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1 OBJECTIVE

1.1 This specification establishes the necessary technical requirements for design, manufacture and supply signalling for navigation aids, aviation obstruction warning signals for aircraft and helideck lighting systems for all facilities of PETROBRAS Offshore Units, including installations in modules and packages.

1.2 This specification establishes the necessary technical requirements for design, manufacture and supply lighting fixtures and floodlights, rescue and searchlights and associated equipment and materials for all facilities of PETROBRAS Offshore Units, including installations in modules and packages.

1.3 Classification Society requirements shall prevail over requirements of this document.

2 REFERENCE STANDARDS AND DOCUMENT LIST

2.1 GENERAL

At the design development and for equipment specification, IEC standards shall be used, all on their latest revisions. Exceptionally, where it is clearly justifiable, ANSI, IEEE and others, internationally recognized standards, may be used. Their use shall be restricted to specific cases and shall be approved by PETROBRAS.

2.2 CODES, STANDARDS AND RECOMMENDED PRACTICES

2.2.1 IEC – INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079	Explosive Atmospheres - All parts
IEC 61892	Mobile and Fixed Offshore Units - Electrical Installations - All parts
IEC 62612	Self-ballasted LED lamps for general lighting services with supply voltages > 50 V - Performance requirements
IEC 62717	LED modules for general lighting – Performance requirements
IEC 62722-2-1	Luminaire performance – Part 2-1: Particular requirements for LED luminaires

Note: When all parts are informed, all applicable parts shall be used as reference. If a specific part in mentioned in text, it will be listed following the general code reference.

2.2.2 IMO - INTERNATIONAL MARITIME ORGANIZATION

IMO Res. MSC.81(70) REVISED RECOMMENDATION ON TESTING OF LIFE-SAVING APPLIANCES

2.2.3 LABOUR SECRETARY - MINISTRY OF ECONOMY - REGULATORY STANDARDS FOR OCCUPATIONAL SAFETY AND HEALTH

NR-10	Segurança em Instalações e Serviços em Eletricidade
NR-12	Segurança no Trabalho em Máquinas e Equipamentos
NR-37	Segurança e Saúde em Plataformas de Petróleo

2.2.4 DPC – MARINHA DO BRASIL – DIRETORIA DE PORTOS E COSTAS

NORMAM-05/DPC Normas da Autoridade Marítima para Homologação de Material.

NORMAM-27/DPC Normas da Autoridade Marítima para Homologação de Helideques Instalados em Embarcações e em Plataformas Marítimas.

RIPEAM 72 Regulamento Internacional para Evitar Abalroamentos no Mar.

Portaria nº 21/DPC de 29/01/2020 Altera as Normas da Autoridade Marítima para Homologação de Material -NORMAM-05/DPC.

2.2.5 ISO - INTERNATIONAL STANDARDIZATION ORGANIZATION

17884 Ships and marine technology — Searchlights for high-speed craft

2.3 REFERENCE DOCUMENTS

[1] I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS

[2] I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS

[3] I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS

[4] I-ET-3010.00-5140-741-P4X-004 – SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS

[5] STRUCTURAL REQUIREMENTS SPECIFICATON

[6] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING

[7] MOTION ANALYSIS

[8] I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS

Note**:** Documents without code in the list are documents with variations according to project characteristics. Verify in project documentation list the reference for codes of these documents.

3 SIGNALING, WARNING, AND HELIDECK

All Signalling for Navigation Aid, Warning Signals for Aircraft and Helideck Lighting System specified into the following sections shall comply with the hazardous areas criteria, IP grades definitions, standardizations and all other requirements (when applicable) defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

3.1 SIGNALLING FOR NAVIGATION AID

3.1.1 GENERAL

3.1.1.1 The navigation aid warning lights systems shall comply with NORMAM and RIPEAM standards.

3.1.1.2 Each light circuit shall be provided with automatic monitoring device, giving indication of extinction of the lamp.

3.1.1.3 All lamps used for signalling and navigation aids shall be certified to operate in hazardous areas Zone 1 Group IIA T3 following definitions in IEC 61892-1 and IEC 61892-7.

3.1.1.4 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods.

3.1.2 NAVIGATION AID SIGNALLING

3.1.2.1 The navigation aid system shall be formed by intermittent white lamps installed at all four corners of the Unit. These lights shall flash in synchronism, transmitting the letter “u” in the Morse Code in accordance with the following cycle:

a) “flash” 0.4 s.

b) “eclipse” 0.5 s.

c) “flash” 0.4 s.

d) “eclipse” 0.5 s.

e) “flash” 1.2 s.

f) “eclipse” 12 s.

3.1.2.2 These flashlights shall have a minimum range of ten (10) nautical miles on any direction. The lamps shall operate automatically, by photocell, between sunset and sunrise and shall be fitted with manual actuation devices installed in the Control Room or in the Radio Room. Photocell enclosures shall be made of copper free aluminium according to requirements in I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

3.1.2.3 All lighting fixtures shall be weather, vapour and gas proof and shall be provided with protective gratings.

3.1.2.4 Equipment for control of the lamps and foghorns shall be housed in weatherproof boxes built of non-metallic material.

3.1.2.5 Two foghorns shall be located at Unit in diametrically opposite corners position (next to white intermittent lamps), with a range of at least 2 (two) nautical miles in any direction.

3.1.2.6 The foghorns shall emit in synchronism the character "u" in the Morse Code, in accordance with the following cycle:

a) whistle 0.75 second.

b) silence 1.00 second.

c) whistle 0.75 second.

d) silence 1.00 second.

e) whistle 2.50 seconds.

f) silence 24.0 seconds.

3.2 AVIATION OBSTRUCTION WARNING SIGNALS FOR AIRCRAFT

3.2.1 The aircraft warning lights systems shall comply with NORMAM and RIPEAM standards.

3.2.2 Each light circuit shall be provided with automatic monitoring device, giving indication of extinction of the lamp.

3.2.3 Continuous red lamps installed on elevated points of the Unit, such as derrick, booms of cranes and other vertical obstructions to approach by helicopter shall form the warning signals for aircraft. Provision shall be made for installation of a lamp at the top of each obstacle previously related and others of such fittings along the respective structure, with spacing from top downwards at intervals not exceeding ten meters. These lamps shall have a minimum range of ten (10) nautical miles on any direction.

3.2.4 Flare towers for systems that operate with flame and pilot unlit (i.e., closed flare system) shall have permanent obstruction warning lights clearly visible from any direction of approach indicating the presence of the structure from a height ten meters above the level of the landing area until the top. The warning lights system shall be composed of sets of low intensity omnidirectional steady red lights located at ten meters intervals and/or sets of non-glare metal halide floodlights. The number of warning lights or floodlights per set shall be at least the same number of legs of the flare tower. The luminous flux shall be provided in Vendor Document and approved by PETROBRAS and Classification Society.

3.2.5 These lights shall be installed with heat shields when necessary and shall have a minimum intensity of 10 candelas. For floodlights the minimum produced luminosity shall be of 10 candelas/sqm. Except for cranes' signalling (always on), the lamps shall operate automatically by photocell, between sunset and sunrise and shall be fitted with manual actuation devices installed in the Central Control Room and in the Radio Room.

3.2.6 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods.

3.3 HELIDECK LIGHTING SYSTEM

3.3.1 Helideck lighting system shall be designed in accordance with the Marine/Aeronautic directive NORMAM-27/DPC, which complementary aspects are mentioned below:

a) The helideck lighting system shall not cause dazzling sight on the pilot during landing and take-off operations.

b) LED technology or Floodlights can be applied.

3.3.2 LEDs inside landing area floor or LED strips, these technologies shall not result in floor elevations and shall not have its sealing be compromised.

3.3.3 Floodlights:

a) Four floodlights shall be installed to light the touch area. These floodlights shall be proper for LED and shall be located in each of the helideck's corners.

b) It shall not be accepted sodium vapour lamps or Xenon floodlights.

3.3.4 The lighting fixtures shall be weatherproof and suitable for marine use, being provided with protective gratings.

3.3.5 Provision shall be made for illumination of the wind direction indicator (windsock) for night-time use or when conditions of visibility so require. This lighting shall be made with LED floodlights or with internal LEDs.

3.3.6 Helideck Status Light shall be designed in accordance with the Marine/Aeronautic directive NORMAM, shall be weatherproof and suitable for marine use, being provided with protective gratings.

3.3.7 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods.

4 LIGHTING FIXTURES AND FLOODLIGHTS

All Lighting Fixtures and Floodlights specified into the following sections shall comply with the hazardous areas criteria, IP grades definitions, standardizations and all other requirements (when applicable) defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

4.1 GENERAL REQUIREMENTS

4.1.1 Lighting fixtures and floodlights shall follow requirements of IEC 61892-6.

4.1.2 All lighting fixtures and floodlights (except Searchlights, see 5.1.3) shall use LED lamps.

4.1.3 All lighting fixtures and floodlights shall be complete, with sockets and accessories.

4.1.4 All accessories, like hinges, lockers, bolts, and nuts shall be of stainless steel AISI-316L.

4.1.5 Threaded joints shall comply with I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

4.1.6 All outdoor lighting fixtures and floodlights shall be certified for marine use.

4.2 LIGHTING FIXTURES

4.2.1 Lighting fixtures with incorporated battery, shall have local indication LEDs for ON (normal) and FAILURE (mains power failure or battery fault) conditions.

Note: lighting fixtures with incorporated battery shall only be used in few specific locations and previously approved by PETROBRAS.

4.2.2 It shall not be acceptable “Ex n” lighting fixtures, see Table 1.

4.2.3 Pendant Lighting fixtures shall be provided with an extra safeguarding against falling down if the screwed connections loosen, as required in IEC 61892-6.

Note: For Lighting fixtures, it shall be used stainless steel cable AISI-316L.

4.2.4 In order to comply with the standardization all Ex Lighting fixtures shall be provide by the same manufacturer.

4.2.5 Lighting fixtures with LED lamps shall comply with IEC 62722-2-1.

4.2.6 LED (Ex) lamps lighting fixtures shall comply with IEC 60079-28.

4.2.7 All LED lighting fixtures shall have diffuser wings, reflectors, or other means, in order to not cause inconvenient obfuscation.

4.2.8 Lighting fixtures with high reliability, long life LED lamps, type-approved by Classification Society, shall be provided for the following systems:

- Aircraft obstruction warning system.
- Navigation aid signalling system.
- Helideck signalling system (including windsock and status lights).
- Muster stations lights.
- Emergency generator and auxiliary generator starting and control panels lights.
- Firefighting pumps starting and control panels lights.

- Lifeboat and rescue boat embarkation stations lights.

4.3 LIGHTING FIXTURES FOR INDOOR INSTALATIONS

4.3.1 Lighting fixtures for battery rooms shall be “Ex e”, proper for Zone 1, Group IIC, T1, see Table 1.

4.3.2 Lighting fixtures for Paint rooms shall be “Ex e”, proper for Zone 1, Group IIB, T3. See Table 1.

4.3.3 All Lighting fixtures for indoor installations shall be fabricated in stainless steel AISI-316L, or carbon steel with ALUZINC coat.

4.3.4 Lighting fixtures used indoors shall be embodied-mounted type, recessed, with mirror reflectors and anodized diffuser wings.

4.3.5 Lighting fixtures for workbenches shall have diffuser wings and reflectors, in order to not cause inconvenient obfuscation, reflex and excessive shadows.

4.3.6 All indoor lighting fixtures in accommodation modules and offices, shall be certified to be installed in rooms with ceiling B-15 class.

4.4 LIGHTING FIXTURES FOR OUTDOOR INSTALLATIONS

4.4.1 For standardization reason and as defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS, all lighting fixtures for outdoor installations shall be suitable and certified for installation in hazardous areas Zone 1 Group IIA temperature T3, if:

- Installed in external safe areas (non-hazardous areas), that shall be kept operating during emergency shutdown ESD-3P and ESD-3T.
- Installed in external areas, process plant area and pump room.

4.4.2 These lighting fixtures shall be “Ex e”, see Table 1.

4.4.3 For outdoor installations, lighting fixtures shall be in FRP or stainless steel AISI-316L.

4.5 FLOODLIGHTS

4.5.1 Floodlights for lifeboat landing areas (sea level) shall have quick restart and long lifetime.

4.5.2 Floodlights shall be provided with an extra safeguarding against falling down if the screwed connections loosen, as required in IEC 61892-6.

Note: For Floodlights, it shall be used stainless steel AISI-316L safety net.

4.5.3 Floodlights to support offloading operations shall comply with the requirements of items 5.1.1 and 5.1.4. They shall be fitted with LED lamps (IEC 62722-2-1 and IEC 60079-28).

4.6 FLOODLIGHTS FOR INDOOR INSTALATIONS

4.6.1 All floodlights for indoor installations shall have corrosion resistant seamless housings made of seawater resistant aluminium (according to I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS) or carbon steel with ALUZINC coat.

4.6.2 When LED lamps floodlights are used indoors, they shall have diffuser wings, reflectors, or other means, in order to not cause inconvenient obfuscation.

4.6.3 All indoor floodlights in accommodation modules and offices, shall be certified to be installed in rooms with ceiling B-15 class.

4.7 FLOODLIGHTS FOR OUTDOOR INSTALLATIONS

4.7.1 All floodlights installed outdoors shall be suitable to operate in hazardous areas Zone 1 Group IIA T3, even if located in non-hazardous areas, see Table 1.

4.7.2 For outdoor installations, all floodlights shall have corrosion resistant seamless housings made of stainless steel AISI-316L.

4.8 SUMMARY OF HAZARDOUS CLASSIFICATION

For lighting fixtures and floodlights the Ex hazardous classification by zone is defined in Table 1.

Table 1 – Lighting fixtures and Floodlights Ex Classifications by Zone.

AREA CLASSIFICATION	LIGHTING EQUIPMENT	NORMAL LOADS	ESSENTIAL LOADS	EMERGENCY LOADS
Internal, safe area non-hazardous (1)	Lighting Fixture (LED)			
	Floodlights (LED)			
External areas non classified	Lighting Fixture (LED)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)
	Floodlights (LED)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)
Zone 2	Lighting Fixture (LED)	Ex e (Zone 1 IIA T3) (3)	Ex e (Zone 1 IIA T3) (3)	Ex e (Zone 1 IIA T3) (3)
	Floodlights (LED)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)	Ex e (Zone 1 IIA T3)
Zone 1	Lighting Fixture (LED)	Ex e (Zone 1 IIA T3) (2)	Ex e (Zone 1 IIA T3) (2)	Ex e (Zone 1 IIA T3) (2)

Notes:

1) Normal, essential, and emergency lighting fixtures and floodlights installed in indoor non-hazardous areas that normally (a) or (b), are not required to be suitable for hazardous areas, as defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and IEC 61892-1.

   a) have overpressure or;
   b) where the ventilation arrangement is such that gas cannot penetrate into the room (such as Accommodation, Engine rooms, Electrical room, and Control room).

   In case conditions “a” or “b” cannot be achieved, alternative solutions for lighting fixtures classification shall be submitted to PETROBRAS for approval.

2) Lighting Fixtures installed inside Paint room shall be Ex-e, certified to Zone 1 II B T3.

3) Lighting Fixtures installed inside Battery room shall be Ex-e, certified to Zone 1 II C T1.

5 RESCUE AND SEARCHLIGHTS

5.1 GENERAL REQUIREMENTS

5.1.1 All Rescue and Searchlights specified into the following sections shall comply with the hazardous areas criteria, IP grades definitions, standardizations and all other requirements (when applicable) defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

5.1.2 Rescue and searchlights shall be corrosion resistant, strong construction, protection degree according to reference I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS, completely sealed, provided with heat radiators and suitable to operate on structures subject to vibration and winds up to 50 m/sec.

5.1.3 Searchlights shall be supplied complete with LED or halogen lamp of 2kW, 220V, and with local controlgear, including an ON/OFF switch. This controlgear shall be duly interconnected to the searchlight through flexible metal conduit and shall be according to I-ET-3010.00-5140-741-P4X-004 – SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

5.1.4 Searchlights shall be manually operated and allow movement within the following angles:

a) rotation angle / pan angle minimum: 270º.

b) elevation angle / tilt up: 60º.

c) depth angle / tilt down: 75º.

5.1.5 If otherwise, project documentation makes a request for motor controlled search lights:

5.1.5.1 The effective light emission sectors shall be circular and reach vertically and horizontally at least 6°, as required by IMO RESOLUTION MSC.81(70).

5.1.5.2 The optical light axis of searchlights shall be capable of being panned at least 175° horizontally to either side and tilt minimum 30° downward and minimum 30° upward, starting from the zero position, as required by ISO 17884.

5.1.6 Any searchlight located in classified area shall have its switch inhibited by gas presence sensor installed within 1 meter or less of the searchlight position or by A&C gas detection alarm. Inhibition of blocking overrun may be allowed in control room only.

5.1.7 Rescue and searchlights shall have IMO certificate approval, complying with IMO RESOLUTION MSC.81(70), as defined in NORMAM-05/DPC. This is requested by Portaria nº 21/DPC de 29/01/2020.

6 LED LAMPS

6.1 GENERAL REQUIREMENTS

6.1.1 LED lamps shall follow IEC 62722-2-1, IEC 62612, and IEC 62717.

6.1.2 LED modules lifetime and lumen output over life shall be informed according to IEC 62717 and dimensioned to life expectancy defined in applications where it is used.

6.1.3 Minimum efficiency required shall be 85%.

6.1.4 Strobe effect is not allowed, and it shall have a low blurring.

6.1.5 Led casing shall be colourless or white matte.

6.1.6 Maximum surface temperature shall be 200°C, at environment temperature between -20°C and 40°C.

6.1.7 Temperature colour shall be between 5000 K and 6000 K (Cool white).

6.1.8 LED luminous Efficiency shall be 120 lm/W or superior.

6.1.9 LED Lamps shall be linear with double pin connectors.

6.1.10 Minimum time warranty shall be 4 years.

6.1.11 Lifetime shall be superior to 50,000 h at 40°C (see temperatures defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS for application location reference) with a minimum luminous flux of 70% at the end of this period.

6.1.12 The tests reports indicated in IEC 62612 shall be informed for linear LED lamps that have an embedded drive.

6.1.13 Linear lamps may not have their functionality compromised by the burning of LED units.

6.1.14 Led Lamps and Drives shall be covered by their respective lighting fixtures and floodlights Ex certifications when used in hazardous areas as defined in previous sections, complying with IEC 60079-7 and IEC 62717.

6.2 LED POWER DRIVER

6.2.1 Power driver and electronic components requirements shall:

- Allow driver supply of 220Vac, 60Hz and 220Vcc.
- Allow driver supply voltage fluctuation of ± 10% of nominal voltage.
- Have a minimum voltage surge protection: 2.0 kV between phases and 2.0 kV between phase and ground.
- Built-in electronic system for active control of the LED power supply chain and correction of the power factor.
- Harmonic content according to the requirements and limits of the IEC 61000-3-2 standard: 1.1.17 class C.
- THD (Total Harmonic Distortion) driver: < 15%.
- Driver power factor: > 0.95.
- Efficiency of electronic Power modules (driver): greater than 85%.
- Short circuit protection, over current, over voltage and over temperature.
- Natural convection cooling.

7 LIGHTING MATERIALS

7.1 LAMPS SOCKETS

7.1.1 Sockets shall be according to those indicated for LED lamps.

7.1.2 Sockets shall be anti-vibration type and suitable for naval use.

7.2 LIGHTING POLES AND LIGHTING SUPPORT STRUCTURES

7.2.1 GENERAL REQUIREMENTS

7.2.1.1 All lighting poles and lighting supporting structures shall comply with the STRUCTURAL REQUIREMENTS SPECIFICATON.

7.2.1.2 These structures shall be designed so the electrical equipment installed on them shall comply with the mandatory requirements of electrical equipment's for motion and inclination limits and for vibration limits, all defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

7.2.1.3 Lighting poles and lighting supporting structures shall be identified according to I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

7.2.1.4 Lighting fixtures and Floodlights shall follow maximum hight installations defined at I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

- Lighting Fixtures and floodlights for normal and essential lighting shall be installed at a maximum high of 2 m or, otherwise, 3 m, if either the free movement of people or any cargo handling operation is in some way affected.
- For mounting heights above this limit, it shall be used floodlights and a fixed access resource shall be provided.

7.2.1.5 Lighting poles and lighting supporting structures shall be detailed according to I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS.

7.2.1.6 The material of the poles shall be stainless steel AISI-316L or HDG (hot dipped galvanized) steel painted according to I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

7.2.1.7 The material of their accessories, including screws, washers, and profiled trays, shall be stainless steel AISI-316L.

7.2.1.8 Whenever possible poles using lighting fixtures in a horizontal position or modular supports shall be used.

7.2.2 MODULAR SUPPORTS

7.2.2.1 Standard commercial modular supports may be used for installation of lighting fixtures and floodlights poles and support structures.

7.2.2.2 If using modular supports:

a) These supports shall include modular support channels, bolted to the starter brackets using anti-vibration self-lock mechanisms. These locking mechanisms shall present test certifications from a third party certification society.

b) The calculations of the supports shall be presented. PETROBRAS naval data input for calculation is available in MOTION ANALYSIS report.

c) With bolted starters, it shall be used anti-corrosion pastes certified by the manufacturer.

d) It shall be used anti-vibration bolts with maximum torque informed by the manufacturer.

e) The modular support manufacturer shall assure the full structure conductivity for earthing purposes.

f) It shall be considered the maximum tolerance of +/- 5mm applying to all main support dimensions. For cut-out and auxiliary dimensions, the tolerance is +/-3mm.

7.2.2.3 The use of modular supports shall be approved by PETROBRAS.

7.2.3 LIGTHING STRUCTURES REQUIREMENTS FOR MAINTENANCE

7.2.3.1 For lighting fixtures and floodlights, provisions shall be made for the inclusion of a demountable junction/interface in the vertical section of the posts, when the highest end of these equipment is above 3.5 meters. Other specific cases may apply if the location is approved by PETROBRAS.

7.2.3.2 In these cases, the following requirements apply:

a) The design and detailing of the lighting fixtures support shall include accessories that allow disassembly, bending or jointing of the supports, avoiding mounting scaffolds for maintenance.

b) The design shall allow a safe and manual lay down/bend over of moving parts without the disconnection of these parts and need of local hoisting or lifting gear.

c) The proposed solution shall be presented the design calculations of the supports, interfaces, and overall included parts and equipment. Naval data input for calculation is available in MOTION ANALYSIS report.

7.2.3.3 In case existing a demountable junction/interface in the vertical section of the posts:

a) Cable loops shall be provided to enable lighting fixtures disassembly to the floor.

b) A second safety cable (the first is to prevent the luminaire from falling) shall be installed by inserting eyelets in the two sections of the luminaire separated by flanges, to prevent it from falling during the disassembly process for maintenance.

7.2.3.4 The proposed design and respective calculations shall be sent to PETROBRAS for approval.

7.3 CONDUITS

7.3.1 Conduits shall be of galvanized steel and supplied painted according to requirements defined in I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

7.3.2 Conduits to be applied on hazardous areas shall be SCHEDULE 40, seamless.

7.3.3 For other areas, including indoor living quarters, conduits shall be medium seamless type.

7.3.4 All conduits shall have their paint finished after their installation.

8 ANNEX I – ABBREVIATIONS AND ACRONYMS

A&C	Automation and Control System
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
DPC	Departamento de Portos e Costas
ESD	Emergency Shutdown
EPL	Equipment Protection Level
ET	Technical Specification
FPSO	Floating, Production, Storage and Offloading Unit
FSO	Floating, Storage and Offloading Unit
HDG	Hot Dipped Galvanized
IEC	International Electrotechnical Commission
IEEE	Institute of Electrotechnical and Electronic Engineers
INMETRO	Instituto Nacional de Metrologia Normalização e Qualidade Industrial
ISO	INTERNATIONAL STANDARDIZATION ORGANIZATION
LED	Light Emitting Diode