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	CLIENT:	BÚZIOS	
	JOB :	HIGH CAPACITY FPSO	
	AREA:	BÚZIOS	
<b>SRGE</b>	TITLE:		INTERNAL
	<b>GAS SAMPLING SYSTEM</b>		ESUP

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THIS FORM IS PART OF PETROBRAS N-381 REV.J ANNEX A – FIGURE A.1.



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## 1. INTRODUCTION

### 1.1 OBJECTIVE

This technical specification describes the minimum requirements and criteria in conformance with relevant regulations and High Capacity FPSO basic design documents for the design, manufacturing, assembly, supply, installation, testing and commissioning of GAS SAMPLING SYSTEM, which consists of the Gas Sampling Panel PN-5520550 and accessories to perform the interconnection with the forward ballast tanks and cofferdam. The GAS SAMPLING SYSTEM objective is to provide gas measurement and analysis for ballast tanks and void spaces adjacent to cargo, slop or produced water tanks. The PACKAGE is comprised of a central unit for collection and analysis of the atmosphere of the referred tanks for the hydrocarbon gas concentration. Additionally, the GAS SAMPLING PANEL shall also analyze the tanks' atmosphere for H<sub>2</sub>S (hydrogen sulfide) concentration.

### 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.

**GAS SAMPLING SYSTEM** the package name.

**OWNER:** Petrobras.

All other 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

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## 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
- ASME B 31.1 Process Piping
- BGV German Safety Regulations
- DIN German National Standard Code
- EN European Standards
- ISO International Standard Organization
- IMO – International Maritime Organization
- VDE / IEC German National Electric Standard Codes / International Electric Codes
- Classification Society defined for the Hull scope.
- Marpol (International Convention for the Prevention of Pollution from Ships) regulations;
- SOLAS – International Convention for the Safety of Life at Sea;
- MSC.1/Circ.1370 - GUIDELINES FOR THE DESIGN, CONSTRUCTION AND TESTING OF FIXED HYDROCARBON GAS DETECTION SYSTEMS

### 2.2 BRAZILIAN CODES AND STANDARDS

- NR – Brazilian Federal Government Regulatory Norms (Norma Regulamentadora);
- NORMAM-01 – Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto;

### 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
<b>GENERAL</b>	
I-DE-3010.1Y-1200-942-P4X-002	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
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
I-ET-3010.1Y-1200-91A-P4X-001	REQUIREMENTS FOR O&M MANUALS AND DATABOOKS
I-ET-3010.1Y-1200-919-P4X-001	REQUIREMENTS FOR VENDORS TRAINING CONTENT AND PROGRAM
<b>CONSTRUCTION</b>	
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
<b>HULL SYSTEMS</b>	
I-DE-3010.1Y-5520-944-P4X-001	GAS SAMPLING SYSTEM



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I-DE-3010.1Y-6124-944-P4X-001	HULL SERVICE AND INSTRUMENT AIR DISTRIBUTION SYSTEM
I-DE-3010.1Y-5330-944-P4X-003	COFFERDAM, VOID SPACES AND STORES DRAINING SYSTEM
I-DE-3010.1Y-5335-944-P4X-001	BALLAST SYSTEM (FWD)
<b>NAVAL</b>	
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
<b>MECHANICAL</b>	
I-ET-3010.00-1200-300-P4X-001	NOISE AND VIBRATION CONTROL REQUIREMENTS
<b>PAINTING</b>	
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
DR-ENGP-I-1.15	COLOR CODING
<b>SAFETY</b>	
I-ET-3010.00-5400-947-P4X-002	SAFETY SIGNALING
DR-ENGP-M-I-1.3	SAFETY ENGINEERING GUIDELINE
I-RL-3010.1Y-5400-98G-P4X-002	GAS DISPERSION ANALYSIS
<b>PIPING</b>	
I-ET-3010.1Y-1200-200-P4X-002	HULL PIPING SPECIFICATION
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLT MATERIALS
<b>ELECTRICAL</b>	
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS

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I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5140-712-P4X-001	LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-002	SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
<b>INSTRUMENTATION AND AUTOMATION</b>	
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
I-ET-3010.1Y-1200-800-P4X-005	FIELD INSTRUMENTATION

Table 1 – Reference Documents

Note: Reference Documents latest revision shall be considered.


#### 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.

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<p>4.1.4. All elements of the PACKAGE shall be of proven design and well within the manufacturer's actual experience.</p> <p><b>4.2 SAFETY REQUIREMENTS</b></p> <p>4.2.1. Personnel safety protection shall be provided according to Brazilian Regulatory Norms (NR) issued by Brazilian Government.</p> <p>4.2.2. Warning signs in Brazilian Portuguese language shall be provided where risk of personnel injury exist.</p> <p>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.</p> <p>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".</p> <p>4.2.5. Safety signaling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALING.</p> <p>4.2.6. Double block &amp; bleed arrangements are required for isolation of equipment in piping classes of 300# and above.</p> <p><b>4.3 NOISE AND VIBRATIONS</b></p> <p>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.</p> <p><b>4.4 MOTIONS AND ACCELERATION</b></p> <p>4.4.1. All equipment shall be able to withstand with the UNIT subjected to 100-year return period environmental conditions.</p> <p>4.4.2. All equipment shall be able to operate with the UNIT subjected to 1-year return period environmental conditions.</p> <p>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.</p> <p>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.</p> <p>4.4.5. For the design data and information regarding motion requirements refer to I-RL-3010.1Y-1350-960-P4X-009 – MOTION ANALYSIS.</p>			



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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

### 5.1 SCOPE OF SUPPLY

5.1.1. PACKAGER shall supply the GAS SAMPLING SYSTEM PACKAGE EQUIPMENT:

PN-5520550 – GAS SAMPLING PANEL, as well as all the other components indicated in I-DE-3010.1Y-5520-944-P4X-001 as PACKAGER scope of supply.

5.1.2. Minor components for sampling lines:


- i. Non-return valves, supplied loose by PACKAGER to be installed by HULL SUPPLIER;
- ii. Penetration pieces, supplied loose by PACKAGER to be welded by HULL SUPPLIER;
- iii. Isolation valves, supplied loose by PACKAGER to be installed by HULL SUPPLIER;
- iv. Flame arresters, supplied loose by PACKAGER to be installed by HULL SUPPLIER;
- v. Three-way valve, supplied loose by PACKAGER to be installed by HULL SUPPLIER;
- vi. Pipes for the interconnection of the GAS SAMPLING PANEL PN-5520550 to the referred tanks are in HULL SUPPLIER scope.

5.1.3. All the materials specified above shall be constituted of stainless steel 316. Other materials may be subjected for Petrobras for analysis and approval but shall follow the CS and statutory applicable requirements.

5.1.4. Different components for the GAS SAMPLING SYSTEM from the ones presented above might be acceptable and shall be sent to Petrobras for analysis and approval, as per on PACKAGER design.

5.1.5. Portable instruments for manual sampling:

- i. PACKAGER shall provide two (02) portable instruments to perform manual sampling of the tanks' atmosphere for hydrocarbon gas concentration and two (02) portable instruments to perform manual sampling of the tanks atmosphere for H<sub>2</sub>S concentration. The manual sampling equipment shall be able to be connected on the three-way valve (see I-DE-3010.1Y-5520-944-P4X-001) and also on the GAS SAMPLING PANEL PN-5520550. Any adaptors to allow the connection of the manual instrument on the sampling points (three-way valve or GAS SAMPLING PANEL) shall be provided by PACKAGER.

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#### 5.1.6. Calibration kit:

- i. PACKAGER shall provide 01 (one) calibration kit, containing cylinders for the calibration of all the sensors contained in the GAS SAMPLING PANEL PN-5520550 (hydrocarbon and H<sub>2</sub>S gas). The calibration kit shall be provided with all connections/adaptors to allow the correct calibration of the sensors. This kit shall be used for the shipyard tests (commissioning) and final conditioning of the system. It is HULL SUPPLIER responsibility to guarantee that all sensors comprised in the GAS SAMPLING PANEL PN-5520550 are correctly calibrated prior to the first oil of the FPSO.

#### 5.1.7. Sampling pipes protection:

- i. All sampling pipes shall have a metal protection on the exposed areas, to guard them against any damage due to impact. It is HULL SUPPLIER scope to design and install those protections, following the PACKAGER recommendations.


### 5.2 PACKAGE LOCATION

- 5.2.1. The GAS SAMPLING PANEL PN-5520550 shall be located in the forecastle, inside the Inert Gas System Room, interconnected with tubing from:

COFFERDAM, Water Ballast Tank 01 PS/SB, Water Ballast Tank 02 PS/SB, Water Ballast Tank 03 PS/SB, Water Ballast Tank 04 PS/SB; Water Ballast Tank 05 PS/SB; Water Ballast Tank 06 PS/SB; Water Ballast Tank 07 PS/SB; Water Ballast Tank 08 PS/SB; Forward Peak Tank PS/SB.

### 6. PACKAGE SPECIFICATION

- 6.1.1. The GAS SAMPLING SYSTEM PACKAGE (GAS SAMPLING PANEL PN-5520550 and other components indicated in I-DE-3010.1Y-5520-944-P4X-001) purpose is to provide gas measurement and analysis for the forward ballast tanks and void spaces adjacent to cargo, slop or produced water tanks. The PACKAGE is comprised of a central unit for collection and analysis of the atmosphere of the referred tanks for the hydrocarbon gas concentration. Additionally, the GAS SAMPLING PANEL shall also analyze the tanks' atmosphere for H<sub>2</sub>S (hydrogen sulfide) concentration.
- 6.1.2. The PACKAGE equipment shall be designed so that it may readily be tested and calibrated.
- 6.1.3. Audible and visual alarms shall be initiated in the SOS-HMI and at the GAS SAMPLING PANEL HMIs when the vapour concentration in one of the monitored spaces reaches a pre-set value.
- 6.1.4. Sampling pipes shall be constructed in stainless steel 316 and shall be of a minimum of six (06) millimeters inner diameter.

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6.1.5. The GAS SAMPLING PANEL shall be designed to sample and analyze from each sampling line of each protected space, sequentially at intervals not exceeding 30 minutes. The measurement intervals shall be adjustable on the system control panel to allow setting the interval between 5 and 30 minutes.

6.1.6. It shall be provided means to prevent the gas sampling pipes from clogging by using compressed air to perform flushing of the clogged line. There shall be an alarm indicating if any of the gas sampling lines are clogged.

6.1.7. The number and specification of the extraction pumps shall be as per PACKAGER design, and it shall be provided one (01) or more back-up pumps of equal power of the main extraction pumps, as per CS and statutory rules. The design shall be arranged so that the system will switch over to the back-up pump(s) in case of failure of the main pump(s), and an alarm shall be initiated in the GAS SAMPLING PANEL PN-5520550 and also in the Central Control Room. The suction capacity for the extraction pumps shall be enough for the correct analysis of the atmosphere of the most distant spaces with regards to the GAS SAMPLING PANEL PN-5520550.

## 6.2 UTILITIES AVAILABLE ONBOARD

The GAS SAMPLING PANEL PN-5520550 shall be interconnected with the essential air supply (see I-DE-3010.1Y-5520-944-P4X-001), which is in HULL SUPPLIER scope. If any adjustments on the air pressure is required for the correct functioning of the PACKAGE, it is PACKAGER scope to provide a pressure regulator device.

## 6.3 SKID REQUIREMENTS


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

6.3.2. Skid foundation structural steel components shall be designed and fabricated in accordance with AISC ASD.

6.3.3. 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.

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

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

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6.3.6. 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. GENERAL REQUIREMENTS

### 7.1 ELECTRICAL REQUIREMENTS

7.1.1. The GAS SAMPLING PANEL PN-5520550 shall be fed according to I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.

7.1.2. 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.

7.1.3. 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.

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

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


7.1.6. 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.

7.1.7. 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.

7.1.8. 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. For instrumentation interface details, such as quantity and location of HMIs and package classification, PACKAGER and HULL SUPPLIER shall follow I-ET-3010.1Y-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGE UNITS.

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7.2.2. The following alarms shall be foreseen in the GAS SAMPLING SYSTEM, as well as any other alarms required by CS, statutory rules or according to PACKAGER design:

- i. When gas concentrations are above the setpoint in any monitored space (alarm setpoint according to I-ET-3010.1Y-1200-800-P4X-005 - FIELD INSTRUMENTATION);
- ii. Low/no flow in any sampling pipe (clogging alarm);
- iii. Any fault condition, such as power failure or short-circuit;
- iv. Any tempering with the alarm setpoint;
- v. Failure of any self-test functions provided in the system by PACKAGER;

7.2.3. A visual alarm should remain in effect while an alarm condition is present. The audible alarm may be silenced manually in the SOS-HMI or in the GAS SAMPLING PANEL PN-5520550.

7.2.4. If the gas confirmed alarm for the GAS SAMPLING PANEL PN-5520550 is unanswered withing 2 minutes, the helideck status light shall be activated.

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


7.2.6. The instrumentation and control design shall fulfill the requirements of:

- i. I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and
- ii. I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

7.2.7. 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.

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

7.2.9. The GAS SAMPLING PANEL PN-5520550 shall be internally monitored by its own sample point(s), to detect any leakages from the sampling pipes to the panel interior. If the gas concentration inside the GAS SAMPLING PANEL PN-5520550 reaches the setpoints stablished in I-ET-3010.1Y-1200-800-P4X-005 - FIELD INSTRUMENTATION, the gas analyzing unit shall be automatically shut down and isolated from the sampling pipes (any shutdown or solenoid valves shall be

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automatically closed), and alarms shall be triggered on the GAS SAMPLING PANEL HMI(s) and CCR.

### 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 NAMEPLATES AND TAG NUMBERING

7.4.1. 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.

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

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

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

7.4.5. 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

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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. PACKAGER shall submit his Quality Assurance / Quality Control handbook to HULL SUPPLIER for information.

8.2.2. 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.


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<p>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.</p> <p>8.4.4. Unless waive by OWNER, the following PACKAGE inspections and checks shall be witnessed by OWNER inspector:</p> <ul style="list-style-type: none"> <li>i. verification of equipment construction materials (vessels, heat exchangers, pumps, etc.) for conformity with the specification requirements.</li> <li>ii. verification of piping, fittings and valves conform to specification of materials and fabrication.</li> <li>iii. reports for all NDT performed on the pressure retaining parts (radiographic, dye penetrant, magnetic particles and ultrasonic inspection).</li> <li>iv. approval of the relief valve settings and witness of their testing after setting.</li> <li>v. review of Inspection and Test Records.</li> <li>vi. visual check.</li> <li>vii. Electrical tests as: <ul style="list-style-type: none"> <li>- a MEGGER test for cables and electric motors.</li> <li>- all tests stated in the respective motors and power / control panel respective specifications.</li> </ul> </li> </ul> <p><b>8.5 FACTORY ACCEPTANCE TEST (FAT)</b></p> <p>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.</p> <p>8.5.2. For Factory Acceptance Test (FAT) minimum scope requirements:</p> <ul style="list-style-type: none"> <li>i. Pressure test (usually hydrostatic) test of all vessels, heat exchangers, tanks, pumps, pipes and valves. <ul style="list-style-type: none"> <li>o Note: All piping systems and equipment shall be drained and dried after hydrostatic testing.</li> </ul> </li> <li>ii. Electrical continuity checks on all wiring and earthing.</li> </ul>			



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<ul style="list-style-type: none"> <li>iii. Functional checks on all instruments and valves.</li> <li>iv. Alarms and Equipment Protection Tests.</li> <li>v. All other equipment tests and factory checking to be carried out according to the FAT procedure.</li> </ul>			
<p>8.5.3. For Factory Acceptance Test (FAT) event invitation e reports:</p> <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>iv. Acceptance of FAT will not be considered as the final acceptance test of the PACKAGE.</li> </ul>			
<p><b>8.6 PRE-COMMISSIONING AND COMMISSIONING</b></p>			
<p>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.</p>			
<p>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.).</p>			
<p>8.6.3. Final acceptance will be on satisfactory completion of commissioning tests as specified by OWNER.</p>			
<p><b>9. PACKAGE DELIVERY REQUIREMENTS</b></p>			
<p><b>9.1 PRESERVATION, PACKING AND TRANSPORTATION</b></p>			
<p>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.</p>			
<p>9.1.2. PACKAGER / MANUFACTURER shall submit to HULL SUPPLIER the PACKAGE preservation requirements and recommendations with all necessary</p>			

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<p>considerations for the PACKAGE Equipment preservation during the UNIT whole design life.</p> <p>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.</p> <p>9.1.4. In any case, suitable preservation and protective measures shall be provided to prevent equipment deterioration prior to entering into service.</p> <p>9.1.5. All packings shall be clearly marked for shipping, including lifting points, gross weight, dimensions and center of gravity.</p> <p>9.1.6. All sea fastening and temporary supports used on the equipment for shipment shall be clearly identified.</p> <p>9.1.7. PACKAGER / MANUFACTURER shall ensure that all loose valves, tubes and instruments are supplied with plastic caps.</p> <p>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.</p> <p>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.</p> <p>9.1.10. The equipment shall be thoroughly cleaned internally and be free of all loose foreign materials.</p> <ul style="list-style-type: none"> <li>i. The preparation shall make the equipment suitable for outdoor storage in a coastal tropical climate from the time of Shipment.</li> <li>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.</li> <li>iii. Spare parts and tools to be packed separately and clearly marked "Spare Parts" and "Tools" respectively.</li> </ul> <p><b>9.2 SPARE PARTS, CONSUMABLES AND TOOLS</b></p> <p>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.</p> <p>9.2.2. All spare parts recommended or required by the CS: such spare parts will be delivered together with the relevant equipment;</p>			

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<p>9.2.3. All special tools required for construction, pre-commissioning, commissioning and all levels of maintenance and operation.</p> <p>9.2.4. Spare parts list recommended by PACKAGER / MANUFACTURER for two years of operation.</p> <p><b>9.3 DOCUMENTATION</b></p> <p>9.3.1. Drawings and Weight Control</p> <p>For Engineering Documentation minimum requirements:</p> <ul style="list-style-type: none"> <li>i. PACKAGER / MANUFACTURER design drawings shall show all necessary dimensions and details required for interface information and installation.</li> <li>ii. Clearances for maintenance shall be shown on the drawings.</li> <li>iii. Drawings and documents shall be clear and completely legible with all text in the English language.</li> <li>iv. Instruction manuals for operation and maintenance of the PACKAGE equipment shall be provided in Portuguese language.</li> <li>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.</li> <li>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. <ul style="list-style-type: none"> <li>o Note: Operational weight means the component dry weight added to the respective component fluid weight on operational condition.</li> </ul> </li> <li>vii. PACKAGER shall send in advance all recommendations for PACKAGE installation, maintenance and commissioning.</li> </ul> <p>9.3.2. Data Book</p> <p>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:</p> <ul style="list-style-type: none"> <li>i. Certified drawings, data sheets, technical specifications, performance curves and calculation memorandum.</li> <li>ii. Construction, maintenance and operating manuals, instructions for preservation and commissioning, and all catalogs, including of the sub-suppliers.</li> </ul>			

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- 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.