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| B | REVIEWED CLEANING IN PLACE (CIP) REQUIREMENTS IN 5.1.1 ; 6.1.12 ; 6.1.13 AND 6.1.14 ; EXTENSIVE HULL SUPLLIER AND SUPPLY SCOPE DEFINITIONS ON ITENS 1.2 ; AND ALONG ITEMS 4 ; 5.1 AND 5.2 AND ALONG ALSO ITEMS 6.1 ; 7 AND 8. |

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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 **SLOP TREATMENT UNITS** and related components, devices and apparatus, in conformance with relevant regulations and FPSO Basic Design documentation, conceived to treat oily water from Slop Tanks, prior its proper discharge overboard to the sea.

## 1.2. DEFINITIONS

SLOP TREATMENT CENTRIFUGES SYSTEM: It is defined as equipments to treat Slop Tanks inventory, supplied interconnected with other facilities, equipments and devices provided by Hull Supllier, tested, and ready to operate, requiring the available utilities from the Unit for the SLOP TREATMENT CENTRIFUGES System operation.

HULL SUPLLIER: It is defined as the responsible for project, assembly, construction, fabrication, testing and furnishing of the SLOP TREATMENT CENTRIFUGES System.

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

## 1.3. ABBREVIATIONS

| | |
|---|---|
| AIT | Oil Content Sensor / Analyzer |
| 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.

- ASME B16.5 – Pipe Flanges & Flanged Fittings
- ASME B31.3 – Process Piping
- AWS D1.1 – Structural Welding Code
- ISO International Standard Organization

- IEC International Electrotechnical Commission
- MARPOL 73/78 Convention
- IMO Marine Environment Protection Committee 1975
- Resolution IMO MEPC 107 (49) 2003
- 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 SLOP TREATMENT CENTRIFUGES System 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. FPSO BASIC DESIGN REFERENCE DOCUMENTS

| DOCUMENT CODE (*) | DOCUMENT TITLE |
|---|---|
| **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- METOCEAN DATA | METOCEAN DATA |
| I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES | GENERAL SPECIFICATION FOR AVAILABLE UTILITIES |
| I-RL- MOTION ANALYSIS | MOTION ANALYSIS |
| I-ET- FIELD INSTRUMENTATION | FIELD INSTRUMENTATION |
| I-ET- INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS | INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS |
| I-DE- GENERAL NOTES | GENERAL NOTES |

| HULL SYSTEMS | |
|---|---|
| I-DE- SLOP DISCHARGE SYSTEM | SLOP DISCHARGE SYSTEM |
| I-DE-HULL SERVICE AND INSTRUMENT AIR DISTRIBUTION | HULL SERVICE AND INSTRUMENT AIR DISTRIBUTION |
| I-DE- FRESH, HOT AND POTABLE WATER SYSTEM DISTRIBUTION | FRESH, HOT AND POTABLE WATER SYSTEM DISTRIBUTION |
| I-FD- SLOP TREATMENT CENTRIFUGES | SLOP TREATMENT CENTRIFUGES |
| I-MD- DESCRIPTIVE MEMORANDUM - HULL SYSTEMS | DESCRIPTIVE MEMORANDUM - HULL SYSTEMS |

Table 1 – FPSO basic design reference 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. Above mentioned title naturally may vary slightly from one project to another; therefore, document list shall be used accordingly.

### 3.2. FPSO BASIC DESIGN TYPICAL DOCUMENTS

| DOC CODE | DOC TITLE |
|---|---|
| **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 |
| **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 |
| I-ET-3010.00-1352-130-P4X-001 | FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS |
| **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 GUIDELINE |
| **ELECTRICAL** | |
| 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 FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-700-P4X-003 | ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-700-P4X-007 | SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-700-P4X-009 | GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-712-P4X-001 | LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS |
| I-ET-3010.00-5140-741-P4X-004 | SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS 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-3010.00-1200-800-P4X-015 | REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716) |
| I-ET-3010.00-5520-888-P4X-001 | AUTOMATION PANELS |

Table 2 – FPSO basic design typical documents.

## 4. DESIGN REQUIREMENTS

### 4.1. DESIGN CONDITIONS

4.1.1. SLOP TREATMENT CENTRIFUGES System Equipments 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. HULL SUPLLIER shall select and install the equipments for the full range of operational conditions as specified in this technical specification.

4.1.3. SLOP TREATMENT CENTRIFUGES System Equipments 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 FPSO Basic Design reference documents.

4.1.4. Where applicable on a FPSO, the whole SLOP TREATMENT CENTRIFUGES System and its components shall observe specific international regulations such as Resolution IMO MEPC 107 (49) 2003, and the correlates IMO Marine Environment Protection Committee 1975 and MARPOL 73/78 Convention.

4.1.5. All elements of the SLOP TREATMENT CENTRIFUGES System 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 HULL SUPLLIER 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.

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 FPSO displacement and accelerations refer to I-RL–MOTION ANALYSIS.

4.4.6. SLOP TREATMENT CENTRIFUGES System is also to withstand inertial forces during transportation from construction site to the final offshore location.

## 5. SLOP TREATMENT CENTRIFUGES SYSTEM SCOPE OF SUPPLY

### 5.1. SCOPE OF SUPPLY

5.1.1. SLOP TREATMENT CENTRIFUGES shall be supplied with the following minimum components:

- Two (2 x 100%) **Slop Treatment Centrifuges** driven by electrical induction motors, **each one** with the following minimum components:
  - One (1) integral Centrifuge sludge collection tank, to collect sludge (solids, oily agglomerates, and residual water), result of the Slop Treatment Centrifuges System, prior its discharge back to Slop Tanks; or to drums to be filled prior disembark.
  - One (1) integral positive displacement sludge pump to periodically pump the sludge (solids, oily agglomerates, and residual water) from the sludge collection tank to the Slop Tanks, or to drums to be filled prior disembark.
  - Integral Centrifuge devices (or pumps) to forward separated oil to Slop Tanks.

- Integral Centrifuge devices (or pumps) to forward separated water to overboard discharge (treated water) or its return to Slop Tanks (non-treated water).
- Cleaning In place (CIP) System.
- Slop Treatment Centrifuges integral control panel;

5.1.2. The devices, instruments and apparatus listed bellow shall also be integrated by Hull Supllier in this Slop Treatment Centrifuges System, partially illustrated in Figure 1 bellow.

- Two (2 x 100%) FIT Flowmeters to measure and totalize treated water directed to overboard discharge.
- Control valves to divert the treated and non-treated effluent.
- Two (2 x 100%) Oil content sensor (AIT), on Centrifuges unified outlet, with command via control valves, the treated effluent water to overboard discharge or return untreated effluent water to Slop Tanks
- Two (2) Nitrogen compact generator unit, one to each Slop Treatment Centrifuge.
  - Note: Nitrogen scope to be confirmed according to the Basic Design basis as highlighted on item 6.3.3.

5.1.3. SLOP TREATMENT CENTRIFUGES shall be connected, wired, and supplied as a complete unit, ready for installation and operation.

5.1.4. Preferably the Slop Treatment Centrifuges System shall be provided, as a minimum, in TWO SKIDS, each containing ONE Centrifuge, both positioned close to each other on Main Deck. If it is not possible due to space restrictions on Main Deck or due to HULL SUPLLIER limitation, ONE SKID shall be provided, containing both Centrifuges. It is up to Hull Supllier decision to divide the Slop Treatment Centrifuges System in more skids, containing separately, for instance, N2 Generator, AITs, FITs, etc. The above listed equipment or components shall be supplied and integrated by HULL SUPLLIER, as integral parts of the SLOP TREATMENT CENTRIFUGES, never exceeding its Skid(s) limits.

- Note: skid(s) minimum requirements are detailed on item 7.4.

5.1.5. Additionally, all piping interconnections, flanges, valves, control valves, instruments and all other necessary accessories shall be supplied by HULL SUPLLIER to ensure the required performance degree of the SLOP TREATMENT CENTRIFUGES System under safe conditions. All those items shall be installed within Skid(s) limits.

**5.2. EQUIPMENTS LOCATION**

5.2.1. SLOP TREATMENT UNIT Skid(s) shall be installed on Main Deck, a classified area, aft- portside. All applicable hazardous area certificates shall be supplied.

5.2.2. For equipment location both I-DE-GENERAL ARRANGEMENT and I-DE-AREA CLASSIFICATION – GENERAL shall be considered.

## 6. SLOP TREATMENT CENTRIFUGES SPECIFICATION

### 6.1. GENERAL

6.1.1. **SLOP TREATMENT CENTRIFUGES** System has the purpose to treat oily waters received in **Slop Tanks** and discharge treated water overboard.

6.1.2. Slop Treatment System is detailed on the below scheme on Figure 1. SLOP TREATMENT CENTRIFUGES receive the oily water from the Slop Tanks through the **Slop Discharge Pumps** (2 x 100%) to be treated and discharged to the sea. The separated oil and the non-treated water effluent shall be returned to the Slop Tanks, the same for the sludge generated during the centrifugation process.

- Note 1: for Slop Discharge System refer to I-DE-SLOP DISCHARGE SYSTEM.
- Note 2: for Slop Discharge Pumps capacity refer to I-FD-SLOP DISCHARGE PUMPS.

6.1.3. Alternatively, **Slop Pumps** (2 x 100%) installed each one on Dirty / Clean Slop Tanks could be aligned for this purpose, as back-up pumps.

6.1.4. Centrifuges shall be able to operate in an isolated mode (one Centrifuge in operation and the other stopped) or in a simultaneous mode (both Centrifuges in operation at the same time).

6.1.5. According to Figure 1 bellow, after the oily water influent from Slop Tanks and upstream the two **Slop Treatment Centrifuges** inlet there shall be an internal by-pass.

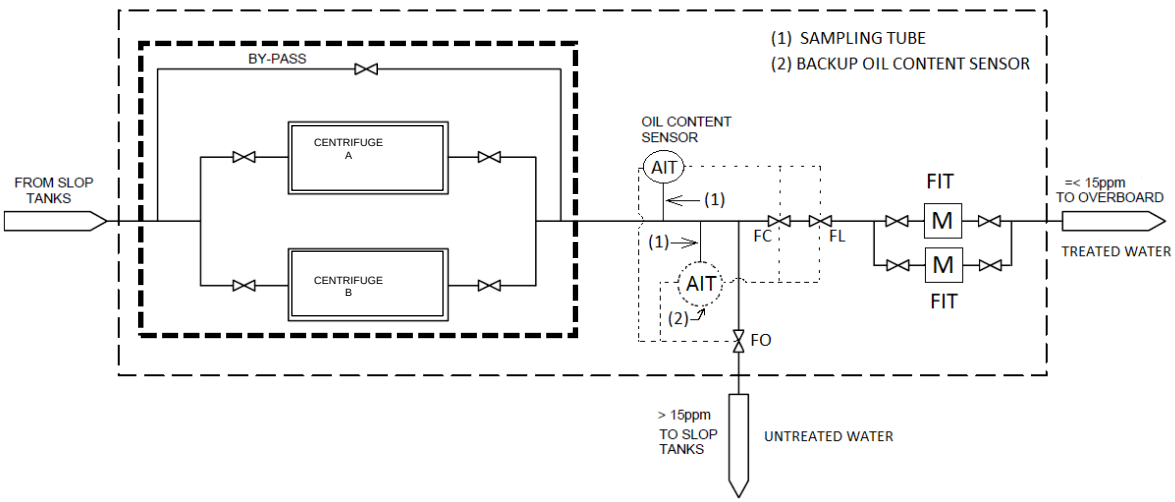

Figure 1 – Slop Treatment System Scheme.

6.1.6. Downstream the Slop Treatment Centrifuges there shall be Oil Content Sensors AIT (HULL SUPLLIER scope of supply as indicated in 5.1) to check the oil content of the effluent water after the centrifugation process. If the oil content is less or equal to 15 ppm (Note 3), this treated effluent water shall be automatically directed overboard to sea. If the oil content is higher than 15 ppm, this untreated effluent water shall be automatically returned to the Slop Tanks (for details see I-DE-SLOP DISCHARGE SYSTEM).

- Note 1: despite of the above-mentioned Oil Content Sensors AIT to be installed on the skid(s), another one (1) AIT shall be supplied by HULL SUPLLIER loose as backup. This backup AIT shall have all its infrastructure (sampling conditioning, probe, cables, etc.) mounted on the skid(s), but the analyzer itself shall be kept dismounted, in the FPSO warehouse.

- Note 2: This backup AIT sensor is indicated as item “(2)” on Figure 1. A logic shall be carried out to define which of the two analyzers is in operation for valves control.

- Note 3: according to MARPOL Annex I, Chapter 3, Regulation 15 – Control of discharge of oil and IMO MEPC 107 (49) 2003.

6.1.7. SLOP TREATMENT CENTRIFUGES skid(s) shall be provided with control valves to divert the discharge of treated or untreated effluent water automatically. On the treated water overboard discharge line stream, two (2) sequential redundant control valves shall be provided, one of them shall have a “fail close” (FC) actuator and the other “fail latch” (FL). The untreated effluent water control valve (slop discharge) shall have a “fail open” (FO) actuator.

6.1.8. According to Figure 1, SLOP TREATMENT CENTRIFUGES System shall be provided with two (2) FIT Flowmeters to indicate and record the amount of treated effluent water discharged overboard. The FIT Flowmeters shall be integrated with FPSO supervisory system (SOS) in the control room (CCR).

6.1.9. SLOP TREATMENT CENTRIFUGES shall be provided with protections against oily water inlet **low, no-flow** and **overflow** scenarios to avoid Centrifuges damage. For this purpose, it shall be provided Centrifuges integral control valves and FITs (flow indicator and transmitters) to regulate flow through each Centrifuge, allowing inlet overflows to be diverted back to Slop Tanks using a dedicated recirculation line.

- Note 1: these Centrifuges protections shall be able to stop the Centrifuges.

- Note 2: the detailed design of the SLOP TREATMENT CENTRIFUGES recirculation line flow control is HULL SUPLLIER's scope and is not represented in Figure 1.

6.1.10. The SLOP TREATMENT CENTRIFUGES skid(s) shall be provided with protections against inlet oily water **low** and **high-pressure** scenarios to avoid Centrifuges damage. These additional protections shall be conceived, despite the centrifugal submerged pumps, feeding the Slop Treatment Centrifuge System, own flow, and pressure control. These Centrifuges protections shall be able to stop the Centrifuges.

6.1.11. The Centrifuges shall be self-cleaning type.

- Note: for fresh, hot, and potable water supply, refer to I-DE- FRESH, HOT, AND POTABLE WATER SYSTEM DISTRIBUTION.

6.1.12. Each Slop treatment centrifuge shall be provided with one integrated Cleaning in place (CIP) system. The CIP system consists in a Tank (different from sludge tank), a set of valves, a filter and a circulating pump for recirculating the cleaning liquid from the tank to the centrifuge and return to the tank during non-operation mode.

6.1.13. The CIP tank shall have a connection for fresh water supply and an opening for manual chemical injection. This tank shall have a level indicating instrument and a drain port directed to the main deck drainage system.

6.1.14. The Centrifuges MANUFACTURER shall inform on equipment operation manual the recommended chemical products for CIP system, to be used in case the Centrifuge is excessively contaminated with oily residues.

6.1.15. The sludge (solids, oily agglomerates, and residual water) retained in the SLOP TREATMENT CENTRIFUGES skid(s) sludge collection tanks shall be discharged to Slop Tanks by their respective positive displacement pumps.

6.1.15.1. These pumps shall have sufficient head to prevent clogging by debris at the line's siphon outlets inside Slop Tanks (400 mm above bottom plate) (Note 1), with Slop Tanks fully loaded and at the maximum design pressure in each Slop Tank inert gas atmosphere of 2000 mm H2O (g) (Note 2).

- Note 1: for the actual Slop Tank siphon position refer to I-DE-SLOP DISCHARGE SYSTEM.
- Note 2: for actual Slop Tank pressure refer to I-DE-HYDROCARBON AND INERT GAS DISTRIBUTION SYSTEM.

6.1.15.2. Alternatively, these positive displacement pumps could divert the sludge to full-fill drums on Main Deck, to be disembarked latter by a UNIT`s crane to a support vessel.

6.1.15.3. The positive displacement sludge pumps shall be protected against overpressure. This protection shall be able to stop safely the positive displacement sludge pumps.

6.1.16. For the centrifugal process fresh water shall be supplied by FPSO Hull Systems by Hull Supllier according to Vendor requirements. For fresh water properties refer to I-RL- GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

6.1.17. For structural works HULL SUPLLIER shall follow requirements of item 8.2 of this technical specification. For bolt and nuts materials apply the requirements of I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS.

6.1.18. For the Centrifuges Low-Voltage Induction Motors, see item 7.1 of this technical specification.

6.1.19. For the Centrifuges Panels, see item 7.1 of this technical specification.

6.1.20. General requirements for instruments, valves and accessories are as follows:

a. The level gauges shall be installed in such position that the level indicated in the instrument will be easily seen. All level gauges shall have flanged connections, which can be isolated and be complete with vent and drain, valves, and connection.

b. All valves shall be positioned with the stem pointing upwards. They shall be located in such a way that the hand wheel or actuator will not obstruct walkways, being easily accessible for O&M activities. Where hand operated valves are not easily operable, gear operated valves shall be used.

c. Valves, instruments, etc. elevated 1.75 m or more above the floor, shall have access ladders or platform provided.

d. Sampling point facilities shall be provided complete, with necessary fittings and valves, and the design shall reflect nature of the fluids being sampled.

6.1.21. SLOP TREATMENT CENTRIFUGES System equipments Maximum Allowable Working Pressure (MAWP) shall be higher than the maximum pressure that may occur at SLOP TREATMENT CENTRIFUGES System inlet tie-in point.

6.1.21.1. In particular cases where it is not possible to comply with above requirement, it shall be included on SLOP TREATMENT CENTRIFUGES System scope of supply devices for pressure control together with devices

for protection against over pressure, for example, a combination of a self-operated pressure reducing valve and a pressure relief valve.

- Note: this requirement (item 6.1.21) is also applicable for SLOP TREATMENT CENTRIFUGES required utilities, such as, but not limited to, seawater/fresh water cooling, compressed air, diesel, nitrogen.

## 6.2. FLOWMETERS AND OIL CONTENT SENSOR SPECIFIC REQUIREMENTS

6.2.1. According to Figure 1 above, the two (2) FIT Flowmeters shall be installed in parallel with their respective isolating valves, constantly measuring the flow of treated effluent water discharged to sea, if the oil content sensor AIT detects the effluent water is adequately treated.

6.2.1.1. One (1) FIT Flowmeter will measure the treated water flow to overboard, while the second is conceived as installed spare.

6.2.1.2. The two (2) FIT Flowmeters shall be of magnetic type and shall comply with I-ET–FIELD INSTRUMENTATION.

6.2.2. The oil content sensors AIT shall be PETROBRAS type approved. For more details, see I-ET–FIELD INSTRUMENTATION.

6.2.2.1. The oil content constantly measured by oil content sensor AIT shall be indicated in SOS-HMI. In case the oil content sensor AIT detects an oily water contamination above or equal to 15 ppm, there shall be a specific alarm in the Central Control Room.

6.2.2.2. The oil content sensor AIT sampling tubes (indicated on Figure 1) shall comply with requirements of I-ET-3010.00-1200-588-P4X-001 – SAMPLE CONNECTIONS. A ‘SC8 H1’ type of sample connection shall be used. The sampling tubes shall be installed in the center of the treated water discharge line, with 90 degrees bending against the discharge flow direction.

6.2.2.3. The oil content sensors AIT and its sampling tubes shall comply with applicable requirements of I-DE-GENERAL NOTES.

6.2.2.4. There shall be a minimum 3% (three percent) slope between the sampling tubes intrusive point and the AIT instrument itself.

6.2.2.5. On the respective sampling tube of each oil content sensor AIT (indicated on Figure 1), it shall be installed a flowmeter indicator and transmitter FIT, magnetic or ultrasonic type, in order to measure the flow passing through the AIT sensors. For external analyzers, provided with a sampling tube and an ultrasonic cleaning system, they shall be turned off and kept with water inside or in a full line in case of process plant shutdown. These FITs aren’t represented on Figure 1.

- Note: upstream of each sampling tube shall be installed a manual or

automatic flow/pressure adjustment valve (FCV or PCV) to adjust the flow sent to the oil content sensor AIT.

6.2.2.6. Whenever intrusive probes / sampling systems are used, the blocking valve / device shall be supplied by the oil content sensor AIT analyzer vendor. This valve shall be compatible with the sampling system used and collection probe. Valve body size shall be adapted for the service / probe type. In case the sampling system / probe is not compatible with a block valve, other means to isolate the analyzer from the process fluid shall be foreseen and shall be submitted for approval. For further requirements regarding analyzers connections, see I-ET–FIELD INSTRUMENTATION.

6.2.2.7. Oil content sensors AIT maintenance, calibration tasks, sampling, and readings, shall be easily taken and performed at / from Main Deck.

6.2.3. The Centrifuges outlet line, where the oil content sensor AIT and FIT flowmeters are installed, shall be designed to avoid vacuum, which may lead to malfunction on these devices.

6.2.4. The oil content sensors AIT and FIT flowmeters shall be easily accessible for O&M – Operation and Maintenance – purposes, within SLOP TREATMENT CENTRIFUGES skid(s) limits, never inside any tank.

**6.3. NITROGEN GENERATOR REQUIRED BY CENTRIFUGES IN ZONE 1**

6.3.1. Nitrogen - $N_2$ - injection aims to inject $N_2$ inside Centrifuges carcass, to prevent atmosphere air (and oxygen) to penetrate in the Centrifuges and get in contact with interior oily potentially inflammable liquids or gases in hot Centrifuges components.

6.3.2. If the BUYER UNIT project is able to produce and supply $N_2$ with purity >= 98% to the SLOP TREATMENT CENTRIFUGES, this BUYER available $N_2$ may be used by HULL SUPLLIER for the Centrifuges.

6.3.3. Otherwise, if BUYER`s UNIT project does not produce and supply $N_2$, HULL SUPLLIER shall provide two (2) dedicated Nitrogen compact generators to be installed in its SLOP TREATMENT CENTRIFUGES with the following characteristics:

a. Nitrogen compact generators shall have configuration 2x100% with a cross-over line, so that each Nitrogen compact generator could be aligned with each one of the Centrifuges.

b. $N_2$ shall be generated through compressed air (non-essential instrument air or service air), available at BUYER`s unit project.

c. $N_2$ flow and pressure shall be defined in accordance with the Slop Treatment Centrifuges System consumption requirements. HULL SUPLLIER shall supply the Nitrogen compact generators guaranteeing all design and interconnections with the Slop Treatment Centrifuges System.

d. Nitrogen compact generators shall be preferably installed in a non-hazardous area, as a non-Ex equipment. If it is not possible, the compact $N_2$ generators shall be Ex-classified.

e. Nitrogen compact generators shall be provided by a field proven vendor, HULL SUPLLIER partner / supplier, with all applicable certificates and suitable for the FPSO design life in the offshore environment.

6.3.4. SLOP TREATMENT CENTRIFUGES System skid(s) compressed air balance and electrical load balance shall be evaluated/updated due to the dedicated Nitrogen compact generators inclusion.

## 7. GENERAL REQUIREMENTS

### 7.1. ELECTRICAL REQUIREMENTS

7.1.1. SLOP TREATMENT CENTRIFUGES electrical equipment, material, low-voltage induction motors, and grounding installation shall comply with the drawing and technical specifications listed on Table 2.

### 7.2. INSTRUMENTATION AND AUTOMATION REQUIREMENTS

7.2.1. SLOP TREATMENT CENTRIFUGES System criteria for instrumentation, automation, interface, and control design shall follow the technical specifications listed on Table 2.

### 7.3. PAINTING REQUIREMENTS

7.3.1. SLOP TREATMENT CENTRIFUGES System skid(s) painting and coating shall be performed 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. SKID(S) LAYOUT AND FOUNDATION REQUIREMENTS

7.4.1. SLOP TREATMENT CENTRIFUGES System skid(s) components detailed on item 6 which are supplied assembled on skid(s) shall follow the below minimum requirements.

7.4.2. SLOP TREATMENT CENTRIFUGES System skid(s) 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 HULL SUPLLIER lifting procedure.

7.4.3. The skid(s) main frame shall be all welded construction. Structural skid(s) welds, including lifting facilities shall be continuous and shall comply with AWS D1.1

(structural welding code) and CS Rules. Skid(s) structure shall be designed to be welded to the supporting structure unless otherwise specified.

7.4.4. SLOP TREATMENT CENTRIFUGES System skid(s) layout and arrangement shall be designed to provide sufficient access to pumps, instruments, equipment, and control panels 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.

7.4.5. All necessary maintenance davits, monorails, padeyes or trolleys shall be provided to ensure the safe and easy maintenance conditions.

7.4.6. Access ladders, platforms, gratings, and any other access device shall be metallic type and designed according to HULL SUPLLIER standard and to the industrial recognized international codes.

### 7.5. NAMEPLATES AND TAG NUMBERING

7.5.1. HULL SUPLLIER / Vendor Equipments 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.

7.5.2. 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. SLOP TREATMENT CENTRIFUGES SYSTEM MANUFACTURING AND DELIVERY REQUIREMENTS

### 8.1. GENERAL

8.1.1. All materials and equipment supplied by HULL SUPLLIER / Vendor Equipments 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 three (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. MANUFACTURING

8.2.1. SLOP TREATMENT CENTRIFUGES 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 technical specifications listed on Table 1 and Table 2.

## 8.3. DOCUMENTATION

8.3.1. For the SLOP TREATMENT CENTRIFUGES System 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 SLOP TREATMENT CENTRIFUGES System 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 SLOP TREATMENT CENTRIFUGES System 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 SYSTEM and EXHIBIT VIII - DIRECTIVES FOR COMMISSIONING.

## 8.6. PRESERVATION, PACKING AND TRANSPORTATION

For SLOP TREATMENT CENTRIFUGES System preservation, packing and transportation requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.