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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 and testing of TANK CLEANING MACHINE in conformance with relevant regulations and REFERENCE HULL 01 FPSO design documentation.

TANK CLEANING MACHINE package is composed by the fixed cleaning machines with the purpose to clean the cargo, slop, produced water and off-spec oil tank with the COW (crude oil washing) and SWW (sea water washing) process.

TANK CLEANING MACHINE package shall also be composed by the Portable cleaning machines.

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.

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


1.3. ABBREVIATIONS

COW	Crude Oil Washing
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
SWW	Sea Water Washing

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.

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- ASME B31.3 – Process Piping
- ASME B16.5 – Pipe Flanges & Flanged Fittings IMO Regulation A.446 (XI) as amended by Resolution-A.497 (XII) and A.897 (XXXI) – Annex III – item 4.2.9
- ISO International Standard Organization
- 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.
- INMETRO Resolution 115, Mach 21st 2022 (hazardous areas)

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
HULL SYSTEMS	
I-DE-3010.2E-5271-944-P4X-001	TANKS CLEANING AND RECIRCULATION SYSTEM
I-FD-3010.2E-5271-390-P4X-001	TANK CLEANING MACHINE
I-MD-3010.2E-1200-940-P4X-027	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS


Table 1 – Reference Hull 01 FPSO basic design.

3.2. TYPICAL DOCUMENTS

REF DOC NUMBER	REF DOC NAME
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GENERAL	
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
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
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
DR-ENGP-M-I-1.3	SAFETY ENGINEERING
PIPING	
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-200-P4X-115	REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING
I-ET-3010.2E-1200-200-P4X-001	PIPING SPECIFICATION FOR HULL

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ELECTRICAL	
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS
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


Table 2 – Reference Hull 01 Typical Documents.

3.3. SPECIFIC PROJECT DOCUMENTS

REF DOC NUMBER	REF DOC NAME
GENERAL	
I-DE- GENERAL ARRANGEMENT	GENERAL ARRANGEMENT
I-DE- AREA CLASSIFICATION – GENERAL	AREA CLASSIFICATION – GENERAL
I-ET- AUTOMATION INTERFACE OF PACKAGE UNITS	AUTOMATION INTERFACE OF PACKAGE UNITS
I-ET- FIELD INSTRUMENTATION	FIELD INSTRUMENTATION
I-ET- METOCEAN DATA	METOCEAN DATA
I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES	GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-RL- MOTION ANALYSIS	MOTION ANALYSIS
I-DE- CAPACITIES PLAN	CAPACITIES PLAN

Table 3 – Specific Project Documents

- Note: these above item 0 documents title and number may vary slightly from one project to another. Project's document list shall be consulted to verify the correct document number and title.

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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 REFERENCE HULL 01 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 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. For additional safety requirements refer to DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE.


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.

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<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-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-3010.00-1350-960-P4X-001 – DESIGN REQUIREMENTS – NAVAL ARCHITECTURE.</p> <p>4.4.5. For the design data and information regarding motion requirements refer to I-RL- – MOTION ANALYSIS.</p> <p>4.4.6. PACKAGE is also to withstand inertial forces during transportation from construction site to the final offshore location.</p> <p>5. PACKAGE SCOPE OF SUPPLY</p> <p>5.1. SCOPE OF SUPPLY</p> <p>5.1.1. PACKAGER shall supply fixed cleaning machines for each cargo, produced water, off-spec oil and slop tanks.</p> <p>5.1.2. The preliminary estimated quantity of fixed tank cleaning machines, in order to comply with requirements of items 6.2.7 and 6.2.8 below, is one hundred and nineteen (119).</p> <ul style="list-style-type: none"> ○ Note 1: top fixed tank cleaning machines shall be supplied each one with their own pipe stacks. ○ Note 2: tank cleaning machines final quantity, capacity and distribution per tank shall be defined by PACKAGER, during the detail design phase, following the tanks shadow diagrams approved by CS. ○ Note 3: the quantity and distribution of fixed tank cleaning machines per tank indicated in I-DE-3010.2E-5271-944-P4X-001 TANKS CLEANING AND RECIRCULATION SYSTEM is schematic only. <p>5.1.3. PACKAGER shall supply the shadow diagram for cargo, slop, produced water and off-spec oil tanks.</p> <p>5.1.4. For cargo, slop, produced water and off-spec oil tanks identification, dimensions and volumetric capacity refer to I-DE- CAPACITIES PLAN.</p> <p>5.1.5. In addition to the fixed machines, PACKAGER shall supply two (2) portable cleaning machines.</p> <p>5.1.6. For bottom cleaning machines refer to item 6.3.5.</p> <p>5.1.7. Tank cleaning machines shall be supplied with all accessories and any other devices to ensure the safe and proper performance of the PACKAGE as required</p>			

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on this document and from the relevant rules, regulations and good industrial practices as mentioned on item 2 of this document.

6. PACKAGE SPECIFICATION

6.1. GENERAL

6.1.1. All cargo, slop, produced water and off-spec oil tanks shall have fixed cleaning machines installed inside (command on top).

6.1.2. All fixed cleaning machines shall have the capacity and design parameters informed on I-FD-3010.2E-5271-390-P4X-001 – TANK CLEANING MACHINE.

6.1.3. For crude oil and sea water fluid density, viscosity and other remaining technical parameters refer to I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

6.1.4. Package's instrumentation shall fully comply with requirements of I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS, I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS, I-ET- AUTOMATION INTERFACE OF PACKAGE UNITS and I-ET-FIELD INSTRUMENTATION.

6.2. TANK CLEANING MACHINES LOCATION AND ARRANGEMENT

6.2.1. Tank Cleaning Machines shall be installed on top of the cargo, slop, produced water and off-spec oil tanks, all closed and classified compartments.

6.2.2. Cargo, slop, produced water and off-spec oil tanks are classified as zone 0.

6.2.3. Tank Cleaning Machines command head with control devices shall be installed just above the tanks over the Main Deck steel plate, which is considered zone 1.


6.2.4. For the area’s classification refer to I-DE- AREA CLASSIFICATION – GENERAL.

6.2.5. For equipment location refer to I-DE- GENERAL ARRANGEMENT.

6.2.6. Each cargo, slop, produced water and off-spec oil tanks and shall have a shadow diagram issued by the tank cleaning machines PACKAGER during the detail engineering phase. PACKAGER shall produce the shadow diagrams for each tank and submit them to CS for approval.

6.2.7. The number of cleaning machines per tank shall be confirmed by the PACKAGER during detail design. The tanks shadow diagram shall follow IMO Regulation a.446 (XII), as amended by Resolution-A.497 (XII) and A.897 (XXXI) – Annex III – item 4.2.9 and shall be approved by OWNER and CS.

6.2.8. Fixed Tank Cleaning Machines arrangement shall guarantee a maximum shadow of 10% in the horizontal plane and 15% in the vertical plane of each cargo, slop, produced water and off-spec oil tanks, according to IMO Regulation A.446 (XI).

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Note: In addition to above IMO criteria, the areas under the horizontal stringer nº 6 (elevation 3800mm on aft transversal bulkhead) including tank bottom, aft transversal bulkhead and longitudinal bulkheads of all tanks shall be properly cleaned. If necessary, a fixed cleaning machine shall be provided to avoid a concentrated shadow on this region.

6.3. FIXED TANK CLEANING MACHINES

6.3.1. Fixed Tank Cleaning Machines shall be designed to work on Crude Oil Washing (COW) and Sea Water Washing (SWW) operations.

6.3.2. PACKAGER shall provide the top fixed tank cleaning machines pipe stack.

6.3.3. Each tank cleaning machines specification, including their operational points shall be provided according to the PACKAGER criteria.

6.3.4. Fixed Tank Cleaning Machines of the slop tanks shall have preferably the same specification of the cargo, produced water and off-spec oil tanks cleaning machines.

6.3.5. Bottom cleaning machines are acceptable for cargo, slop, off-spec and produced water tanks.

- Note 1: the use of the bottom cleaning machines shall be avoided and only considered if it is not possible to comply with the maximum shadow requirements. In this case, the feed pipeline of the bottom cleaning machines shall be built with steel spec B18H.
- Note 2: the piping lines to be installed inside the tanks for the bottom cleaning machines installation shall not have pockets (“U” shaped lines) to avoid seawater (SWW) or crude oil (COW) to be trapped on them pipeline.

6.3.6. Fixed tank cleaning machines interconnection with the Hull cleaning machines header are detailed on I-DE-3010.2E-5271-944-P4X-001 – TANKS CLEANING AND RECIRCULATION SYSTEM. For flanges specification refer to I-ET-3010.2E-1200-200-P4X-001 – PIPING SPECIFICATION FOR HULL.


6.3.7. Fixed tank cleaning machines shall be programmable type.


- Note: for bottom cleaning machines, PACKAGER shall define whether it will be programmable or non-programmable, both are acceptable.

6.3.8. For the fixed tank cleaning machines material selection, since the tanks will be covered by the process plant gas as the HYDROCARBON GAS BLANKET SYSTEM this process gas characteristics shall be considered accordingly.

6.4. PIPE STACKS

6.4.1. The top fixed tank cleaning machines of the cargo, slop, produced water and off-spec oil tanks shall be tank top cleaning machines type with their own pipe stacks.

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<p>6.4.2. Pipe stacks shall be designed to allow the direct disassembly of the top fixed cleaning machines without any tank opening.</p> <p>6.4.3. Proper pipe sectioning shall be eventually provided, if necessary, to allow the disassembly through the gap within process plant modules and Main Deck, which is 4.5 meters.</p> <p>6.4.4. Each section of the pipe stack shall not be longer than 2 meters.</p> <p>6.4.5. Care shall be taken regarding the vibration condition of the pipe stacks since no supports are expected for them inside the tanks.</p> <p>6.5. PORTABLE CLEANING MACHINES</p> <p>6.5.1. Portable cleaning machines shall be used in case of malfunction or maintenance of fixed cleaning machine.</p> <p>6.5.2. PACKAGER shall indicate the proper location of the openings on main deck dedicated to the portable machines to allow the use as back-up of the fixed machine.</p> <p>6.5.3. Portable cleaning machines shall be supplied with the minimum below items:</p> <ul style="list-style-type: none"> i. Two hot (sea) water hose being one for each machine with grounding and approved by CS for use on cargo, slop, produced water and off-spec oil tanks. ii. Hose length shall be designed to allow the tank bottom plates cleaning. The use of hose extensions may be applied. iii. A device to allow the portable cleaning machines installation without any inert gas pressure loss inside the tanks. iv. A steel cable to allow the portable cleaning machines maneuvering inside the tanks. v. A tripod for the portable cleaning machines lifting. <ul style="list-style-type: none"> ▪ Note: PACKAGER shall indicate the location to properly store the items mentioned above. <p>6.5.4. For more information see typical detail I of the I-DE-3010.2E-5271-944-P4X-001 – Tanks Cleaning and Recirculation System.</p> <p>7. GENERAL REQUIREMENTS</p> <p>7.1. PAINTING REQUIREMENTS</p> <p>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.</p>			

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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. AVAILABLE ON BOARD

7.2.1. For utilities available onboard refer to I-RL-GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

7.3. NAMEPLATES AND TAG NUMBERING

7.3.1. 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.

7.3.2. 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 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. 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.

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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 and 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.