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REVISION INDEX

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0	ORIGINAL

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1. SUBJECT

This document provides the minimum requirements to be followed by SELLER 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”. The ENV System main function is to acquire, store and transmit meteorological and oceanographic data with maximum availability.

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
ETEX	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
LARS	Launch and Recovery System

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* – ETEX;

d. MCA 101-1: *Instalação de Estações Meteorológicas de Superfície e de Altitude*;

e. NORMAM-223: *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 All systems shall be installed in appropriated rack in the Telecommunication Upper Room of the Accommodation Module.

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

4.3 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 SELLER'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 SELLER's responsibility. All documents are to be submitted for the PETROBRAS' approval.

4.4 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.

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

4.6 SELLER shall also provide any explanations requested by PETROBRAS.

4.7 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.

4.8 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 ETEX-M (Exclusive Telecommunications Stations 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 SELLER shall be responsible for the acquisition of the DADAS license software that will be responsible for integrate and processing the meteorological and oceanographic sensors information for ENV System and HMS.

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 data relating to the thermal plume and high turbulence according to the wind direction and speed combinations shall be available and visible to the helicopter operators on HMS screen.

6.8.1. Ensure that the helicopter operators are notified of potential hot plume impact (Caution) according to the Temperature Gradient Matrix and limits during Normal Operations.

6.8.2. Ensure that the helicopter operators are notified of potential hot plume impact (Caution) according to the Temperature Gradient Matrix and limits during Emergency / Blackstart Operations.

6.8.3. Ensure that the helicopter operators are notified of potential high turbulence according to the wind direction and speed combinations.

6.9 The HMS and ETEX Class "M" standards are included in the ENV system. These standards are covered in the ICA 63-10 and NORMAM-223 regulations. The ENV system replication in the radio room, with appropriated access in the screen to the

radio operator, shall be configured to display ETEX Class “M” and HMS information only.

6.10 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.

6.11 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.

6.12 SELLER 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.

6.13 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.

6.14 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.

6.15 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.

6.16 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 NORMAM-223, or

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

6.17 SELLER 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.

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

6.19 SELLER 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.

6.20 The ENV system shall be powered by the FPSO UPS in 220 VAC/60 Hz and other voltages (12 VDC, 24 VDC or 48 VDC) to power the equipment and sensors, shall be obtained internally in the package with the use of rectifiers.

6.21 The manufacturing and the installation of the ENV System structures under the responsibility of SELLER 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.

7. SCOPE OF SUPPLY

7.1 GENERAL REQUIREMENTS

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

7.1.2. SELLER shall follow the regulations of the Brazilian Air Force for the ETEX installation and operation.

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

7.1.4. After installing the meteorological sensors, SELLER shall provide the linear offset measurements for each sensor.

7.1.5. During the period of BOT – Build, Operating and Transfer, the entirely HMS and ENV system operation and maintenance will be scope of the SELLER.

7.1.6. At the period of transfer the operations to PETROBRAS, all the sensors shall have at least 6 months of valid calibration. The certificates of calibration shall be sent to the PETROBRAS Oceanographic Department (salaoperacoes-ocn@petrobras.com.br)

7.1.7. During the design phase, all sensors location shall be submitted via Technical Query (TQ) for approval.

7.2 HMS AND METEOROLOGICAL SENSORS

7.2.1. WIND INTENSITY AND DIRECTION

7.2.1.1. SELLER shall supply four (04) wind sensors. Two (2) shall be installed at the highest point near the helideck, one (01) at the highest point at the bow of the FPSO and one (01) stand in spare. The wind sensor is not restricted by its manufacturer and model. It shall have the following specification or greater precision. They shall be installed in accordance with premises in NORMAM-223.

7.2.1.2. 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.

7.2.1.3. 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.

7.2.1.4. The sensors shall be located into a position free of any interference, allowing the freely circulation of the wind. Barriers near the sensors such as antenna radars, towers, buildings, stairs, chimneys, flares or any other equipment or structure shall be avoided. 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 to install the anemometers.

7.2.1.5. 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. SELLER shall indicate the direction of the unit on the pole supporting the anemometer to facilitate the heading of the sensor during maintenance.

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

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

7.2.2. RELATIVE HUMIDITY AND TEMPERATURE PROBE AND BAROMETRIC PRESSURE SENSOR

7.2.2.1. SELLER shall supply two (02) sensors from each, one (01) shall be installed and one (01) shall stand in spare. The sensors are not restricted by its manufacturer and model. It shall have the following specification or greater precision.

7.2.2.2. 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.

7.2.2.3. 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.

7.2.2.4. As a reference, PETROBRAS uses relative humidity and temperature probe of VAISALA model HMP155 with a “radiation shield” model DTR503.

7.2.2.5. As a reference, PETROBRAS barometric pressure sensor of R.M. Young model 61402L with pressure port model 61002 and weather-proof box model 61360.

7.2.2.6. The 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 and NORMAM-223.

7.2.3. **WEATHER DISPLAY**

7.2.3.1. 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)

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

7.2.3.3. Weather display shall 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.

7.2.4. ATTITUDE SENSOR

7.2.4.1. SELLER shall follow Brazilian Navy regulations to procure and install the attitude sensor according to NORMAM-223. 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.

7.2.4.2. 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. Heave rate – accuracy and precision of 0.1 m.s-1 RMS (Root Mean Square) between 0 and 1.3 m.s-1.

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

7.2.4.4. After installing the attitude sensor, SELLER shall provide the linear and angular offset measurements of this sensor, the geometric center designed of the FPSO and the center of the helideck.

7.2.5. LIDAR WIND SENSOR (VERTICAL WIND PROFILER)

7.2.5.1. SELLER shall supply one (01) LIDAR WIND SENSOR with minimum of range from 10m to 300m.

7.2.5.2. LIDAR WIND SENSOR shall have at least 0.1 m/s of wind speed accuracy and less than 0.5° of direction variation.

7.2.5.3. The sampling rate shall be at least 50Hz for a great quality of data acquisition into the offshore environment.

7.2.5.4. The sensor shall be specific for offshore applications.

7.2.5.5. Installation Notes: Places with obstacles to the laser beam shall be avoided. The sensor shall be placed near the helideck level.

7.2.5.6. Installation should be as recommended by manufacturer. Preferably, to facilitate the maintenance, it should be installed at an easy place access to the equipment.

7.3 OCEANOGRAPHIC SENSORS

7.3.1. VERTICAL CURRENT PROFILER

7.3.1.1. SELLER 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.

7.3.1.2. 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.

7.3.1.3. 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).

7.3.1.4. 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.

7.3.1.5. 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.

7.3.1.6. The communication cable used to connect the Vertical Current Profiler to the junction box shall be exclusive for its uses. Solutions that provide one umbilical cable to connect the ADCP and another sensor will not be accepted by PETROBRAS.

7.3.1.7. 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.

7.3.2. CURRENT METER

7.3.2.1. SELLER 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.

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

7.3.2.3. 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).

7.3.2.4. The communication cable used to connect the CURRENT METER to the junction box shall be exclusive for its uses. Solutions that provide one umbilical cable to connect the CURRENT METER and another sensor will not be accepted by PETROBRAS.

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

7.3.3. **WAVE SENSOR**

7.3.3.1. SELLER 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.

7.3.3.2. 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.

7.3.3.3. The equipment module, installed externally, shall be controlled solely by the ENV System.

7.3.3.4. Installation should be as recommended in the installation manual. Preferably, in order to facilitate of maintenance, the equipment should be installed at an easy place access to the modules inside the equipment.

7.4 COMPUTERS AND RACK

7.4.1. COMPUTERS

7.4.1.1. It shall be supplied and installed four (04) 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.

7.4.1.2. Two (02) 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. Four (04) USB v3.0 ports or higher
f. Three (03) Ethernet ports (10/100/1000baseT)
g. Video card with PCI Express X16 with 02 GB RAM (minimum)
h. Operational system: Windows 11 Pro 64 bit or higher with TPM 2.0 and license in Portuguese.

7.4.1.3. SELLER is responsible for any operational system or hardware upgrade required by PETROBRAS at any time until the commissioning final acceptance.

7.4.1.4. It shall be supplied one (01) KVM Switch with integrated monitor and rack mounting to access and operate both industrial computers on 7.4.1.2. For this device shall be considered the minimum resolution of 1920 x 1200.

7.4.1.5. The inputs/outputs interface of the KVM shall be compatible with both computers on 7.4.1.2.

7.4.1.6. Additionally, a serial device server (MOXA NPort 5600 Series) with minimum 16 serial ports and 2 Ethernet ports is required, one will be connected to the computer with DADAS Server, and one will be connected to PETROBRAS Network. The NPort shall connect all the sensors with serial communications available.

7.4.1.7. Both computers shall be connected to the serial server that will be connected to meteorological station, oceanographic sensors and AHRS via standard serial RS-232 with the DB9 or RJ45 connector. SELLER 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.

7.4.1.8. SELLER 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.

7.4.1.9. 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. SELLER shall acquire both (computer and conversion module specified by PETROBRAS).

7.4.1.10. SELLER 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.

7.4.1.11. The remaining (02) two computers shall have the minimum requirements below:

a. Processor: Clock of 3 GHz or higher

64 bits

Shall support virtualization technology

b. Memory: 16 GB or higher

Standard DDR4 or high

Frequency 2100 MHz or high

c. Hard disk:1TB

Interface SATA

d. Monitor 24'' with minimum resolution 1920 x 1200.

e. Keyboard and mouse.

f. At least (02) two ethernet ports.

g. At least (03) three USB v3.0 ports or higher.

h. Operational system: Windows 11 Pro 64 bit or higher with TPM 2.0 and license in Portuguese.

7.4.1.12. SELLER is responsible for any operational system or hardware upgrade required by PETROBRAS at any time until the commissioning final acceptance.

7.4.1.13. The computers on 7.4.1.11 shall be installed at CCR and Radio Room.

7.4.2. DATA VIEWING SOFTWARE

7.4.2.1. SELLER 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.

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

7.4.3. ENV SYSTEM RACK

7.4.3.1. 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. 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.

7.4.3.2. 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.

7.4.3.3. 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.

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

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

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

7.5 HMS – HELIDECK MONITORING SYSTEM

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

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

7.6 HELIDECK STATUS LIGHT

7.6.1. It shall be supplied a complete helideck status light complying with Brazilian Navy Authorities regulations (NORMAM-223).

7.6.2. The status light on/off switch shall be located for the Helicopter Landing Officer next to the helideck and for the helicopter operators inside the ETEX.

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 LAUNCH AND RECOVERY SYSTEM (LARS)

a. LARS shall be operational, and shroud shall be deployed and pulled back to the deck.

8.7 APPROVAL OF COMMISSIONING

8.7.1. SELLER 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

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

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

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

9.1.1.3. In places with the least possible vibration.

9.1.1.4. 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 SELLER is essential in order to verify the interaction of the underwater bundles of the current profiler with the underwater structures.

9.1.1.5. 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.

9.1.1.6. 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.

9.1.1.7. The system shall deploy and recovery the shroud without any significant horizontal unevenness. When deployed, the shroud shall be at the horizontal level.

9.1.1.8. 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.

9.1.1.9. 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.

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

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

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

9.1.1.13. 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.

9.1.1.14. 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.

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

10. OFFSET MEASUREMENTS

10.1 TOPOGRAPHIC REPORT

10.1.1. A topographic report shall 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. BLOCK DIAGRAM

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

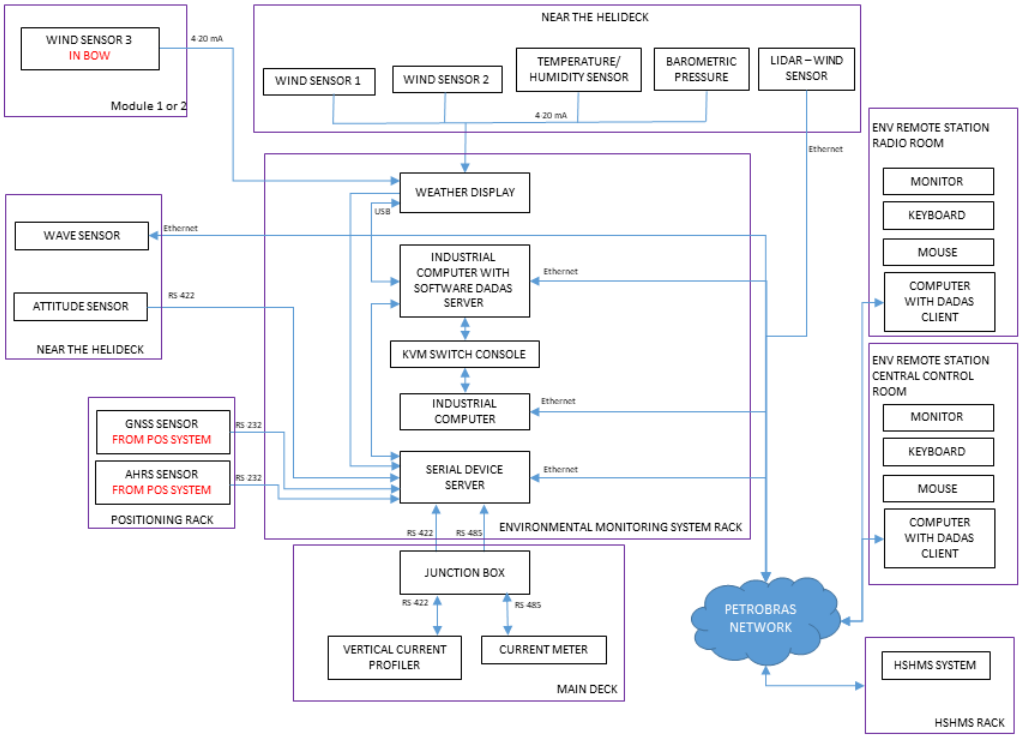

Figure 1: Block diagram for ENV System.

12. SUPPORT AND FRAME STRUCTURES OF THE OCEANOGRAPHIC EQUIPMENT

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.

Example of trapdoor structures:

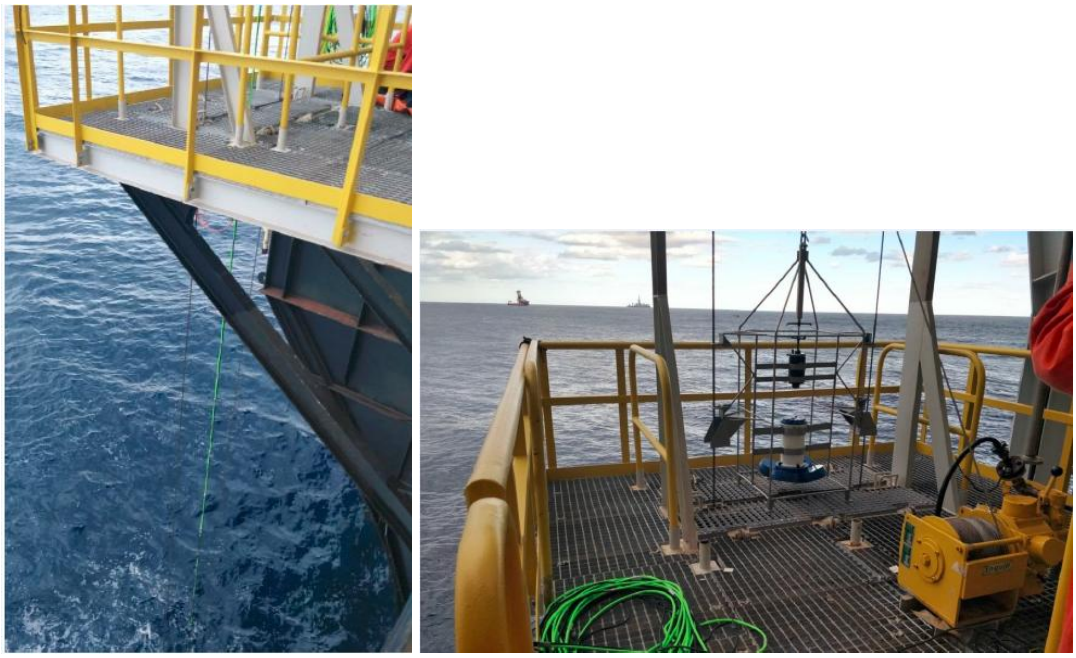

Figure 2: Advanced deck structure as a trapdoor. [Left] Sensors in operation; [Right] Sensors on the deck for maintenance.

Example of structure with tilting frame:

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

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

Example of equipment cage:

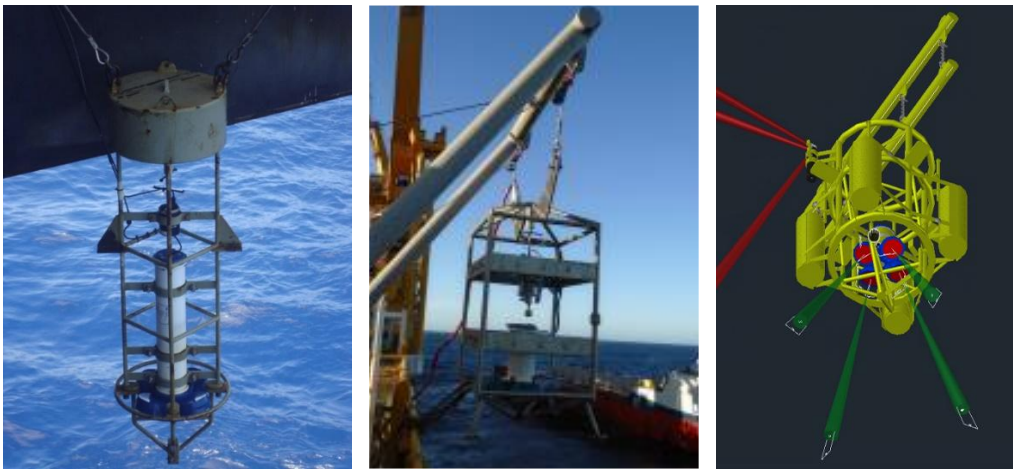

Figure 4: [left] cage model with ballast below [center] cage model with ballast integrated in the structure [right] 3D cage model showing acoustic signals propagating without obstacle.