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PROJECT	PROJ-US	PROJ-US	PROJ-US						
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CHECK	CY22	CY22	CY22						
APPROVAL	X187	X187	Y3S7						

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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 tests of an infrastructure and network for Bluetooth Low Energy (BLE) beacons and TAGs to be used for location and tracking of people and equipment in FPSO.

2. ABBREVIATIONS

ABNT	Associação Brasileira de Normas Técnicas - Brazilian Association of Technical Standards
ANATEL	Agência Nacional de Telecomunicações - Brazilian Telecommunication Authority
ANSI	American National Standards Institute
APC	Angled Physical Contact polishing
ART	Anotação de Responsabilidade Técnica - Technical Responsibility Note
ASTM	American Society for Testing and Materials
BLE	Bluetooth Low Energy
CLC	European Committee for Electrotechnical Standardization - CENELEC
CREA	Conselho Regional de Engenharia e Agronomia - Brazilian Engineering Counsel
DPC	Departamento de Portos e Costas - Department of Ports and Coasts
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
IP-XX	Ingress Protection Code
IS	Intrinsic Safe
ITU	International Telecommunication Union
LAN	Local Area Network
LSZH/LS0H	Low Smoke Zero Halogen
MODU	Mobile Offshore Drilling Unit
NORMAN	Normas da Autoridade Marítima – Maritime Authority Standards
OSI	Open Systems Interconnection
SOLAS	Safety Of Life At Sea
WAN	Wide Area Network
WLAN	Wireless Local 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

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- 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 61000: Electromagnetic compatibility (EMC) series - all parts
- i. IEC 61892-7: Mobile and fixed offshore units - electrical installations - part 7: hazardous area
- j. IEEE 802.11: wi-fi standards
- k. IEEE 802.3: Standards “af” and “at”
- l. IMO MODU: Code for the construction and equipment of mobile offshore drilling units.
- m. IMO SOLAS: International convention for the safety of life at sea.
- n. ITU recommendation M.1801: Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHZ
- o. CENELEC TR 50427/2004: Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation – guide.

3.2 Brazilian Standards

3.2.1. INMETRO - Instituto Nacional de Metrologia, Qualidade e Tecnologia


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

3.2.2. MINISTÉRIO DO TRABALHO

- a. NR-10: Segurança em instalações e serviços em eletricidade
- b. NR-37: Segurança e saúde em plataformas de petróleo
- c. In addition, it shall be followed all other NR’s – Normas Regulamentadoras (Regulatory Standards) applicable to this Technical Specification.

3.2.3. ANATEL – Agência Nacional de Telecomunicações

- a. Ato Nº 14.448 (04/12/2017): Anexo I - Requisitos técnicos para a avaliação da conformidade de equipamentos de radiocomunicação de radiação restrita.

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3.2.4. DPC – DEPARTAMENTO DE PORTOS E COSTAS


- a. NORMAM 201: 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, whose design and installation shall take into account their requirements and comments.

4. GENERAL REQUIREMENTS

- 4.1 In order to comply with the PETROBRAS Corporative Network, all the required materials shall be based on the technology indicated in this Technical Specification.
- 4.2 For PETROBRAS detailed design requirements, installation, configuration and tests, CONTRACTOR shall comply with the Descriptive Memorandum I-MD-3010.00-5510-760-PPT-001 GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN.
- 4.3 For telecommunication symbols, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-0000-940-P4X-002 – SYMBOLS FOR PRODUCTION UNITS DESIGN.
- 4.4 For telecommunication TAGs, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.
- 4.5 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.
- 4.6 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.
- 4.7 Brackets, bolts, nuts, washers and any other mechanical fixing elements shall be made in stainless steel.
- 4.8 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.

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- 4.9 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).
- 4.10 Any other available models of equipment with external body made of non-metallic materials approved by Classification Society shall be submitted for analysis and approval of PETROBRAS.
- 4.11 Equipment and accessories shall be appropriate to be installed on places with marine atmosphere, hazardous areas (dust and gas explosive atmospheres) and in accordance with the classifications zone and groups established by IEC / ABNT.
- 4.12 All equipment, materials and antennas, if necessary, shall be homologated by National Telecommunications Agency (ANATEL).
- 4.13 CONTRACTOR shall present the "Certificate of homologation" issued by the Brazilian Telecommunications Regulatory Agency "ANATEL", for the total characteristics specified. These Certificates shall be presented in the technical proposal and submitted to PETROBRAS for approval before the purchase order.
- 4.14 The equipment and accessories shall attend the ingress protection degree, protection type, classifications zone and groups established by IEC / ABNT.
- 4.15 All equipment that will make part of the detailed design shall have type approval certificate for technical conformity with the International and National standardization organism: ABNT, IEC, INMETRO and ANATEL.
- 4.16 The equipment and materials shall be supplied packed suitably for long periods of storage and be protected against mechanical impact and adverse weather conditions.
- 4.17 CONTRACTOR shall submit a Calculation Report with the estimated coverage/reach of the Bluetooth Low Energy receivers.
- 4.18 CONTRACTOR shall also perform a predictive survey using a software based on RF propagation algorithms, plot a heat coverage map and it shall be submitted to Petrobras Approval before purchase order and locate the equipment.
- 4.19 The heat map shall consider power level range colors varying 3dB minimum, from target power level to system margin calculated.
- 4.20 After the installation and the acceptance tests of the BLE Infrastructure, CONTRACTOR shall submit a new detailed drawing with the measurements of RF power levels and reach of the BLE beacons on all over the UNIT for PETROBRAS final analysis and final approval.
- 4.21 In outdoor areas, exposed to marine atmosphere, CONTRACTOR shall avoid the galvanic corrosion of equipment, antennas, panels, boxes, coaxial cables fixing accessories. Galvanic insulation shall be implemented wherever contact between

different metallic materials is needed. For reference, follow the example shown in below:



Figure 1: Example of installation to avoid galvanic corrosion

4.22 CONTRACTOR shall utilize tubing term-contractile materials (adhesive lined heat shrink tube) as a sealant form for ending, cable splices or bundling of cables. It shall create a barrier for against water, moisture, dirt and other environmental contaminants. An example is shown in Figure 2.

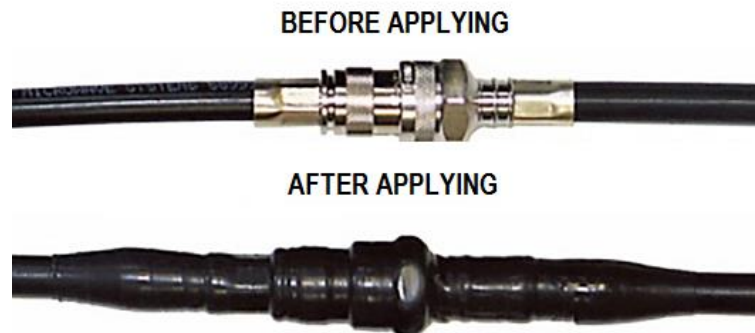


Figure 2 – Term-contractile material


4.23 In order to avoid extra efforts on the connection of the RF cable to the antenna, the use of a flexible RF tail will be mandatory to make this connection; as shown in Figures 3 and 4.



Figure 3: RF flexible tail




Figure 4: Connection between RF cable and RF flexible tail

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- 4.24 All antennas, if applicable, shall be properly positioned on the Unit as to provide maximum efficiency with minimum interference risk or possibility of “shadow” zones. Shadow zones are areas that a tag is not noticed by at least 3 receivers at the outdoor industrial areas, or at least 1 inside indoor areas.
- 4.25 CONTRACTOR shall design, supply and install all cables type flame retardant and LSZH/LS0H.
- 4.26 In case of info specs conflict or mistake, PETROBRAS shall be asked for final decision.

5. SYSTEM DEFINITIONS

- 5.1 POB System shall be considered as a critical system to support people attendance confirmation at muster stations and to easily find people on board during real or simulated emergency situations.
- 5.2 The system central infrastructure shall be duplicated in different locations: Telecom Upper (POB-System A) and Lower (POB-System B) Rooms whose equipment shall be simultaneously powered by both UPS bus bar.
- 5.3 The POB Management Infrastructure and Tracking System shall use Bluetooth Low Energy (BLE) technology.
- 5.4 The Bluetooth standard to allow communication between the BLE TAG (portable) and the BLE beacons (fixed) shall be 5.0 or higher, according to System Vendor.
- 5.5 The entire Unit shall be covered by such POB System, so that by any system workstation it is possible to point the localization of anyone carrying a TAG.
- 5.6 For all equipment proposed, it shall be ensured, by CONTRACTOR, that all items do not have an EoS/EoL (End-of-Sale / End-of-Life) warning issued by the manufacturer.
- 5.7 All transmitter radios and appliances, if applicable, shall be certified in accordance with ANATEL Standards and CONTRACTOR shall provide all necessaries licenses to regular operation in Brazil.
- 5.8 The BLE beacons can communicate between them using Bluetooth Mesh SIG standard.
- 5.9 The BLE beacons can also communicate through the Wi-Fi network for a more accurate localization.
- 5.10 Wi-Fi system specified by I-ET-3010.00-5517-768-PPT-003 HULL WLAN SYSTEM, by I-ET-3010.00-5517-768-PPT-005 TOPSIDES WLAN SYSTEM and the structured cabling specified by I-ET-3010.00-5517-768-PPT-002 HULL STRUCTURED CABLING NETWORK and I-ET-3010.00-5517-768-PPT-004 TOPSIDES STRUCTURED CABLING NETWORK can also be used to complete

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POB solution. If any additional LAN point is required to be installed or to be relocated, it shall be foreseen and approved by PETROBRAS.

- 5.11 The BLE beacons that will be powered by batteries shall present autonomy for 3 years, considering a 2s time transmission cycle. The battery status shall be monitored remotely, and alarms shall be sent warning when the battery achieves 20% of its autonomy and keep warning at each 5% lower than 20%.
- 5.12 The BLE Infrastructure shall be composed, at least, by:
- a. BLE beacons (standalone devices);
 - b. BLE TAGs (portable TAGs);
 - c. All accessories required to install all equipment;
 - d. Cables;
 - e. Softwares of management, visualization and configuration.
- 5.13 All devices shall be suitable and have certificate to operate in accordance with the hazardous area classification.
- 5.14 All devices shall have ingress protection of, at minimum, IP-66.
- 5.15 The BLE beacon and its battery shall be in according to classification area; whose battery shall be able to be replaced without removing the BLE beacon from its support. Otherwise, the mounting kit shall allow the BLE beacon to be removed, keeping the mounting kit fixed on the structure or wall.
- 5.16 All devices shall be installed in places suitable to facilitate the maintenance service by portable ladders of maximum 2 meters height without mounting any temporary scaffolding.
- 5.17 The follow diagram clarifies the entire system requirements.

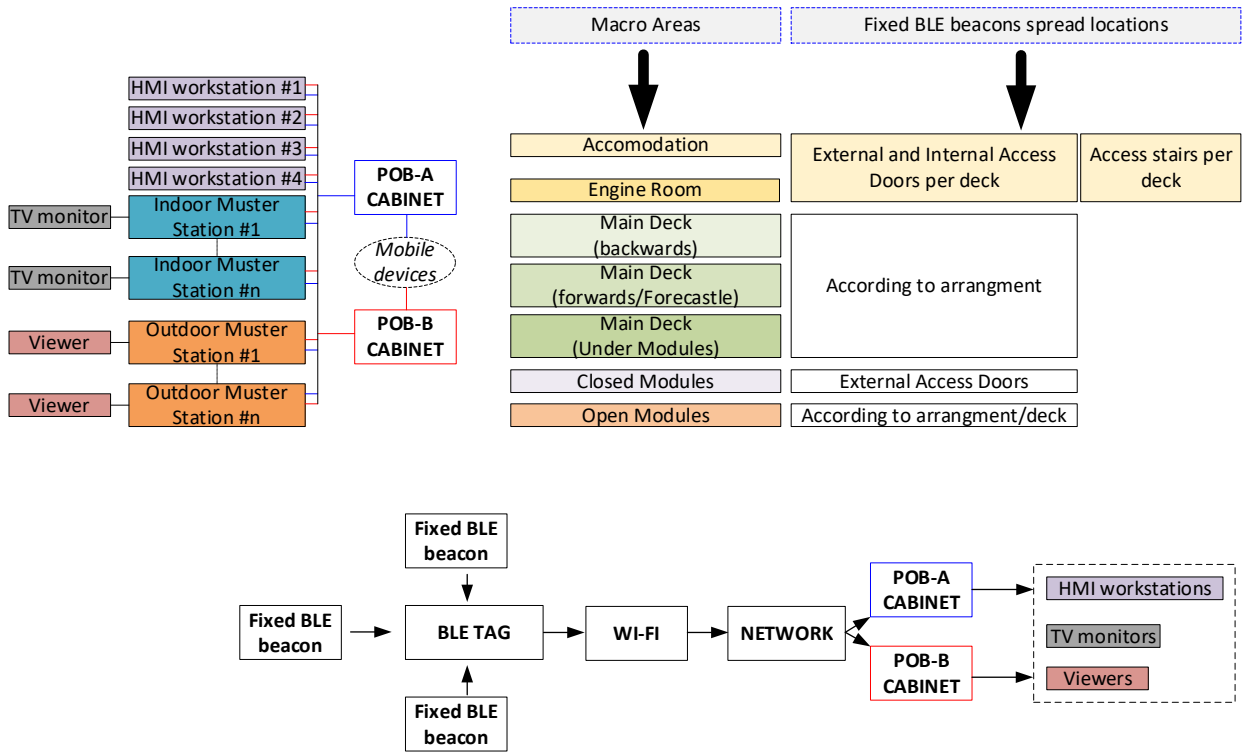




Figure 1: Schematic example of the infrastructure topology

6. TECHNICAL REQUIREMENTS

- 6.1 Equipment and materials shall be supplied with cable passage holes sealed with plastic plugs in the holes to be used and definitive plugs (made of the same material as the equipment and accessories) in the reserve holes.
- 6.2 Electrical equipment installed in external safe (non-hazardous) areas, that will operate during emergency shutdown ESD-3 shall be certified for installation in hazardous areas Zone 2 Group IIA temperature T3 according to IEC 61892-1.
- 6.3 Equipment, cables, boxes, materials and accessories for installation in the industrial areas (outdoor or indoor) of unit shall be specified and assembled taking into account the adverse operating conditions on FPSO such as:
 - a. Atmosphere with high content of humidity, salts hydrocarbons and other corrosive factors;
 - b. Environment subject to the presence of explosive gases shall be in accordance with Hazardous area classification;
 - c. Exposure to weather conditions (sun and rain) and maritime atmosphere;
 - d. Air temperature: From -10°C up to +50°C;
 - e. Air Humidity: 95%.

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- 6.4 Minimum requirements for enclosure to be used in industrial areas:
- a. Type of Protection: in accordance with requirements for installed environment;
 - b. EX Zone 1
 - c. Gas Group: IIA;
 - d. Ingress Protection: IP-66;
 - e. Temperature Class T3.
- 6.5 The sensitivity of the receiver (minimum signal strength received) shall be -100dBm.
- 6.6 The BLE beacons shall capture TAGs beacons and inform it to the WI-FI Network the public information at the internal data structure (Generic Access data field, Generic data field, Device information and Services).
- 6.7 The information listed on the previous item shall be captured and sent to the application server.
- 6.8 All irradiating devices at outdoor areas shall comply with IEC 60079-0 item 6.6 and CLC/TR50427.
- 6.9 In each indoor muster point, it shall be provided a 32 inches TV monitor straight connected to both POB systems (A and B) by means of a KVM device. Such monitor must present the list of all people supposed to be at that muster point with a clear indication of the absent or attended ones.
- 6.10 In each outdoor muster point, it shall be provided any small screen viewer (tablet) with the total of people absent or attended at that muster point. Such small screen (tablet) must be proper for harsh environments and be installed inside the appropriated box, according to classification area.
- 6.11 It shall be provided and installed 01 (one) dedicated HMI workstation (with mouse, keyboard and 24 inches monitor) straight connected to both POB systems (A and B) at the following rooms:
- a. GPLAT (Petrobras OIM office)
 - b. CCR
 - c. Reception desk office
 - d. Telecom Control Room
- 6.12 TV monitors, KVMs and small screens shall also be powered from Unit's UPS power and from circuit breakers inside the closer POB cabinet available.
- 6.13 POB system shall be able to be remotely accessed.

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6.14 It shall also be considered and provided real time and historical (at least 60 days) visualization software for workstations (desk computers) and mobile devices; management system software (to configure the system, to manage battery time lives, to TAGs subscriptions, to configure on demand perimeter fences); software to provide instant notifications on workstations and portable devices.

6.15 **CLOSED RACK FOR THE POB SYSTEM**

6.15.1. It shall be physically installed in a dedicated rack in Upper Telecom Room and another one in Telecom Lower Room.

6.15.2. CONTRATOR shall provide, assemble and install CLOSED RACKs, to installation of all systems described below:


- a. It shall be closed, 19 inches standard, 44U height, minimum depth of 1000 mm (internal dimensions) and 800 mm of useful width (internal dimensions).
- b. It shall have AC sockets ABNT NBR 14136 standard 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. Vertical cable organizer, for Ethernet cables and optic cables;
- g. Internal light only on the rear access;
- h. Complete earthing Kit;
- i. Color: RAL 7035;
- j. Every time a data rack is leaning the wall and it is not possible to access and open its rear door, the rack shall be swing frame type for easy access and maintenance.
- k. It shall have enough circuit breakers, from Unit's UPS, to power every workstation and monitor, TV monitors and display viewers far from POB cabinet.

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- 6.15.3. It shall be supplied cage nuts (M5) and screws (at least 15 mm) for all of the positions.
- 6.15.4. Each POB cabinet shall be cabled (02 FTP cable) to data cabinet for connection with electrical access switch, if required, and to connection to Special Monitoring Switch (02 FTP cable).
- 6.15.5. Each POB cabinet shall be interconnected to each other in order to allow system redundancy between them.

7. SCOPE OF SUPPLY

- 7.1 CONTRACTOR shall supply, install, configure and test the BLE infrastructure Network within the scope of the Contract and in accordance with this Technical Specification.
- 7.2 CONTRACTOR shall be responsible for supplying all instruments to be used during tests in accordance with the Test Book purposed by CONTRACTOR, by VENDOR and approved by PETROBRAS.
- 7.3 CONTRACTOR shall supply all hardware, manuals, licenses and software necessary for the BLE beacons operation and management.
- 7.4 CONTRACTOR shall be responsible for providing all instruments needed for the installation, configuration, acceptance tests and further maintenance.
- 7.5 CONTRACTOR shall deliver an as-built document of this system in .dgn file format with the exact location of each BLE beacon in the FPSO, using the final General Arrangement plant of the Unit as a base.
- 7.6 500 (five hundred) BLE TAGs in a tag shape, complying with hazardous areas zone 1 (EPL Gb) compatible with the BLE beacons.
- 7.7 All licenses, certificates, databooks and passwords shall be delivered to PETROBRAS in order to have all information to operate the system.
- 7.8 04 (four) HMI workstation kit (mouse, keyboard, monitor, KVM).
- 7.9 01 (one) 32 inches TV monitor to each indoor muster point.
- 7.10 01 (one) small screen viewer to each outdoor muster point.
- 7.11 BLE beacons in a number to cover the whole Unit.
- 7.12 02 (two) closed racks.
- 7.13 02 (two) mutli-charger for at least 10 tags each to be installed on the Reception desk.

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7.14 04 (four) FTP cables from each POB cabinet to LAN cabinet at the same deck;

7.15 04 (four) additional BLE beacons to work as fence perimeters on demand.

8. DIMENSIONING CRITERIA


8.1 The whole Unit shall have standalone BLE beacon's devices spread everywhere, self-powered, with no data cabling.

8.2 Inside indoor areas, the BLE beacons shall be installed at least at the following locations:

- a. Each Muster station;
- b. Mess room;
- c. Auditorium;
- d. Meeting rooms;
- e. Reception and briefing room;
- f. Warehouses;
- g. Every accommodation indoor stairs access between decks;
- h. Every accommodation outdoor access between decks;
- i. Engine room entrance and all its floors;
- j. Workshops;
- k. Central Control Room;
- l. Topside closed modules entrances;
- m. Panel rooms;
- n. Forecastle Temporary Refuge.
- o. All battery rooms;

8.3 Additional areas shall be considered in order to ensure full coverage of internal and external areas according to Detail Design to be developed.


8.4 In all external area (escape routes), the maximum distance between BLE must be 20 meters installed in line.

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- 8.5 The system shall be able to store the last position read.
- 8.6 CONTRACTOR shall install BLE beacons all over outdoor areas according to coverage map to be developed and submitted to PETROBRAS approval.
- 8.6.1. The following areas shall have a dedicated BLE beacons:
- a. Lifeboats platform;
 - b. Antenna's deck;
 - c. Helideck access;
 - d. All over the Main Deck;
 - e. All over decks of all open modules.

9. COMMISSIONING

- 9.1 CONTRACTOR shall be responsible to realize a technical commissioning activity, check, test and evaluate the operation of equipment, panels, installations and wireless covering, in order to permit their use under normal operating conditions.
- 9.2 A technician with professional level certified by the manufacturer of the PoB Control equipment provided shall perform the Installation, configuration and Commissioning activities.
- 9.3 The following verifications shall be 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 an user to log into the device remotely: This operation enables a user to remotely log in to the device in the central equipment room to deploy services.

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- 9.4 CONTRACTOR shall follow the verifications and commissioning activities in accordance with Contract documents and this Technical Specification.
- 9.5 All configurations shall be recorded by means of tables and print screens according to each equipment.
- 9.6 The minimum acceptance criteria shall be:
- 9.6.1. Outdoor and indoor areas, helideck access, lifeboats platform and antenna's deck: Each Bluetooth tag shall be noticed by at least 01 (one) receiver. The acceptance tests shall verify the BLE parameters of at least 20 tested tags at the same location.
- 9.6.2. Muster points, lifeboats platform, mess room and auditorium: The receivers installed at those locations shall be able to receive and report BLE information from at least 250 BLE beacons (tags). The acceptance tests shall verify the BLE parameters of the 250 tested tags at the same location.
- 9.7 As a matter of general acceptance, both systems shall be activated with displays monitors in each muster point and desk computers installed with system software available to identify each trackable TAG delivered and spread everywhere around the unit and WLAN System coverage completely tested and approved.