	<b>TECHNICAL SPECIFICATION</b>		Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>		
	CLIENT: <b>BÚZIOS</b>			SHEET: <b>1</b> of <b>14</b>	
	JOB : <b>HIGH CAPACITY FPSO</b>				
	AREA: <b>BÚZIOS</b>				
<b>SRGE</b>	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>			<b>INTERNAL</b>	
				<b>ESUP</b>	

File No.: MICROSOFT WORD 2016 – I-ET-3010.1Y-5410-220-P4X-001\_A.docx


### INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
A	REVISED WHERE INDICATED


	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	DEC/28/20	MAR/19/21							
PROJECT	ENG	ENG							
EXECUTION	CXZ0	CXZ0							
CHECK	BYA6	U3Y0							
APPROVAL	CYEL	CYEL							

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

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 2 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL ESUP

<b>TABLE OF CONTENTS</b>	<b>PAGE</b>
<b>1. INTRODUCTION .....</b>	<b>3</b>
1.1.....OBJECTIVE.....	3
1.2.....DEFINITIONS .....	3
1.3.....ABBREVIATIONS .....	3
<b>2. NORMATIVE REFERENCES .....</b>	<b>3</b>
2.1.....INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS .....	3
2.2.....BRAZILIAN CODES AND STANDARDS.....	4
2.3.....CLASS APPROVAL AND CERTIFICATION .....	4
<b>3. REFERENCE DOCUMENTS.....</b>	<b>4</b>
<b>4. DESIGN REQUIREMENTS .....</b>	<b>6</b>
4.1.....DESIGN CONDITIONS.....	6
4.2.....SAFETY REQUIREMENTS .....	6
4.3.....MOTIONS AND ACCELERATION .....	7
<b>5. PACKAGE SCOPE OF SUPPLY .....</b>	<b>7</b>
5.1.....SCOPE OF SUPPLY .....	7
5.2.....PVSV VALVES LOCATION .....	8
<b>6. PACKAGE SPECIFICATION .....</b>	<b>8</b>
6.1.....GENERAL.....	8
6.2.....VACUUM PRESSURE / BREATHER VALVES REQUIREMENTS.....	8
<b>7. GENERAL REQUIREMENTS.....</b>	<b>9</b>
7.1.....PAINTING REQUIREMENTS .....	9
7.2.....NAMEPLATES AND TAG NUMBERING.....	9
<b>8. PACKAGE MANUFACTURING .....</b>	<b>10</b>
8.1.....GENERAL.....	10
8.2.....QUALITY ASSURANCE AND CONTROL SYSTEM .....	10
8.3.....INSPECTION AND TESTS .....	10
8.4.....FACTORY ACCEPTANCE TEST (FAT) .....	11
8.5.....PRE-COMMISSIONING AND COMMISSIONING.....	12
<b>9. PACKAGE DELIVERY REQUIREMENTS.....</b>	<b>12</b>
9.1.....PRESERVATION, PACKING AND TRANSPORTATION.....	12
9.2.....SPARE PARTS, CONSUMABLES AND TOOLS .....	13
9.3.....DOCUMENTATION .....	13

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 3 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL

## 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 VACUUM PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM in conformance with relevant regulations and High Capacity FPSO basic design documentation.

VACUUM PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM is composed by pressure, vacuum and breather valves which have the purpose to ensure the pressure and vacuum levels inside the cargo, slop, produced water and off-spec tanks compatible with the structural integrity of these tanks. Those valves are the first safety barrier against overpressure and vacuum on tanks.

### 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.

VACUUM PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM the package name.

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

### 1.3. ABBREVIATIONS

CCR Central Control Room

CS Classification Society

FAT Factory Acceptance Tests

FPSO Floating Production Storage and Offloading Unit


PVSV Vacuum / Pressure and Breather Valve for closed vent system

SOS.....Supervisory and Operation System

SOS-HMI..... Human Machine Interface of SOS

## 2. NORMATIVE REFERENCES

### 2.1. INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.1Y-5410-220-P4X-001	REV. A
	BÚZIOS		SHEET: 4 of 14
	TITLE: VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM		INTERNAL

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
- MARPOL
- 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.


## 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-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-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS

	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 5 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL
		ESUP	
<b>I-RL-3010.1Y-1200-940-P4X-001</b> GENERAL SPECIFICATION FOR AVAILABLE UTILITIES			
<b>I-ET-3A36.00-1000-941-PPC-001</b> METOCEAN DATA			
<b>CONSTRUCTION</b>			
<b>I-ET-3010.00-1200-955-P4X-001</b> WELDING			
<b>I-ET-3010.00-1200-955-P4X-002</b> REQUIREMENTS FOR WELDING INSPECTION			
<b>I-ET-3010.00-1000-970-P4X-002</b> REQUIREMENTS FOR NDT			
<b>I-ET-3010.00-0000-970-P4X-001</b> REQUIREMENTS FOR PROCEDURES AND PERSONNEL QUALIFICATION AND CERTIFICATION			
<b>HULL SYSTEMS</b>			
<b>I-DE-3010.1Y-1350-944-P4X-001</b> CLOSED VENTING SYSTEM			
<b>I-DE-3010.1Y-5241-944-P4X-004</b> INERT GAS DISTRIBUTION SYSTEM.			
<b>I-DE-3010.1Y-5271-944-P4X-001</b> TANKS CLEANING AND RECIRCULATION SYSTEM			
<b>I-MD-3010.1Y-1200-940-P4X-027</b> DESCRIPTIVE MEMORANDUM - HULL SYSTEMS			
<b>NAVAL</b>			
<b>I-DE-3010.1Y-1350-960-P4X-002</b> CAPACITIES PLAN			
<b>I-ET-3010.1Y-1350-960-P4X-002</b> DESIGN REQUIREMENTS - NAVAL ARCHITECTURE			
<b>I-RL-3010.1Y-1350-960-P4X-009</b> MOTION ANALYSIS			
<b>PAINTING</b>			
<b>I-ET-3010.00-1200-956-P4X-002</b> GENERAL PAINTING			
<b>DR-ENGP-I-1.15</b> COLOR CODING			
<b>SAFETY</b>			
<b>DR-ENGP-M-I-1.3</b> SAFETY ENGINEERING GUIDELINE			

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.1Y-5410-220-P4X-001	REV. A
	BÚZIOS		SHEET: 6 of 14
	TITLE: VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM		INTERNAL
			ESUP

I-ET-3010.00-5400-947-P4X-002	SAFETY SIGNALING
<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>INSTRUMENTATION AND AUTOMATION</b>	
I-ET-3010.00-1200-800-P4X-013	GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS

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.
- 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

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.1Y-5410-220-P4X-001	REV. A
	BÚZIOS		SHEET: 7 of 14
	TITLE: VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM		INTERNAL

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. MOTIONS AND ACCELERATION

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

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

4.3.3. 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.

4.3.4. 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.

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

4.3.6. 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. PACKAGE scope of supply shall be as the following:

- 23 Vacuum / Pressure Safety Valves dedicated to each cargo (18 pieces), slop (2 pieces), produced water (2 pieces) and off-spec oil tank (1 piece).
- 23 Vacuum / Breather Safety Valves dedicated to each cargo (18 pieces), slop (2 pieces), produced water (2 pieces) and off-spec oil tank (1 piece).
- 01 Pressure Safety Valve (with no vacuum section) to be installed on the Vent Posts header.
- 02 Portable PVSVs for the water ballast tank, cofferdam or void spaces adjacent to cargo, slop, produced water tanks for contingency operations where these tanks are connected to the closed venting system.

5.1.2. Each Vacuum Pressure and Breather Safety Valves shall be supplied as a complete unit, ready for installation and operation.

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.1Y-5410-220-P4X-001	REV. A
	BÚZIOS		SHEET: 8 of 14
	TITLE: VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM		INTERNAL

## 5.2. PVSV VALVES LOCATION

- 5.2.1. VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM shall be installed on closed vent header piping branches destined to the cargo, slop, produced water and off-spec oil tanks with interconnection as the typical detail III of I-DE-3010.1Y-1350-944-P4X-001 – PIPING AND INSTRUMENT DIAGRAM CLOSED VENTING SYSTEM.
- 5.2.2. For the PVSV location per tank refer to I-DE-3010.1Y-1350-944-P4X-001 – CLOSED VENTING SYSTEM.
- 5.2.3. For the portable PVSVs installation arrangement and location refer to I-DE-3010.1Y-1350-944-P4X-001 – CLOSED VENTING SYSTEM typical detail II.
- 5.2.4. For the single pressure safety valve (with no vacuum section) dedicated to the pressure relief for Vent Posts in tanks purging and gas dilution operations refer to I-DE-3010.1Y-5241-944-P4X-004 – PIPING AND INSTRUMENT DIAGRAM INERT GAS DISTRIBUTION SYSTEM.
- 5.2.5. For the area classification plan refer to I-DE-3010.1Y-5400-94A-P4X-001 – AREA CLASSIFICATION – GENERAL.

## 6. PACKAGE SPECIFICATION


### 6.1. GENERAL

- 6.1.1. Vacuum / Pressure and Breather safety valves have the purpose:
- To keep the pressure of the hull cargo area structural tanks (cargo, slop, produced water, off-spec tanks) within safety allowable limits.
  - To relief the gas (mainly inert gas) from the cargo area tanks through a piping header up to the vent posts placed at the bow area of the UNIT.
  - To perform the cargo, slop, produced water and off-spec oil tanks purging.
- 6.1.2. Those valves have not the same working principle as a classic PSV, which under their operation conditions shall be removed after use. PVSV shall be designed for continuous tanks vacuum / pressure relief operation with no necessary removal after opening and with the flow rate and vacuum / pressure set points as detailed on I-DE-3010.1Y-1350-944-P4X-001 – CLOSED VENTING SYSTEM.

### 6.2. VACUUM PRESSURE / BREATHER VALVES REQUIREMENTS

- 6.2.1. All PVSVs and PSV shall be installed on classified area zone 1.
- 6.2.2. All valves shall be supplied with flame arrester on the PVSV vacuum section.
- 6.2.3. Flange specification shall follow ASME 16.5.
- 6.2.4. Valves opening shall be started immediately at the valves set.



	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 9 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL

6.2.5. Vacuum / Pressure and Breather Valves shall have two (2) independent sections: one (1) for vacuum and other one (1) for pressure / breather.

- Note: except the single PSV installed on the Vent Post header, which shall have only the pressure section.

6.2.6. Vacuum section suction shall be as free as possible from any admission except ambient air. Despite of that, flame screens AISI 316 stainless steel or similar shall be therein installed to ensure safe admission.

6.2.7. Vacuum Pressure and Breather Valves shall be installed on horizontal position. Draining points shall be provided at the valves discharge with double blocking manual valves.

6.2.8. PVSV maximum pressure and minimum flow shall be as the following:

- a. The maximum working pressure of the valves shall be limited by the P/V Breakers (TQ-GG-5241501A/B-02 / TQ-GG-5241501A/B-03) minimum pressure. For the design pressure applicable regulations shall be applied.
  - For P/V Breaker TQ-GG-5241501A/B-02 data refer to I-ET-3010.1Y-5241-424-P4X-001 – HULL INERT GAS GENERATORS and
  - For P/V Breaker TQ-GG-5241501A/B-03 data refer to I-DE-3010.1Y-5271-944-P4X-001 – TANKS CLEANING AND RECIRCULATION SYSTEM.
- b. The minimum valve flow shall be reached anytime during the valve opening to make sure that, at 100% opening, the valve flow could be above the respective tank's inlet flow during UNIT tanks purge or offloading operations.
- c. Working and design closed vent system temperature are 40° C and 70° C respectively.

**7. GENERAL REQUIREMENTS**

**7.1. PAINTING REQUIREMENTS**


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


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

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

**7.2. NAMEPLATES AND TAG NUMBERING**

7.2.1. PACKAGER / MANUFACTURER Equipment shall have nameplates in Brazilian Portuguese language, made of stainless steel AISI 316L, with 3 mm minimum

	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 10 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL
ESUP			
<p>thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location.</p> <p>7.2.2. Tagging of all instruments, electrical, mechanical and piping items, including valves, shall be carried out.</p> <p>7.2.3. Tags shall be supplied with the number and description in the Brazilian Portuguese Language, unless otherwise stated in the technical data sheets.</p> <p>7.2.4. For TAG numbering refer to I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN</p> <p>7.2.5. For Instrumentation tagging the ISA –5.1 and N-1710 shall be followed.</p> <p><b>8. PACKAGE MANUFACTURING</b></p> <p><b>8.1. GENERAL</b></p> <p>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.</p> <p>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.</p> <p>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.</p> <p><b>8.2. QUALITY ASSURANCE AND CONTROL SYSTEM</b></p> <p>8.2.1. PACKAGER shall submit his Quality Assurance / Quality Control handbook to HULL SUPPLIER for information.</p> <p>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.</p> <p><b>8.3. INSPECTION AND TESTS</b></p> <p>8.3.1. 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.</p> <p>8.3.2. PACKAGE inspection, tests and events shall be attended by the MANUFACTURER, PACKAGER, HULL SUPPLIER, CS and OWNER inspection</p>			

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.1Y-5410-220-P4X-001	REV. A
	BÚZIOS		SHEET: 11 of 14
	TITLE: VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM		INTERNAL

team whenever necessary.

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

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

- i. verification of equipment construction materials 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.

#### 8.4. FACTORY ACCEPTANCE TEST (FAT)


8.4.1. 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.


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


- i. Pressure test (usually hydrostatic) test of all valves.
- ii. All other equipment tests and factory checking to be carried out according to the FAT procedure approved by parts.

8.4.3. 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.

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 12 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL
ESUP			
<p>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.</p> <p>iv. Acceptance of FAT will not be considered as the final acceptance test of the PACKAGE.</p> <p><b>8.5. PRE-COMMISSIONING AND COMMISSIONING</b></p> <p>8.5.1. 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>8.5.2. 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>8.5.3. 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 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 valves 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</p>			

	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 13 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL
ESUP			
<p>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>Spare parts, consumables, and tools shall be provided by PACKAGER / MANUFACTURER as the following minimum requirements:</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> <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> </ul>			

	<b>TECHNICAL SPECIFICATION</b>	Nr: <b>I-ET-3010.1Y-5410-220-P4X-001</b>	REV. <b>A</b>
	BÚZIOS		SHEET: 14 of 14
	TITLE: <b>VACUUM / PRESSURE AND BREATHER VALVES FOR CLOSED VENTING SYSTEM</b>		INTERNAL
ESUP			
<p>iv. Instruction manuals for operation and maintenance of the PACKAGE equipment shall be provided in Portuguese language.</p> <p>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.</p> <p>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.</p> <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> <p>vii. PACKAGER shall send in advance all recommendations for PACKAGE installation, maintenance and commissioning.</p> <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> <ol 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> <li>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.</li> <li>iv. The documentation requested by Brazilian law NR-13, subdivided for equipment (if applicable).</li> </ol> <p>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.</p>			