		TECHNICAL SPECIFICATION N I-ET-3010.00-5271-390-P4X-001							1			
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TECHNICAL SPECIFICATION

Nr:

13

2 of

SHEET:

ESUP

PAGE

TABLE OF CONTENTS

1.	INTRODUCTION4
1.1	. OBJECTIVE4
1.2	. DEFINITIONS4
1.3	ABBREVIATIONS
2.	NORMATIVE REFERENCES
2.1	. INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS
2.2	. BRAZILIAN CODES AND STANDARDS
2.3	CLASS APPROVAL AND CERTIFICATION
3.	REFERENCE DOCUMENTS5
3.1	. HULL SYSTEMS REFERENCE DOCUMENTS
3.2	. TYPICAL DOCUMENTS
4.	DESIGN REQUIREMENTS7
4.1	DESIGN CONDITIONS
4.2	. SAFETY REQUIREMENTS7
4.3	NOISE AND VIBRATIONS
4.4	MOTIONS AND ACCELERATION8
5.	PACKAGE SCOPE OF SUPPLY8
5.1	. SCOPE OF SUPPLY8
6.	PACKAGE SPECIFICATION9
6.1	. TANK CLEANING MACHINES LOCATION AND ARRANGEMENT
6.2	. FIXED TANK CLEANING MACHINES
6.3	. TANK CLEANING MACHINES PIPE STACKS11
6.4	. PORTABLE CLEANING MACHINES11
7.	GENERAL REQUIREMENTS12
7.1	PAINTING REQUIREMENTS
7.2	. AVAILABLE ON BOARD12
7.3	NAMEPLATES AND TAG NUMBERING12
8.	PACKAGE MANUFACTURING AND DELIVERY REQUIREMENTS12
8.1	. GENERAL12
8.2	. WELDING
8.3	DOCUMENTATION

	TECHNICAL SPECIFICATION	Nr: I-ET-3010.00-5271-390-	P4X-001	REV.
BR	-		sheet: 3	of 13
PETROBRAS		IING MACHINE	INTER	RNAL
			ESU	JP
8.4. SPARE	PARTS			13
8.5. INSPE	CTION AND TESTS			13
8.6. PRESE	RVATION, PACKING AND TRAN	SPORTATION		13



13

TECHNICAL SPECIFICATION

4 of

SHEET:

1. INTRODUCTION

TITLE:

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 basic design documentation.

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TANK CLEANING MACHINE package is composed by the fixed cleaning machines with the purpose to clean the cargo, slop, produced water, settling 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



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I-ET-3010.00-5271-390-P4X-001

SHEET:

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.

- 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

TECHNICAL SPECIFICATION

- MARPOL Chapter IV
- Classification Society defined for the Hull scope.

2.2. BRAZILIAN CODES AND STANDARDS

- NR Brazilian Federal Government Regulatory Norms (Normas Regulamentadoras NRs)
- NORMAM 201 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. HULL SYSTEMS REFERENCE DOCUMENTS

DOC CODE (*)	DOC TITLE
HULL SYSTEMS	
I-DE-TANKS CLEANING AND	TANKS CLEANING AND
RECIRCULATION SYSTEM	RECIRCULATION SYSTEM
I-FD-TANK CLEANING MACHINE	TANK CLEANING MACHINE
I-MD-DESCRIPTIVE MEMORANDUM - HULL SYSTEMS	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS
GENERAL	
I-DE- GENERAL ARRANGEMENT	GENERAL ARRANGEMENT
I-DE- AREA CLASSIFICATION – GENERAL	AREA CLASSIFICATION – GENERAL

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			TANK CLEANING MACHINE				Ρ	
	I-ET- AUTO	MATION INTERFACE	AU	COMATION INTERFACE C	OF PAC	CKA	GE	
	OF PACKA	GE UNITS	UNITS					
	I-ET- FIELD	INSTRUMENTATION	FIELD INSTRUMENTATION					
	I-ET- METOCEAN DATA			METOCEAN DATA				
	I-RL- GENE	RAL SPECIFICATION	GEI	NERAL SPECIFICATION F	FOR			
	FOR AVAIL	ABLE UTILITIES	AVAILABLE UTILITIES					
	I-RL- MOTI	ON ANALYSIS	MO	TION ANALYSIS				
I-DE- CAPACITIES PLAN				PACITIES PLAN				

Table 1 – Specific Project Documents.

 (*) Note: the above documents code number is intentionally omitted since this technical specification is issued for different basic design projects. The actual document code shall be checked across the contractual basic design document list. Title naturally may vary slightly from one project to another.

3.2. TYPICAL DOCUMENTS

DOC CODE (*)	DOC TITLE
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-3010.00-1200-200-P4X-115	REQUIREMENTS FOR PIPING FABRICATION AND COMMISSIONING
I-ET-3010.00-1200-200-P4X-116	REQUIREMENTS FOR BOLTED JOINTS ASSEMBLY AND MANAGEMENT
I-ET-3010.00-1200-955-P4X-001	WELDING
I-ET-3010.00-1200-970-P4X-003	REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION
I-ET-3010.00-1200-970-P4X-004	NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS
MECHANICAL	
I-ET-3010.00-1200-300-P4X-001	NOISE AND VIBRATION CONTROL REQUIREMENTS
NAVAL	-
I-ET-3010.00-1350-960-P4X-001	DESIGN REQUIREMENTS – NAVAL ARCHITECTURE
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 SIGNALLING
DR-ENGP-M-I-1.3	SAFETY ENGINEERING

		TECHNICAL SPECIFICATION	N	Nr:	I-ET-:	3010.0	0-5271	-390-F	P4X-00 1		REV.	Α
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	I=L I=3010.0		MATERIALS									
	I-ET-3010.0	0-1200-200-P4X-115	REQUIREMENTS FOR PIPING									
	121 0010.0		FABRICATION AND COMMISSIONING									
	I-ET-3010.0	0-1200-200-P4X-001	PIPING SPECIFICATION FOR HULL									
	ELECTRIC	AL										
		0 5140 700 B4X 003	GROUNDING INSTALLATION TYPICAL									
	I-DE-3010.00-5140-700-P4X-003		DETAILS									
	INSTRUMENTATION AND AUTOMATION											
		0 1200 800 B4X 002	AUTOMATION, CONTROL AND									
	I-ET-3010.0	0-1200-800-P4A-002	INSTRUMENTATION ON PACKAGE UNITS									
		0 1200 800 847 013	GENERAL CRITERIA FOR									
I-ET-3010.0		00-1200-800-P4X-013		INSTRUMENTATION PROJECTS								

Table 2 – Typical Documents.

4. DESIGN REQUIREMENTS

4.1. DESIGN CONDITIONS

- 4.1.1. PACKAGE Equipment shall be designed for a design life defined on I-MD-DESCRIPTIVE MEMORANDUM – HULL SYSTEMS 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 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

	TECHNICAL SPECIFICATION	^{Nr:} I-ET-3010.00-5271-390-F	94X-001	REV.	Α
BR	-	sheet: 8	of	13	
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MSC.1/Circ. 1379, all equipment and material to be supplied by PACKAGER shall be "asbestos free".

- 4.2.5. Safety signalling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING.
- 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.
- 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-001 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. PACKAGER shall supply fixed cleaning machines for each cargo, slop, produced water, settling (if applicable) and off-spec oil tanks, as detailed on I-DE-TANKS CLEANING AND RECIRCULATION SYSTEM.
 - Note: the quantity of the fixed tank cleaning machines detailed on I-DE-TANKS CLEANING AND RECIRCULATION SYSTEM is only preliminary the final quantity of these cleaning machines shall be defined in the detailed design phase, after approval of the shadow diagrams.
- 5.1.2. In addition to the fixed tank cleaning machines, PACKAGER shall supply two (02) portable cleaning machines.



- 5.1.3. For bottom cleaning machines refer to item 6.3.5.
- 5.1.4. Tank cleaning machines shall be supplied with all accessories and any other devices to ensure the PACKAGE safe performance as required on this document and on the relevant rules, regulations and good industrial practices as mentioned on item 2 of this document.

6. PACKAGE SPECIFICATION

6.1. TANK CLEANING MACHINES LOCATION AND ARRANGEMENT

- 6.1.1. Tank Cleaning Machines shall be installed on top of the cargo, slop, produced water, settling (if applicable) and off-spec oil tanks, all closed and zone 0 classified compartments.
- 6.1.2. 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.
- 6.1.3. For the area's classification refer to I-DE- AREA CLASSIFICATION GENERAL.
- 6.1.4. For equipment location refer to I-DE- GENERAL ARRANGEMENT and I-DE-TANKS CLEANING AND RECIRCULATION SYSTEM.
- 6.1.5. Each cargo, slop, produced water, settling and off-spec oil tanks 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.
- 6.1.6. 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.
- 6.1.7. 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, settling and off-spec oil tanks, according to IMO Regulation A.446 (XI).
 - Note¹: In addition to above IMO criteria, the areas under the horizontal stringer n^o 6 (elevation 3800mm on aft transversal bulkhead) including tank bottom, aft transversal bulkhead, longitudinal bulkheads and the oil collecting boxes (skimming pumps) of all tanks shall be properly cleaned. If necessary, a fixed cleaning machine shall be provided to avoid a concentrated shadow on this region.
 - Note²: The fixed cleaning machine installed in oil collecting boxes shall be installed in a position that does not damage the submerged pump of that oil collecting boxes.



- 6.2.7. Fixed tank cleaning machines shall be programmable type.
 - Note: for the bottom cleaning machines, PACKAGER shall define whether it will be programmable or non-programmable, both are acceptable.
- 6.2.8. For the fixed tank cleaning machines material selection, since the tanks will be covered by the FPSO process plant fuel gas as the HYDROCARBON GAS BLANKET SYSTEM, this process gas characteristics shall be considered accordingly.
- 6.2.9. All fixed tank cleaning machines shall have the capacity and design parameters informed on I-FD-TANK CLEANING MACHINE.
- 6.2.10. For crude oil and sea water fluid density, viscosity and other remaining technical parameters refer to I-RL-GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.



6.3. TANK CLEANING MACHINES PIPE STACKS

- 6.3.1. The top fixed tank cleaning machines of the cargo, slop, produced water, settling (if applicable) and off-spec oil tanks shall be tank top cleaning machines type with their own pipe stacks.
- 6.3.2. Pipe stacks shall be designed to allow the direct disassembly of the top fixed cleaning machines without any tank opening.
- 6.3.3. 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.
- 6.3.4. Each section of the pipe stack shall not be longer than 2 meters. If sections longer than 2 meters are duly necessary, it shall be approved by OWNER.
- 6.3.5. Care shall be taken regarding the vibration condition of the pipe stacks since no supports are expected for them inside the tanks.

6.4. PORTABLE CLEANING MACHINES

- 6.4.1. Portable cleaning machines shall be used in case of malfunction or maintenance of fixed cleaning machine.
- 6.4.2. 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.
- 6.4.3. Portable cleaning machines shall be supplied with the minimum below items:
 - i. Two (02) hot (sea) water hose being one (01) for each portable machine with grounding and approved by CS for use on cargo, slop, produced water, settling 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.
 - Note: PACKAGER shall indicate the location onboard to properly store the above-mentioned items.
- 6.4.4. For more information see typical detail I of the I-DE- TANKS CLEANING AND RECIRCULATION SYSTEM.



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I-ET-3010.00-5271-390-P4X-001

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7. GENERAL REQUIREMENTS

TECHNICAL SPECIFICATION

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. 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.



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8.2. WELDING

8.2.1. PACKAGE equipment, structures and piping welding, welding inspection, nondestructive testing (NDT), bolted joints assembly and piping fabrication and commissioning activities shall be performed in compliance with the technical specifications list on Table 1 and Table 2.

TANK CLEANING MACHINE

8.3. DOCUMENTATION

TITLE:

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 and Test Plan (ITP), Factory Acceptance Test (FAT), Inspection Release Certificate (IRC) and Site Acceptance Test (SAT), refer to EXHIBIT V - DIRECTIVES FOR PROCUREMENT, EXHIBIT VII - DIRECTIVES FOR QUALITY ASSURANCE SYSTE and EXHIBIT VIII - DIRECTIVES FOR COMMISSIONING.

8.6. PRESERVATION, PACKING AND TRANSPORTATION

TECHNICAL SPECIFICATION

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