PETROBRAS	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-5521-931-PEA-001	
	CLIENT: ESUP		SHEET: 1 of 20
	JOB: ENVIRONMENTAL MONITORING		
	AREA: -		
SUB	TITLE: METOCEAN DATA ACQUISITION SYSTEM		INTERNAL
			SSUB/GDSO/STGO

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REVISION INDEX

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0	ORIGINAL ISSUE
A	REVISED WHERE INDICATED

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DATE	APR/01/22	OCT/25/20022							
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1. SUBJECT

1.1 This document provides the minimum requirements to be followed by CONTRACTOR regarding design, manufacturing of structures and installation of the Environmental Data Acquisition System (ENV System) to be used in Floating, Production Storage and Offloading (FPSO) platforms deployed in Brazilian offshore basins. The abbreviation ENV refers to the word “Environmental”.

2. ABBREVIATIONS

CCR	Central Control Room
IEC	International Electro-Technical Commission
NMEA	National Marine Electronics Association
OCEANOP	Meteorological-Oceanographic Data Collection Operational System
POS	Positioning Reference Systems for DP Shuttle Tanker Operations
UCD	Data Collection Unit
EPTA	Telecommunication Services and Air Traffic Stations
HMS	Helideck Monitoring System
ENV	Environmental Data Acquisition System
DADAS	DADAS - Environmental Monitoring Software
FAT	Factory Acceptance Test
UPS	Uninterruptible Power Supply
FPSO	Floating, Production Storage and Offloading

3. REFERENCE DOCUMENTS, CODES AND STANDARDS

3.1 The installation and the equipment shall comply with rules and recommendations of the classification society, as well as following technical standards in their latest versions.

a. IEC-60079 – Electrical Devices for Explosive Gaseous Atmospheres;
b. NMEA 0183 – Standard for Maritime interface between electronic devices;
c. ICA 63-10: *Estações Prestadoras de Serviços de Telecomunicações e de Tráfego Aéreo* – EPTA;
d. MCA 101-1: *Instalação de Estações Meteorológicas de Superfície e de Altitude*;
e. NORMAM-27: *Normas da autoridade marítima para homologação de helideques instalados em embarcações e em plataformas marítimas*.

3.2 Brazilian Standards

a. Portaria INMETRO nº 115 (21/março/2022): Regulamento de avaliação da conformidade de equipamentos elétricos para atmosferas potencialmente explosivas, nas condições de gases e vapores inflamáveis e poeiras combustíveis.

b. NR-10: Segurança em instalações e serviços em eletricidade

c. NR-37: segurança e saúde em plataformas de petróleo

d. ANATEL: Resolutions from Agência Nacional de Telecomunicações.

4. GENERAL REQUIREMENTS

4.1 For PETROBRAS detailed design requirements for Installation, Configuration, Tests training and commissioning CONTRACTOR shall comply with the Technical Specification I-MD-3010.00-5510-760-PPT-001 – GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN.

4.2 For telecommunications symbols, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-0000-940-P4X-002 – SYMBOLS FOR PRODUCTION UNITS DESIGN.

4.3 For telecommunications TAGs, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

4.4 All electrical requirements for telecom package shall be in accordance with I-ET-3010.00-5140-700-P4X-003 – ELETRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE, I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS, I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS and I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.

4.5 All systems shall be installed in appropriated rack in the Telecommunication Upper Room of the Accommodation Module.

4.6 The Environmental Data Acquisition System monitors and computers shall be installed inside the CCR – Central Control Room and Radio Room.

4.7 All details of designs, materials, structures, installation (including communication wiring and the installation of junction boxes, assemblies, documentations, tests and commissioning are included in the CONTRACTOR's scope of deliveries, unless when specified otherwise herein. Moreover, the elaboration of a schedule for the delivery of designs, technical drawings, installation and commissioning reports and reports on test procedures are under the CONTRACTOR's responsibility. All documents are to be submitted for the PETROBRAS' approval.

4.8 The ENV System shall be designed, manufactured, tested and certified according to the Rules of the Classification Society, when applicable. The commissioning and functional tests shall be done by the supplier.

4.9 PETROBRAS shall approval the detailed design for validation the locations for installation of sensors.

4.10 CONTRACTOR shall also provide any explanations requested by PETROBRAS.

4.11 Upon commissioning, the ENV System shall be a Data Collection Unite (or Unidade de Coleta de dados, UCD in Portuguese) for PETROBRAS' Meteorological-Oceanographic Data Collection Operational System (OCEANOP) operating in several exploration and production units. The UCD sensors, the data collection methods and the data acquisition and processing software shall be standardized in order to operate with the OCEANOP System.

4.12 Any modifications in this specification regarding the model or manufacture of any equipment or structure and the lack of parts of the system shall be submitted for the PETROBRAS' approval.

5. SYSTEM DEFINITIONS

5.1 Each Petrobras oil production unit has an ENV system composed of meteorological and oceanographic sensors called UCD. Collected data is sent to a database and goes through an automatic qualification system. A manual qualification is also carried out by a team of oceanographers and meteorologists. Qualified data is stored in a database and made available on a web page to the entire company in near real time.

5.2 Meteorological sensors are part of the EPTA-M (Station Providing Telecommunications and Air Traffic Services category M) and of the HMS (Helideck Monitoring System), which also has a motion sensor.

5.3 Meteo-oceanographic data is used for planning and monitoring of vessel operations, consulting for accident investigation, underwater operations planning (diving and equipment installation), engineering projects, contingency cases (man overboard and oil spill), among others.

5.4 Some production units, according to the rules of the field bidding, have a requirement to monitor environmental data for the Operating License with the Brazilian environmental agency (IBAMA).

6. TECHNICAL REQUIREMENTS

6.1 The ENV System shall measure, present, store and transmit meteorological data (wind intensity and direction, air temperature, atmospheric pressure and relative humidity of air) and oceanographic data (intensity and direction of sea currents; height, direction and period of waves) to other systems.

6.2 Data on sea currents shall be measured by acoustic profilers and fixed current meters and the meteorological data shall be measured by a multi-parameter meteorological station.

6.3 CONTRACTOR shall be responsible for the acquisition of the DADAS license software that will be responsible for integrate the meteorological and oceanographic sensors information.

6.4 This system works without the intervention of an operator and restarts automatically after power outages. The oceanographic and meteorological sensors shall be controlled solely by DADAS, whereas the use of computers or additional software shall not be accepted.

6.5 The ENV System shall receive the navigation data (from GNSS and AHRS sensors) of the Positioning and navigation System and of the gyroscope system,

which shall be used for synchronization of time and bow angle, so as to correct information regarding the direction of meteorological-oceanographic sensors.

6.6 The data collected shall be processed and presented locally in real time on onboard displays. The data shall also be available in the CCR and in the Radio Room.

6.7 The data also shall be transmitted through PETROBRAS corporate network to the headquarter of the OCEANOP System onshore in order to qualify and provide the information to several of PETROBRAS' applications.

6.8 The HMS and EPTA Class "M" standards are included in the ENV system. These standards are covered in the ICA 63-10 and NORMAM-27 regulations. The ENV system replication in the radio room, with appropriated access in the screen to the radio operator, shall be configured to display EPTA Class "M" and HMS information only.

6.9 The Helideck Monitoring System – HMS shall be integrated in the ENV system and provide wind speed (direction, intensity and gusts), ambient temperature, helideck movements in real-time, data storage, reporting tools and critical alarms. It aims to assist in the safety of air operations.

6.10 The motion sensors shall be positioned on the floor of the helideck. If this is not possible, the values presented for pitch, roll, heave, heave rate and inclination shall be corrected for the height and position of the helideck, while thermometers and Wind sensors shall be installed, mandatorily, close to the helideck.

6.11 CONTRACTOR shall be responsible for the supply and installation of the computer of the meteorological and oceanographic sensors of their electronic components, as well all other materials between the computer and the sensor.

6.12 Helideck status light is an alert visual system aid shall be installed as an aid to warn of conditions that may be dangerous to the helicopter or its occupants.

6.13 The helideck status light consists of a red light, flashing, installed close to the AAFD limit line, there may be, also, in other locations of the UNIT, so that it is visible in any direction of approach of the aircraft.

6.14 The status light when turned on will mean that the helideck does not offer safe conditions for aircraft operation. When the status light is off it means that there is a safe condition to operate on that helideck.

6.15 The status light shall be activated manually by the Radio Operator in the conditions:

a. When the parameters required in the HMS exceed the limits stipulated by NORMAN-27, or

b. From the Fire and Gas panel when the platform is in emergency situation.

6.16 CONTRACTOR shall be responsible for all materials include accessories for the installation of wiring, over-water and underwater communication cables, power

cables, interfaces, racks, steel cables, switchboards, cages, crane, ballasts, connectors, adaptors, junction boxes, foundations, structures, clamps and supports for fixating the sensors, sensor handling and recovery devices, tools, installation accessories, paints, ropes and any other necessary items.

6.17 The manuals of the sensors shall be followed, especially regarding the assembly inclination angle (minimum inclination is preferable) and rotation.

6.18 CONTRACTOR shall use the 3D simulation software for locations of the installation sensors and the interaction of the underwater bundles of the current profiler with the underwater structures of the unit.

6.19 The ENV system shall be powered by the FPSO UPS in 220 VAC/60 Hz and other voltages (12 VDC and 24 VDC) to power the equipment and sensors, shall be obtained internally in the package with the use of rectifiers.

6.20 The manufacturing and the installation of the ENV System structures under the responsibility of CONTRACTOR shall be done in such a way as to facilitate maintenance and make it safe and effective. Means for recovering the sensors for cleaning and maintenance shall be made available in proper work platform and with safe devices for handling and lifting equipment.

6.21 As per required by I-ET-3010.00-1351-140-P4X-002 DIGITAL TWIN FOR HULL STRUCTURAL INTEGRITY MANAGEMENT, information from Metocean System shall be forwarded by LAN to HSHMS System.

7. SCOPE OF SUPPLY

7.1 The meteorological sensors shall be part of a “Estação Prestadora de Serviços de Telecomunicações e Tráfego Aéreo (EPTA) categoria M” which is regulated by ICA 63-10.

7.2 CONTRACTOR shall follow the regulations of the Brazilian Air Force for the EPTA installation and operation.

7.3 The sensors installation site shall be in accordance with MCA 101-1.

7.4 After installing the meteorological sensors, CONTRACTOR must provide the linear offset measurements for each sensor.

7.5 WIND INTENSITY AND DIRECTION

7.5.1. CONTRACTOR shall supply four wind sensors. Two shall be installed at the highest point near the helideck, other at the highest point at the bow of the FPSO and another stand in spare. The wind sensor is not restricted by its make and model. It shall have the following specification or greater precision

7.5.2. Take a measuring range from 0 to 60 m.s-1 for intensity and 0 to 360° for direction; the accuracy of 0.3 m.s-1 or 1% of reading for speed and 3° for direction; and the temperature limit of its operation is plausible with the expected temperature where the FPSO will operate.

7.5.3. As a reference PETROBRAS uses Anemometer 05106 Marine Model of R.M. Young with line driver and current loop outlet, installed at the highest point near the helideck. At the bow of the FPSO uses RM Young 05501 L.M Model, which is an intrinsically safe version, suitable for use in hazardous areas, if necessary.

7.5.4. Installation note: The sensors shall be installed in two different places, both of which shall be totally free of any interference for the circulation of the wind such as antenna radars, towers, buildings, stairs, chimneys or flares. The best places are the highest points in the units, which are generally the telecommunications towers. Even when on such towers, the anemometers shall be installed above any other structure, such as windsocks. Poles can be fixated in order to install the anemometers.

7.5.5. In order to facilitate the maintenance of the anemometers, the support pole shall be telescopic and have a mechanism so that it does not rotate around its own axis. CONTRACTOR shall indicate the direction of the unit on the pole supporting the anemometer in order to facilitate the heading of the sensor during maintenance.

7.5.6. For this sensor, CONTRACTOR needs to supply the gyroscope system signal on the computer to correct the information measured data.

7.5.7. The spare anemometer shall be for use in hazardous areas, if necessary.

7.6 RELATIVE HUMIDITY AND TEMPERATURE PROBE AND BAROMETRIC PRESSURE SENSOR

7.6.1. CONTRACTOR shall acquire two sensors from each, one shall be installed and the other shall stand in spare. The sensors are not restricted by its make and model. It shall have the following specification or greater precision.

7.6.2. The relative humidity and temperature probe shall be installed with radiation shield. Take a measuring range from 0 to 100% to relative humidity and -10 to 50°C to temperature; Have accuracy of 1% of reading for relative humidity and of 0,3°C for temperature.

7.6.3. The barometric pressure sensor shall be installed with pressure port. Take a measuring range from 500 to 1100 hPa; with accuracy of 0.3 hPa; and the temperature limit of its operation is plausible with the expected temperature where the FPSO will operate.

7.6.4. As a reference, PETROBRAS uses relative humidity and temperature probe of R.M. Young model 41382LC with a “radiation shield” model 41003P or VAISALA model HMP155 with a “radiation shield” model DTR503 and barometric pressure

sensor of R.M. Young model 61402L with pressure port model 61002 and weather-proof box model 61360.

7.6.5. Installation note: These sensors shall be installed far from heat sources such as air vents and exhausts, and in place of free atmospheric circulation. They shall be installed in accordance with premises in MCA 101-1.

7.7 WEATHER DISPLAY

7.7.1. Weather display should connect the sensors to the computer. The weather display shall show and transmit weather data through two serial ports in the format below.

II.I DDD II.I DDD II.I DDD TT.T UUU PPPP.P, where:

II.I: wind intensity (in $m.s^{-1}$)

DDD: wind direction (in degrees)

TT.T: air temperature (in °C)

UUU: relative humidity (in %)

PPPP.P: atmospheric pressure (in mb)

7.7.2. As a reference, PETROBRAS uses R. M. Young model 26800H Programmable Translator, interconnection cables and line filters.

7.7.3. Installation note: preferably, weather display should be installed in the rack dedicated to the ENV system. Its setting shall be in compliance with the DADAS requirements and, for these purposes. PETROBRAS can be consulted in order to provide guidance about this matter.

7.8 OCEANOGRAPHIC SENSORS

7.8.1. VERTICAL CURRENT PROFILER

7.8.1.1. CONTRACTOR shall install an Acoustic Doppler Current Profiler (ADCP) that has at least a maximum range of 1000 m. Whereas operating should profile at least 700 m.

7.8.1.2. The Vertical Current Profiler shall be capable of configuring the depth cell size between 16 and 20 m, velocity accuracy of 1% of measured value ± 5 mm.s-1, velocity resolution of 1 mm.s-1 and velocity range of ± 5 m.s-1.

7.8.1.3. This sensor is operated by DADAS server and communication between ADCP and serial device server shall be in two-ways (sensor to server and server to sensor).

7.8.1.4. There are two Vertical Current Profilers that PETROBRAS uses, Acoustic Doppler Current Profiler (ADCP) models Pinacle 45 kHz real time of Teledyne RD Instruments or Signature55 of Nortek.

7.8.1.5. The following items are included: maintenance kit, operation manual, transducer serial outlet and control cable of the ENV system with a connection for underwater extensions at the tip of the transducer, a power cable, an interconnection cable, spare parts and the software of sensors.

7.8.1.6. Installation Notes: Instrumentation places with obstacles to the acoustic bundles and side lobes of the current profilers should be avoided. The support structure of the sensors shall be constructed and positioned so as to not create this type of obstacle.

7.8.2. **CURRENT METER**

7.8.2.1. CONTRACTOR shall install a Current Meter that has accuracy of 1% or 5 mm.s-1 to velocity and 2° to direction; range of 0 to 5 m.s-1 to velocity and 0 to 360° to direction.

7.8.2.2. As a reference, PETROBRAS uses the Aquadopp Mooring of Nortek.

7.8.2.3. This sensor is operated by DADAS server and communication between Current Meter and serial device server shall be in two-ways (sensor to server and server to sensor).

7.8.2.4. Installation notes: Current meter shall be installed in the same cage as the current profiler.

7.8.3. **WAVE SENSOR**

7.8.3.1. CONTRACTOR shall install an equipment to evaluate the wave direction, period and height. In order to better quantify the wave measurements, the equipment needs to remove the FPSO movements from the data. Wave data has range of 0 to 30 m to height, 3 to 30 s to period and 0 to 360° to direction.

7.8.3.2. The equipment shall be installed following the guidelines established by the manufacturer, especially in relation to the recommended height in relation to sea level and the free area of structures around the sensor.

7.8.3.3. The equipment module, installed externally, shall be controlled solely by the DADAS software.

7.8.3.4. Installation Notes: installation should be as recommended in the installation manual. Preferably, in order to facilitate of maintenance, they should be installed for easy access to your modules.

7.8.4. **ATTITUDE SENSOR**

7.8.4.1. CONTRACTOR shall follow Brazilian Navy regulations to procure and install the attitude sensor according to NORMAM-27. The sensor shall be installed under the helideck center or as close as possible provided that the information is displayed referenced to the helideck center.

7.8.4.2. The sensor shall have at least three accelerometers assembled orthogonally. It shall have the following specifications or better:

a. Attitude – accuracy and precision of 0.1° RMS (Root Mean Square) between 0° and 3.5° for pitch and roll angles. Range of at least ± 20°.

b. Heave – accuracy and precision of ± 0.1 meters. Range of at least ± 10 meters.

c. Average heave rate – accuracy and precision of 0.1 $m.s^{-1}$ RMS (Root Mean Square) between 0 and 1.3 $m.s^{-1}$.

7.8.4.3. The sensor shall have the protection class IP66 or upper of its enclosure and connector.

7.8.4.4. After installing the attitude sensor, CONTRACTOR must provide the linear and angular offset measurements of this sensor, the geometric center designed of the FPSO and the center of the helideck.

7.9 **COMPUTERS AND RACK**

7.9.1. **COMPUTERS**

7.9.1.1. It shall be supplied and installed 04 (four) computers. All shall be installed for exclusive use of the ENV System. These computers shall receive the standard PETROBRAS image installed by PETROBRAS and shall be connected to the PETROBRAS network and be used exclusively as part of the OCEANOP System.

7.9.1.2. (02) two industrial computers shall have the minimum requirements below:

a. Processor: Clock of 3 GHz or high
64 bits
Shall support virtualization technology

b. Memory: 16 GB or high
   Standard DDR4 or high
   Frequency 2100 MHz or high
c. Hard disk: 1TB
   Interface SATA
d. Watchdog Card
e. 04 USB v3.0 ports or high
f. 03 Ethernet ports (10/100/1000baseT)
g. Video card with PCI Express X16 with 02 GB RAM (minimum)
h. Operational system: Windows 10 Professional 64 bit or higher, license in Portuguese.
i. Keyboard with built-in mouse for 19" rack
j. Industrial LCD monitor for assembly on 19” rack, resolution 1280x1024 or higher

7.9.1.3. CONTRACTOR is responsible for any Windows version and hardware upgrade required by PETROBRAS.

7.9.1.4. Additionally, a serial device server (MOXA NPort 5600 Series) with minimum 8 serial ports is required. The NPort shall connect all the sensors.

7.9.1.5. Both computers shall be connected with the serial server that will be connected meteorological station, oceanographic sensors and AHRS via standard serial RS-232 with the DB9 or RJ45 connector. CONTRACTOR shall provide the proper converters to translate the signals to RS-232. All sensors installed shall provide data exclusively to the computer dedicated to the ENV System.

7.9.1.6. CONTRACTOR shall request PETROBRAS for the sensor test procedure according to the setting accepted by DADAS. These tests can be performed in the software of the manufacturers of each sensor. The computer of the ENV System shall be connected to the Platform’s UPS.

7.9.1.7. The industrial computers and all sensor control equipment shall be installed in a 19" rack. At PETROBRAS’ discretion, new instrumentations may receive Ethernet-serial conversion modules as substitutes for the computers. CONTRACTOR shall acquire both (computer and conversion module specified by PETROBRAS).

7.9.1.8. CONTRACTOR is responsible for supplying all software and hardware as well as for their settings, so as to unite the data from the ENV System and present them in appropriate format in the computer. This includes all corresponding integrations.

7.9.1.9. The others (02) two computers shall be standard with minimum: operational system Windows 10 Professional, or newer version, in Portuguese; to be installed software Dadas Client; monitor 24''; keyboard and mouse. CONTRACTOR is responsible for any version upgrade required by PETROBRAS. These computers will be installed at CCR and Radio Room, connect to PETROBRAS network and they shall follow technical specifications of I-ET-3010.00-5511-768-PPT-001 IT EQUIPMENTS.

7.9.2.10 CONTRACTOR is responsible for any Windows version and hardware upgrade required by PETROBRAS.

7.9.2. **DATA VIEWING SOFTWARE**

7.9.2.1. CONTRACTOR shall provide the meteorological-oceanographic data in the acquisition and display software DADAS by A+D (www.automasjon.no) in PETROBRAS' version. For this, a software license shall be bought and installed in one of the industrial computer. The software shall be kept for the whole system operation period. The purchased license shall be able to work with 500 variables and 6 simultaneous Clients.

7.9.2.2. The system (computer + DADAS) shall be installed and the sensors acquire and store data.

7.9.3. **ENV SYSTEM RACK**

7.9.3.1. CONTRATOR shall provide and install (01) one CLOSED RACK, for all ENV SYSTEM indoor equipment installation. This rack shall follow the specifications below:

a. It shall be closed, 19 inches standard, 42U height, minimum depth of 1000 mm (internal dimensions) and 800 mm of useful width (internal dimensions).

b. It shall have AC universal standard sockets for 19 inches standard. This AC universal standard sockets shall be equipped, at least, 04 (four) AC outlets in additional for PETROBRAS future use.

c. Glazed door at the front: Single-pane safety glass, 3 mm, including 130° hinge, and security lock;

d. Sheet steel bi-parting rear door, including 130° hinge and security lock;

e. A cooling system shall be installed for each cabinet and it shall be composed by 02 (two) fans on the bottom to inflate cold air inside and 02 (two) fans on the top to exhaust heated air to be collected by exhausters on ceiling. Additional clarifications for HVAC at I-MD-3010.00-5510-760-PPT-001 GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN. Vertical cable organizer, for RF cables and controllers cable;

f. Vertical cable organizer, for RF cables and controllers cable;

g. Internal light only on the rear access;

h. Complete earthing Kit;

i. Color: RAL 7035.

7.9.3.2. ENV SYSTEM equipment shall be connected to both Unit´s UPS bus bar A and B by means of an ATS device with enough outputs outlets to power each required equipment**.**

7.9.3.3. Automatic Transfer Switch (ATS) features required:

a. The ATS device shall provide reliable, redundant power to single-corded equipment loads. The ATS device shall have 02 (two) input power cords supplying power to the connected loads.

b. The ATS device shall have has built-in network connectivity, which allows for remote management via Web, Telnet, SNMP and SSH.

c. Input: 02 (two) inputs for two separate power sources (A, B).

d. Outputs: 08 (eight) outputs (minimum) to power equipment.

e. Transfer time: 10ms maximum.

f. Visual singling operation mode indication by frontal LEDs.

g. 19” standard for rack installation.

7.9.3.4. The ENV computer and the weather display shall be installed in the rack and connected to the environmental sensors.

7.9.3.5. The rack shall be installed close to the POS rack in the Telecommunication Upper Room.

7.9.3.6. Annex presents a diagram exemplifying the connections between the meteorological and oceanographic instruments, the computer and the PETROBRAS network.

7.10 **HMS – Helideck Monitoring System**

7.10.1. It shall be supplied a complete HMS – Helideck Monitoring System complying with Brazilian Civil Aviation Authorities regulations.

7.10.2. During Hook up operation in Brazil the meteorological and attitude sensors shall be calibrated for less than 6 months.

7.11 **Helideck Status Light**

7.11.1. It shall be supplied a complete helideck status light complying with Brazilian Navy Authorities regulations (NORMAM-27).

8. COMMISSIONING

8.1 CABLE INTEGRITY

8.1.1. The following tests shall be executed for all instrumentation cables after installation:

a. Electrical continuity.

b. Insulation test with megohmmeter.

8.2 METEOROLOGICAL SENSORS

a. Wind sensor shall be properly installed with bow orientation.

b. Gyroscope sensor shall be working during the commissioning.

c. Wind direction shall be tested at 0, 90, 180 and 270 degrees.

d. Temperature and wind speed data shall be compared with portable meteorological station.

8.3 OCEANOGRAPHIC SENSORS

a. Current profiler and current meter shall be communicating with the industrial computer at RACK.

b. Basic commands shall respond correctly.

c. Sensors shall be installed in the cage.

d. The cage shall be submerged and single ping tests shall be made.

e. Wave sensor shall be communicating with the industrial computer and work properly.

8.4 COMPUTERS

a. Dadas software shall be installed and working properly.

b. Industrial computers shall be communicating with serial device server.

c. All sensors shall be communicating with serial device server.

d. Standard computers shall be working with Dadas Client and communicating with Dadas Server.

8.5 ATTITUDE SENSOR

a. Sensor shall be installed near the helideck and distances between sensor and helideck center provided.

8.6 WINCH

a. Winch shall be operational and cage have to be submerged and pulled back to the deck.

8.7 Approval of commissioning

8.7.1. CONTRACTOR shall submit the entire system specified herein to approval by the PETROBRAS, which shall evaluate the designs, the manufacturing and installation of the structures and the data collected for approval of the commissioning.

8.7.2. After the installation of the sensors, the data collected shall go through an evaluation period of at least one month. In such period, the data shall be continuously approved by the consistency rules of PETROBRAS.

8.7.3. In case of PETROBRAS does not approve the data, the issues are to be solved as soon as possible, and a new homologation process will begin.

9. INFRASTRUCTURE REQUIREMENTS

9.1 Surface oceanography instrumentation

9.2 The support and fixation structures of the oceanographic equipment shall be constructed and installed according to the premises below:

9.2.1. It shall be provided safe ways of recovering equipment for maintenance and cleaning, such as proper work platforms and safety brakes for the crane;

9.2.2. It shall have handling and safety devices installed, such as an advanced floor with a manhole or a tilting frame for oceanographic sensors;

9.2.3. In places with the least possible vibration;

9.2.4. In such a position that the sensors do not receive any interferences and do not interact with parts of the unit, such as arms, columns, anchoring lines, risers, thrusters, hull, etc. A 3D simulation intended for evaluation provided by

CONTRACTOR is essential in order to verify the interaction of the underwater bundles of the current profiler with the underwater structures;

9.2.5. In conditions that allow the sensors to be at least 30 m deep and at least 8 m below the hull in order to avoid operation above water due to the action of waves and tides and to avoid any influence from parts of the platform, such as arms, anchoring lines, hull and other underwater parts of the unit. Places such as the bow and the stern are the most indicated due to the inclination of the hull;

9.2.6. So as to minimize all movements the sensors shall be subjected, structures fixed in only one support cable shall not be acceptable, since they allow for the rotation of the sensors;

9.2.7. They shall meet the needs for prevention and protection against damages caused by hitting other structures, as well by other vessels operating near the unit;

9.2.8. The underwater electric cables shall be inserted in protective hoses or otherwise electromagnetic cables used in the cage shall be hollow and meshed so as to reduce the water carryover area;

9.2.9. Ballast shall be built in rings to ease the assembly during movement;

9.2.10. Hoses shall be used in order to protect the submerged cable;

9.2.11. All materials (equipment cage, ropes, cables, screws, parts, nuts, shackles, etc.) provided by CONTRACTOR shall be made of stainless steel 316L, except for ballasts, which may be made of other materials other than ferromagnetic materials;

9.2.12. Technical designs shall include the installation of junction boxes, which should be as close as possible of the sensor installation places, and shall have protection and safety degrees compatible with the characteristics of the places where they are being installed;

9.2.13. The space dedicated to the winch for lifting oceanographic sensors shall be established as close as possible to the location where the sensors are to be installed.

9.2.14. Annex contains examples of support and frame structures of the oceanographic equipment.

10. OFFSET MEASUREMENTS

10.1 The linear and angular offset measurements required in this Technical Specification shall be determined by CONTRACTOR using land topographic survey.

10.2 A topographic report must be generated with the following information:

a. Description of the technique, methodology and equipment used for linear and angular offsets survey, as well as indices/calculations that requested accuracy has been achieved;

b. Drawing with vertical and horizontal offsets with decimetric tolerance between the attitude sensor, helideck center, geometric center of the FPSO, meteorological sensors and vessel draft (minimum, maximum and medium);

c. Diagram containing angular offsets with decimal degree tolerance, the attitude sensor, helideck center and the geometric center designed of the FPSO.

11. ANNEX

11.1 Block diagram

11.1.1. Block diagram exemplifying the connections between the meteorological and oceanographic instruments, the computer and the PETROBRAS network.

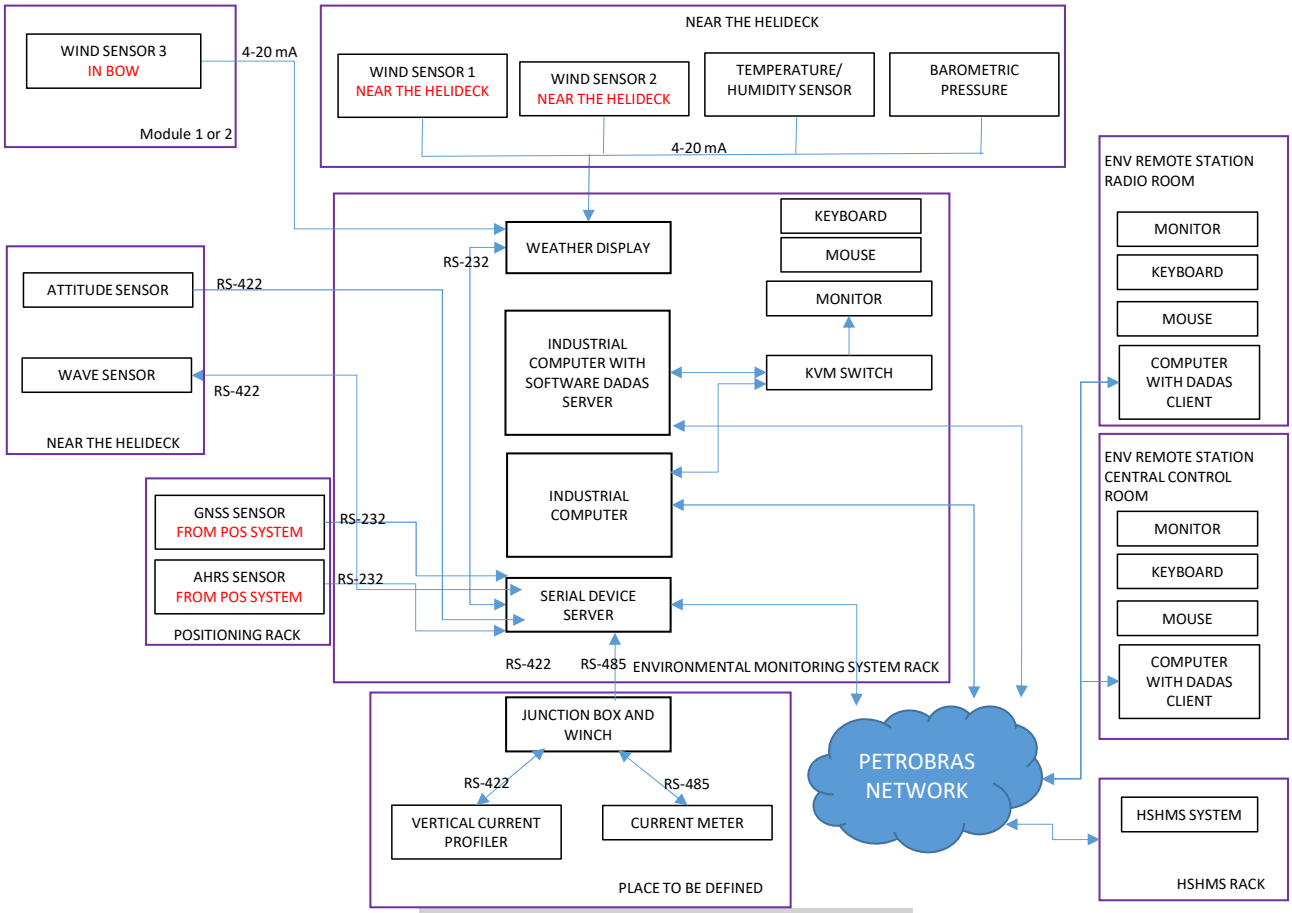

Figure 1: Block diagram for ENV System.

11.2 Support and frame structures of the oceanographic equipment

11.2.1. From Petrobras' experience, the most efficient structures are such as an advanced floor with trapdoor (Figure 2) or a tilting frame (Figure 3), where the winches and the cage maintenance location are on the same deck.

11.2.2. Example of trapdoor structures:

Figure 2: Advanced deck structure as a trapdoor. [Left] Sensors in operation; [Right] Sensors on the deck for maintenance.

11.2.3. Example of structure with tilting frame:

Figure 3: Structure with a-frame. [Left] Sensors in operation; [Right] Sensors on the deck for maintenance.

11.3 The equipment cage needs to be hollow and have enough ballast to avoid drag and suffer the effects of buoyancy.

11.3.1. Example of equipment cage:

Figure 4: [left] cage model with ballast below [center] cage model with ballast integrated in the structure [right] 3D cage model showing acoustic signals propagating without obstacle.