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	CLIENT: SRGE		SHEET: 1 of 14
	JOB: TELECOMMUNICATION TRANSMISSION		
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TIC	TITLE: SATELLITE SYSTEM		INTERNAL
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1. SUBJECT

1.1 The subject of this document is to establish the criteria and basic characteristics for the detailed design, supply, installation and commissioning of the satellite communication system that shall be installed in PETROBRAS FPSO Unit.

2. ABBREVIATIONS

ABNT	Associação Brasileira de Normas Técnicas (Brazilian Association of Technical Standards)
AC	Alternating Current
ACU	Antenna Control Unit
ANATEL	Agencia Nacional de Telecomunicações (Brazilian Telecommunication Authority)
ANSI	American National Standards Institute
ART	Anotação De Responsabilidade Técnica (Technical Responsibility Note)
ASTM	American Society for Testing and Materials
ATS	Automated Transfer Switch
AWG	American Wire Gauge
BUC	Block up Converter
CAB	Cable
CAT	Category
CATV	Community Antenna Television
CCR	Central Control Room
CCTV	Closed Circuit Television
CODEC	Codifier & Decodifier
CREA	Conselho Regional de Arquitetura e Urbanismo (Brazilian Engineering Counsel)
DC	Direct Current
DIO	Dispositivo Intrmediário Óptico (Optical Distribution Drawer)
EIA	Electronic Industries Alliance
FPSO	Floating, production, storage and offloading
GMDSS	Global Miritime Distress Safety System
GPS	Global Positioning System
IDU	Indoor Data Unit
IEC	International Electrotechnical Commission
IEEE	Institute of Electric and Electronic Engineers
Inmetro	Instituto Nacional de Metrologia (National Institute of Metrology)
IMO	International Maritime Organization
IP	Internet Protocol
IS	Intrinsec Safe
ITU	International Telecommunication Union
LAN	Local Area Network
LED	Light Emitting Diode
LNB	Low Noise Block Converter
LSZH	Low Smoke Zero Halogen
MEO	Medium Earth orbit
MODU	Mobile Offshore Drilling Unit

NOC	Network Operation Center
ODU	Outdoor Data Unit
OSI	Open Systems Interconnection
PLL	Phase Locked Loop
PoE	Power Over Ethernet
PSK	Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
TIA	Telecommunications Industry Association
SOLAS	Safety Of Life At Sea
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VAC	Volts Alternating Current
VDC	Volts Direct Current
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network

3. REFERENCE DOCUMENTS, CODES AND STANDARDS

3.1 International Standards

a. IEC 1000-4-2: Electrostatic discharge (ESD) requirements.

b. IEC 60079: Electrical apparatus for explosive gas atmospheres - all parts.

c. IEC 60092-502: Electrical installations on ships.

d. IEC 60331: Tests for electric cables under fire conditions - circuit integrity – all parts.

e. IEC 60332: Flame-retardant characteristics of electric cables.

f. IEC 60529: Degrees of protection provided by enclosures (IP code).

g. IEC 60533: Electrical and electronic installations in ships - electromagnetic compatibility.

h. IEC 60945: Maritime navigation and radiocommunication equipment and systems – general requirements – methods of testing and required test results.

i. IEC 61000: Electromagnetic compatibility (EMC) series - all parts.

j. IEC 61892-7: Mobile and fixed offshore units - electrical installations - part 7: hazardous area.

k. CENELEC CLC/TR 50427 - Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation – Guide

l. IEEE 802.1Q™-2005: "IEEE standard for Local and metropolitan area networks: Virtual Bridged Local Area Networks".

m. IEEE 802.2™-1989: "Information Processing Systems - Local Area Networks - Part 2: Logic link control".

n. CISPR 22: Information technology equipment; Radio disturbance characteristics; Limits and methods of measurement.

o. EN 55022: Information technology equipment; Radio disturbance characteristics; Limits and methods of measurement.

p. IMO MODU Code: Code for the Construction and Equipment of Mobile Offshore Drilling Units.

q. IMO Resolution A.1021: Codes on Alerts and Indications.

r. IMO Resolution A.801: Provision of Radio Services for the Global Maritime Distress and Safety System.

s. IMO SOLAS: International Convention for the Safety of Life at Sea.

3.2 Brazilian Standards

3.2.1. *INMETRO*

a. INMETRO PORTARIA 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.

3.2.2. *NR's – Normas Regulamentadora*

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

b. NR-37: Segurança e saúde em plataformas de petróleo.

c. It shall be followed all others NR's – Normas Regulamentadoras (Regulatory Standards) from Ministério do Trabalho (Brazilian Ministry of Labor) applicable to this Technical Specification.

3.2.3. *ANATEL – Regulations of Agência Nacional de Telecomunicações.*

3.2.4. *DPC – Departamento de Portos e Costas.*

a. NORMAM 01: Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto.

3.3 Classification Society

3.3.1. The detailed design shall be submitted to approval by Classification Society. The design and installation shall take into account their requirements and comments.

4. SYSTEM DEFINITIONS

4.1 The Satellite Communication System consists of 02 (two) complete and independent remote stations: a Ka Band VSAT System and a Ku/C Band VSAT System.

4.2 This antenna will point to the satellite regardless of the movements of the ship it is on and will do this very accurately. The Antenna shall be assembled inside a Radome and consists of a satellite antenna dish & feed with a linear, or a circular Low Noise Block converter (LNB) with polarization motor mounted, if necessary, on a stabilized antenna pedestal.

4.3 For satellite tracking functionality, the GPS compass shall connect to the antenna system through the GPS compass interface (NMEA Interface) of the Antenna Control Unit (ACU).

4.4 The roll, sway, yaw, surge, heave and pitch movements shall be compensated by the stabilized system in that way the signal level performance will not present any variations. That features high performance stabilization and satellite tracking using a 3-axis or 2-axis of stabilization and 1-axis of polarization.

4.5 The remote stations will be used in normal situations, in order to make possible the voice and data communication with PETROBRAS Network.

5. GENERAL REQUIREMENTS

5.1 CONTRACTOR shall be responsible to provide the source of GPS Compass signal from GPS compass antenna.

5.2 For more technical requirements details to antennas mounting and cables launching, CONTRACTOR shall consider, at least, the guideline on item 5 of “Harmonization of GMDSS requirements for radio installations on board SOLAS ship”, issued by IMO and IEC standards.

5.3 For more technical requirements details to electromagnetic and electrical, CONTRACTOR shall consider, at least, the guideline on items 6 an 8 of “Harmonization of GMDSS requirements for radio installations on board SOLAS ship”, issued by IMO and IEC standards.

5.4 For PETROBRAS detailed design requirements for installation, configuration, tests training and commissioning, CONTRACTOR shall comply with the

DESCRIPTIVE MEMORANDUM I-MD-3010.00-5510-760-PPT-001 – GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN.

5.5 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.

5.6 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.

5.7 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.

5.8 Equipment and accessories installed in outdoor or industrial areas shall be suitably rugged and their external bodies shall be made in non-metallic material, suitable for harsh environments and in accordance with IEC and ABNT standards, apart from the ones whose classification area require to be metallic as Ex-d junction boxes.

5.9 Brackets, bolts, nuts, washers and any other mechanical fixing elements shall be made in stainless steel.

5.10 In case of difficulty for supplying some accessory with external body made with non-metallic materials, it will be necessary to submit them for analysis and approval of PETROBRAS.

5.11 It shall be avoided equipment and accessories with their external bodies built in aluminum alloy. Anything different shall be submitted to PETROBRAS approval. In case of approval, this alloy shall not contain in its composition more than 0.25% of copper and shall comply with the ASTM-B-179 standard (ANSI alloy 356.1).

5.12 In outdoor areas, exposed to marine atmosphere, CONTRACTOR shall avoid the galvanic corrosion of junction boxes supports, horns supports and bolts. Galvanic insulation shall be implemented wherever contact between different metallic materials is needed.

5.13 Equipment and accessories shall attend the ingress protection degree, protection type, classifications zone and groups established by IEC / ABNT.

5.14 All antennas and transmission equipment shall be homologated by ANATEL (Brazilian Government Authority) as per Resolution n° 715/2019 - Aprova o Regulamento de Avaliação da Conformidade e de Homologação de Produtos para Telecomunicações.

5.15 All equipment that will make part of technical proposal shall have type approval certificate by Classifying Society and technical conformity with the International and National standardization organism: ABNT, IEC, INMETRO and ANATEL.

5.16 Equipment and materials shall be supplied packed suitable for long periods of storage and be protected against mechanical impact and adverse weather conditions.

5.17 CONTRACTOR shall submit the VSAT antennas arrangement and calculation report with total loss for RF cables that will be used for this system, before the purchase order for PETROBRAS analysis and approval. These documents shall have information about distances between communication unit and antenna, quantity of connections, datasheet of RF cables and connectors, RF power input/output in the communication unit and RF power input/output in the antenna.

5.18 PETROBRAS will be responsible for Ka band and Ku/C band provider service contract.

5.19 Both VSAT systems shall be assembled, configured, tested and certified by VENDOR at shipyard, in accordance with Ka and Ku/C band satellite provider requirements, as informed by PETROBRAS during the detailed design.

5.20 CONTRACTOR shall guarantee that both systems shall be commissioned by VENDOR representative technician at the shipyard and also in Brazil as soon as the unit arrives at site location in Brazil.

5.21 The pedestals for VSAT antennas installation shall guarantee a safety access for the telecom technicians.

5.22 A service light and service female LAN outlet shall be properly installed inside each radome for maintenance purposes.

5.23 CONTRACTOR, for both VSAT systems, shall assure, in accordance with Ka and Ku/C band all satellite circuit provider requirements, as informed by PETROBRAS during the detailed design.

6. TECHNICAL REQUIREMENTS

6.1 VSAT equipment of Ka Band VSAT System and of Ku/C Band VSAT System shall be feed by 220 VAC UPS System.

6.2 An ATS device shall be used in cabinet to power each VSAT System from each UPS bus bar.

6.3 The air conditioner inside the Ka band and Ku/C band antennas radome shall be powered by normal panel.

6.4 VSAT antennas shall be installed without any shadow towards the satellites.

6.5 Ka Band VSAT System shall be compatible with mPower solution from O3B vendor.

7. SCOPE OF SUPPLY

7.1 CONTRACTOR shall supply, install, test and commissioning 02 (two) independent and complete VSAT System, within the scope of the Contract and in accordance with this Technical Specification.

7.2 01 (one) **Ka Band System** based on MEO (Medium Earth orbit) Solution platform technologies with minimum of 03 antennas and mPower compatible.

Item	Code	Description	Quantity
01	VSAT equipment	Set (kit) with all equipment required by Vendor for a Ka band O3B mPower solution with 03 (three) BUC (ODU), 03 (three) ACU (Antenna Controller Unit), 03 (three) LNB PLL type, 01 (one) modem.	01
02	VSAT equipment (spare parts)	Set (kit) with for a Ka band O3B mPower solution with 01 (one) BUC (ODU), 01 (one) ACU (Antenna Controller Unit), 01 (one) LNB PLL type, 01 (one) modem.	01
03	2,2 m antenna	Stabilized Ka Band antenna, with 2.2m minimum diameter + air conditioning + standard spare parts kit recommended by Vendor other listed herein.	03

Table 01: Ka Band System

7.2.1. The Ka Band system shall be dimensioned for the minimum bandwidth of 25 + 25 Mbps.

7.3 01 (one) **Ku/C Band System** based on Comtech technology or other vendor to be informed by PETROBRAS during detailed design.

Item	Code	Description	Quantity
01	Modem equipment	Satellite Comtech - CDM-625A Advanced Satellite Modem or superior; - Data rate equal or superior 10Mbps	01
02	Modem equipment (spare parts)	Satellite Comtech - CDM-625A Advanced Satellite Modem or superior; - Data rate equal or superior 10Mbps	01

03	RF System	a) TX Frequency: 14.00~14.5GHz Ku-band b) IF frequency: Standard 950 – 1450MHz c) Frequency Reference: 10MHz d) Power ODU: 100W Ku band e) LNB PLL type from 11.7 to 12.2 GHz with local oscillator stability of +/-50 KHz or better	01
04	RF System (spare parts)	a) TX Frequency: 14.00~14.5GHz Ku-band b) IF frequency: Standard 950 – 1450MHz c) Frequency Reference: 10MHz d) Power ODU: 100W Ku band e) Power ODU: 80W C band f) Ku band: LNB PLL type from 11.7 to 12.2 GHz with local oscillator stability of +/-50 KHz or better g) C band: LNB PLL type	01
05	2,2 m antenna	Ku/C VSAT Maritime Stabilized Antenna, with 2.2m minimum diameter + air conditioning + standard spare parts kit.	01

Table 02: Ku/C Band System

7.3.1. Note: The modem equipment indicated in the table is a reference and it shall be confirmed by PETROBRAS during the detailed design.

7.3.2. The Ku/C Band system shall be dimensioned for the minimum bandwidth of 10 Mbps.

7.3.3. Ku/C VSAT stabilized antenna shall be able to work in dual-band model.

7.4 01 (one) GPS Compass equipment with 3D receiver, information display monitor, and Serial Outputs with GPS data information enough to automatically positioning all antennas. This Equipment shall be used also by other telecommunications systems. It shall be installed in the VSAT System Rack and fed by FPSO - UPS.

7.5 VSAT RACK

7.5.1. CONTRACTOR shall provide and install (01) one CLOSED RACK, for all VSAT 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.

f. 04 (four) vertical cable organizer: two in front and two on rear;

g. Internal light only on the rear access;

h. Complete earthing Kit;

i. Color: RAL 7035.

j. It shall be provided, installed and commissioned 03 (three) 19 inches rack mounted switchboard: 02 (two) for AC and 01 (one) for DC and 01 (one) ATS.

7.6 SPARE PARTS

7.6.1. CONTRACTOR shall supply 01 (one) kit of commissioning spare parts for Ka Band VSAT System and 01 (one) for Ku/C Band VSAT System with the minimum items:

a. Axis servo driver
b. Axis encoder
c. Axis motor
d. Axis wiring
e. Antenna control unit
f. Cable kits
g. Surge protector
h. Cable mutiplexer
i. Power supply
j. GPS

7.7 MANAGEMENT SOFTWARE AND SPECIAL TOOLS

7.7.1. CONTRACTOR shall supply all necessary special tools for the operation and maintenance of the systems.

7.7.2. CONTRACTOR shall supply all software (MS Windows compatible, at lastest version), hardware and accessories necessaries for the operation and maintenance of the systems.

8. COMMISSIONING

8.1 CONTRACTOR shall be responsible to realize a technical commissioning activity, check, test and evaluate the operation of equipment, panels, installations, protections and RF covering, in order to permit or authorize their use under normal operating conditions.

8.2 A professional team certified by the VSAT equipment manufacturer provided, shall perform the Installation and Commissioning activities.

8.3 The following verifications, at least, shall be verified as scope of commissioning activities in accordance with Contract and this Technical Specification.

a. Check hardware and network environments;

b. Basic commissioning: After checking the physical environment of the products, check whether, the basic information such as software system, license, and system time is correct, ensuring that the site is running properly;

c. After checking physical environments, check basic information for accuracy. The basic information includes the software system, licenses, and system time. This ensures that the local equipment works properly and suits interconnection commissioning;

d. Device check: Check devices to ensure that the device status meet deployment requirements and prepare for access commissioning and basic service commissioning;

e. Configuring a user to login to the device remotely: This operation enables a user to remotely login to the device in the central equipment room to deploy services.

f. Check and record values of VSWR, return loss and distance to fail obtained from properly calibrated Anritsu Cell Master Tool or similar for each RF device/cable installed.

g. A proper table with measured values of VSWR at each device (antenna, coupler, splitter, radio) shall be presented comparing them to manufacturer values.

8.4 Special attention shall be done during running the coaxial cabling whose activity shall be properly inserted in constructability schedule, so that they do not get smashed.

8.5 CONTRACTOR shall consider that the Acceptance Testing shall evaluate signal strength, connectivity and bandwidth throughput in each VSAT system, which values shall be recorded.

8.6 All structured cabling shall be certified by calibrated data certifier equipment.

8.7 PETROBRAS shall realize a visual inspection to check the presence of all items listed on the detailed design and fill in the configurations and handbooks:

a. Antennas system;
b. Modems;
c. Cabling;
d. Cabinets;
e. Handbooks;
f. Energy.

8.8 CONTRACTOR shall follow the verifications and commissioning activities in accordance with Contract documents and this Technical Specification.

8.9 CONTRACTOR shall test all servomotors for all axis inside each antenna.

8.10 All data equipment shall be configured with parameters informed by Petrobras during Commissioning phase and under the witness of PETROBRAS Telecom Team.

8.11 All configurations shall be recorded by means of tables and print screens according to each equipment.

8.12 System will be pre-commissioned in commissioning site and final commissioned in offshore site in Brazil.

8.13 PETROBRAS will do the XPOL (cross polarization test) test of each antenna, to check the proper isolation between polarizations at site operation. By this test, PETROBRAS will contact its local satellite provider and rise a non-modulated carrier to be informed by satellite provider. The value of XPOL parameter will be informed by satellite provider to be compared with antennas datasheet value. Such acceptance will be carried in TTAS-2.

8.14 All antennas shall be completely tight up so that can cannot swing during voyage to offshore site.

8.15 PETROBRAS will be in charge to provide satellite link contract with Brazilian satellite provider for site operation.

9. LEGALIZATION REQUIREMENTS

9.1 CONTRACTOR shall provide to PETROBRAS all documents and forms required to legalize the Satellite Communication System, subject of this technical specification, including the payment of the ART (technical responsibility term) to CREA.

9.1.1. CONTRACTOR shall issue these documents, at least 200 days before the unit leaves the shipyard.

9.1.2. CONTRACTOR shall provide the requested signed report of ANATEL resolution number 700 about Evaluation of Human Exposure to Electric, Magnetic and Electromagnetic Fields Associated with the Operation of Radiocommunication Transmitting Stations.

10. SHUTDOWN TELECOMMUNICATIONS SYSTEM

10.1 To meet the requirements of IEC 60079-0 and CENELEC CLC / TR 50427, CONTRACTOR shall provide a shutdown telecommunication system to avoid ignition risks when flammable gases leak is detected in the antenna deck/top roof.

10.2 All VSAT antennas shall be turned off when the fire and gas panel detect flammable gases in the antenna deck.

10.3 All air conditioner installed inside the antennas' radomes shall be turned off when the fire and gas panel detect flammable gases in the antenna deck/top roof.

10.4 This automation can be done in the electrical panel or inside the VSAT cabinet.

10.5 Additional information shall be found in I-ET-3010.00-5264-769-PPT-002 HULL SHUTDOWN TELECOMMUNICATION SYSTEM.