

	TECHNICAL SPECIFICATION		Nr: I-ET-3010.1Y-5271-390-P4X-001
	CLIENT: BÚZIOS		SHEET: 1 of 17
	JOB : HIGH CAPACITY FPSO		
	AREA: BÚZIOS		
SRGE	TITLE: TANK CLEANING MACHINE		INTERNAL
			ESUP

File No.: MICROSOFT WORD 2016 – I-ET-3010.1Y-5271-390-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/29/20	MAR/22/21							
PROJECT	ENG	ENG							
EXECUTION	CXZ0	CXZ0							
CHECK	BYA6	U3Y0							
APPROVAL	CYEL	CYEL							

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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, commissioning and tests of TANK CLEANING MACHINE in conformance with relevant regulations and High Capacity FPSO basic 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.

TANK CLEANING MACHINE the package name.

OWNER: PETROBRAS.

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

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 Regulation a.446 (XII) as amended by Resolution-A.497 (XII) and A.897 (XXXI) – Annex III – item 4.2.9
- 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
GENERAL	
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



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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
I-RL-3010.1Y-1200-940-P4X-001	GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
I-ET-3A36.00-1000-941-PPC-001	METOCEAN DATA
CONSTRUCTION	
I-ET-3010.00-1200-955-P4X-001	WELDING
I-ET-3010.00-1200-955-P4X-002	REQUIREMENTS FOR WELDING INSPECTION
I-ET-3010.00-1000-970-P4X-002	REQUIREMENTS FOR NDT
I-ET-3010.00-0000-970-P4X-001	REQUIREMENTS FOR PROCEDURES AND PERSONNEL QUALIFICATION AND CERTIFICATION
HULL SYSTEMS	
I-DE-3010.1Y-5271-944-P4X-001	TANKS CLEANING AND RECIRCULATION SYSTEM
I-FD-3010.1Y-5271-390-P4X-001	TANK CLEANING MACHINE
I-MD-3010.1Y-1200-940-P4X-027	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS
NAVAL	
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
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	
DR-ENGP-M-I-1.3	SAFETY ENGINEERING GUIDELINE
I-ET-3010.00-5400-947-P4X-002	SAFETY SIGNALING
PIPING	
I-ET-3010.1Y-1200-200-P4X-002	PIPING SPECIFICATION FOR HULL
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS

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 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. Mandatory safety items as established in DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE are to be considered complementary requirements to the pertinent extent. In case of items in conflict with this document, OWNER shall be consulted.
- 4.2.7. HAZOP and PHA shall be performed according to DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE.
- 4.2.8. Double block & bleed arrangements are required for isolation of equipment in piping classes of 300# and above.

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-3A36.00-1000-941-PPC-001 – METEOCEAN 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-3010.1Y-1350-960-P4X-002 – DESIGN REQUIREMENTS - NAVAL ARCHITECTURE.
- 4.4.5. For the design data and information regarding motion requirements refer to I-RL-3010.1Y-1350-960-P4X-009 – 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 four (4) fixed cleaning machines for each cargo, produced water and off-spec oil tanks and two (2) for each slop tank.
- Note: Fixed tank cleaning machines shall be supplied each one with their own pipe stacks.
- 5.1.2. PACKAGER shall supply the shadow diagram for cargo, slop, produced water and off-spec oil tanks.
- 5.1.3. For cargo, slop, produced water and off-spec oil tanks identification, dimensions and volumetric capacity refer to I-DE-3010.1Y-1350-960-P4X-002 – CAPACITIES PLAN.
- 5.1.4. In addition to the fixed machines, PACKAGER shall supply two (2) portable cleaning machines.
- 5.1.5. For bottom cleaning machines refer to item 6.3.5.
- 5.1.6. 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 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-3010.1Y-5271-390-P4X-001 – TANK CLEANING MACHINE.
- 6.1.3. The tank cleaning machines (Z-5271501/588) distribution and quantity per tank are preliminarily informed on I-DE-3010.1Y-5271-944-P4X-001 – TANKS CLEANING AND RECIRCULATION SYSTEM.
- 6.1.4. For crude oil and sea water fluid density, viscosity and other remaining technical parameters refer to I-RL-3010.1Y-1200-940-P4X-001 – GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

6.2 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-3010.1Y-5400-94A-P4X-001 – AREA CLASSIFICATION - GENERAL.
- 6.2.5. For equipment location refer to I-DE-3010.1Y-1200-942-P4X-001 – GENERAL ARRANGEMENT.
- 6.2.6. The number of cleaning machines per tank shall be confirmed by the PACKAGER during detail design. The minimum number shall be defined according to the tanks shadow diagram, which shall follow IMO Regulation a.446 (XII) as amended by Resolution-A.497 (XII) and A.897 (XXXI) – Annex III – item 4.2.9 shall be approved by OWNER and CS.
- 6.2.7. 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.
- 6.2.8. Fixed Tank Cleaning Machines arrangement shall guarantee a maximum shadow of 5% in the horizontal plane and 10% in the vertical plane of each cargo, slop, produced water and off-spec oil tanks.

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 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 not acceptable for cargo, off-spec and produced water tanks.
- Note: For the Slop Tanks, if it is not possible to comply with the maximum shadow requirements the use of bottom cleaning machines is acceptable in these tanks. In this case, the feed pipeline of the bottom cleaning machines shall be built with steel spec B18H.
- 6.3.6. Fixed tank cleaning machines interconnection with the Hull cleaning machines header are detailed on I-DE-3010.1Y-5271-944-P4X-001 – TANKS CLEANING AND RECIRCULATION SYSTEM. For flanges specification refer to I-ET-3010.1Y-1200-200-P4X-002 – PIPING SPECIFICATION FOR HULL.



6.4 PIPE STACKS

- 6.4.1. The 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.
- 6.4.2. Pipe stacks shall be designed to allow the direct disassembly of the fixed cleaning machines without any tank opening.
- 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.
- 6.4.4. Each section of the pipe stack shall not be longer than 2 meters.
- 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.

6.5 PORTABLE CLEANING MACHINES

- 6.5.1. Portable cleaning machines shall be used to clean eventual remaining areas of the cargo, slop, produced water and off-spec oil tanks where the fixed cleaning machines could not reach to clean because the shadow areas.
- 6.5.2. PACKAGER shall indicate on the corresponding shadow diagrams the proper location for the openings on main deck dedicated to the portable machines.
- 6.5.3. Portable cleaning machines shall be supplied with the minimum below items:
- 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.
 - 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.
- 6.5.4. For more information see typical detail I of the I-DE-3010.1Y-5271-944-P4X-001 – Tanks Cleaning and Recirculation System.

7. GENERAL REQUIREMENTS

7.1 PAINTING REQUIREMENTS

- 7.1.1. External painting and coating shall be 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 thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location.

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

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.

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

7.2.5. 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 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.

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.

8.4.4. 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.



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- ii. verification of piping, fittings and equipment accessories 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. review of Inspection and Test Records.
- v. visual check.
- vi. Any other test to ensure the PACKAGE safe design and operational performance.

8.5 FACTORY ACCEPTANCE TEST (FAT)

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, to demonstrate its compliance with the project specifications and allow its release to shipyard.

8.5.2. PACKAGER shall define the FAT scope with the functional tests to satisfy the PACKAGE performance according to all design and operational minimum requirements as herein detailed on this document, rules and regulations and the High Capacity FPSO reference documents.

8.5.3. 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.
- 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.
- iv. Acceptance of FAT will not be considered as the final acceptance test of the PACKAGE.

8.6 PRE-COMMISSIONING AND COMMISSIONING

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.



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.).

8.6.3. Final acceptance will be on satisfactory completion of commissioning tests as specified by OWNER.

9. PACKAGE DELIVERY REQUIREMENTS

9.1 PRESERVATION, PACKING AND TRANSPORTATION

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.

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.

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.

9.1.4. In any case, suitable preservation and protective measures shall be provided to prevent equipment deterioration prior to entering into service.

9.1.5. All packings shall be clearly marked for shipping, including lifting points, gross weight, dimensions and center of gravity.

9.1.6. All sea fastening and temporary supports used on the equipment for shipment shall be clearly identified.

9.1.7. PACKAGER / MANUFACTURER shall ensure that all loose valves, tubes and instruments are supplied with plastic caps.

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.

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.

9.1.10. The equipment shall be thoroughly cleaned internally and be free of all loose foreign materials.

- i. The preparation shall make the equipment suitable for outdoor storage in a coastal tropical climate from the time of Shipment.

- 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.
- iii. Spare parts and tools to be packed separately and clearly marked "Spare Parts" and "Tools" respectively.

9.2 SPARE PARTS, CONSUMABLES AND TOOLS

- 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.
- 9.2.2. All spare parts recommended or required by the CS: such spare parts will be delivered together with the relevant equipment.
- 9.2.3. All special tools required for construction, pre-commissioning, commissioning and all levels of maintenance and operation.
- 9.2.4. Spare parts list recommended by PACKAGER / MANUFACTURER for two years of operation.

9.3 DOCUMENTATION

9.3.1. Drawings and Weight Control

For Engineering Documentation minimum requirements:

- i. PACKAGER / MANUFACTURER design drawings shall show all necessary dimensions and details required for interface information and installation.
- ii. Clearances for maintenance shall be shown on the drawings.
- iii. Drawings and documents shall be clear and completely legible with all text in the English language.
- iv. Instruction manuals for operation and maintenance of the PACKAGE equipment shall be provided in Portuguese language.
- 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.
- 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.
 - o Note: Operational weight means the component dry weight added to the respective component fluid weight on operational condition.



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- vii. PACKAGER shall send in advance all recommendations for PACKAGE installation, maintenance and commissioning.

9.3.2. Data Book

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:

- i. Certified drawings, data sheets, technical specifications, performance curves and calculation memorandum.
- ii. Construction, maintenance and operating manuals, instructions for preservation and commissioning, and all catalogs, including of the sub-suppliers.
- 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).

9.3.3. 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.