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	JOB: <b>BASIC DESIGN - REVIT I</b>					
	AREA: <b>MARLIM LESTE E SUL</b>					
TITLE: <b>HULL STRUCTURAL TANKS LEVEL, INTERFACE, PRESSURE AND TEMPERATURE MONITORING SYSTEMS</b>			ESUP			
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B	REVISED WHERE INDICATED, INCLUDING CONSISTENCY ANALYSIS					
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## 1. INTRODUCTION

### 1.1. Objective

1.1.1. This specification describes the minimum requirements for the supply of the Hull Structural Tanks Level, Oil-water Interface, Pressure and Temperature Monitoring Systems (HSTS), to be installed at the UNIT (FPSO), covering: all equipment, materials, software, interconnection, documentation, configuration, tests, installation, and training.

1.1.2. Regarding tanks, the specification refers to all types of possible tanks and the applicable ones shall be obtained from Naval Systems documentation.

### 1.2. Definitions

1.2.1. Refer to I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS.

### 1.3. Abbreviations, acronyms and initialisms

Item	Description
AC/DC	Alternating Current / Direct Current
CCR	Central Control Room
CCR-OA	Central Control Room - Operation Ambiance
CCR-EA	Central Control Room - Equipment Ambiance
CS	Classification Society
CSS	Control and Safety System
DC/DC	Direct Current / Direct Current
FAT	Factory Acceptance Test
FMCW	Frequency Modulated Continuous Wave
FPSO	Floating Production Storage and Offloading
HCS	Hull Control System
HMI	Human-Machine Interface
HSD	Hull Shutdown System
HSTS	Hull Structural Tanks Level, Interface, Pressure and Temperature Monitoring Systems
IACS	International Association of Classification Societies
I/O	Input / Output
IP	Ingress Protection Ratings
LAN	Local Area Network
mmWC	Millimeters of Water Column
OPC	Open Platform Communications
OPC-UA	OPC Unified Architecture
P&ID	Piping and Instrument Diagram
RTDS	Real Time Data Server
SAT	Site Acceptance Test
SIT	Site Integration Test
SOS	Supervision and Operation System



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UI	Unified Interpretation – A resolution issued by IACS
UR	Unified Requirement – A resolution issued by IACS

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## 2. REFERENCE DOCUMENTS, CODES AND STANDARDS

### 2.1. External references

#### 2.1.1. International codes, recommended practices, and standards

<b>IEC – INTERNATIONAL ELECTROTECHNICAL COMMISSION</b>		
IEC	60079	EXPLOSIVE ATMOSPHERE – ALL PARTS
IEC	60529	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
IEC	61892	MOBILE AND FIXED OFFSHORE UNITS - ELECTRICAL INSTALLATIONS - ALL PARTS
IEC	62381	AUTOMATION SYSTEMS IN THE PROCESS INDUSTRY- FACTORY ACCEPTANCE TEST (FAT), SITE ACCEPTANCE TEST (SAT) AND SITE INTEGRATION TEST (SIT)

<b>IMO – INTERNATIONAL MARITIME ORGANIZATION</b>	
SOLAS	International Convention for the Safety of Life at Sea
MARPOL	International Convention for the Prevention of Pollution from Ships

#### 2.1.2. Classification Society

2.1.2.1. The detailed design shall be submitted to Classification Society for approval.

2.1.2.2. The Unified Requirements (URs) and Unified Interpretations (UIs) of IACS, applicable and in force in the detailing design, shall be observed and their requirements implemented.

2.1.2.3. The design and installation shall be updated following requirements, comments of Classification Society as well as URs and UIs mentioned in item 2.1.2.2.

#### 2.1.3. Brazilian Codes and Standards


<b>INMETRO – INSTITUTO NACIONAL DE METROLOGIA, QUALIDADE E TECNOLOGIA</b>	
PORTARIA Nº 115 (21/MARÇO/2022)	REQUISITOS DE AVALIAÇÃO DA CONFORMIDADE PARA EQUIPAMENTOS ELÉTRICOS PARA ATMOSFERAS EXPLOSIVAS - CONSOLIDADO

### 2.2. Internal references

2.2.1. Internal Reference documents are important not only for package-related requirements, but also for requirements that dictate how interfaces with other systems shall be executed.


#### 2.2.2. Project Documents

2.2.2.1. All Hull structural tanks shall have level, interface, pressure and temperature monitoring systems, covered by the HSTS system. Therefore, in addition to the documents presented below, all Hull structural tanks P&IDs shall be used as reference documents (not all of them are explicitly included in the table).

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*Table 2.2-I – Reference Project Documents (Hull structural tanks P&IDs are not listed)*

TYPICAL DOCUMENTS	
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
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-3010.00-5520-861-P4X-001	CONTROL AND SAFETY SYSTEM - CSS
I-ET-3010.00-5520-861-P4X-002	SUPERVISION AND OPERATION SYSTEM - SOS
I-ET-3010.00-5520-888-P4X-001	AUTOMATION PANELS
I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
DOCUMENTS 3010.2Q	
I-DE-3010.2Q-1350-944-P4X-005	TANK LEVEL, PRESSURE, TEMPERATURE AND FLOODING INDICATION SYSTEM
I-DE-3010.2Q-5115-944-P4X-002	FRESH, HOT AND POTABLE WATER SYSTEM
I-DE-3010.2Q-5133-944-P4X-003	DIESEL OIL PURIFIER AND SERVICE SYSTEM
I-DE-3010.2Q-5133-944-P4X-004	DIESEL OIL STORAGE SYSTEM
I-DE-3010.2Q-5330-944-P4X-001	BILGE, SLUDGE, BALLAST (AFT) AND GENERAL SERVICE SEAWATER SYSTEM
I-DE-3010.2Q-6650-944-P4X-001	DRAUGHT, TRIM AND HEEL INDICATION SYSTEM
I-DE-3010.2Q-5520-800-P4X-002	AUTOMATION AND CONTROL ARCHITECTURE
I-ET-3010.2Q-1200-800-P4X-001	INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS
I-ET-3010.2Q-1200-800-P4X-005	FIELD INSTRUMENTATION
I-ET-3010.2Q-1200-800-P4X-014	AUTOMATION INTERFACE OF PACKAGED UNITS
I-MD-3010.2Q-5520-800-P4X-003	AUTOMATION NETWORK DESCRIPTION

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### 3. ENVIRONMENTAL AND OPERATION CONDITIONS

#### 3.1. General

3.1.1. For operating and environmental conditions, refer to I-ET-3010.2Q-1200-800-P4X-001 - INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS.

#### 3.2. Environmental Conditions

3.2.1. All instrumentation components, including alarm and indicator devices, shall be designed for use in a marine environment, resistant to corrosion, and capable of operating under all prevailing environmental conditions.

3.2.2. The HSTS components will be installed at different classification areas and at different environmental conditions. They will also be subjected to electromagnetic and radio-frequency interferences, vibration and/or mechanical shocks. The HSTS components shall be adequate to these afore mentioned conditions.

#### 3.3. Operation Conditions

3.3.1. Each component shall be designed and tested for the full range of pressure and temperature in service.

3.3.2. Ex protection and certification:


3.3.3. This specification defines the type of Ex protection for equipment and components. For any missing definition, Ex protection shall follow I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS and I-ET-3010.2Q-1200-800-P4X-005 - FIELD INSTRUMENTATION.

3.3.4. In open areas and non-classified zone, equipment and components shall have Ex protection for Zone 2 Exdc IIA T3 Gc.

3.3.5. All HSTS equipment and components shall have conformity certificates complying with PORTARIA INMETRO Nº 115 DE 21/MARÇO/2022 and its annexes.

3.3.6. The whole system, as well as the components individually, shall be approved by the Classification Society.

3.3.7. The system shall be designed to operate continuously for 24 hours a day, 7 days a week, for a period of 25 years.

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## 4. DESIGN REQUIREMENTS

### 4.1. Concept

4.1.1. Hull Structural Tanks Level, Interface, Pressure and Temperature Monitoring Systems shall consist of tank sensors, instruments, associated electronics, communication systems and computer-based workstations including monitor and keyboard. The system shall also be used to measure the vessel's draft. The workstations shall display all measured values in form of figures, bar graphs and mimics. Setting of Low, High (LSH—90%), High High (LSHH—95%), and Emergency (LSHHH—98%) level alarms shall be included in system.

4.1.2. Hull Structural Tanks Level, Interface, Pressure and Temperature Monitoring Systems shall include, at least, the following items, in accordance with Classification Society requirements:

- I. Remote Ullage, Pressure and Temperature Monitoring System, composed by level, oil-water interface, pressure and temperature monitoring system for structural inert gas blanketed tanks and level monitoring system for structural atmospheric tanks.
- II. High Level Overfill System for structural inert gas / hydrocarbon blanketed tanks.
- III. Draft Measurement System.
- IV. Stability and Load Calculator.
- V. Portable Closed Ullage Manual Measuring Systems.

### 4.1.3. Tankage

4.1.3.1. The UNIT (FPSO) is equipped with tanks described in P&IDs mentioned in item 4.14.1.

### 4.2. Bidding Process


4.2.1. Only one supplier shall be responsible for the design, integration and supply of Remote Ullage, Pressure and Temperature Monitoring System, High Level Overfill System, Draft Measurement System and Stability and Load Calculator.

4.2.2. The solution shall be provided to the greatest extent possible from the same manufacturer. This includes all instruments, sensors, equipment, and other components of the solution that receive signals from other instruments or that have space to accommodate a sensor/transmitter of another variable. For any component that the manufacturer does not have a solution for, another manufacturer may be used. However, statements from the parties (manufacturers) shall be provided to demonstrate that the components are cross-compatible.

### 4.3. Electrical, Instrumentation and Automation General Guidelines

4.3.1. HSTS shall be powered according to the requirements in I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS. The different



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power supplies inside the panels shall be converted and distributed, including where necessary an AC/DC or DC/DC stabilized power supply unit for the cabinet internal distribution of 24 Vdc.

4.3.2. All instruments shall be designed according to I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS and I-ET-3010.2Q-1200-800-P4X-005 - FIELD INSTRUMENTATION.

4.3.3. The transmitters shall not depend on an internal battery, eliminating the necessity of regular battery maintenance.

4.3.4. All sensors wet parts shall have materials compatible to respective process fluids.

4.3.5. Every HSTS software shall be supplied with their respective licenses. Demo and under development versions will not be accepted.

4.3.6. Radar level measurement shall be based on Frequency Modulated Continuous Wave (FMCW) technology. The radar shall be non-contacting type and deflection plates shall be installed following manufacturer requirements. Stilling well shall not be used.

4.3.6.1. For the following, BUYER shall be questioned and shall approve prior to implementation: Where it is demonstrated to be impractical an installation without the use of stilling well, these may be used with non-contacting radar (FMCW) with antenna type designed to be used with stilling well.

4.3.6.2. The gas phase is liable to change the fluid composition that may operate with compositions of hydrocarbon gases to inert gas produced by hydrocarbon combustion, being blanketed tanks the most significant case. This alters the medium dielectric constant and if not demonstrated that level measurement is not degraded a solution shall be implemented, such as employing instruments permanently in gas-phase that consistently measure a fixed distance, enabling the inference of the dielectric constant.

4.3.7. All data from HSTS shall be monitored in the UNIT (FPSO) Supervisory System screens (SOS HMIs) through an Ethernet IEEE 802.3 channel.

4.3.7.1. In order to perform the data integration to SOS HMIs, the communication between PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel—and the Package Unit Data Servers shall be performed by Gigabit Ethernet (IEEE 802.3) through Package Unit LAN.

4.3.7.2. The communication drivers between HULL SOS RTDS (HULL PACKAGE UNITS) and HSTS, based on OPC-UA, shall be supplied and certified as OPC compliant by OPC Foundation. Since HULL SOS RTDS operate in redundancy, it shall be supplied a driver license for each Server that composes the set of Servers.

4.3.7.3. For more details, refer to I-DE-3010.2Q-5520-800-P4X-002 - AUTOMATION AND CONTROL ARCHITECTURE, I-ET-3010.00-5520-861-P4X-002 - SUPERVISION AND OPERATION SYSTEM - SOS and I-MD-3010.2Q-5520-800-P4X-003 - AUTOMATION NETWORK DESCRIPTION.

4.3.8. The HSTS shall comply with the requirements of a P2S Package described in document I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON

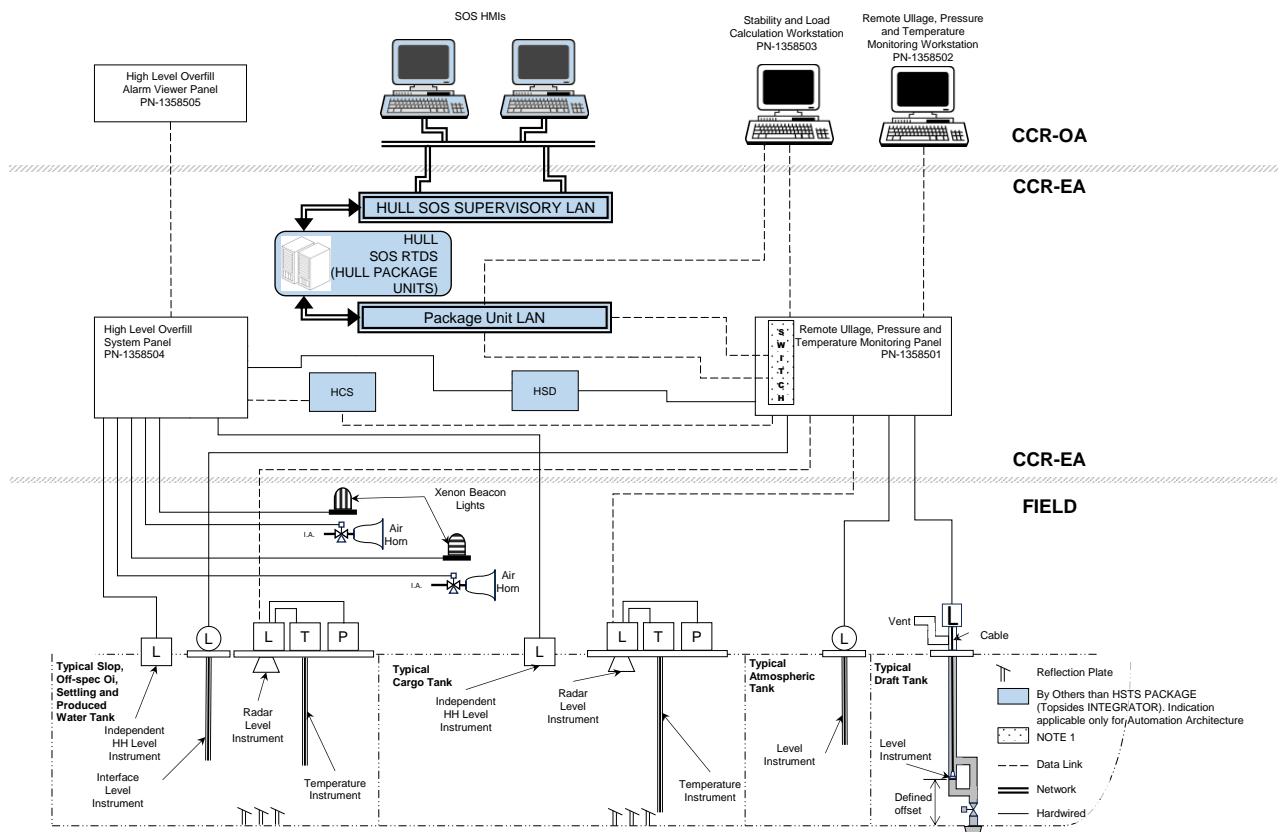
PACKAGE UNITS and I-ET-3010.2Q-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS.

4.3.9. There are requirements for equipment connected to UNIT (FPSO) Supervisory Network described in the documents referred in this specification. These are not only technical but also requirements for compatibility with, such as to follow the same manufacturer.

**4.4. System Architecture**

4.4.1. It shall be supplied a system in approved and established technologies with emphasis in use of field-proven software and hardware components.

4.4.2. The basic architecture of HSTS is described in Figure 4.4-I. It shall be included in the proposal the following structure to satisfy the requirements of this specification.




NOTE 1: refer to item 4.3.9.

**Figure 4.4-I - HSTS Automation Architecture**

4.4.2.1. Another type of architecture may be presented and subjected to BUYER approval.

**4.5. Draft Measurement System**

4.5.1. Hull draft shall be measured at six (6) positions, in both sides: forward, midship and aft. It

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shall be used either indirect or direct draft measurement by hydrostatic pressure.

4.5.2. Draft indication shall be made available at the SOS HMIs and, also, in the Stability and Load Calculation Workstation.

4.5.3. The sensors shall be intrinsically safe type and certified for hazardous areas Zone 0, Ex ia, Group IIA, T3, Ga.

4.5.4. The transmitters shall be certified for hazardous areas Zone 1, Ex ia, Group IIA, T3, Gb.

4.5.5. The draft transmitters shall be installed on the main deck and their enclosures shall have protection degree multiple coded as IP-66/IP-67 according to IEC 60529.

4.5.6. The draft sensors shall be installed immersed in the ballast tanks and have enclosure class IP68. Draft sensors shall be IP68 adequate to at least 32 meters depth.

4.5.7. The draft transmitters shall be connected to PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel. The output signals shall be 4-20 mA/HART, 24 Vdc.


#### **4.6. Remote Ullage, Pressure and Temperature Monitoring System**

##### 4.6.1. Main components of Remote Ullage, Pressure and Temperature Monitoring System

- I. Level, gas pressure and temperature measurements for inert / hydrocarbon gas blanketed tanks (Cargo, Slop, Off-spec oil, Settling and Produced water tanks).
- II. Level measurement for atmospheric tanks: Ballast, Bilge, Water (Fresh water and Distilled water), Diesel (Diesel storage and Diesel service) and Sludge.
- III. Oil-water interface level measurement for Cargo, Slop, Off-spec oil, Settling and Produced water tanks.
- IV. Remote Ullage, Pressure and Temperature Monitoring Panel (PN-1358501).
- V. Remote Ullage, Pressure and Temperature Monitoring Workstation (PN-1358502).

##### 4.6.2. Level Measurement for Inert / Hydrocarbon Gas Blanketed Tanks

- I. For each inert/hydrocarbon gas blanketed tank, the ullage (level) shall be measured by radar (FMCW), with the transmitters placed on the top of each tank.
- II. These radar level instruments may be combined with pressure sensors. If they are not combined, separate pressure sensors/transmitters shall also be supplied. The radar's antenna shall be appropriate for the measurement ranges.
- III. The sensors shall be intrinsically safe type (Ex ia) and certified for hazardous areas Zone 0, Group IIA, T3, Ga, according to IEC 60079.
- IV. The transmitters shall be certified for hazardous areas Zone 1, Group IIA, T3, Ex ia, Gb.

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- V. The transmitters' enclosures shall have protection degree multiple coded as IP-66/IP-67, according to IEC 60529.
- VI. All necessary cables to interconnect the panel to physical instruments shall be properly specified. BUYER shall confirm the length of cables required for this interconnection in the Detail Design phase.
- VII. The levels of Cargo, Slop, Off-spec oil, Settling and Produced water tanks shall be continuously monitored in the Central Control Room (Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).
- VIII. The following alarm levels shall be included in both HSTS workstation and SOS HMIs:
  - a. Low Level: To be defined during Detail Design phase.
  - b. High Level: LSH = 90%.
  - c. High High Level: LSHH = 95%.
  - d. Emergency Level: LSHHH = 98%.

#### 4.6.3. Gas Pressure Measurement for Inert / Hydrocarbon Gas Blanketed Tanks

- I. Each Cargo, Slop, Off-spec oil, Settling and Produced water tank shall have a dedicated internal pressure monitoring system. This system shall be designed to operate in a pressure range between the vacuum of 1,000 mmWC and a pressure of 2,400 mmWC.
- II. The pressure measurement may be implemented by pressure sensor combined with the radar level instruments (FMCW). In this case, the pressure sensor output may be multiplexed together with the level signal for transmission or be interconnected directly as an analog input to PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel. Another possibility is to have a pressure transmitter that houses the interconnection of temperature sensors described in item 4.6.4. From pressure transmitter the signals for pressure and temperature converge to level instrument (FMCW) and then interconnected to PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel. Any other configuration shall be presented to BUYER for analysis and approval.
- III. The sensors shall be intrinsically safe type (Ex ia) and certified for hazardous areas Zone 0, Group IIA, T3, Ga, according to IEC 60079.
- IV. The Cargo, Slop, Off-spec oil, Settling and Produced water tanks internal pressure shall continuously be monitored in the Central Control Room (Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).
- V. Whenever the vacuum is lower than 350 mmWC or the pressure is higher than 1,300 mmWC, visual and sounding alarms shall be actuated in the Central Control Room (both in Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).

#### 4.6.4. Temperature Measurement for Inert / Hydrocarbon Gas Blanketed Tanks

- I. Each Cargo, Slop, Off-spec oil, Settling and Produced water tanks shall be fitted with three (3) temperature sensors. Measurement shall be made using PT-100 temperature


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sensors fitted in fabricated thermowells in each tank. A deck connection box shall be provided at the top of each well. The temperature sensors shall be protected by a stainless steel thermowell.

- II. This system shall be designed to operate in a temperature range between 5 °C and 100 °C (Celsius degrees).
- III. Whenever the temperature of any sensor is over 80 °C or the internal tank painting maximum temperature limit (whichever is smaller), a visual and sound alarm shall be generated in the Central Control Room (both in Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).
- IV. The temperature sensors shall be positioned in the tanks as follows: one (1) sensor near the tank bottom, one (1) meter above the tank bottom plating; one (1) sensor in the middle of the tank; one (1) sensor near the tank top, 5 (five) meters below the main deck plating.
- V. The 03 (three) temperature measurements shall be continuously monitored in the Central Control Room (Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).
- VI. The sensors shall be intrinsically safe type (Ex ia) and certified for hazardous areas Zone 0, Group IIA, T3, Ga, according to IEC 60079. Since PT100 sensors are considered simple apparatus according to IEC 60079, the installation shall be described in detail in documentation to be analyzed by BUYER.
- VII. Each temperature sensor may be connected directly to the respective radar level instrument (FMCW), be interconnected to pressure transmitter and then both pressure and temperature signals are interconnected to radar level instrument or be interconnected directly as an analog input to PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel.

#### 4.6.5. Level Measurement for Atmospheric Tanks

- I. For atmospheric structural tanks: Ballast, Bilge, Diesel (Diesel storage and Diesel service), Sludge, Water (Fresh water and Distilled water) etc, the liquid level shall be measured and transmitted by submerged hydrostatic pressure sensors.
- II. The sensors shall be intrinsically safe type (Ex ia) and certified for hazardous areas Zone 0, Group IIA, T3, Ga and the transmitters shall be certified for hazardous area Zone 1, Group IIA, T3, Ex ia, Gb, according to IEC 60079.
- III. The transmitters' enclosures shall have protection degree multiple coded as IP-66/IP-67 and the sensors enclosures shall have protection degree IP-68, according to IEC 60529. The depth required to IP-68 for the level sensors shall be at least 4 (four) meters, respecting the sensor position in relation to the full tank level. For certification purposes the duration of the immersion test shall be 20 days.
- IV. The sensors shall have blockage valves to allow proper maintenance, not requiring changes of tank level.
- V. The analog output signals shall be 4-20 mA/HART, 24 Vdc.
- VI. All necessary cables to interconnect the PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel—to the physical instruments shall be specified including

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required entity parameters. If HSTS package and cable distribution are not under the same contract, then BUYER shall confirm the length of cables required for this interconnection in the Detail Design phase.


VII. The atmospheric tanks levels shall be continuously monitored in the Central Control Room (Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).

4.6.6. The following alarm levels shall be included both HSTS workstation and SOS HMIs:

- I. Low Level: To be defined by during Detail Design.
- II. High Level: LSH = 90%.
- III. High High Level: LSHH = 95%.
- IV. Emergency Level: LSHHH = 98%.

4.6.7. Oil-water interface level measurement for Cargo, Slop, Off-spec oil, Settling and Produced water tanks.

- I. For Cargo, Slop, Off-spec oil, Settling and Produced water tanks, the oil-water interface liquid level shall be measured and transmitted by an oil-water interface level transmitter.
- II. The sensors shall be intrinsically safe type (Ex ia) and certified for hazardous areas Zone 0, Group IIA, T3, Ga and the transmitters shall be certified for hazardous area Zone 1, Group IIA, T3, Ex ia or Ex db, Gb, according to IEC 60079.
- III. The enclosures shall have protection degree multiple coded as IP-66/IP-67 according to IEC 60529.
- IV. The technology of the sensors shall be energy absorption. Each service shall be analyzed to determine the number of points to measure interface (interface level switches) and where it shall be used a profiler to measure the interface within a range.
- V. Seal housing devices shall be available for maintenance and range adjustment of the transmitters without need to stop the process. Design and sizing shall be according to manufacturer. Special tools for removal and maintenance shall also be supplied.
- VI. Enough space shall be foreseen around the level transmitter flange, so that the probe may be inserted / removed from the tank easily.
- VII. The height of the sensor inside the tank shall be determined for each tank during detailed engineering design phase between Operation, Naval Systems and Automation.
- VIII. All necessary cables to interconnect the PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel—to physical instruments shall be properly specified. If HSTS package and cable distribution are not under the same contract BUYER shall confirm the length of cables required for this interconnection in the Detail Design phase.
- IX. The Cargo, Slop, Off-spec oil, Settling and Produced water tanks oil-water interface levels shall be continuously monitored in the Central Control Room (Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS HMIs).

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#### 4.6.8. Remote Ullage, Pressure and Temperature Monitoring Panel (PN-1358501)

- I. The Remote Ullage, Pressure and Temperature Monitoring Panel shall be installed indoors, in air-conditioned area, at CCR-EA and shall be in accordance with I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS. The Panel shall be supplied fully assembled and tested.
- II. Cabinet configurations shall be based on a modular size of 800 mm (W) x 800 mm (L) x 2100 mm (H), with a maximum of two modules fixed together for shipping purposes.
- III. The PN-1358501—Remote Ullage, Pressure and Temperature Monitoring Panel—shall be composed of dedicated power supply, programmable logic-controllers, I/O cards, network cards, Ethernet switches and any other equipment necessary for the data acquisition, logic execution and data transmission to the Remote Ullage, Pressure and Temperature Monitoring Workstation and SOS Package Unit Data Servers.
- IV. Remote Ullage, Pressure and Temperature Monitoring Panel shall be certified by the Classification Society.
- V. For other requirements for Remote Ullage, Pressure and Temperature Monitoring System, see I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and I-ET-3010.2Q-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS.


#### 4.6.9. Remote Ullage, Pressure and Temperature Monitoring Workstation (PN-1358502)

- I. The System shall be supplied with a Remote Ullage, Pressure and Temperature Monitoring Workstation, composed of a computer running an operating system and a supervisory software, able to display all the variables and alarms related to the Remote Ullage, Pressure and Temperature Monitoring System (level, pressure, temperature, ullage and draft measurements and alarms).
- II. The Remote Ullage, Pressure and Temperature Monitoring Workstation shall be supplied as an industrial microcomputer for use in offshore environmental conditions with one 24" video monitor, hard disk, ABNT2 keyboard and optical mouse – all of them wired – and 100/1000 Mbps Ethernet IEEE 802.3 network interface cards. Processor type, hard disk type/space and memory shall be according to the use of the necessary software in its maximum performance configuration. Use of refurbished, used or economy-line equipment is forbidden.
- III. The Remote Ullage, Pressure and Temperature Monitoring Workstation shall be installed in CCR-OA. All interconnection cables shall be supplied by HSTS SUPPLIER.

#### 4.7. Stability and Load Calculation Workstation (PN-1358503)

4.7.1. As per Classification Society requirements, it shall be provided an independent computer with a system capable to perform loading calculations such as bending moment and shear forces, stability on normal or damaged conditions.

4.7.2. The Loading Calculator shall acquire on-line data from Remote Ullage, Pressure and Temperature Monitoring System and Draft Measurement System, and shall be able to use that information online and offline. Draft and trim corrections shall be done automatically within the

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system.

4.7.3. Loading Calculator software shall comply with the requirements from IP/API for calculations and naming.

#### **4.8. High Level Overfill System**

4.8.1. Each Cargo, Slop, Off-spec oil, Settling, and Produced water tanks shall be fitted with a High Level Overfill System independent from Remote Ullage, Pressure and Temperature Monitoring System, in accordance with Classification Society rules.

4.8.2. The High Level Overfill System shall be composed of level instruments for each above-mentioned tank and an Alarm panel located at CCR-OA.

4.8.3. The principle of operation of level instrument from item 4.8.2 may be capacitive switches or other technology as long as it is approved by BUYER. The instrument signal shall not be based on voltage level.

NOTE: From previous experience, signals based on voltage level is highly susceptible to noise degradation.

4.8.4. For each level measurement, two (2) alarm levels shall be generated: High High Level (LSHH—95%) and Emergency Level (LSHHH—98%).

4.8.5. The sensors shall be intrinsically safe (Ex ia) type, and certified for hazardous areas Zone 0, Group IIA, T3, Ga, according to IEC 60079.

4.8.6. The instrument enclosures shall have IP protection degree according to I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.


4.8.7. All necessary cables to interconnect the PN-1358504—High Level Overfill System Panel—to physical instruments shall be specified including required entity parameters. If HSTS package and cable distribution are not under the same contract, then BUYER shall confirm the length of cables required for this interconnection later in the Detail Design phase.

4.8.8. The independent level instruments shall be connected to PN-1358504—High Level Overfill System Panel—and then to CSS-HSD. This connection to CSS-HSD shall be done through hardwired signals following what is defined in I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.

4.8.9. Xenon beacon lights of different colors and air horn shall be provided, to be installed on main deck, in order to alarm in case of High High (95%) or Emergency Level (98%) in any Cargo, Slop, Off-spec oil, Settling or Produced water tanks, in accordance with Classification Society (CS), SOLAS and MARPOL Requirements. These lights and horn shall be connected to PN-1358504—High Level Overfill System Panel.

#### **4.9. Portable Closed Ullage Manual Measuring Systems**



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4.9.1. It shall be supplied two Portable Closed Ullage Manual Measuring Systems, and the necessary tank fittings, to be used as manual level measurement system for Cargo, Slop, Off-spec oil, Settling and Produced water tanks.

4.9.2. The necessary tank fittings include tank penetration pieces on Main Deck, ball valves, adaptors for connection of instruments, and weather protection caps.

4.9.3. Each portable closed ullage manual measuring system shall consist of a densimeter, an oximeter, an H<sub>2</sub>S meter, a hydrocarbon meter (tankscope), an ullage sensor, a thermometer, a portable oil-water interface sensor and a sampler (min. 1000ml sample bottle).

4.9.4. The ball valves shall be locked closed. They shall be installed on Main Deck above the tanks as per I-DE-3010.2Q-1350-944-P4X-005 - TANK LEVEL, PRESSURE, TEMPERATURE AND FLOODING INDICATION SYSTEM.

4.9.5. Adaptors for connection of each instrument to the valves shall be supplied.

4.9.6. Weather protection caps shall be supplied in order to protect the necessary tank fittings.

4.9.7. Ball valves and weather protection caps shall have their material specifications approved by BUYER.

4.9.8. All systems shall be intrinsically safe (Ex ia) type, suitable to operate in Zone 0, Group IIA, T3, Ga, (CS approved type certificate) and the installation design and work shall be approved by the Classification Society on site, as well.

4.9.9. The equipment shall be mounted and used on deck and shall be waterproof type, suitable to be exposed to the sunrays and to the marine environment.

4.9.10. Electrical/electronic equipment and instruments enclosures for use on deck shall have protection degree multiple coded as IP-66/IP-67.

4.9.11. The oil-water interface sensor and sampler shall be able to measure and sample from tanks top to bottom.


#### **4.10. Accessories and Tools**

4.10.1. Junction Boxes shall comply with requirements of I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.

4.10.2. Spare parts shall be in suitable quantities for system maintenance during UNIT (FPSO) life cycle.

#### **4.11. Cabinet Project**

4.11.1. All panels shall be in accordance with I-ET-3010.00-5520-888-P4X-001 -

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AUTOMATION PANELS.

#### 4.12. Interface with CSS and SOS

4.12.1. Since HSTS is a P2S package-unit, it has hardwired connections with CSS and network connections (Ethernet IEEE 802.3) with SOS.

4.12.2. The hardwired interface with CSS is described in I-ET-3010.2Q-1200-800-P4X-014 - AUTOMATION INTERFACE OF PACKAGED UNITS.

4.12.3. All HSTS data shall be available at SOS HMIs, besides in its panels and workstation.


#### 4.13. Constructability

4.13.1. It shall be foreseen facilities / available space for removal for maintenance of all instruments installed in tanks during operation phase. Also, the instruments installation location shall be defined in Detail Design phase including as premises the aforementioned facilities and available space.

4.13.2. Prior to integration into the overall CSS, the HSTS shall be available on a standalone basis for early marine operations such as towing to the Topsides integration yard. The Remote Ullage, Pressure and Temperature Monitoring Workstation shall be capable of being temporarily located at an existing temporary control room during early marine operations.

#### 4.14. Documentation

4.14.1. The relevant related P&IDs are I-DE-3010.2Q-1350-944-P4X-005 - TANK LEVEL, PRESSURE, TEMPERATURE AND FLOODING INDICATION SYSTEM, I-DE-3010.2Q-5115-944-P4X-002 - FRESH, HOT AND POTABLE WATER SYSTEM, I-DE-3010.2Q-5133-944-P4X-003 - DIESEL OIL PURIFIER AND SERVICE SYSTEM, I-DE-3010.2Q-5133-944-P4X-004 - DIESEL OIL STORAGE SYSTEM, I-DE-3010.2Q-5330-944-P4X-001 - BILGE, SLUDGE, BALLAST (AFT) AND GENERAL SERVICE SEAWATER SYSTEM and I-DE-3010.2Q-6650-944-P4X-001 - DRAUGHT, TRIM AND HEEL INDICATION SYSTEM. Other documentation may be asked if necessary.

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## 5. DOCUMENTATION

### 5.1. General

5.1.1. All supplied documents shall be text searchable.

### 5.2. At proposal

5.2.1. Complete documentation of the HSTS, covering all devices and services, shall be supplied with the proposal, for approval, and for final acceptance.

5.2.2. It shall be supplied with the proposal at least the following technical documents:

- I. Technical specifications, comprising: system, equipment, accessories, cables, materials and software.
- II. Datasheets and brochures for each equipment, instrument and instrumentation accessories essential for instrument functioning.
- III. All equipment and installation data including: material list, equipment list, spare part list, power consumption and heat dissipation, weight, software manual, panel layout, system layout etc.
- IV. Complete description of services, training courses, tests etc.


### 5.3. During detailing and for final acceptance

5.3.1. A complete documentation of the HSTS, covering all devices and services, shall be supplied for final acceptance.

5.3.2. It shall be supplied for approval along with the HSTS itself at least the following technical documents:


- I. Technical specifications, comprising: system, equipment, accessories, cables, materials and software.
- II. Datasheets and drawings for each equipment, instrument and instrumentation accessories essential for instrument functioning.
- III. Installation drawings including general arrangement, electrical diagrams, wiring diagrams, cable list, material list, equipment list.
- IV. Test procedures, training course program, services schedule.
- V. Programming tools, system reports, system diagnosis etc.

5.3.3. Complete HSTS certified documentation, including operation manual, installation manual and maintenance manual shall be provided as requested at BID documents, including all

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programming, configurations software and commented source codes.

5.3.4. The commented programming, configuration and source codes are mandatory, to be kept during the UNIT (FPSO) lifecycle.

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## 6. ACCEPTANCE TESTS

### 6.1. General

6.1.1. It shall be submitted to BUYER, for approval, detailed FAT, SAT and SIT programs at least 60 (sixty) days in advance of respective programmed test date.

### 6.2. Factory Acceptance Test—FAT—

6.2.1. The following tests shall be performed at FAT prior to delivery:

- I. Visual Inspection.
- II. Input and output signal levels verification.
- III. Functional test.

### 6.3. Site Acceptance Test—SAT— & Site Integration Test—SIT—

6.3.1. After the installation of the system the above tests listed in item 6.2 (FAT) shall be repeated at the Site Acceptance Test (SAT). For Site Integration Tests (SIT) refer to IEC 62381 - AUTOMATION SYSTEMS IN THE PROCESS INDUSTRY - FACTORY ACCEPTANCE TEST (FAT), SITE ACCEPTANCE TEST (SAT) AND SITE INTEGRATION TEST (SIT).