery unit under specific condition (test) and acceptance criteria hereafter described.

1. The test is considered concluded and accepted if the number of countable failures is zero and the accumulated (aggregated) time in service is higher than 240h;
2. If in the meantime any number of countable failures occurs, the procedure below shall be followed as mandatory (see FIGURE 1):

a) The turbomachinery unit is considered accepted if it reaches the accumulated time in service indicated in the “Acceptance Zone”;
b) If any number of countable failures during the test achieves to the “Rejection Zone”, the turbomachinery test is rejected and a root cause analysis shall be performed to identify failure mechanism and solution be implemented, turbomachinery unit repaired and the test restarted from the beginning. Both, the unit elapsed running time and number of failures shall be disregarded and a new reliability test be carried out;
c) Nevertheless, if accumulated time in service and number of failures is within between rejection and acceptance lines the test must go on up to reach the “Acceptance Zone”;
d) The test is considered concluded as soon as it reaches the “Acceptance zone” or when it reaches 720h of accumulated (aggregated) time at most with no more than 7 countable failures.

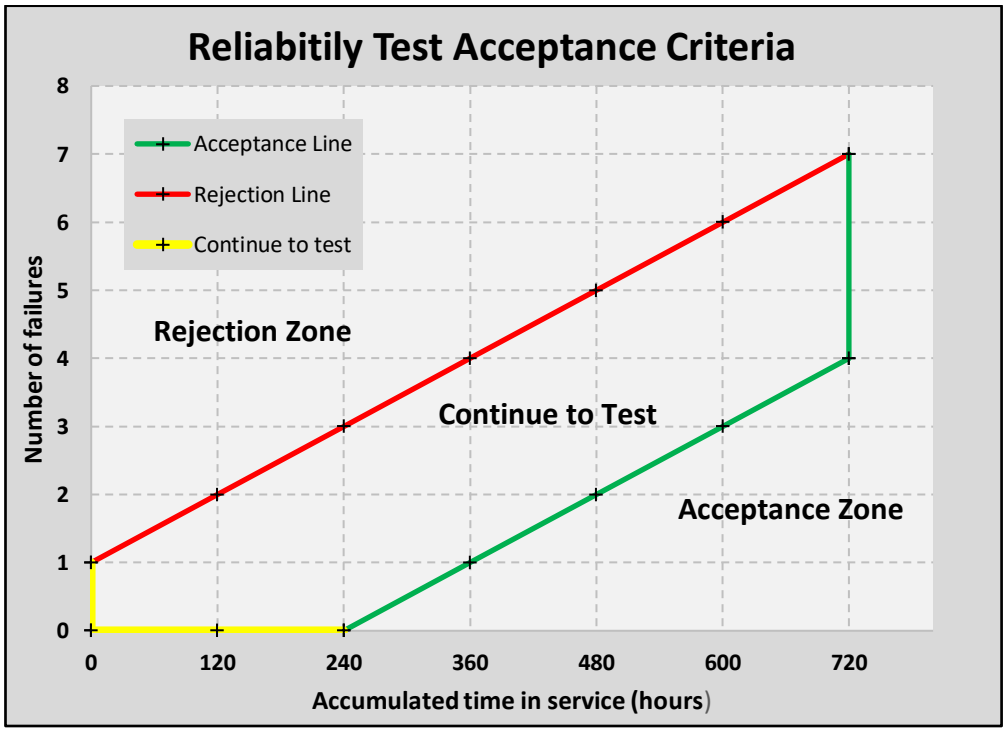

FIGURE 1: ACCUMULATED TIME VERSUS NUMBER OF FAILURES

1. Only failures occurring within the turbomachinery boundaries limits shall be considered (see FIGURES 2A, 2B, 2C, 2D and 2E). Countable failure is any event that causes complete or partial loss of system's capability of providing its expected output (see APPENDIX 1).

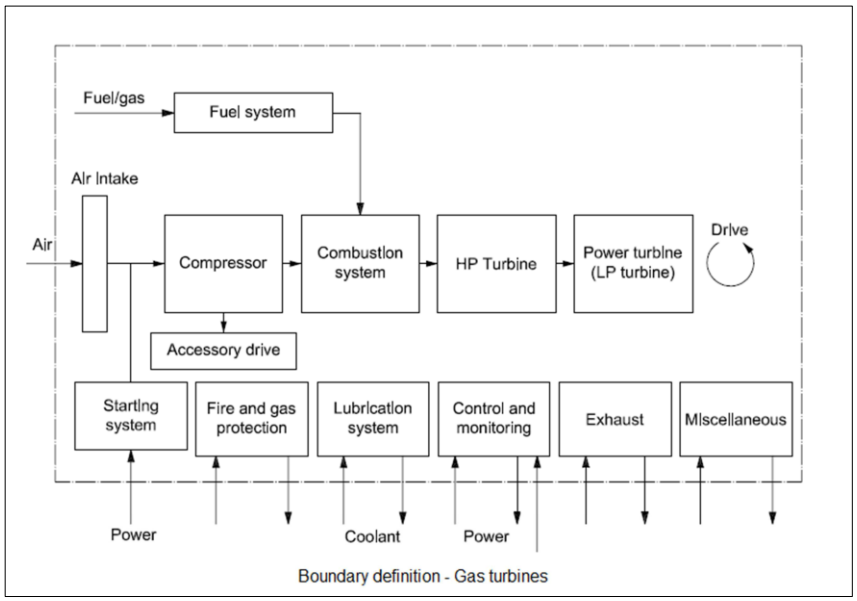

FIGURE 2A

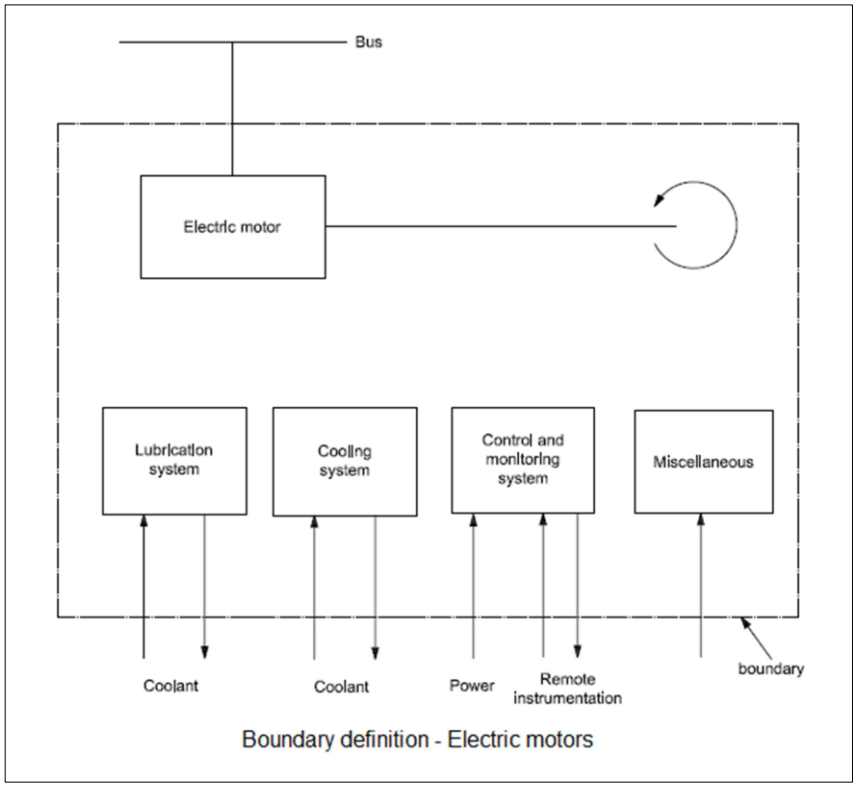

FIGURE 2B

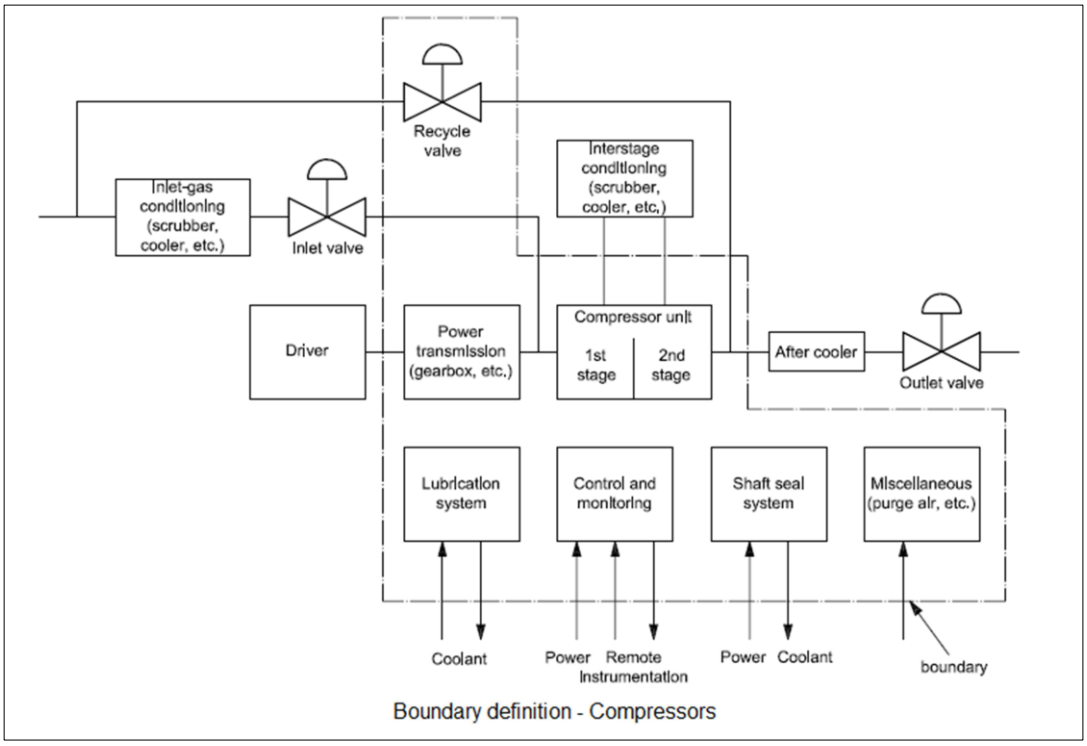

FIGURE 2C

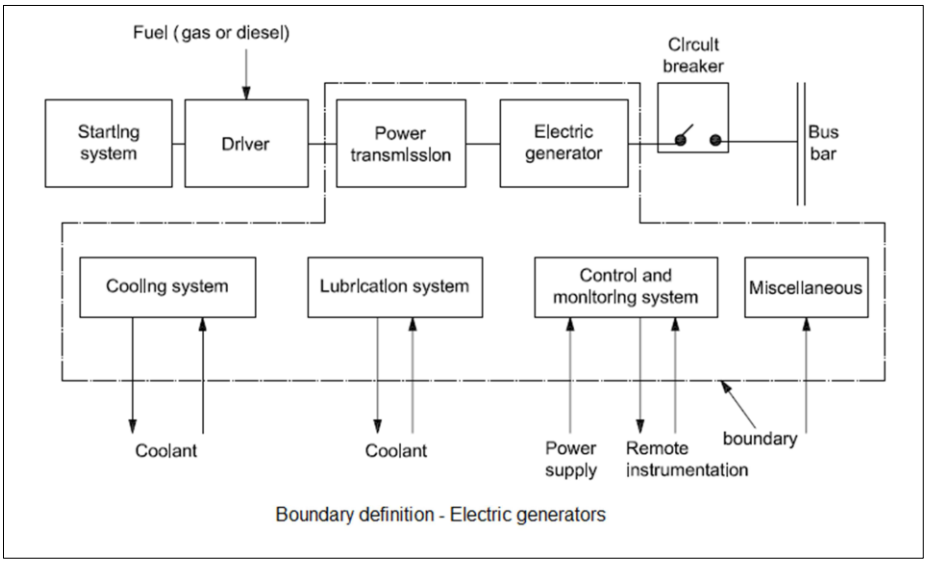

FIGURE 2D

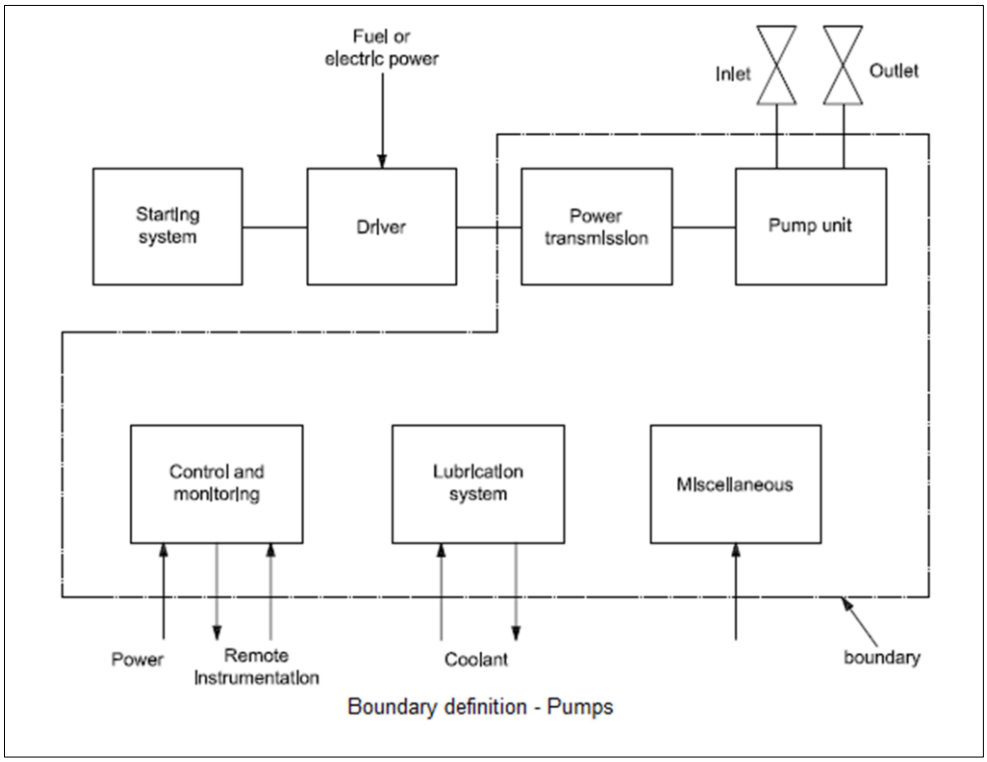
Fuel or
electric power
Inlet
Outlet
Starting
system
Driver
Power
transmission
Pump unit
Control and
monitoring
Lubrication
system
Miscellaneous
Power
Remote
Instrumentation
Coolant
boundary
Boundary definition - Pumps

FIGURE 2E

APPENDIX 1 – COUNTABLE FAILURE TABLE

1.	Any failure resulted from faulty manufacturing or engineering for main or ancillary equipment, components or systems that demand casing disassembly, realignment, adjustment, replacement or repair of any component.
2.	Performance disturbances caused by malfunction of performance/capacity controllers, speed controllers, anti-surge controllers, protection systems, communications devices and interlocking within the package that request re-programming or re-configuration.
3.	Any repeated actuation (two consecutive or three non-consecutive events) of the same trip that request re-configuration, recalibration and re-setting of parameters.
4.	More than three unsuccessful starts in sequence demanding recalibration and re-setting of startup system.
5.	Vibration & bearing temperature levels higher than specified / contracted.
6.	Failure to stop on demanding during test sequence.

General Notes:

1- Any external cause (from outside turbomachinery boundaries) that leads to the shutdown shall be disregarded. The test shall continue after restart the turbomachinery unit counting the aggregated time so far.

2- Any other occurrence that cause no immediate neither critical impact on the equipment/system function will be considered as typically non-critical failures, and therefore will not interrupt the test (abnormal instrument reading, minimum external leakage, signal transmission with intermittent disconnection, poor response to feedback, false alarm, faulty instrument indication or similar malfunction).

3- Any lack off or reduced ability to provide heating/cooling/exhausting/ventilation of auxiliary systems due to external poor sources shall be evaluate in order to not jeopardize the test result. If necessary, the test shall be interrupted up to all external sources are in steady condition.