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## INDEX OF REVISIONS

| REV. | DESCRIPTION AND/OR REVISED SHEETS |
|---|---|
| 0 | ORIGINAL ISSUE |
| A | REVISED WITHIN RISK ANALISYS PHASE |
| B | REVISED WHERE INDICATED |

| | REV. 0 | REV. A | REV. B | REV. C | REV. D | REV. E | REV. F | REV. G | REV. H |
|---|---|---|---|---|---|---|---|---|---|
| DATE | JAN/08/21 | MAR/08/21 | APR/15/21 | | | | | | |
| PROJECT | ENG | ENG | ENG | | | | | | |
| EXECUTION | CXZ0 | CXZ0 | PMX4 | | | | | | |
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# 1. INTRODUCTION

## 1.1. OBJECTIVE

The purpose of this technical specification is to describe the minimum requirements for the design, manufacturing, assembly, supply, installation, commissioning and tests of SANITARY TREATMENT AND VACUUM UNIT (Z-5312502) in conformance with relevant regulations and High Capacity FPSO design documentation.

## 1.2. DEFINITIONS

PACKAGE: It is defined as an assembly of equipment supplied interconnected, tested and ready to operate, requiring only the available utilities from the Unit for the Package operation.

PACKAGER: It is defined as the responsible for project, assembly, construction, fabrication, testing and furnishing of the Package.

SANITARY TREATMENT AND VACUUM UNIT the package name.

All definitions are found on I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS

## 1.3. ABBREVIATIONS

| | |
|---|---|
| CS | Classification Society |
| FAT | Factory Acceptance Tests |
| FPSO | Floating Production Storage and Offloading Unit |
| SOS | Supervisory and Operation System |
| SOS-HMI | Human Machine Interface of SOS |
| STU | Sewage Treatment Unit |
| BOD | Biochemical Oxygen Demand |

# 2. NORMATIVE REFERENCES

## 2.1. INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS

The equipment will be designed and manufactured in accordance with the following codes and standards, if not mentioned otherwise.

- ANSI American National Standards Institute
- API American Petroleum Institute

- ASME American Society Of Mechanical Engineers
- BGV German Safety Regulations
- DIN German National Standard Code
- EN European Standards
- ISO International Standard Organization
- IMO – International Maritime Organization – MPEC.227 (64)
- MARPOL – Chapter IV
- VDE / IEC German National Electric Standard Codes / International
- Electric Codes
- Classification Society defined for the Hull scope.

## 2.2. BRAZILIAN CODES AND STANDARDS

- NR – Brazilian Federal Government Regulatory Norms (Normas Regulamentadoras NRs)
- NORMAM-01 – Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto;
- CONSELHO NACIONAL DO MEIO AMBIENTE – CONAMA Resolução nº 430, de 13 de maio de 2011;
- NOTA TÉCNICA CGPEG/DILIC/IBAMA Nº 01/11 – PROJETO DE CONTROLE DA POLUICA - IBAMA

## 2.3. CLASS APPROVAL AND CERTIFICATION

The PACKAGE shall be designed, manufactured and tested according to the design reference documents, normative requirements and in accordance with the latest editions of Classification Society Rules, Regulations and Standards.

# 3. REFERENCE DOCUMENTS

| REF DOC NUMBER | REF DOC NAME |
|---|---|
| **GENERAL** | |
| I-DE-3010.1Y-1200-942-P4X-001 | GENERAL ARRANGEMENT |
| I-DE-3010.1Y-5400-94A-P4X-001 | AREA CLASSIFICATION – GENERAL |
| I-ET-3000.00-0000-940-P4X-002 | SYMBOLS FOR PRODUCTION UNITS DESIGN |

| | |
|---|---|
| I-ET-3000.00-1200-940-P4X-001 | TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN |
| I-RL-3010.1Y-1200-940-P4X-001 | GENERAL SPECIFICATION FOR AVAILABLE UTILITIES |
| I-ET-3A36.00-1000-941-PPC-001 | METOCEAN DATA |
| **CONSTRUCTION** | |
| I-ET-3010.00-1200-955-P4X-001 | WELDING |
| I-ET-3010.00-1000-970-P4X-002 | REQUIREMENTS FOR NDT |
| I-ET-3010.00-1200-955-P4X-002 | REQUIREMENTS FOR WELDING INSPECTION |
| I-ET-3010.00-0000-970-P4X-001 | REQUIREMENTS FOR PROCEDURES AND PERSONNEL QUALIFICATION AND CERTIFICATION |
| **HULL SYSTEMS** | |
| I-DE-3010.1Y-5310-944-P4X-001 | BLACK AND GRAY WATER SYSTEM |
| I-DE-3010.1Y-5310-944-P4X-002 | BLACK AND GRAY WATER SYSTEM COLLECTION |
| I-MD-3010.1Y-1200-940-P4X-027 | DESCRIPTIVE MEMORANDUM - HULL SYSTEMS |
| **NAVAL** | |
| I-DE-3010.1Y-1350-960-P4X-002 | CAPACITIES PLAN |
| I-ET-3010.1Y-1350-960-P4X-002 | DESIGN REQUIREMENTS - NAVAL ARCHITECTURE |
| I-RL-3010.1Y-1350-960-P4X-009 | MOTION ANALYSIS |
| **MECHANICAL** | |
| I-ET-3010.00-1200-300-P4X-001 | NOISE AND VIBRATION CONTROL REQUIREMENTS |
| **PAINTING** | |
| I-ET-3010.00-1200-956-P4X-002 | GENERAL PAINTING |

| | |
|---|---|
| DR-ENGP-I-1.15 | COLOR CODING |
| **SAFETY** | |
| I-ET-3010.00-5400-947-P4X-002 | SAFETY SIGNALING |
| **PIPING** | |
| I-ET-3010.1Y-1200-200-P4X-002 | PIPING SPECIFICATION FOR HULL |
| I-ET-3010.00-1200-251-P4X-001 | REQUIREMENTS FOR BOLTING MATERIALS |
| **ELECTRICAL** | |
| I-DE-3010.00-5140-700-P4X-003 | GROUNDING INSTALLATION TYPICAL DETAILS. |
| 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 AND EQUIPMENT FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-700-P4X-003 | ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-712-P4X-001 | LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS |
| **INSTRUMENTATION AND AUTOMATION** | |
| I-ET-3010.00-1200-800-P4X-002 | AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS |
| I-ET-3010.1Y-1200-800-P4X-014 | AUTOMATION INTERFACE OF PACKAGE UNITS |
| I-ET-3010.00-1200-800-P4X-013 | GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS |
| I-ET-3010.00-5520-888-P4X-001 | AUTOMATION PANELS |

Table 1 – Reference Documents

# 4. DESIGN REQUIREMENTS

## 4.1. DESIGN CONDITIONS

4.1.1. PACKAGE Equipment shall be designed for a 30-year life in a corrosive offshore environment without the need for replacement of any major component due to wear, corrosion, fatigue, or material failure.

4.1.2. PACKAGER shall design the equipment for the full range of operational conditions as specified in this technical specification.

4.1.3. PACKAGE Equipment shall be designed with the compliance of the normative and design requirements as stated in this specification and complying with the technical parameters stated on the above item 3 with the High Capacity FPSO basic design reference documents.

4.1.4. All elements of the PACKAGE shall be of proven design and well within the manufacturer's actual experience.

## 4.2. SAFETY REQUIREMENTS

4.2.1. Personnel safety protection shall be provided according to Brazilian Regulatory Norms (NR) issued by Brazilian Government.

4.2.2. Warning signs in Brazilian Portuguese language shall be provided where risk of personnel injury exist.

4.2.3. Rotating equipment outer parts, such as pulleys, couplings, belts and flywheels, shall have rigid protection, manufactured with aluminum ASTM B211 and shall be capable of being easily removed.

4.2.4. In accordance with the requirements of SOLAS II-1, Regulation 3-5, and MSC.1/Circ. 1379, all equipment and material to be supplied by PACKAGER must be "asbestos free".

4.2.5. Safety signaling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALING.

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

## 4.3. NOISE AND VIBRATIONS

4.3.1. Noise and vibrations limits shall be in conformance with I-ET-3010.00-1200-300-P4X-001 – NOISE AND VIBRATION CONTROL REQUIREMENTS.

## 4.4. MOTIONS AND ACCELERATION

4.4.1. All equipment shall be able to withstand with the UNIT subjected to 100-year return period environmental conditions.

4.4.2. All equipment shall be able to operate with the UNIT subjected to 1-year return period environmental conditions.

4.4.3. All environmental conditions are defined in I-ET-3A36.00-1000-941-PPC-001 – METOCEAN DATA, at any draft from fully loaded to the minimum loaded / ballasted condition.

4.4.4. For the Hull loading conditions details and the maximum designed operational trim and heel inclinations refer to I-ET-3010.1Y-1350-960-P4X-002 – DESIGN REQUIREMENTS - NAVAL ARCHITECTURE.

4.4.5. For the design data and information regarding motion requirements refer to I-RL-3010.1Y-1350-960-P4X-009 – MOTION ANALYSIS.

4.4.6. PACKAGE is also to withstand inertial forces during transportation from construction site to the final offshore location.

## 5. PACKAGE SCOPE OF SUPPLY AND LOCATION

### 5.1. SCOPE OF SUPPLY

| | TAG | Description | Qty |
|---|---|---|---|
| 1 | Z-5312502A/B | Sewage Treatment Unit | 2 x 100% |
| 2 | PN-Z-5312502A/B | Sewage Treatment Unit Panel | 2 x 100% |
| 3 | TQ-Z-5312502 | Grease Trap | 1 x 100% |
| 4 | FT-Z-5312502A/B | Catcher Unit | 2 x 100% |
| 5 | --- | Manual Handeheld kits for measuring DO (dissolved oxygen) levels from samples | 2 x 100% |

Table 2 – Scope of Supply

5.1.1. PACKAGER shall supply two (2 X 100%) Sewage Treatment Unit – Z-5312502A/B biological type being each one able to attend 100% of the POB with 240 people.

5.1.2. Sewage treatment units shall be provided with vacuum system for black waters.

Gray waters shall be collected by gravity.

5.1.3. PACKAGER shall supply both STU Units fully assembled on structural skids and ready for operation.

5.1.4. Grease trap (TQ-Z-5312502) to collect the Accommodation Galley gray water.

5.1.5. Catcher Units (FT-Z-5312502A/B) for black waters.

5.1.6. PACKAGER shall supply all interconnection piping, flanges, valves, electrical panel and terminations, instrument, and any other device for the safe and full operational performance of the equipment following all normative regulations, standards and the minimum requirements for design and operation herein mentioned on this specification.

## 5.2. EQUIPMENT LOCATION

5.2.1. PACKAGE shall be installed on Engine Room which is a closed and non-classified compartment as defined on I-DE-3010.1Y-5400-94A-P4X-001 – AREA CLASSIFICATION - GENERAL.

5.2.2. I-DE-3010.1Y-1200-942-P4X-001 – GENERAL ARRANGEMENT shall also be used as reference for equipment location.

# 6. PACKAGE SPECIFICATION

## 6.1. SEWAGE TREATMENT UNIT (STU)

6.1.1. The STUs shall be conceived to keep one of them in continuous operation while the other one is in stand-by. It shall be conceived means to operate simultaneously both Sewage Treatment Units Z-5312502A/B while the one in operation is put out of operation (for instance, maintenance purposes), and the one, in stand-by, is put to operate.

6.1.2. PACKAGER shall provide a written procedure about how to put one Sewage Treatment Unit out of operation, while the other one is put to assume 100% of its 240 POB nominal capacity. These procedures shall include samples collection instructions to confirm the effectiveness of the Sewage Treatment Unit that was put in operation, to comply with 100% of the 240 people POB.

6.1.3. STU shall be designed for a POB of 240 people with a daily flow rate of 250 liters per person, as a minimum, corresponding to a total daily treatment capacity of 60 $m^3$. For the STU capacity, PACKAGER shall take into account a Biochemical Oxygen Demand (BOD) of 2,000 mg/liter at STUs inlet. Considering PACKAGER expertise, STUs shall be dimensioned taking also into account periods of peak treatment demand along the day, to be defined in detailing phase.

6.1.4. The time interval between periodic maintenance shall not be shorter than 365 days.

6.1.5. During such interventions the maximum sludge removal volume shall be approximately 10 $m^3$, considering the regular sludge age (mean Cell Residence Time) conceived for the STUs dimensioning and effectiveness.

6.1.6. STUs shall not require any other sludge removal intervention between periodic maintenance, or within the 365 days period mentioned on 6.1.2.

6.1.7. PACKAGER shall provide the certificate, or any other similar document issued by Brazilian Regulations (IBAMA, CONAMA, etc.) to ensure the pathogenic of the discarded sludge.

6.1.8. STUs shall be IMO type approved as per MPEC.227 (64).

6.1.9. Both STUs shall have two pumps (2X100%) to collect the treated fluid and discharge it overboard.

6.1.10. STUs shall have two (2) sample points at each treatment tank (each stage), one (1) at the bottom and other one (1) at the center tank's height. In the tank where the settlement of sludge takes place, five (5) sample points shall be provided, distributed in different heights of the tank.

6.1.11. It shall be possible to measure the DO (dissolved oxygen) inside the aeration tank. For this purpose, together with the sample points mentioned on previous paragraph, two (2) manual handheld kits for measuring DO levels shall be provided. The kits shall have appropriate certificate of calibration. Other alternatives to measure DO levels in the aeration tank may be proposed by PACKAGER and shall be submitted to OWNER for approval.

6.1.12. To avoid the absence of oxygen and consequently the growth of anaerobic bacteria, the equipment shall be provided with two air blowers that shall guarantee the amount of oxygen that the process needs.

6.1.13. The biological reactor of the STU must have an easily removable hatch or other similar access device to allow its interior visual inspection, measurements and sample collections of its interior liquid effluents, the liquid from the sludge return line and the scum return line.

6.1.14. Before leaving the equipment, the liquid shall pass through a disinfection chamber, where it shall be mixed and disinfected with liquid chlorine.

6.1.15. Tanks inside the sewage treatment units shall have a level transmitter and alarm to indicate the possibility of overflow. The signal obtained by the level transmitter shall be integrated to platform supervisory system (SOS) in the control room. This signal shall be interlocked with the first XV (on/off) valve downstream the Gray Water Holding Tank (TQ-5310501). This valve shall close in case of very high level at STU tanks.

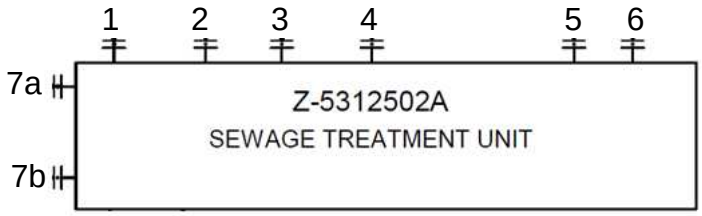
6.1.16. STU shall receive all black water flows from the collection system and also the gray water (in case it is not provided with any exclusive treatment for gray water).

6.1.17. The treatment of gray water segregated from black water may be accepted if the disposal parameters meet current regulations. In no case the disposal of untreated black or gray water will be accepted.

- Note: gray water discharge to overboard is allowed for a contingency scenario only with the purpose of securing the safety of a FSPO and those on board or saving life at sea, as stablished by IMO, MARPOL Section IV.

6.1.18. Final system data to be revised during detailed design phase.

## 6.2. STU HIGH CAPACITY CONFIGURATION




- Note: for Z-5312502B the same configuration shall be applied.

6.2.1. STU Inlet points (influent):

1) 2” Gray water from infirmary.
2) 3” Black water from Topsides WC.
3) 4” Black water from Accommodation.
4) 2” Black water from infirmary.
5) 6” Gray water from Holding Tank, Grease Trap, Topsides WC and ER WC.
6) STU Vent.

6.2.2. STU Outlet points (effluent):

7a) 2” Gray water to overboard.

7b) 2” Gray water to overboard.

- Note: both 7a) and 7b) joins ahead STUs, upstream the flowmeter.

6.2.3. Sewage system gray and black water piping lines slope, accessories, valves and the STUs vent lines shall follow the sewage treatment unit PACKAGER's recommendations.

6.2.4. Piping arrangement and design for the black and gray water systems shall be approved by the PACKAGER.

6.2.5. all the black and gray water system, from collection going through treatment and

overboard or offshore discharge, shall be submitted to the approval of the sewage treatment system package vendor.

## 6.3. STU VENT SYSTEM

6.3.1. Each STU shall have a dedicated vent piping system.

6.3.2. STUs vent system or any other retention tank vent system shall be positioned in an open area on Main Deck aft of Engine Room forward bulkhead in a proper place to not cause any disturbance to the crew with odor dispersed.

6.3.3. Also, STU vent piping system shall be distant enough from the Hull air intakes so as to not create a short circuit.

6.3.4. The whole network of the sewage treatment unit (Z-5312502A/B) vent system shall be self-draining in any normal trim and hell condition. under no circumstances, hydraulic seals shall be formed on these pipes.

6.3.5. Any other air suction shall be close to the STU vent.

6.3.6. Contention barrier on the open deck outside Engine Room shall be provided for any vent piping.

## 6.4. HOLDING TANK (TQ-5310501)

6.4.1. Gray water collected from Accommodation Upper Level are directed to a gray water holding tank TQ-5310501 dimensioned for gray water peak accumulation. This tank has a volume of 15m³ and is not part of the PACKAGER scope of supply.

## 6.5. GREASE TRAP (TQ-Z-5312502)

From Accommodation Galley the grease trap shall follow the below minimum requirements:

6.5.1. Grease trap shall be rectangular type and installed at a level below the galley and messroom.

6.5.2. Grease trap location shall have facilities for inspection and maintenance and hot / cold water connection points.

6.5.3. Grease trap shall be provided with connections for itself draining, washing and cleaning.

6.5.4. Grease trap shall have a By-pass line with a single normally closed blocking valve for maintenance. This by-pass line and valve are not PACKAGER scope.

6.5.5. All effluents discarded from grease trap shall be treated before the discharge to the sea.

## 6.6. SLUDGE REMOVAL

6.6.1. During STUs maintenance period the sludge removal shall be destinated to a 200 liters drums by gravity and/or pneumatic portable pumps. it shall be provided handling facilities for the drums until a cargo handling area.

- Note: one header shall be provided to receive sludge from both STUs as detailed on I-DE-3010.1Y-5310-944-P4X-001 – PIPING AND INSTRUMENT DIAGRAM BLACK AND GRAY WATER SYSTEM. This Header is HULL SUPPLIER scope.

## 6.7. CATCHER UNITS (FT-Z-5312502A/B)

6.7.1. Sewage system shall have two (2) Catcher Filters (2 x 100%) to collet solids and large objects from the black water collection system.

i. Catcher Filter (FT-Z-5312502A) receives black water from the infirmary.

ii. Catcher Filter (FT-Z-5312502B) receives black water from the Accommodation Upper Level and Engine Room WC.

6.7.2. Both Catcher Filters (FT-Z-5312502A/B) shall be installed on Engine room with accessible areas for maintenance.

- Note: a maintenance purpose by-pass line with a single blocking valve shall be installed for both Catcher Filters (HULL SUPPLIER scope).

## 6.8. SEAWAGE SYSTEM SAMPLE POINTS

6.8.1. Sewage system shall be provided with sample points for the STUs inlet flow of grey and black waters (upstream treatment).

6.8.2. Since black waters are collected by vacuum system, STUs shall be provided with a sample point downstream of the vacuum pumps and upstream the first treatment stage. This sample point is PACKAGER design and scope of supply.

6.8.3. Sample points shall also be provided for grey and black waters STUs outlet flow (treated discharge to overboard) for both STUs.

i. Those sample point shall be installed on Engine Room as close as possible of the water ballast tank Nº9 P/S (TQ-5335509P/S).

ii. Those sample point connection shall have double blocking ball valves type and a blind flange.

# 7. GENERAL REQUIREMENTS

## 7.1. ELECTRICAL REQUIREMENTS

7.1.1. All electrical equipment installed in hazardous areas (see Area Classification documentation) or installed outdoors and kept on during emergency condition

(ESD) shall be certified according to IEC 61892, INMETRO Resolution 179, May 18th 2010 and INMETRO resolution 89, February 23rd 2012.

7.1.2. All electrical signal connections for external interconnection with the panel shall be clustered in junction boxes with at least IP-56 level of protection, located inside the panel and grouped according to the different types of signals involved.

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

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

7.1.5. Concerning electrical system voltages and quantity of feeders for motors, panels and auxiliaries, centrifugal pumps shall be fed according to definitions of I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.

7.1.6. 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.

7.1.7. Grounding installations shall comply with I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS and I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.

## 7.2. INSTRUMENTATION AND AUTOMATION REQUIREMENTS

7.2.1. PACKAGE shall be protected with all necessary instruments to operate safely, adequately and without interruption in a tropical marine environment.

7.2.2. The instrumentation and control design shall fulfill the requirements of the following technical specifications:

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

ii. I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

7.2.3. The minimum requirements for the adequate interfacing of the PACKAGE Automation and Instrumentation System with the UNIT are described on I-ET-3010.1Y-1200-800-P4X-014 – AUTOMATION INTERFACE OF PACKAGE UNITS.

7.2.4. For the control and automation panels design requirements I-ET-3010.00-5520-888-P4X-001 – AUTOMATION PANELS shall be considered.

## 7.3. PAINTING REQUIREMENTS

7.3.1. Painting and coating in accordance with I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING and DR-ENGP-I-1.15 COLOR CODING.

7.3.2. All components shall be delivered fully painted/coated, unless otherwise indicated on this specification.

7.3.3. The performed pre-treatment and complete coating shall be in accordance with the paint manufacturer's data sheets.

## 7.4. SKIDS LAYOUT AND FOUNDATION REQUIREMENTS

7.4.1. PACKAGE components detailed on item 6 which are supplied assembled on skids shall follow the below minimum requirements.

7.4.2. PACKAGE skid structure shall be designed to withstand the design conditions mentioned on item 4.4 and to ensure the lifting conditions on manufacturing site and shipyard. Lifting lugs shall be provided according to PACKAGER lifting procedure.

7.4.3. The Skid main frame shall be all welded construction. Structural skid welds, including lifting facilities shall be continuous and shall comply with AWS D1.1 (structural welding code) and CS Rules.

7.4.4. Skid structure shall be designed to be welded to the supporting structure unless otherwise specified.

7.4.5. PACKAGE skid layout and arrangement shall be designed to provide sufficient access to pumps, instruments, equipment, and control panels so as to ease the operability and maintenance with safe conditions. Instruments and alves shall be installed on a suitable height to allow safe access for monitoring, operation, and maintenance.

7.4.6. All necessary maintenance davits, monorails, padeyes or trolleys shall be provided to ensure the safe and easy maintenance conditions.

7.4.7. Access ladders, platforms, gratings, and any other access device shall be metallic type and designed according to PACKAGER / MANUFACTURER standard and to the industrial recognized international codes.

7.4.8. PACKAGE skid shall have a drip pan to collect drained water from the equipment with drain flanges for the connection with the Hull draining system.

7.4.9. PACKAGE Equipment and components shall be located entirely within the skids / equipment base perimeter, including all equipment, piping, valves, electrical, instrumentation and controls.

## 7.5. AVAILABLE ON BOARD

7.5.1. For utilities available onboard refer to I-RL-3010.1Y-1200-940-P4X-001 – GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

## 7.6. NAMEPLATES AND TAG NUMBERING

7.6.1. PACKAGER / MANUFACTURER Equipment shall have nameplates in Brazilian Portuguese language, made of stainless steel AISI 316L, with 3 mm minimum thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location.

7.6.2. Tagging of all instruments, electrical, mechanical and piping items, including valves, shall be carried out.

7.6.3. Tags shall be supplied with the number and description in the Brazilian Portuguese Language, unless otherwise stated in the technical data sheets.

7.6.4. For TAG numbering refer to I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN

7.6.5. For Instrumentation tagging the ISA –5.1 and N-1710 shall be followed.

# 8. PACKAGE MANUFACTURING

## 8.1. GENERAL

8.1.1. All materials and equipment supplied by PACKAGER / MANUFACTURER shall be brand new (not overhauled), field proven, free from defects and accepted by Owner and the Classification Society.

8.1.2. Materials and equipment shall be manufactured according to internationally recognized standards for the offshore oil drilling and production industries, and shall be in conformance with the Basic Design and Agreement specifications and requirements.

8.1.3. Field proven definition: Systems and equipment shall demonstrate satisfactory operation at least in 3 floating offshore installation units, operating under process conditions (pressure, flow, capacity and similar fluids) for a minimum of 24,000 hours. For rotating equipment, they must demonstrate operation with fluid, flow and discharge pressure similar to the design. Unproven designs or prototypes (including components) without offshore service will not be accepted.

## 8.2. QUALITY ASSURANCE AND CONTROL SYSTEM

8.2.1. Engineering, fabrication and manufacturing shall conform to good manufacturing practices. Quality system according to ISO 9001 in relevant extent shall be in place and implemented.

## 8.3. WELDING AND NDT

8.3.1. All equipment, structures and piping welds shall be performed according to the requirements described in the latest revision of I-ET-3010.00-1200-955-P4X-001 – WELDING.

8.3.2. Welding shall be carried out with procedures and welders qualified in accordance with ASME Section IX. Welding shall not be performed before qualified welding procedures have been approved.

8.3.3. Intermittent fillet welds are not acceptable.

8.3.4. Welding inspection and NDTs shall be performed according to the requirements described in the latest revision of

- I-ET-3010.00-1000-970-P4X-002 – REQUIREMENTS FOR NDT and
- I-ET-3010.00-1200-955-P4X-002 – REQUIREMENTS FOR WELDING INSPECTION.

8.3.5. Qualification and Certification for procedures and personnel shall be in accordance with I-ET-3010.00-0000-970-P4X-001 – REQUIREMENTS FOR PROCEDURES AND PERSONNEL QUALIFICATION AND CERTIFICATION.

8.3.6. Final NDTs, 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.

## 8.4. INSPECTION AND TESTS

8.4.1. PACKAGER / MANUFACTURER shall develop and implement an Inspection and Test Plan (ITP) containing hold points, review and witness points following the schedule of the PACKAGE inspections, tests and events accordingly.

8.4.2. PACKAGE inspection, tests and events shall be attended by the MANUFACTURER, PACKAGER, HULL SUPPLIER, CS and OWNER inspection team whenever necessary.

8.4.3. PACKAGE shall be tested according to the design codes, applicable industry standards, CS Rules and any other one requirement stated on this technical specification.

8.4.4. Unless waive by OWNER, the following PACKAGE inspections and checks shall be witnessed by OWNER inspector:

i. verification of equipment construction materials (vessels, heat exchangers, pumps, etc.) for conformity with the specification requirements;

ii. verification of piping, fittings and valves conform to specification of materials and fabrication;

iii. reports for all NDT performed on the pressure retaining parts (radiographic, dye penetrant, magnetic particles and ultrasonic inspection);

iv. approval of the relief valve settings and witness of their testing after setting;

v. review of Inspection and Test Records;

vi. visual check.

vii. Electrical tests as:

- a MEGGER test for cables and electric motors;
- all tests stated in the respective motors and power / control panel respective specifications.

## 8.5. FACTORY ACCEPTANCE TEST (FAT)

8.5.1. FAT is a set of functional and performance tests to be executed in any equipment, electrical, instrumentation and telecom panels or any other commissionable item carried out on the PACKAGER / MANUFACTURER factory or in specialized test facilities, in order to demonstrate its compliance with the project specifications and allow its release to shipyard.

8.5.2. For Factory Acceptance Test (FAT) minimum scope requirements:

i. Pressure test (usually hydrostatic) test of all vessels, heat exchangers, tanks, pumps, pipes and valves.

o Note: All piping systems and equipment shall be drained and dried after hydrostatic testing.

ii. Performance test, NPSH test and Mechanical running test of all pumps.

iii. Electrical continuity checks on all wiring and earthing.

iv. Functional checks on all instruments and valves.

v. Alarms and Equipment Protection Tests.

vi. All other equipment tests and factory checking to be carried out according to the FAT procedure approved by parts.

8.5.3. For Factory Acceptance Test (FAT) event invitation e reports:

i. OWNER, CS and HULL SUPPLIER shall be communicated about the FAT event following ITP and the fabrication schedule. FAT invitation schedule shall be negotiated during PACKAGE kick-off meeting on the detail design phase.

ii. PACKAGER shall issue the FAT procedure for all parts involved as OWNER, HULL SUPPLIER and CS, where applicable, and submit to them for approval.

iii. PACKAGER shall issue the FAT report with all test results and duly signed or stamped by all parts that witnessed the FAT and with the test reference documentation attached.

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

### 8.6. PRE-COMMISSIONING AND COMMISSIONING

8.6.1. PACKAGER / MANUFACTURER shall be required to provide any necessary support for installation, assembly, pre-commissioning and commissioning of the PACKAGE either at a shore based fabrication yard or onboard the FPSO.

8.6.2. PACKAGER / MANUFACTURER is responsible for assembly supervision of the PACKAGE equipment, including the assembly of components to be delivered loose (for example, some components of the pumps, like stuffing box, etc.).

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

## 9. PACKAGE DELIVERY REQUIREMENTS

### 9.1. PRESERVATION, PACKING AND TRANSPORTATION

9.1.1. PACKAGER / MANUFACTURER shall ensure all the conditions and practices of preservation, packing and transportation are fulfilled and following the PACKAGE / Equipment specific and technical characteristics recommendations.

9.1.2. PACKAGER / MANUFACTURER shall submit to HULL SUPPLIER the PACKAGE preservation requirements and recommendations with all necessary considerations for the PACKAGE Equipment preservation during the UNIT whole design life.

9.1.3. Preservation and packing shall be proper for transportation and storage in a marine environment and protected against moisture and damage during transport, handling and lifting.

9.1.4. In any case, suitable preservation and protective measures shall be provided to prevent equipment deterioration prior to entering into service.

9.1.5. All packing shall be clearly marked for shipping, including lifting points, gross weight, dimensions and center of gravity.

9.1.6. All sea fastening and temporary supports used on the equipment for shipment shall be clearly identified.

9.1.7. PACKAGER / MANUFACTURER shall ensure that all loose valves, tubes and

instruments are supplied with plastic caps.

9.1.8. PACKAGER / MANUFACTURER shall also ensure that all electric panels and motors will be supplied with Volatile Corrosion Inhibitor (VCI) impregnated plastic protection or similar, and external plug for space heater connection.

9.1.9. PACKAGER / MANUFACTURER shall provide clear and comprehensive instructions on the exterior of all packages advising the necessary warning notices for unpacking, handling and installing the equipment on arrival at destination.

9.1.10. The equipment shall be thoroughly cleaned internally and be free of all loose foreign materials.

i. The preparation shall make the equipment suitable for outdoor storage in a coastal tropical climate from the time of Shipment.

ii. If there is a risk of damage to valves and other appurtenances during transportation, they shall be disconnected and tagged. All components shall then be securely packed as above.

iii. Spare parts and tools to be packed separately and clearly marked “Spare Parts” and “Tools” respectively.

## 9.2. SPARE PARTS, CONSUMABLES AND TOOLS

9.2.1. All equipment / material consumable and spare parts recommended by PACKAGER / MANUFACTURER for the construction, testing, commissioning, pre-operation and start-up phases.

9.2.2. All spare parts recommended or required by the CS, such spare parts will be delivered together with the relevant equipment;

9.2.3. All special tools required for construction, pre-commissioning, commissioning and all levels of maintenance and operation

9.2.4. Spare parts list recommended by PACKAGER / MANUFACTURER for two years of operation.

## 9.3. DOCUMENTATION

9.3.1. Drawings and Weight Control

For Engineering Documentation minimum requirements:

i. PACKAGER / MANUFACTURER design drawings shall show all necessary dimensions and details required for interface information and installation.

ii. Clearances for maintenance shall be shown on the drawings.

iii. Drawings and documents shall be clear and completely legible with all text in the English language.

iv. Instruction manuals for operation and maintenance of the PACKAGE equipment shall be provided in Portuguese language.

v. Drawings are only accepted when signed by PACKAGER as checked and approved. All revised editions of drawings or documents shall show the revisions clearly marked up, the issue date and PACKAGER's checked and approved signatures.

vi. PACKAGER / MANUFACTURER shall produce a weight / center of gravity data sheet considering each PACKAGE component with the respective assembly dry and operational weight and CoG.

- Note: Operational weight means the component dry weight added to the respective component fluid weight on operational condition.

vii. PACKAGER shall send in advance all recommendations for PACKAGE installation, maintenance and commissioning.

9.3.2. Data Book

PACKAGER shall issue a PACKAGE / Equipment Data Book to be delivered to HULL SUPPLIER for approval. Data Book minimum content shall be as the following:

i. Certified drawings, data sheets, technical specifications, performance curves and calculation memorandum.

ii. Construction, maintenance and operating manuals, instructions for preservation and commissioning, and all catalogs, including of the sub-suppliers.

iii. All certificates of materials and equipment, certificates of electrical cables and equipment to hazardous areas, all tests, destructive and non-destructive examinations, test reports (including FAT), certificates and reports of classification society, procedures for welding qualifications and welding processes.

iv. The documentation requested by Brazilian law NR-13, subdivided for equipment (if applicable).

v. The documentation requested by Brazilian law NR-10, subdivided for equipment (if applicable).

Data Book delivery standard and conditions including number of parts and sections, number of printed and electronic copies will be further defined by OWNER on detail design phase.

## 9.4. TRAINING

9.4.1. PACKAGER shall provide training to qualify OWNER technicians for operation and maintenance (install, dismantle, replace parts, make adjustment, etc.) of each equipment.