

	<b>TECHNICAL SPECIFICATION</b>		Nr: <b>I-ET-3010.2E-5260-700-P4X-001</b>
	CLIENT: <b>SRGE</b>		SHEET: <b>1</b> of <b>15</b>
	JOB: <b>REFERENCE HULL 01</b>		
	AREA: <b>-</b>		
<b>SRGE</b>	TITLE: <b>MARINE GROWTH PREVENTION SYSTEM</b>		<b>INTERNAL</b>
			<b>ESUP</b>

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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
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PROJECT	ENE	ENE							
EXECUTION	PMX4	PMX4							
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## 1. INTRODUCTION

### 1.1. OBJECTIVE

This specification describes and specifies the minimum requirements and criteria in conformance with relevant regulations of REFERENCE HULL 01 FPSO, for the design, manufacturing, installation, testing and supply of MGPS - MARINE GROWTH PREVENTION SYSTEM package, conceived to mitigate the risk of marine life formation in the systems fed by sea water from the Engine Room Sea Chests, its collection pipes, equipment and accessories.

### 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.

**MARINE GROWTH PREVENTION SYSTEM:** the package name.

**ONWER:** Petrobras – Petróleo Brasileiro S/A

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

MGPS Marine Growth Prevention System

SOS Supervisory and Operation System

SOS-HMI Human Machine Interface of SOS

## 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
- 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;

**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**

**3.1. REFERENCE HULL 01 FPSO DESIGN**

REF DOC NUMBER	REF DOC NAME
<b>HULL SYSTEMS</b>	
I-DE-3010.2E-5111-944-P4X-004	ENGINE ROOM SEA WATER COOLING SYSTEM
I-MD-3010.2E-1200-940-P4X-027	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS
<b>OUTFITTING</b>	
I-DE-3010.2E-1351-140-P4X-001	HULL GENERAL NOTES AND TYPICAL DETAILS

**3.2. TYPICAL DOCUMENTS**

REF DOC NUMBER	REF DOC NAME
<b>GENERAL</b>	
I-ET-3000.00-0000-940-P4X-002	SYMBOLS FOR PRODUCTION UNITS DESIGN
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
I-ET-3000.00-1200-940-P4X-001	TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
<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>MECHANICAL</b>	
I-ET-3010.00-1352-130-P4X-001	FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS.
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
<b>PIPING</b>	
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS



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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-3010.00-1200-800-P4X-013	GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS
I-ET-3010.00-5520-888-P4X-001	AUTOMATION PANELS
I-ET-3010.00-1200-800-P4X-015	REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716)

**3.3. SPECIFIC PROJECT DOCUMENTS**

REF DOC NUMBER	REF DOC NAME
<b>GENERAL</b>	
I-DE- GENERAL ARRANGEMENT	GENERAL ARRANGEMENT
I-DE- AREA CLASSIFICATION – GENERAL	AREA CLASSIFICATION – GENERAL
I-ET- AUTOMATION INTERFACE OF PACKAGED UNITS	AUTOMATION INTERFACE OF PACKAGED UNITS
I-ET-METOCEAN DATA	METOCEAN DATA

I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES	GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-RL- MOTION ANALYSIS	MOTION ANALYSIS

Table 1 – Reference Documents

- Note: these above item 3.3 documents title and number may vary slightly from one project to another. Project’s document list shall be consulted in order to verify the correct document number and title.

**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 REFERENCE HULL 01 FPSO Design Documents.

**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 shall 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.

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### 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-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-3010.00-1350-960-P4X-003 – DESIGN REQUIREMENTS - NAVAL ARCHITECTURE.

4.4.5. For the design data and information regarding motion requirements refer to I-RL-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

### 5.1. SCOPE OF SUPPLY

5.1.1. Electrolysis Tanks: these tanks (Z-5260501A/B) serve to install the anodes and prepare ionized sea water for injection into the sea chests.

5.1.2. Anodes: the copper anodes materials shall comply with the main function of preventing marine life growth, and, the aluminum anodes, as a secondary role, shall protect the piping network against corrosion.

5.1.3. Control Panels: the panels (PN-Z-5260501A/B) that control the entire system.

### 5.2. EQUIPMENT LOCATION

5.2.1. The MGPS – Marine Growth Prevention System – PACKAGE shall be installed inside Engine Room, a closed and non-classified compartment as defined on I-DE- AREA CLASSIFICATION – GENERAL, and I-DE-GENERAL ARRANGEMENT and shall be used as reference for equipment location.



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## 6. PACKAGE SPECIFICATION

### 6.1. MGPS GENERAL REQUIREMENTS

- 6.1.1. The MGPS (Marine Growth Prevention System) shall be an anode electrocatalytic type, without chemicals injection, to treat sea water streams in the Engine Room.
- 6.1.2. The sea water to be treated at MGPS System shall be taken from the discharge stream of the Engine Room Cooling Sea Water Pumps (B-5111501A/B/C) in the Engine Room. Any of these pumps in this system shall serve the two electrolysis tanks.
- 6.1.3. Electrolysis Tanks (Z-5260501A/B) shall be compatible with the maximum pressure from sea water pumps (B-5111501A/B/C) discharge.
- 6.1.4. The Electrolysis Tanks (Z-5260501A/B) discharge shall be sent to the Engine Room Sea Chests Z-5111502S/P. The injection point in the sea chests shall be as far as possible from the Engine Room Crossover suction, in a shower scheme or perforated tube branched, net flute style, for better sea chest protection coverage.
- 6.1.5. The main anodes function is to release copper ions to mitigate the growth of marine life in the pipes and accessories that collect sea water from the Sea Chest Engine Room (Z-5111502P/S). The secondary function of these anodes is to release aluminum ions in order to reduce the corrosion process in the same pipes and accessories.
- 6.1.6. All control functions shall be accomplished by the MGPS Control Panels (PN-Z-5260501A/B), modulating automatically current outputs to the Anodes as consequence of CU and AL ions concentration in the branched network.
- 6.1.7. The sea water flow may vary, but CU and AL ions concentration shall be controlled within target values as mentioned bellow. Even if there is no flow through one of the seachests (2x100%), there shall be a minimum treated sea water injection in this stand-by sea chest to prevent marine growth in it.
- 6.1.8. The CU ions shall correspond to a target concentration of 6 PPB (particles per billion), in the networks branched from Engine Room Sea Chest (Z-5111502P/S). AL ions shall correspond to a target of 0,5 PPB concentration, in the networks branched from Engine Room Sea Chest (Z-5111502P/S). The measures shall be taken by two sets of CU and AL redundant concentration sensors at a representative branch for the operation with one or both of Engine Room Sea Chest (Z-5111502P/S). Each of these measures shall be inputs for the Control Panels (PN-Z-5260501A/B).
- 6.1.9. The Control Panel of the **MGPS** System shall send monitoring signals to the SOS and its variables shall be seen on the SOS-HMI.
- 6.1.10. The MINIMUM permanent sea water flow to be treated, corresponds to TWO (2) of the Engine Room Cooling Sea Water Pumps B-5111501A/C (3x50%), and

the MAXIMUM sea water flow corresponds to the mentioned Two (2) Engine Room Cooling Sea Water Pumps flow, ADDED simultaneously with the following:

- a) Two (2) Engine Room Cooling Sea Water Pumps B-5111501A/C (3x50%);
- b) One (1) Fire Water Jockey Pump B-5420502A/B (2x100%);
- c) One (1) Ballast (AFT), Bilge and General Service Pump B-5330502A/C (3x100%);
- d) One (1) Inert Gas Generator Sea Water Pump B-5241502A/B (2x100%);
- e) One (1) Inert Gas Seal Pump B-5241501A/B (2x100%).

6.1.11. The minimum interval between anodes change-outs shall be 5 years.

## 6.2. MGPS MAINTENANCE REQUIREMENTS

6.2.1. There shall be sufficient area around and above the Electrolysis Tanks (Z-5260501A/B) to allow anodes replacement, with adequate handling facilities for maintainability.

6.2.2. The MGPS Package material (flanges, screws, gaskets, etc.) shall be suitable to operate with sea water.

## 7. GENERAL REQUIREMENTS

### 7.1. ELECTRICAL REQUIREMENTS

7.1.1. PACKAGE electrical equipment, material, low voltage induction motors, and grounding installation shall comply with the following references:

- a) I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
- b) I-ET-3010.00-5140-712-P4X-001 – LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.
- c) I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.
- d) I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.
- e) 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.

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## 7.2. INSTRUMENTATION AND AUTOMATION REQUIREMENTS

7.2.1. PACKAGE instrumentation and control design shall fulfill the requirements of the following technical specifications:

- a) I-ET-3010.00-1200-800-P4X-002 – AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.
- b) I-ET-3010.00-1200-800-P4X-013 – GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.
- c) I-ET-AUTOMATION INTERFACE OF PACKAGED UNITS.
- d) I-ET-3010.00-5520-888-P4X-001 – AUTOMATION PANELS.

## 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 valves 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.



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7.4.7. Access ladders, platforms, gratings and any other access device shall comply with I-ET-3010.00-1352-130-P4X-001 - FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS. Metallic material is also acceptable and I-DE-3010.2E-1351-140-P4X-001 – HULL GENERAL NOTES AND TYPICAL DETAILS, item 3.23, shall be followed for metallic grating requirements.

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-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 as detailed on I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

**8. PACKAGE MANUFACTURING AND DELIVERY REQUIREMENTS****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 shall 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. WELDING

8.2.1. PACKAGE equipment, structures and piping welding, welding inspection, non-destructive testing (NDT), bolted joints assembly and piping fabrication and commissioning activities shall be performed in compliance with the following technical specifications:

- a) I-ET-3010.00-1000-970-P4X-002 – Requirements for NDT.
- b) I-ET-3010.00-1000-955-P4X-002 – Requirements for Welding Inspection.
- c) I-ET-3010.00-1000-955-P4X-001 – Welding.
- d) I-ET-3010.00-1200-200-P4X-001 – Requirements for Bolted Joints Assembly and Management.
- e) I-ET-3010.00-1200-200-P4X-115 – Requirements for Piping Fabrication and Commissioning.

## 8.3. DOCUMENTATION

- 8.3.1. For the PACKAGE documentation and data-book requirements refer to EXHIBIT III – DIRECTIVES FOR ENGINEERING.
- 8.3.2. Additionally, for the PACKAGE documentation, data-book requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

## 8.4. SPARE PARTS

- 8.4.1. For the PACKAGE, spare parts, special tools, CS required spare parts and spare parts list recommended for two (2) years of operation refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

## 8.5. INSPECTION AND TESTS

- 8.5.1. For PACKAGE inspection, tests, factory acceptance test (FAT) and inspection release certificate (IRC), refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.
- 8.5.2. For PACKAGE inspection and test plan (ITP) requirements refer to EXHIBIT VII – DIRECTIVES FOR QUALITY ASSURANCE SYSTEM.

## 8.6. PRESERVATION, PACKING AND TRANSPORTATION

- 8.6.1. For PACKAGE preservation, packing and transportation requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

## 8.7. PRE-COMMISSIONING AND COMMISSIONING

- 8.7.1. For PACKAGE pre-commissioning and commissioning requirements and, commissioning spare parts refer to EXHIBIT VIII – DIRECTIVES FOR

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COMMISSIONING.

8.7.2. The system in which PACKAGE is included has the commissioning and site tests requirements detailed on I-MD-COMMISSIONING DESCRIPTIVE MEMORANDUM.