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AREA:

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TITLE:

**SPECIFICATION FOR LIGHTING AND ELECTRICAL
SIGNALLING FOR OFFSHORE UNITS**

INTERNAL

ESUP

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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, towing, anchor and helideck lighting systems for all facilities of PETROBRAS Offshore Units, including installations in modules and packages.
- 1.2 This specification also 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.
- 1.4 Refer to I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS to equalize the understanding about terms mentioned in 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 is 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

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<p>NR-37 Segurança e Saúde em Plataformas de Petróleo</p> <p>2.2.4 DPC – MARINHA DO BRASIL – DIRETORIA DE PORTOS E COSTAS</p> <p>NORMAM-201 Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto</p> <p>NORMAM-321 Normas da Autoridade Marítima para Homologação de Material e Certificação de Laboratórios e Sistemas de Embarque</p> <p>NORMAM-223 Normas da Autoridade Marítima para Registro de Helideques</p> <p>COLREG 72 Convention on the International Regulations for Preventing Collisions at Sea, 1972</p> <p>2.2.5 ISO - INTERNATIONAL STANDARDIZATION ORGANIZATION</p> <p>17884 Ships and marine technology — Searchlights for high-speed craft</p> <p>2.2.6 INMETRO – INSTITUTO NACIONAL DE METROLOGIA NORMALIZAÇÃO E QUALIDADE INDUSTRIAL</p> <p>Portaria nº 69 February 16th, 2022</p> <p>2.3 REFERENCE DOCUMENTS</p> <p>[1] I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS</p> <p>[2] I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS</p> <p>[3] I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.</p> <p>[4] I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS</p> <p>[5] I-ET-3010.00-5140-741-P4X-004 – SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS</p> <p>[6] STRUCTURAL REQUIREMENTS SPECIFICATION</p> <p>[7] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING</p> <p>[8] MOTION ANALYSIS</p> <p>[9] I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS</p> <p>[10] I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS</p> <p>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.</p>						

3 SIGNALLING, WARNING, AND HELIDECK

All Signalling for Navigation Aid, Warning Signals for Aircraft, Towing, Anchor 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-201 and COLREG 72 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-223 and COLREG 72 standards.

3.2.2 These lamps shall be LED Type have a minimum range according to NORMAM-223.

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

3.2.4 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.

3.2.5 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 LED Type 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.


3.2.6 These lights shall be installed with heat shields when necessary and shall have a minimum intensity according to NORMAM-223. 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.

3.2.7 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.

3.2.8 Aircraft warning lights systems shall be power supplied according to I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.

3.3 HELIDECK LIGHTING SYSTEM

3.3.1 Helideck lighting system shall be designed in accordance with NORMAM-223, which complementary aspects are mentioned below:

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<p>a) The helideck lighting system shall not cause dazzling sight on the pilot during landing and take-off operations.</p> <p>b) LED technology shall be applied.</p> <p>3.3.2 LEDs inside landing area floor or LED strips shall not result in floor elevations and shall not have its sealing be compromised.</p> <p>3.3.3 Landing Area, including touch area and Circle H shall be lighted by floor recessed LEDs or LED Strips, according to NORMAM-223.</p> <p>3.3.4 It shall not be accepted sodium vapour lamps or Xenon floodlights for any helideck light.</p> <p>3.3.5 The lighting fixtures shall be weatherproof and suitable for marine use, being provided with protective gratings.</p> <p>3.3.6 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.</p> <p>3.3.7 Helideck Status Light shall be designed in accordance with NORMAM-223, shall be weatherproof and suitable for marine use, being provided with protective gratings.</p> <p>3.3.8 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.</p> <p>3.3.9 Helideck Lighting System shall be power supplied according to I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.</p> <p>3.4 ANCHOR LIGHTING SYSTEM</p> <p>3.4.1 Anchor Lighting system shall be designed in accordance with COLREG 72.</p> <p>3.4.2 Anchor Lighting System shall be power supplied according to I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.</p> <p>3.4.3 Anchor lights shall be weatherproof and suitable for marine use, being provided with protective gratings.</p> <p>3.4.4 All lamps used in the anchor lighting system shall be certified to operate in hazardous areas Zone 2 Group IIA T3 following definitions in IEC 61892-1 and IEC 61892-7.</p> <p>3.4.5 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.</p> <p>3.5 TOWING LIGHTING SYSTEM</p> <p>3.5.1 Towing Lighting system shall be designed in accordance with COLREG 72.</p> <p>3.5.2 Towing Lighting System shall be power supplied according to I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.</p> <p>3.5.3 Temporary power supply for towing lights shall be provided to keep Towing Lighting System energized when the FPSO is towed and the FPSO Power Supply (Main and Emergency Generator) is off.</p>						

- 3.5.4 Towing lights shall be weatherproof and suitable for marine use, being provided with protective gratings.
- 3.5.5 All lamps used in the towing lighting system shall be certified to operate in hazardous areas Zone 2 Group IIA T3 following definitions in IEC 61892-1 and IEC 61892-7.
- 3.5.6 Manufacturer shall provide the necessary spare parts for the commissioning and pre operation periods. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.

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.
- 4.1.7 Floodlights and lighting fixtures shall be provided with an extra safeguarding by means of anti-fall security cable or anti-fall safety net, in order to protect operational personnel and installation against an accidental fall if main fixation is loose. Refer to Table 1 for extra safeguarding installation criteria.

Table 1: Extra safeguarding installation criteria for floodlights and lighting fixtures.

Lighting Equipment	Installation Type	Anti-fall Security Cable Set	Anti-fall Safety Net Set
Lighting Fixture	Pendant Installation	N/A	Yes
	Longitudinal Installation	Yes	N/A
	Transversal Installation	Yes	N/A
	Pole Installation	Yes	N/A
	Inlaid Installation	N/A	N/A
	Bulkhead or Column Installation	Yes	N/A
	Handrail Installation	N/A	Yes
Floodlight	All installations	N/A	Yes

- 4.1.8 Anti-fall security cable and anti-fall safety net set shall be stainless steel AISI-316L.

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<p>4.1.9 For installation details about extra safeguarding installation, refer to I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS.</p>						
<p>4.2 LIGHTING FIXTURES</p>						
<p>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.</p> <p>Notes:</p> <ul style="list-style-type: none"> • Lighting fixtures with incorporated battery shall only be used in few specific locations and previously approved by PETROBRAS. • Examples are in front of emergency and auxiliary generator panels, meeting points, musters stations, central control room etc. • If required autonomy is longer than 8 hours, lighting fixtures with incorporated battery shall not be used. 						
<p>4.2.2 It shall not be acceptable “Ex n” lighting fixtures, see Table 2.</p>						
<p>4.2.3 In order to comply with the standardization, all Ex Lighting fixtures shall be provided by the same manufacturer.</p> <p>Note: This requirements is not applicable for Ex lighting fixtures inside packages.</p>						
<p>4.2.4 Lighting fixtures shall be tubular or modular type with high reliability with long life LED lamps, type-approved by Classification Society, complying with IEC 62722-2-1.</p>						
<p>4.2.5 All LED lighting fixtures shall have diffuser wings, reflectors, or other means, in order to not cause inconvenient obfuscation.</p>						
<p>4.2.6 LIGHTING FIXTURES FOR INDOOR INSTALLATIONS</p>						
<p>4.2.6.1 Lighting fixtures for battery rooms shall be “Ex e”, proper for Zone 1, Group IIC, T1, see Table 2.</p>						
<p>4.2.6.2 Lighting fixtures for Paint rooms shall be “Ex e”, proper for Zone 1, Group IIB, T3. See Table 2.</p>						
<p>4.2.6.3 All Lighting fixtures for indoor installations shall be fabricated in stainless steel AISI-316L, or carbon steel with ALUZINC coat.</p>						
<p>4.2.6.4 Lighting fixtures used indoors shall be embodied-mounted type, recessed, with mirror reflectors and anodized diffuser wings.</p>						
<p>4.2.6.5 Lighting fixtures for workbenches shall have diffuser wings and reflectors, in order to not cause inconvenient obfuscation, reflex and excessive shadows.</p>						
<p>4.2.6.6 All indoor lighting fixtures in accommodation modules and offices, shall be certified to be installed in rooms with ceiling B-15 class.</p>						
<p>4.2.7 LIGHTING FIXTURES FOR OUTDOOR INSTALLATIONS</p>						
<p>4.2.7.1 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:</p>						

- 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.

4.2.7.2 These lighting fixtures shall be “Ex e”, see Table 2.

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

4.3 FLOODLIGHTS

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

4.3.2 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).

4.3.3 Floodlights mounting plates shall have rails to allow the rotation avoiding misalignment among fixation points of the floodlights and mounting plates. It shall be foreseen at least 3 fixation points (one at the center and the others at the lateral).

4.3.4 FLOODLIGHTS FOR INDOOR INSTALLATIONS

4.3.4.1 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.

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

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

4.3.5 FLOODLIGHTS FOR OUTDOOR INSTALLATIONS

4.3.5.1 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 2.

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

4.4 SUMMARY OF HAZARDOUS CLASSIFICATION

For lighting fixtures and floodlights the Ex hazardous classification by zone is defined in Table 2.

Table 2 – 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)

AREA CLASSIFICATION	LIGHTING EQUIPMENT	NORMAL LOADS	ESSENTIAL LOADS	EMERGENCY LOADS
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 the room (such as Accommodation, Engine room, 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: 270°.
- b) elevation angle / tilt up: 60°.
- c) depth angle / tilt down: 75°.

5.1.5 If motor-controlled search lights are required in project documentation:

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).

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<p>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.</p> <p>5.1.6 Any searchlight located in hazardous 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.</p> <p>5.1.7 Rescue and searchlights shall have IMO certificate approval, complying with IMO RESOLUTION MSC.81(70), as defined in NORMAM-321.</p> <p>5.1.8 Rescue and Searchlights shall be provided with an extra safeguarding by means anti-fall safety net, in order to protect operational personnel and installation against an accidental fall if main fixation is loose.</p>			
<h2>6 LED LAMPS</h2>			
<h3>6.1 GENERAL REQUIREMENTS</h3>			
<p>6.1.1 LED lamps shall follow IEC 62722-2-1, IEC 62612, and IEC 62717.</p> <p>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.</p> <p>6.1.3 Minimum efficiency required shall be 85%.</p> <p>6.1.4 Strobe effect is not allowed, and it shall have a low blurring.</p> <p>6.1.5 Led casing shall be colourless or white matte.</p> <p>6.1.6 Maximum surface temperature shall be 200°C, at environment temperature between -20°C and 40°C.</p> <p>6.1.7 Temperature colour shall be between 5000 K and 6000 K (Cool white).</p> <p>6.1.8 LED luminous Efficiency shall be 120 lm/W or superior.</p> <p>6.1.9 LED Lamps shall be linear with double pin connectors.</p> <p>6.1.10 Minimum time warranty shall be 4 years.</p> <p>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.</p> <p>6.1.12 The tests reports indicated in IEC 62612 shall be informed for linear LED lamps that have an embedded drive.</p> <p>6.1.13 Linear lamps may not have their functionality compromised by the burning of LED units.</p> <p>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.</p> <p>6.1.15 LED lamps when integrated with their base shall comply with INMETRO Portaria nº 69 February 16th, 2022.</p>			

6.2 LED POWER DRIVER

6.2.1 Power driver and electronic components requirements shall:

- Allow driver supply of 220Vac, 60Hz and 220Vdc.
- Allow driver supply voltage fluctuation of $\pm 10\%$ 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 The installation of lighting fixtures and floodlight in poles shall be avoided according to I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS. If supports in surrounding bulkheads or structure columns are impracticable, lighting poles application shall be submitted to PETROBRAS for approval.


7.2.1.2 All lighting poles and lighting supporting structures shall comply with the STRUCTURAL REQUIREMENTS SPECIFICATION.

7.2.1.3 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.

7.2.1.4 Lighting Fixtures and floodlights for normal and essential lighting shall be installed at a maximum high of 2.2 m or, otherwise, 3 m, if either the free movement of people or any cargo handling operation is in some way affected.

7.2.1.5 For mounting heights above this limit, it shall be used floodlights and a fixed access resource shall be provided.

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<p>7.2.1.6 Lighting poles and lighting supporting structures shall be detailed according to I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS.</p> <p>7.2.1.7 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.</p> <p>7.2.1.8 The material of their accessories, including screws, washers, and profiled trays, shall be stainless steel AISI-316L.</p> <p>7.2.1.9 Whenever possible poles using lighting fixtures in a horizontal position or modular supports shall be used.</p> <p>7.2.2 MODULAR SUPPORTS</p> <p>7.2.2.1 Standard commercial modular supports may be used for installation of lighting fixtures and floodlights poles and support structures.</p> <p>7.2.2.2 If using modular supports:</p> <ol style="list-style-type: none"> 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. The calculations of the supports shall be presented. PETROBRAS naval data input for calculation is available in MOTION ANALYSIS report. With bolted starters, it shall be used anti-corrosion pastes certified by the manufacturer. It shall be used anti-vibration bolts with maximum torque informed by the manufacturer. The modular support manufacturer shall assure the full structure conductivity for earthing purposes. 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. <p>7.2.2.3 The use of modular supports shall be approved by PETROBRAS.</p> <p>7.2.3 LIGHTING STRUCTURES REQUIREMENTS FOR MAINTENANCE</p> <p>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 poles or structures, when the highest end of these equipment is above 3.5 meters. Other specific cases may apply if the location is approved by PETROBRAS.</p> <p>7.2.3.2 In these cases, the following requirements apply:</p> <ol style="list-style-type: none"> 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. 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. 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. <p>7.2.3.3 In case of demountable junction/interface in the vertical section of the poles or structures:</p>			

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<p>a) Cable loops shall be provided to enable lighting fixtures disassembly to the floor.</p> <p>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.</p> <p>7.2.3.4 The proposed design and respective calculations shall be sent to PETROBRAS for approval.</p>			
<h2>8 LIGHTING GUIDANCE FOR DETAILED DESIGN</h2>			
<h3>8.1 LIGHTING SIZING CRITERIA</h3> <p>Normal, Essential and Emergency Lighting System shall be sized according to requirements defined in I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.</p>			
<h3>8.2 LIGHTING DETAILED DESIGN DOCUMENTATION</h3> <p>Lighting Equipment Material Requisition, Lighting Levels Calculation Memory, Lighting Level Measurement Report and Lighting Distribution Plans shall be issued during Detailed Design according to requirements defined in I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.</p>			
<h3>8.3 LIGHTING INSTALLATION</h3> <p>For Lighting Installation requirements as well Lighting Fixtures and Floodlights identification rules, refer to I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.</p>			

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ESUP

9 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
FRP	Fiberglass Reinforced Plastic
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
THD	Total Harmonic Distortion