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INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
0	ORIGINAL ISSUE									
A	Reviewed, corrected items and references, included and excluded items indicated in text.									
B	REVIEWED WHERE INDICATED.									
C	REVIEWED ITEMS: 2.2.7, 3.5.5, 3.5.6, 3.5.9, 3.5.10, 3.5.11, 3.6.5.3 (Table 3), 3.6.3.3, 3.6.3.8, 3.7.3, 3.7.4, 4.7.5.8, 4.8.5.1.1, 4.8.5.7.2, 4.8.1.8, 4.8.4.8.2, 4.11.24, 4.18.12.3.2, 4.18.12.3.14, 4.20.3, 4.22.26; 4.22.29 4.22.38, 4.23.32, 5.2.3, 5.5.2.1, 5.6.3 (Table 18), 5.7.2, 5.7.8, 5.7.9, 5.7.10, 5.7.11, 5.7.14, 5.8.1, 5.8.2, 5.8.6, 5.13.2.2, 5.13.3.1 a) (iii), 5.13.3.1 b), 5.14.2.4, 5.14.2.8, 5.14.2.9, 5.14.2.10.5, 5.14.2.11.2, 5.14.2.11.3, 5.14.3.1, 5.14.3.3, 5.14.3.7.1, 5.14.4.									
D	REVISED WHERE INDICATED DUE TO CONSISTENCY ANALYSIS									
E	REVISED ITEM 4.18.5.1, ACCORDING TO CLARIFICATION NOTICE DUE TO BIDDER QUESTIONS									
F	REVIEWED WHERE INDICATED.									
G	REVISED WHERE INDICATED DUE TO CONSISTENCY ANALYSIS									
H	REVIEWED ITENS 5.7.10, 5.7.11, 5.7.12.									
J	REVIEWED ITENS 3.6.5.1, 3.8.2, 4.8.3.7.6, 4.18.2.6, 4.18.10.3, 5.7.9, 5.8.7, 5.14.4.									
K	REVIEWED WHERE INDICATED									
L	GENERAL SCOPE AND CONTENT REVIEW - REVIEWED WHERE INDICATED									
M	REVIEWED WHERE INDICATED									
	REV. 0	REV. E	REV. F	REV. G	REV. H	REV. J	REV. K	REV. L	REV. M	
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DESIGN	ESUP	ESUP	EEI/ESES	EEI/ESES	EEI/ESES	EEI/ESES	EEI/ESES	EEI/ESES	EEI/ESES	
EXECUTION	CAVALIERE	BAYO	CLT0	CLT0	CLT0	CLT0	CLT0	CLT0	CLT0	
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**SPECIFICATION FOR ELECTRICAL MATERIAL 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 electrical material for all facilities of PETROBRAS Offshore Units, including installations in modules and packages.
- 1.2 Classification Society requirements shall prevail over requirements of this document.
- 1.3 Important comment for this revision:
- Due to specification review of scope, some previous specification contents have been transferred to other dedicated specifications. Previous information will be addressed in section 3 to indicate the specification reference.

2 REFERENCE STANDARDS AND DOCUMENT LIST


2.1 GENERAL


At the design development and for material 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

- | | | |
|------|----------------|--|
| [1] | IEC 60068-2-10 | Environmental Testing - Part 2-10: Tests - Test J and Guidance: Mould Growth |
| [2] | IEC 60068-2-11 | Basic Environmental Testing Procedures |
| [3] | IEC 60068-2-14 | Environmental Testing - Part 2-14: Tests - Test N: Change of Temperature |
| [4] | IEC 60068-2-2 | Environmental Testing - Part 2-2: Tests - Test B: Dry Heat |
| [5] | IEC 60068-2-30 | Environmental Testing - Part 2-30: Tests - Test Db: Damp Heat, Cyclic (12h + 12h cycle) |
| [6] | IEC 60079 | Explosive Atmospheres - All parts |
| [7] | IEC 60079-0 | Explosive Atmospheres – Part 0: Explosive atmospheres - Part 0: Equipment - General requirements |
| [8] | IEC 60079-11 | Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" |
| [9] | IEC 60079-30-1 | Explosive atmospheres - Part 30-1: Electrical resistance trace heating - General and testing requirements |
| [10] | IEC 60079-30-2 | Explosive Atmospheres - Part 30-2: Electrical Resistance Trace Heating - Application Guide for Design, Installation and Maintenance" |
| [11] | IEC 60079-7 | Explosive Atmospheres - Part 7: Equipment Protection By Increased Safety 'E' |

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[12]	IEC 60092-101	Electrical installations in ships - Part 101: Definitions and general requirements		
[13]	IEC 60092-201	Electrical Installations in Ships - Part 201: System Design - General		
[14]	IEC 60092-350	Electrical installations in ships - Part 350: General construction and test methods of power, control, and instrumentation cables for shipboard and offshore applications		
[15]	IEC 60092-352	Electrical Installations in Ships - Part 352: Choice And Installation Of Electrical Cables		
[16]	IEC 60092-353	Electrical Installations in Ships - Part 353: Power Cables for Rated Voltages 1 KV And 3 KV		
[17]	IEC 60092-354	Electrical Installations in Ships - Part 354: Single- And Three-Core Power Cables with Extruded Solid Insulation for Rated Voltages 6 KV (Um = 7,2 KV) Up To 30 KV (Um = 36 KV) "		
[18]	IEC 60092-360	Electrical Installations in Ships - Part 360: Insulating and Sheathing Materials For Shipboard And Offshore Units, Power, Control, Instrumentation And Telecommunication Cables		
[19]	IEC 60092-376	Electrical Installations in Ships - Part 376: Cables for Control And Instrumentation Circuits 150/250 V (300 V)		
[20]	IEC 60216-1	Electrical Insulating Materials - Properties of Thermal Endurance - Part 1: Ageing Procedure and Evaluation of Test Results		
[21]	IEC 60216-2	Electrical Insulating Materials - Properties of Thermal Endurance - Part 2: Determination of Thermal Endurance Properties of Electrical Insulation Materials - Choice of Test Criteria		
[22]	IEC 60228	Conductors of Insulated Cables		
[23]	IEC 60309	Plugs, socket-outlets and couplers for industrial proposes - All parts		
[24]	IEC 60331	Tests for electric cables under fire conditions – Circuit integrity		
[25]	IEC 60331-11	Tests for electric cables under fire conditions – Circuit integrity – Part 11: Apparatus – Fire alone at a flame temperature of at least 750 degree C.		
[26]	IEC 60331-21	Tests for Electric Cables under Fire Conditions - Circuit Integrity - Part 21: Procedures and Requirements - Cables of Rated Voltage up to and Including 0,6/1,0 kV		
[27]	IEC 60332-1-2	Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame		
[28]	IEC 60332-1-3	Tests on electric and optical fibre cables under fire conditions – Part 1-3: Test for vertical flame propagation for a single insulated wire or cable – Procedure for determination of flaming droplets/particles		
[29]	IEC 60332-3-10	Tests on Electric and Optical Fibre Cables Under Fire Conditions - Part 3-10: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Apparatus		

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[30]	IEC 60332-3-22	Tests on Electric and Optical Fibre Cables Under Fire Conditions - Part 3-22: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category A	
[31]	IEC 60445	Basic and Safety Principles for Man-Machine Interface, Marking and Identification - Identification of Equipment Terminals, Conductor Terminations and Conductors	
[32]	IEC 60519	Safety in Electroheat Installations - All parts	
[33]	IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)	
[34]	IEC 60695-7-2	Fire hazard testing – Part 7-2: Toxicity of fire effluent – Summary and relevance of test methods	
[35]	IEC 60754-1	Test on gases evolved during combustion of materials from cables – Part 1: Determination of the halogen acid gas content	
[36]	IEC 60754-2	Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity	
[37]	IEC 60793	Optical Fibres – All Parts	
[38]	IEC 60793-1-52	Optical fibres – Part 1 - 52: Measurement methods and test procedures – Change of temperature tests	
[39]	IEC 60794	Optical fibre cables - All parts	
[40]	IEC 61034-2	Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements	
[41]	IEC 61086	Coating for Loaded Printed Wire Boards (conformal Coatings) - All parts	
[42]	IEC 61892	Mobile and Fixed Offshore Units - Electrical Installations - All parts	
[43]	IEC 61892-1	Mobile And Fixed Offshore Units - Electrical Installations - Part 1: General Requirements And Conditions	
[44]	IEC 61892-4	Mobile And Fixed Offshore Units - Electrical Installations - Part 4: Cables	
[45]	IEC 61892-6	Mobile and fixed offshore units - Electrical installations - Part 6: Installation	
[46]	IEC 61892-7	Mobile And Fixed Offshore Units - Electrical Installations - Part 7: Hazardous Areas	
[47]	IEC 61914	Cable cleats for electrical installations	
[48]	IEC 62395	Electrical Resistance Trace Heating Systems for Industrial and Commercial Applications - All parts	
[49]	IEC 62444	Cable glands for electrical installations	
[50]	IEC 62631-3-2	Dielectric and resistive properties of solid insulating materials – Part 3-2: Determination of resistive properties (D.C. methods) – Surface resistance and surface resistivity	
[51]	IEC TS 60034-25	Rotating Electrical Machines - Part 25: Guidance for the Design and Performance of a.c. Motors Specifically Designed for Converter Supply	

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 IEEE – INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERING

[52] IEEE 1580 Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Facilities

2.2.3 IMO - INTERNATIONAL MARITIME ORGANIZATION

[53] IMO Res. A.754 (18) RECOMMENDATION ON FIRE RESISTANCE TESTS FOR “A”, “B” AND “F” CLASS DIVISIONS

[54] IMO MODU CODE Code for the Construction and Equipment of Mobile Offshore Drilling Units

[55] IMO 2010 FTP Code Material testing on smoke density and toxicity according to, IMO-Part 2 Resolution MSC.307(88) - ISO 5659-2

[56] IMO SOLAS International Convention for the Safety of Life at Sea

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

[57] NR-10 Segurança em Instalações e Serviços em Eletricidade

[58] NR-12 Segurança no Trabalho em Máquinas e Equipamentos

[59] NR-37 Segurança e Saúde em Plataformas de Petróleo

2.2.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (WHERE SPECIFIED)

[60] ASTM B1 Standard Specification for Hard-Drawn Copper Wire

[61] ASTM B2 Standard Specification for Medium-Hard-Drawn Copper Wire

[62] ASTM B3 Standard Specification for Soft or Annealed Copper Wire

[63] ASTM B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

[64] ASTM B26/B26M Standard Specification for Aluminium-Alloy Sand Casting

[65] ASTM B33 Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purpose

[66] ASTM B108/B108M Standard Specification for Aluminium-Alloy Permanent Mould Casting


[67] ASTM B221 Standard Specification for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes


[68] ASTM B846 Standard Terminology for Copper and Copper Alloys

[69] ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

[70] ASTM D257 Standard Test Methods for DC Resistance or Conductance of Insulating Materials

[71] ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to

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		Chemical Reagents	
[72]	ASTM D635	Standard Test Methods for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position	
[73]	ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials	
[74]	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials	
[75]	ASTM E662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials	
[76]	ASTM F3059	Standard Specification for Fiber-Reinforced Polymer (FRP) Gratings Used in Marine Construction and Shipbuilding	
2.2.6	DNV		
[77]	DNV-OS-D201	OFFSHORE STANDARDS - Electrical installations	
2.2.7	ABNT – ASSOCIAÇÃO BRASILEIRA DE NORMALIZAÇÃO TÉCNICA		
[78]	ABNT NBR 5410	Instalações elétricas de baixa tensão	
[79]	ABNT NBR 14136	Plugues e Tomadas para uso Doméstico e Análogo até 20A/250V em Corrente Alternada - Padronização	
[80]	ABNT NBR 15708-1	Indústrias do petróleo e gás natural — Perfis pultrudados Parte 1: Materiais, métodos de ensaio e tolerâncias dimensionais	
[81]	ABNT NBR 15708-3	Indústrias do petróleo e gás natural — Perfis pultrudados Parte 3: Grade de piso	
[82]	ABNT NBR 15708-4	Indústrias do petróleo e gás natural – Perfis pultrudados Parte 4: Sistema de Bandeamento	
[83]	ABNT NBR 6493	Emprego de cores para identificação de tubulações	
2.2.8	ISO - INTERNATIONAL STANDARDIZATION ORGANIZATION		
[84]	ISO 62	Plastics - Determination of Water Absorption	
[85]	ISO 178	Plastics - Determination of Flexural Properties	
[86]	ISO 179-1	Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test	
[87]	ISO 527	Plastics - Determination of Tensile Properties - All Parts	
[88]	ISO 4892	Plastics - Methods of Exposure to Laboratory Light Sources - All Parts	
[89]	ISO TS 19700	Controlled equivalence ratio method for the determination of hazardous components of fire effluents – Steady state tube furnace - Second Edition	

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2.2.9 UL - UNDERWRITERS LABORATORIES INC.			
[90]	UL 94	UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances	
[91]	UL 1581	UL Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords	
2.2.10 ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE			
[92]	ASME B1.20.1	Pipe Threads, General Purposes (Inch)	
2.2.11 NATIONAL FIRE PROTECTION ASSOCIATION			
[93]	NFPA 780	Standard for the Installation of Lightning Protection Systems	
2.2.12 IACS - INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES			
[94]	IACS No. 73	(June 2002) (Rev.1 Dec 2020) - Type approval procedure for cable trays/protective casings made of plastics materials	
2.3 REFERENCE DOCUMENTS			
[95]	I-DE-3010.00-5140-700-P4X-002 - POWER INSTALLATION TYPICAL DETAILS		
[96]	I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS		
[97]	I-ET-3010.00-1200-955-P4X-001 – WELDING		
[98]	I-ET-3010.00-1352-130-P4X-001 - FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS		
[99]	I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS		
[100]	I-ET-3010.00-5140-700-P4X-008 - SPECIFICATION FOR LIGHTING AND ELECTRICAL SIGNALLING FOR OFFSHORE UNITS		
[101]	I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS		
[102]	I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS		
[103]	I-ET-3010.00-5140-712-P4X-002 - MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS		
[104]	I-ET-3010.00-5140-713-P4X-001 - SPECIFICATION FOR TRANSFORMERS FOR OFFSHORE UNITS		
[105]	I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS		
[106]	I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS		
[107]	I-ET-3010.00-5140-741-P4X-002 - MEDIUM-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS		

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- [108] I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
- [109] I-ET-3010.00-5140-772-P4X-001 - MEDIUM-VOLTAGE FREQUENCY CONVERTER FOR OFFSHORE UNITS
- [110] I-ET-3010.00-5140-772-P4X-002 - SPECIFICATION FOR LOW-VOLTAGE FREQUENCY CONVERTERS, SOFTSTARTERS AND INVERTERS FOR OFFSHORE UNITS
- [111] I-ET-3010.00-5140-773-P4X-002 - SPECIFICATION FOR GENERIC D.C. UPS FOR OFFSHORE UNITS
- [112] I-ET-3010.00-5140-773-P4X-003 - SPECIFICATION FOR A.C. UPS FOR OFFSHORE UNITS
- [113] I-ET-3010.00-5147-711-P4X-001 - MAIN GENERATOR FOR OFFSHORE UNITS
- [114] I-ET-3010.00-5261-700-P4X-001 - EMERGENCY GENERATOR PACKAGE FOR OFFSHORE UNITS
- [115] I-ET-3010.00-5262-700-P4X-001 - AUXILIARY GENERATOR PACKAGE FOR OFFSHORE UNITS
- [116] I-ET-3010.00-5262-700-P4X-002 - HULL GENERATOR PACKAGE FOR OFFSHORE UNITS
- [117] I-ET-3010.00-5140-773-P4X-001 - SPECIFICATION FOR D.C. UPS FOR OFFSHORE UNITS
- [118] I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS
- [119] I-ET-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
- [120] I-ET-3010.00-5520-800-P4X-004 - AUTOMATION NETWORK REQUIREMENTS

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 SCOPE MODIFICATIONS AND ACTUAL REFERENCES

- 3.1 See reference I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS, for the following condition requirements for offshore units:
- Environmental conditions,
 - Heat dissipation characteristics,
 - Motion and inclination limits requirements,
 - Vibration limits requirements,
 - Hazardous areas requirements,
 - Construction requirements, IP grades, etc
 - Warning labels for electrical equipment,
 - Voltage requirements,
 - Frequency requirements,
 - EMC and RFI requirements.
- 3.2 For Main generators, see reference I-ET-3010.00-5147-711-P4X-001 - MAIN GENERATOR FOR OFFSHORE UNITS.
- 3.3 For Hull generators (if existent), see reference I-ET-3010.00-5262-700-P4X-002 - HULL GENERATOR PACKAGE FOR OFFSHORE UNITS.
- 3.4 For Auxiliary generator, see reference I-ET-3010.00-5262-700-P4X-001 - AUXILIARY GENERATOR PACKAGE FOR OFFSHORE UNITS.
- 3.5 For Emergency generator, see reference I-ET-3010.00-5261-700-P4X-001 - EMERGENCY GENERATOR PACKAGE FOR OFFSHORE UNITS.
- 3.6 For Electric induction motors, in Low-Voltage, see reference I-ET-3010.00-5140-712-P4X-001 - LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS
- 3.7 For Electric induction motors, in Medium-Voltage, see reference I-ET-3010.00-5140-712-P4X-002 - MEDIUM-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS.
- 3.8 For D.C. UPS, see references I-ET-3010.00-5140-773-P4X-001 - SPECIFICATION FOR D.C. UPS FOR OFFSHORE UNITS and I-ET-3010.00-5140-773-P4X-002 - SPECIFICATION FOR GENERIC D.C. UPS FOR OFFSHORE UNITS.
- 3.9 For A.C. UPS, see reference I-ET-3010.00-5140-773-P4X-003 - SPECIFICATION FOR A.C. UPS FOR OFFSHORE UNITS.
- 3.10 For Medium-voltage frequency converters, see reference I-ET-3010.00-5140-772-P4X-001 - MEDIUM-VOLTAGE FREQUENCY CONVERTER FOR OFFSHORE UNITS.
- 3.11 For Transformers, see reference I-ET-3010.00-5140-713-P4X-001 - SPECIFICATION FOR TRANSFORMERS FOR OFFSHORE UNITS.
- 3.12 For Low-Voltage MCC and Switchgear, see reference I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.
- 3.13 For Medium-Voltage MCC and Switchgear see, I-ET-3010.00-5140-741-P4X-002 - MEDIUM-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR

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<p>OFFSHORE UNITS.</p> <p>3.14 For Low-Voltage Generic electrical panels (not MCC or Switchgear) see reference, I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.</p> <p>3.15 For Batteries, see reference I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS.</p> <p>3.16 For Low-voltage VSD-FC (variable speed driver - frequency converter), Low-voltage Soft-Starters, and Inverters (D.C.-A.C. converters), see reference I-ET-3010.00-5140-772-P4X-002 - SPECIFICATION FOR LOW-VOLTAGE FREQUENCY CONVERTERS, SOFTSTARTERS AND INVERTERS FOR OFFSHORE UNITS.</p> <p>3.17 For the following equipment for offshore units:</p> <ul style="list-style-type: none"> • Busbar trunkings (busways), • Epoxy resin insulated bus bars, • Microprocessor-based multifunction protection relays (MMR), • Lockout relays, • Intelligent relays (IRS), • Auxiliary relays, • Grounding resistors, • Power capacitors and capacitor banks, • Lightning and Surge Arresters, • Surge protective devices, • Instrument transformers, • Reactors, • Motor actuated valves, <p>see reference I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.</p> <p>3.18 For the following systems and equipment for offshore units:</p> <ul style="list-style-type: none"> • Signalling for navigation aid, • Aviation obstruction warning signals for aircraft, • Helideck lighting system, • Lighting fixtures and floodlights • Rescue and Searchlights • LED Lamps • Lamp Sockets • Lighting poles, lighting support structures and conduits <p>see reference I-ET-3010.00-5140-700-P4X-008 - SPECIFICATION FOR LIGHTING AND ELECTRICAL SIGNALLING FOR OFFSHORE UNITS.</p>			

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4 MATERIALS

4.1 GENERAL

- 4.1.1 All electric material shall have high quality regarding dielectric rigidity, mechanical, thermal, and chemical resistance, following in a strictly manner the standards used for its fabrication.
- 4.1.2 All material employed shall be non-hygroscopic, flame retardant and resistant to corrosion caused by a saline atmosphere environment with the presence of moisture and contact with hydrocarbons.
- 4.1.3 Protecting treatments, including galvanic treatment sand paints, shall not include sealing joints, for which only neutral Vaseline or silicon grease shall be used.
- 4.1.4 All screws, nuts, washers, and connector for fitting equipment shall be made of bichromatized steel or stainless steel AISI-316L, except for application in cable trays and channels and for application in piping inside tanks, or in other specified applications where only stainless steel AISI-316L shall be used.
- 4.1.5 All materials specified into the following sections shall comply with the hazardous areas criteria, IP grades definitions, standardizations, and all other requirements defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

4.2 THREADED JOINTS

- 4.2.1 Unless otherwise stated, all threaded joints shall be taper type, NPT (National pipe taper) with standardized tolerances, according to ASME B1.20.1.
- 4.2.2 Cylindrical (metric) threaded joints are acceptable for lighting fixtures, for control boxes for push-buttons and signalling, for floodlights and for power socket-outlets.
- 4.2.3 Cylindrical (metric) threaded joints for other applications shall be submitted to PETROBRAS approval. For equipment installed in hazardous areas, the threads shall comply with the requirements of IEC 60079-0.

4.3 CONNECTORS FOR POWER, CONTROL AND GROUNDING

- 4.3.1 The connectors for power and control cables shall be made of electrolytic copper with tin coat, as ASTM B1, ASTM B2, ASTM B3, ASTM B8, ASTM B33, or ASTM B846, and shall not be of welded type.
- 4.3.2 The connectors for grounding cables either shall be made of:
- Electrolytic copper with tin coat, as ASTM B1, ASTM B2, ASTM B3, ASTM B8, ASTM B33, or ASTM B846, or.
 - Naval Bronze of classic marine, high-strength, and corrosion-resistant alloy C462 or C464.

Both materials shall not be of welded type.

4.4 GALVANIC INSULATION

- 4.4.1 In order to avoid electrolytic corrosion, contacts between different metallic materials shall be prevented. Galvanic insulation shall be implemented where contact between different metallic materials is necessary.
- 4.4.2 Required by NFPA 780, with the exception of bimetallic connectors, direct contact between metals which galvanic potential differs by more than 0.5 V shall not be permitted.
- 4.4.3 The hot galvanizing by immersion shall have the following minimum characteristics:
- for thickness $\geq 3\text{mm}$: $78\mu\text{m}$ ($550\text{g}/\text{m}^2$).
 - for thickness $< 3\text{mm}$: $50\mu\text{m}$ ($350\text{g}/\text{m}^2$).
 - screws, washers, etc. $\geq 10\text{mm}$: $50\mu\text{m}$.
 - screws, washers, etc. $< 10\text{mm}$: $36\mu\text{m}$.

4.5 ALUMINIUM MATERIALS REQUIREMENTS

- 4.5.1 The use of aluminium casing for electrical equipment and accessories is not allowed for outdoor areas.
- Notes:
- Aluminium material used in internal parts, not exposed to environment can be accepted.
 - Other uses of aluminium material, except external casings, shall be approved by PETROBRAS
- 4.5.2 Aluminium equipment shall be mounted on cast steel structure with a 5 mm rubber or neoprene insulation joint in between and with stainless steel AISI-316L bolts and nuts.
- 4.5.3 All equipment and components made in aluminium shall be in accordance with the alloy specifications as follows:
- ASTM B26/B26M specification, ANSI 356.0 alloys for sand castings.
 - ASTM B108/B108M specification, ANSI 359.0 alloy for permanent mould castings.
 - ASTM B221 specification, 6063 or 6351 alloy for extruded bars, rods, wires, profiles, and tubes.
- 4.5.4 For aluminium superstructures that are provided with insulating material between aluminium and steel in order to prevent galvanic action, the washers or the terminals used to connect grounding cables shall be made of Cupal, according to DNV-OS-D201.

4.6 NON-METALLIC MATERIALS

- 4.6.1 Manufacturer shall furnish the certificates of prototype, issued by a recognized Testing Laboratory, as indicated in Table 1.
- 4.6.2 Certificates shall be homologated by a recognized Brazilian Entity and submitted to PETROBRAS and Classification Society approval.
- 4.6.3 Tests of Table 1 are dispensable, for unmanned area, if the component has a conformity certificate proving that it is adequate to hazardous area installation, issued by a recognized Testing Laboratory and approved by Classification Society.


- 4.6.4 For cable tray see 4.7. Tests of Table 1 are not applicable for cable trays.
- 4.6.5 For junction boxes manufactured in Brazil, acceptance tests of flammability in accordance with UL 94 shall be carried out.
- 4.6.6 Non-metallic materials shall have flame self-extinguishing and non-fire propagating properties.
- 4.6.7 Non-metallic materials shall have a maximum FSI (Flame Spread Index) value of 25 according to ASTM E84 or a maximum burned distance of 30 mm at 10 seconds according to ASTM D635.

Table 1 - Non-Metallic Test Specimens - All Areas.

Tests	Standards ⁽³⁾	Reference value	Plugs and Socket- Outlets	Junction Boxes, Push- Buttons Stations	Lighting Fixtures	Lighting Panels ⁽²⁾	Cable Fittings (Glands)
Toxicity Index ⁽¹⁾	ISO TS 19700	Toxicity Value	X	X	X	X	-
	IMO 2010 FTP Code Part 2	or Certificate of test results with compliance with one of the methods indicated. ⁽⁴⁾					
Smoke Specific Density Generated by Solid Materials ⁽¹⁾	ASTM E662	Smoke Specific Density or Certificate of results with compliance with one of the methods indicated. ⁽⁴⁾	X	X	X	X	-
Traction in Plastic	ISO 527	Tensile strength $\geq 50\text{Mpa}$	X	X	X	X	X
	ASTM D790	or					
	UL 94	UL - Yellow card or similar certificate					
Flexure in Plastic	ISO 178	Flexural strength $\geq 130\text{Mpa}$	X	X	X	X	X
	ASTM D790	Flexural module $\geq 8000\text{Mpa}$					
	UL 94	or UL - Yellow card or similar certificate					
Water Absorption in Plastic	ISO 62	$\leq 50\text{ mg}$	X	X	X	X	X
	UL 94	or UL-Yellow card or similar certificate of Suitable for outdoor use with respect to exposure to water					
Resistance to Sunlight (Ultraviolet Rays)	ISO 4892	UL-Yellow card or similar certificate of Suitable for outdoor use with respect to exposure to Ultraviolet light	X	X	X	X	X
	UL 94						
Resistance to Impact	ISO 179-1	$\geq 7\text{J}$	X	X	X	X	X
	ASTM D256	or					
	UL 94	UL-Yellow card or similar certificate					
Resistance to Chemical Agents	ASTM D543	UL-Yellow card or similar certificate	X	X	X	X	X
	UL 94						
Accelerated Aging	IEC 60216-1 IEC 60216-2	UL-Yellow card or similar certificate of equipment lifetime expected	X	X	X	X	X
Flammability	UL 94	1.5 mm or UL-Yellow card or similar certificate	X	X	X	X	-
Comparative Index of Superficial Resistance	ASTM D257	$\leq 10\text{ G}\Omega$ or	X	X	X	X	-
	UL 94	UL-Yellow card or similar certificate					
Flame-Retardation	IEC 60092-101	$\leq 60\text{ mm}$	X ⁽⁵⁾	X ⁽⁵⁾	X ⁽⁵⁾	X ⁽⁵⁾	-

Notes:

1. Only for manned area. Manned areas are those occupied 24 hours a day, like control room and accommodations.
2. Only for external areas application
3. When more than one standard is mentioned, it is a "or", one of them can be used for reference.
4. Alternative methods (See IEC 60695-7-2) only under Petrobras approval.
5. Only if material is defined as flame retardant.

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<p>4.6.8 Non-metallic materials shall have the following electrical characteristics:</p> <ul style="list-style-type: none"> • Volume resistivity level below 10^5 ohms.m. • Surface resistivity below $1M\Omega$ (10^6 ohms). • Resistance to earth from any point not exceeding $1M\Omega$ (10^6 ohms). <p>Type approval procedure shall be according to IACS No. 73, tests according IEC 62631-3-2.</p>			
<h4>4.7 CABLE TRAYS</h4>			
<h5>4.7.1 CABLE TRAYS GENERAL REQUIREMENTS</h5>			
<p>4.7.1.1 Cable trays include the following types: ladders trays, troughs, channel trays, solid bottom trays, and other similar structures.</p>			
<p>4.7.1.2 Cable trays components include sections of cable trays, sections of channel trays, section of ladder trays, support fittings, assembly fittings, and other accessories of cable trays.</p>			
<p>4.7.1.3 Cable trays and their accessories shall not present crushing, sharp edges or seams which can damage the external cover or cable insulation during launching or can cause damages to the health or physical integrity of personnel.</p>			
<p>4.7.1.4 All cable tray transition parts shall be industrial made, project and dimensioned for the cable sizes loads required. The use of “in field” built transition parts are not accepted.</p>			
<p>4.7.1.5 Cable trays cover material shall be of the same material and the same thickness of cable trays they are protecting.</p>			
<p>4.7.1.6 When cables are subjected to mechanical impacts, proper additional protection by covers shall be foreseen, as defined in IEC 61892-6:</p> <ul style="list-style-type: none"> • Protection cover shall be installed where cables can be: <ul style="list-style-type: none"> ○ exposed to mechanical damage, ○ to a height of at least 500 mm above floor level, ○ and additionally with kick plates around floor penetrations, ○ and when cable trays cross under grated floors. 			
<p>4.7.1.7 In external areas, except for the conditions in 4.7.1.6, vertical sections of cable trays shall not have a cover; due to restrictions in installation, inspection and maintenance and the low probability of mechanical impact, e.g., flare cable trays.</p>			
<p>4.7.1.8 Manufacturers shall provide means to avoid electrolytic corrosion caused by contact of dissimilar materials.</p>			
<h5>4.7.2 CABLE TRAY USE LOCATION</h5>			
<h6>4.7.2.1 INTERNAL AREAS</h6>			
<p>4.7.2.1.1 Cable trays for internal areas 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>4.7.2.1.2 The use of non-metallic cable tray is forbidden.</p>			

4.7.2.2 EXTERNAL AREAS

4.7.2.2.1 Cable trays for external areas shall be stainless steel AISI-316L or heavy-duty, non-metallic, manufactured in composite material reinforced with fiberglass.

4.7.2.2.2 For heavy-duty non-metallic cable trays and protective casings, the following conditions apply:

- It shall not be allowed in external areas which, according to the Fire Propagation Study, may reach temperatures higher than the maximum temperature of use defined by Manufacturer. In this case, stainless steel AISI-316L shall be used.

Explanation notes:

- The Fire Propagation Study define the maximum temperature values that can be reached in case of fire in all process unit modules.
- The non-metallic cable trays and protective casings have a maximum temperature value to which strength capabilities are still under acceptance.
- In case of Fire Propagation Study defines a temperature for specific area that is equal to, or above limit values defined for non-metallic cable trays and protective casings temperature, stainless steel AISI-316L shall be used.

4.7.3 NON-METALLIC CABLE TRAYS


4.7.3.1 Heavy-duty, non-metallic cable trays, manufactured in composite material reinforced with fiberglass, shall comply with the following requirements.


4.7.3.1.1 It shall comply with minimum Fire Integrity Level defined in Table 2.


Note: This table is based in ABNT NBR 15708-3 and ASTM F3059. In case of any divergency between these standards the most restrictive applies.

Table 2 - Criteria for Application of Non-Metallic Cable Trays and Protective Casings.

Area	Minimum Fire Integrity Level
Turbogenerators and Turbo-compressor hoods, moto-generators and moto-compressors rooms, boilers, and furnaces	Level 2
Engine room (cargo pump areas)	Use not allowed
Chain lockers	Level 2
Oil storage tanks	Level 2
Fuel oil tanks	Level 2
Ballast water tanks	Level 2
Cofferdams, void spaces, double bottoms, pipe tunnels, etc.	Use not allowed
Control rooms, inside accommodation, offices	Use not allowed
Embarkation stations on inflatable life rafts, lifeboats, rescue boats, muster stations, in open deck areas	Level 2
Decks between process modules, access catwalks, access ladders, skids of equipment, process plant and utilities, flare access, riser balcony	Level 2
Decks between process modules, access catwalks, access ladders, skids of equipment, process plant and utilities, turret's (including pull in deck), flare access, riser balcony	Level 2
Motor pump hoods for firefighting pump	Level 2
Other closed areas, not described above	Use not allowed

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4.7.3.1.2	It shall be designed complying with requirements of ABNT NBR 15708-4, ASTM F3059, and IACS No. 73. In case of any divergency between these standards the most restrictive applies.					
4.7.3.1.3	It shall be moulded by pultrusion process.					
4.7.3.1.4	It shall have the following electrical characteristics:					
	<ul style="list-style-type: none"> • Volume resistivity level below 10^5 ohms.m. • Surface resistivity below $1M\Omega$ (10^6 ohms). • Resistance to earth from any point not exceeding $1M\Omega$ (10^6 ohms). 					
4.7.3.1.5	Type approval procedure shall be according to IACS No. 73, tests according IEC 62631-3-2.					
4.7.3.2	The definition of Fire Integrity Level for non-metallic cable trays shall be done using the criteria defined for non-metallic floor grating in ABNT NBR 15708-3 and ASTM F3059. See Table 2.					
4.7.3.3	Non-metallic cable trays shall be tested according to ABNT NBR 15708-1, ABNT NBR 15708-4, and IACS No. 73, considering the following minimum test list:					
	<ul style="list-style-type: none"> • Impact Resistance Test • Safe Working Load (SWL) Test • Flame Retardant Test • Smoke and Toxicity Test • Resistivity Test 					
4.7.3.4	It shall be acceptable acrylic and phenolic alternatives for non-metallic cable-trays and accessories.					
4.7.3.5	Composite materials for offshore non-metallic cable trays installations shall have a Class Society type approval certificate that attest that it complies with indicated standards.					
4.7.3.6	The reports of all tests required by ABNT NBR 15708-1, ABNT NBR 15708-4, and IACS No. 73, as well as the tests to obtain the type-approval certificates shall be submitted to PETROBRAS.					
4.7.3.7	Delivery, handling, storage, and preservation requirements of for non-metallic cable trays shall follow I-ET-3010.00-1352-130-P4X-001 - FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS.					
4.7.4	INSTALLATION REQUIREMENTS FOR NON-METALLIC CABLE TRAYS					
4.7.4.1	Installation requirements for non-metallic cable trays shall follow I-ET-3010.00-1352-130-P4X-001 - FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS.					
4.7.4.2	As defined in reference specification above:					
4.7.4.2.1	MANUFACTURER shall present a procedure for installation and assembly of components and structures in composite for evaluation and approval by OWNER.					
4.7.4.2.2	Drilling and/or cut-off of structural profiles shall be carried out according to the design. If any change is required, MANUFACTURER shall approve previously.					

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<p>4.7.4.2.3 Cut ends of shapes shall be properly sealed with compatible resin and then painted using specification of composite MANUFACTURER.</p> <p>4.7.4.2.4 Pressure washer with a flat washer or self-locking nut with a flat washer shall be used to secure structures.</p> <p>4.7.4.2.5 Any amendment to the structural profile required to be made in the field shall have approval from the MANUFACTURER</p> <p>4.7.4.2.6 For non-metallic cable trays, the acceptable torque range on the structural profile fixing screws shall be: 15 N.m minimum and 22 N.m maximum, for union pultruded profiles with thickness > 3mm.</p> <p>4.7.4.2.7 After installation of a composite structural material an inspection shall be carried out to ensure compliance with all requirements presented at design documentation prior the release of the area.</p> <p>4.7.4.2.8 It shall be verified if the connections (curves and leads) of the Cable Tray system present adequate adhesion over the internal lamination blanket, used to join connections to tray.</p>						
<p>4.7.5 CABLE TRAYS SUPPORT STRUCTURES</p> <p>4.7.5.1 Cable trays supports shall be made of 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>4.7.5.2 These supports shall be welded to structure, as required in I-DE-3010.00-5140-700-P4X-002 - POWER INSTALLATION TYPICAL DETAILS. For welding procedures refer to, I-ET-3010.00-1200-955-P4X-001 – WELDING.</p> <p>4.7.5.3 It is acceptable the use of welded pin technologies and assembled stainless steel AISI-316L structures for support of cable trays if:</p> <p>4.7.5.3.1 It is provided that the structural loads generated by cables, trays and unit movement are correctly dimensioned and submitted to PETROBRAS evaluation and approval.</p> <p>4.7.5.3.2 It is used for lighting cable trays, in a maximum of three cable trays per support (i.e.: normal, emergency, essential) and not bigger than 50 mm.</p> <p>4.7.5.3.3 It is used for power cable trays, not hanging, not bigger than 50 mm, only for control or instrumentation purposes.</p> <p>4.7.5.3.4 It is used for telecom cable trays following telecommunication systems requirements. For more information see Telecommunication documents.</p> <p>4.7.5.3.5 All other application cases for welded pin technologies and assembled stainless steel AISI-316L structures for support of cable trays shall be submitted to PETROBRAS evaluation and approval.</p>						
<p>4.8 PHASE AND GROUNDING BARS</p> <p>4.8.1 For grounding bars inside panels and other equipment shall be electrolytic copper.</p> <p>4.8.2 For grounding bars for skids, earthing bosses, or any other bar for grounding in an open environment, they shall be made of stainless steel AISI 316L.</p>						

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4.9 SEALS FOR CABLES PASSAGE ON HAZARDOUS AREAS FLOORS AND BULKHEADS

4.9.1 MULTI CABLE TRANSIT – CONVENTIONAL TYPE WITH BLOCKS (MCT)


- 4.9.1.1 MCTs (Multi Cable Transit) shall follow IEC 61892-6 and be standard type, with passage frame, insert blocks, spare blocks, stay plates, compression plates, end packing, etc.
- 4.9.1.2 Maximum individual frame dimensions shall be 120 mm width and 240 mm height (S-8). Combination frames can be used since each one of the component frames is within above mentioned limits.
- 4.9.1.3 MCTs shall have test certificate issued by Official Laboratory or Certifying Entity, to application on A-60 bulkheads without fire stop blanket over the blocks.
- 4.9.1.4 MCTs blocks shall be multi-diameter type, adjustable to accommodate a range of cable diameters with a solid central plug. Spare blocks shall be solid type.
- 4.9.1.5 Each MCT shall have at least 20% of spare blocks.
- 4.9.1.6 MCT installed below the worst damage waterline, as defined in IMO MODU CODE, shall be designed to support the column foreseen hydrostatic pressure. These MCTs shall have Certificated Test Reports considering minimum pressure of 4 bar.
- 4.9.1.7 MCTs shall be type-approved by Classification Society.
- 4.9.1.8 MCTs shall have certificates issued by an Official Laboratory or Certifying Entity when are applied in hazardous areas.

4.9.1.9 CANCELLED.

- 4.9.1.10 For external areas, only stainless steel MCT frames shall be used.
- 4.9.1.11 If not defined by specific document, for specific purposes or internal areas, MCT frames material shall be previously approved by PETROBRAS.

4.9.2 FLEXIBLE RAPID SEALING SYSTEM

- 4.9.2.1 This system shall be standard type, consisting of split insert cable sleeves and hollows, non-split filler sleeves (160 mm length) and a fire-resistant sealant, based on a single thermal expansive (5 to 10 times expansion capacity) component silicone compound. The colour of the sleeves and sealant shall be dark grey, as defined in ABNT NBR 6493. The type of sleeve shall be marked in yellow on the sleeves. The sealant cartridges shall be coded with batch number, date of manufacturing and its validity.
- 4.9.2.2 The conduit frame shall have a depth of 200 mm with maximum dimensions of 600 x 300mm. The frames may be constructed in rectangular or circular shape. For specific cases, e.g., higher pressure levels, Manufacturer shall indicate the limitation of frame dimensions.
- 4.9.2.3 The sealant shall be applied in a thickness of 20 mm at each side of penetration.
- 4.9.2.4 The size of penetration shall be in accordance with IMO Res. A.754 (18), not exceeding a filling rate of 40%. The shape of the conduit frame shall be designed according to the project requirements.
- 4.9.2.5 Materials shall be supplied by the Manufacturer having test certificate issued by Official Laboratory or Certifying Entity. The Flexible Rapid Sealing System shall be installed

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<p>without extra fire stop blanket at the exposed side around the coaming and in front of the penetration when applied in A-60 bulkheads. No extra insulation shall be needed in front of the penetration when applied in decks.</p>						
4.9.2.6	Insert and filler sleeves (160mm) shall have a wall thickness of 3, 4 or 5 mm depending on the size of the sleeves.					
4.9.2.7	Insert sleeves to be placed around each of the ducted cables (spare sleeves) shall be of the non-split type. Each penetration shall have 20% spare space for later extensions to be filled with filler sleeves.					
4.9.2.8	Flexible Rapid Sealing System installed below the worst damage waterline, as defined in IMO MODU CODE, shall be designed to support the foreseen column hydrostatic pressure. For pressures up to 4 bar the conduit frame shall have individual dimensions of 120 x 280mm. The frames can be combined in larger dimensions, provided that the individual frame dimensions are not exceeded.					
4.9.2.9	The installation of the Flexible Rapid Sealing System shall be permitted in watertight decks, damage area and columns void space provided that the frame size is dimensioned and certified for the required pressure rating.					
4.9.2.10	The wire tights used to fix the sleeves around the cables shall not be of metallic material. These wire tights or strips shall be preferable made of nylon. This is to prevent heating caused by inductive current on metallic wire tights.					
4.9.2.11	Flexible Rapid Sealing Systems shall be type-approved by Classification Society.					
4.9.2.12	CANCELLED					
4.9.2.13	For external areas, only stainless steel frames shall be used for Flexible Rapid Sealing Systems.					
4.9.2.14	If not defined by specific document, for specific purposes or internal areas, frames material used for Flexible Rapid Sealing Systems shall be previously approved by PETROBRAS.					

4.10 CABLE GLANDS

4.10.1 Cable gland shall follow IEC 62444.

4.10.2 Cable gland materials shall be selected in order to avoid electrolytic corrosion caused by contact of dissimilar materials.

4.10.3 Cable glands material shall follow the requirements of Table 3 and IEC 61892-6:

Table 3 - Cable Gland Material


Type of Enclosure Material		Cable Gland Material
FRP (Fiber Reinforced Plastic)	Plastic Enclosures	Aluminium ⁽³⁾ Naval Bronze/Brass ⁽²⁾ , Stainless steel AISI-316L Plastic For Sizes below M32 ⁽¹⁾
	Plastic Enclosures reinforced with a metal gland plate for support of a large supply – and multicore cables	Aluminium ⁽³⁾ Naval Bronze/Brass ⁽²⁾ , Stainless steel AISI-316L
Metal Enclosures (except Aluminium)	Stainless Steel	Naval Bronze/Brass ⁽²⁾ , Stainless steel AISI-316L
	Cast Iron	Stainless steel AISI-316L
	Naval Bronze ⁽²⁾	Naval Bronze/Brass ⁽²⁾
Aluminium enclosures ⁽³⁾		Aluminium ⁽³⁾ Naval Bronze/Brass ⁽²⁾ , Stainless steel AISI-316L
Notes:	1) Nylon cable glands shall be accepted only up to maximum size 1", with metallic plate (made of Stainless Steel AISI-316L, Aluminium or Naval Bronze ⁽²⁾) for grounding, with internal locknut and if they are certified as Ex e or Ex n. 2) Naval Bronze/Brass shall be classic marine, high-strength, and corrosion-resistant alloy C462 or C464, and it shall be 10 micra nickel plated. 3) Aluminium shall follow section 4.5. 4) See IEC 61892-7 for cable glands for Ex equipment.	

4.10.4 The application of Cable Grands shall follow Table 4.

Table 4 - Cable Gland Application Reference

Application	Type of Cable Gland	Notes
Lighting Fixtures	Metric or NPT	(1)
Push Button Box	Metric or NPT	(1)
Signalling Box	Metric or NPT	(1)
Floodlights	Metric or NPT	(1)
Socket-outlets	Metric or NPT	(1)
Junction Boxes	Metric or NPT	(1), (2)
Indoor Electrical Panels	Metric or NPT	(1)
Outdoor Electrical Panels	NPT	(1), (2)
Transformers	Metric	(1)
Low-voltage motors	NPT	(1)
Hazardous Areas Equipment	Metric or NPT	(3)
Other Equipment		(4)
Notes	(1) For materials see Table 3. (2) NPT cable glands shall be used when the enclosure thickness allows threaded holes. (3) The cable gland model shall be in conformity with equipment hazardous area certificate. (4) For equipment not included in above Table consult PETROBRAS for guidance.	

4.10.5 Threaded joints shall comply with item 4.2.


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<p>4.10.6 Cable glands for installation at non threaded holes of removable plates or steel sheet enclosures shall have cylindrical thread with locknut.</p> <p>4.10.7 Cable glands for armoured cables shall be metal type and the metallic pair shall not create an electrolytic corrosion in case of dissimilar metallic material. Stainless steel and copper armour shall use Stainless Steel Cable glands.</p> <p>4.11 POWER SOCKET-OUTLETS</p> <p>4.11.1 Power socket-outlet enclosures shall be made of FRP (Fibre Reinforced Plastic) according to item 4.6.</p> <p>4.11.2 For standardization of plug use, all socket-outlets shall be “Ex de”, except for accommodation internal areas.</p> <p>4.11.3 For standardization and operational safety all Ex outlets shall be from the same manufacturer.</p> <p>4.11.4 Power socket-outlets shall be fitted with the corresponding plugs.</p> <p>4.11.5 Threaded joints shall comply with item 4.2.</p> <p>4.11.6 Power socket-outlets for 480V / 690V circuits shall be provided with blocking switches.</p> <p>4.11.7 All outdoor Ex de socket-outlets shall have an incorporated Ex d disconnect switch, interlocked with the plug to prevent insertion or extraction with the energized socket.</p> <p>4.11.8 Power socket-outlets for 480V / 690V circuits shall be four (04) poles, three-phase + ground type and rated for 63A. Power socket-outlets for diving equipment shall be rated for 125A.</p> <p>Note: All three-phase sockets of the unit shall have the same phase-sequence to prevent an unexpected engine reversal. The phase-sequence R > S > T shall be clockwise.</p> <p>4.11.9 Each power socket-outlet in 480V shall be furnished with one (01) spare plug.</p> <p>4.11.10 For circuits up to 127V, the capacities for socket-outlets shall be 250V, three poles, phase + neutral + ground, 16A. Each socket outlet shall be furnished with one (01) spare plug. The final number of reserve spare plugs shall be agreed with PETROBRAS.</p> <p>4.11.11 For two-phase circuits above 127V up to 240V, the capacities for socket-outlets shall be 250V, three poles, two phases + ground, 16A. Each socket outlet shall be furnished with one (01) spare plug. The final number of reserve spare plugs shall be agreed with PETROBRAS.</p> <p>4.11.12 For three-phase circuits above 127V up to 240V, the capacities for socket-outlets shall be 250V, four poles, three phases + ground, 32A. Each socket outlet shall be furnished with one (01) spare plug. The final number of reserve spare plugs shall be agreed with PETROBRAS.</p> <p>4.11.13 The mechanical protection degree shall be kept and guaranteed with the plug inserted and with the plug extracted.</p> <p>4.11.14 Socket-outlets for accommodation areas shall comply with standardization defined by ABNT NBR 14136, and IEC 60309 where applicable.</p>			


4.12 JUNCTION BOXES

- 4.12.1 Junction boxes enclosures shall be made of stainless steel AISI-316L, or of non-metallic materials according to item 4.6. With the following rule of application:
- stainless steel AISI-316L - for external and internal areas.
 - non-metallic materials - only for external areas.
- 4.12.2 Junction boxes for use in hazardous areas and shall be “Ex e” and shall follow the criteria defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 4.12.3 They shall be provided with terminal blocks when required for interconnection.
- 4.12.4 All metallic junction boxes shall comply with painting criteria defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 4.12.5 For non-metallic junction boxes painting is not required.
- 4.12.6 In order to comply with the standardization all Ex junction boxes shall be provide by the same manufacturer.
- 4.12.7 Cables entrances shall be through the bottom side for all outdoor junction boxes, unless otherwise defined in Project Documentation.
- 4.12.8 For junction boxes installed in high temperature locations (i.e.: flare tower where temperature environments are rated from 250°C up to an extreme of 800°C), the junction boxes and internal components shall be designed for the indicate temperatures.

4.13 UMBILICAL POWER CABLE JUNCTION BOX

- 4.13.1 For the umbilical topside termination, it shall be supplied a topside junction box or single core cable splices. Both cases shall include the field assembly after the umbilical installation.
- 4.13.2 The scope of supply shall include a power junction box (PJB) suitable for operation in hazardous area classified Zone 2, Group IIA, Class T3 according to IEC 60079. The PJB shall be certified by INMETRO as well as the certification authority nominated by PETROBRAS after the umbilical purchase order.
- 4.13.3 For applications with maximum operational VSD output voltage lower than 11 kV, the PJB protection shall be “Ex e” (Increased Safety) according to IEC 60079-7.
- 4.13.4 For applications with maximum operational VSD output voltage equal or greater than 11 kV, the PJB protection shall be “Ex d” (Flameproof) according to IEC 60079-0.
- 4.13.5 The minimum degree of protection provided by the PJB enclosure shall be IP56 according to IEC 60529.
- 4.13.6 The junction box shall provide the electrical connection between the respective protection, made of Stainless Steel AISI 316L and suitable to earth the metallic armour under outer jacket.
- 4.13.7 For the surface cables, PETROBRAS shall be consulted, after the Umbilical purchase order.
- 4.13.8 Cable glands for all incoming cables shall be part of the scope of supply. Cable glands shall be compatible with the PJB hazardous area protection type and degree of protection, made of Stainless Steel AISI 316L and suitable to earth the metallic armour under outer jacket.

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<p>4.13.9 The PJB internal space, layout and insulated cable connections and components shall be compatible with the umbilical electrical power cable specifications, the respective PETROBRAS RM, and the IEC 60079 applicable parts. Each phase connection inside de PJB shall be easily identified with the same identification used in each umbilical power single core cable.</p> <p>4.13.10 The PJB shall allow disconnection and reconnection of surface and subsea power cables maintaining its protection type and degree of protection. The PJB shall allow the performance of insulation resistance measurements of each of these cables when disconnected. The supplier shall provide procedures for safety disconnection and reconnection of surface and subsea cables.</p> <p>4.14 CONTROL BOXES FOR PUSH-BUTTONS AND SIGNALLING</p> <p>4.14.1 Control boxes for push-buttons and signalling installed in hazardous areas and external area equipment shall be Ex de type.</p> <p>4.14.2 Control boxes for push-buttons and signalling shall be made of non-metallic materials according to item 4.6.</p> <p>4.14.3 Push-buttons for ON (START) function shall be without release (return after push). Push-buttons for OFF (STOP) function shall be with release (retain after push).</p> <p>4.14.4 Push-buttons for OFF (STOP) function shall have means for locking with padlock in OFF (STOP) positions.</p> <p>4.14.5 All field push-button shall have a load tag and a load identification or push-button function identification. Identification plate shall be in black acrylic engraved with white letter for equipment installed indoors or in stainless steel AISI-316L for equipment installed outdoors.</p> <p>4.14.6 Push-buttons for ON (START) function shall have a clear protective cover in order to avoid involuntary operation, as defined in NR-12.</p> <p>4.15 TERMINAL LUGS AND TERMINAL BLOCKS FOR CABLES</p> <p>4.15.1 Terminal lugs shall be suitable for naval use, shall be anti-vibration type and assembled on support profiles ("C" channels).</p> <p>4.15.2 In order that neither destruction nor deformation of wires forming the cable occurs, terminal lugs shall be of indirect press over the conductor.</p> <p>4.15.3 They shall have a minimum capacity of 20A/600V and shall be made of steatite or melamine insulation, not containing toxic or organic substances.</p> <p>4.15.4 It shall not be accepted more than one cable connected to each terminal. In case of necessity of connection of more than one cable at the same point, it shall be used one terminal lug for each cable and these terminal lugs shall be connected by metallic bridge bars.</p> <p>4.15.5 Jumpers between terminals through external conductors shall not be accepted in terminal blocks. For this purpose, metallic bridge bars shall be used.</p> <p>4.15.6 The terminals strips shall be installed in order to guarantee enough space to perform the cable terminations, easy access to terminals and easy reading of the identification rings.</p> <p>4.15.7 The terminals strips shall be numbered with progressive numbers and codified as per electrical diagram indications.</p>						

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4.16 CABLE CLEATS

- 4.16.1 The material of cable cleats, straps, saddles, or bands shall comply with Classification Society requirements and IEC 61914.
- 4.16.2 The cleats installed outdoors, in naturally ventilated areas and wash down areas, shall be made of stainless steel, AISI-316L.
- 4.16.3 Trefoil cable cleats for single core power cables shall be approved for the potential short-circuit stress.
- 4.16.4 Cable cleat tests shall follow IEC 61914.
- 4.16.5 The use of plastic material bands or straps is not allowed for fixing electrical cables.

4.17 ELECTRICAL CABLES

4.17.1 GENERAL

- 4.17.1.1 This section requirement applies only to electrical cables.
- 4.17.1.1.1 For Automation and Instrument cables I-ET-3010.00-1200-800-P4X-013 - GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS.
- 4.17.1.1.2 For telecommunication cables see Telecommunication documents.
- 4.17.1.1.3 For Automation and Instrument cables and telecommunication cables see specific Classification Society applicable requirements.
- 4.17.1.2 The minimum requirements for the design, fabrication, and tests of electric cables, shall be in accordance with hereby indicated and with standards IEC 61892-4, IEC 60092-350, IEC 60092-353, IEC 60092-354, IEC 60092-376, IEC 60332-1-2 and IEC 60332-1-3, IEC 60332-3-22 and when required, according to IEC 60331-11 and IEC 60331-21.
- 4.17.1.3 Electrical cables smoke emissions shall comply with IEC 61034-2 and with low toxic emissions defined in IEC 60754-1 and IEC 60754-2.
- 4.17.1.4 Cables installed in or crossing hazardous areas shall additionally comply with requirements of IEC 61892-1 and IEC 61892-7.
- 4.17.1.5 Cables connecting VSD-FCs to motors shall additionally comply with requirements of IEC TS 60034-25.
- 4.17.1.6 Electric cables shall be proper for installation in environments subjected to humidity, salinity and with hydrocarbons chemical action.
- 4.17.1.7 For floating units, all cables shall be “type-approved” by Classification Society.
- 4.17.1.8 Cable splices shall be avoided. If necessary, cable splices shall agree with IEC 61892-7.
- 4.17.1.9 Power cables used in variable frequency drive and similar non-linear-loads applications shall also comply with IEEE 1580 recommended guidelines, where it is applicable.

4.17.2 CONSTRUCTIVE CHARACTERISTICS

- 4.17.2.1 All cables shall be naval type, with compact filling and circular section, flame spread behaviour according to IEC 60332-3-22 Category A.
- 4.17.2.2 Cables shall be suitable to operate under voltage levels shown on project documentation, with following classes:

- a) 150/250(300) V - for control and signalling isolated systems with rated voltage up to 150V or up to 220 V for bolted grounded neutral systems (according to IEC 60092-376).
- b) 450/750 V - for control and signalling isolated systems with rated voltage up to 450V or for bolted grounded neutral systems with rated voltage up to 750V,
- c) 0.6/1.0 kV - for lighting, protection, heating and power systems category B or C (without automatic trip for ground faults) with rated voltage up to 700V, and for lighting, protection, heating, and power systems category A (automatic trip for ground faults) with rated voltage up to 700V, according to IEC 61892-4 and IEC 60092-352.
- d) 1.8/3.0 kV - for heating and power systems with rated voltage above 700 V up to 1.8 kV, were indicated in Project Documentation.
- e) 3.6/6 kV - for power systems with rated voltage up to 4.16 kV.
- f) 6/10 kV - for power systems with rated voltage up to 6.6 kV.
- g) 8.7/15 kV - for power systems category A according to IEC 61892-4 and IEC 60092-352 (automatic trip for ground faults) and with rated voltage up to 13.8 kV.
- h) 12/20 kV - for power systems category B or C according to IEC 61892-4 and IEC 60092-352, (without automatic trip for ground faults) with rated voltage up to 13.8 kV.

4.17.2.3 Cables outer sheath (protective cover) colour shall be:

4.17.2.3.1 For grounding cables, the combination green-and-yellow according to IEC 60445.

4.17.2.3.2 For intrinsically safe apparatus (IS circuits), light blue, according to IEC 60079-11.

4.17.2.3.3 For three phase A.C. cables, brown-black-grey according to IEC 60445.

Note: Any two-phase variation of the three-phase system may use any combination of the colours indicated above, according to IEC 60445.

4.17.2.3.4 For single phase A.C. cables, brown or black, according to IEC 60445.

4.17.2.3.5 For D.C. positive conductor, red, according to ABNT NBR 5410.


4.17.2.3.6 For D.C. negative conductor, black, according to ABNT NBR 5410.

4.17.2.4 The outer sheath (protective cover) for cables exposed to sun light shall be protected against degradation by UV radiation and shall comply with UL 1581 Section 1200. Equivalent certification issued by other recognized laboratory shall be submitted to PETROBRAS approval.

4.17.2.5 The “minimum curvature radius” for multi-core armoured cables shall not exceed ten times their rated diameter and for single-core armoured cables shall not exceed twelve times their rated diameter.

4.17.2.6 Cables for circuits that shall operate under fire conditions (systems for firefighting, fire and gas detection, alarm, public address, shut-down, emergency switch-off, emergency lighting, etc.), cables that feed essential and emergency services that are installed in hazardous areas, and cables crossing machinery space category A, as defined by IMO SOLAS, shall be certified for circuit integrity under fire conditions, according to IEC 60331. These cables and related brackets may also be painted with specific products intended to keep their integrity for the expected fire and time conditions. The test reports of these products and the application procedures shall be subjected to PETROBRAS approval.

4.17.2.7 The shields for medium-voltage cables shall be sized for at least 20A.

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4.17.2.8 Power cables shall be proper for continuous operation, with maximum copper temperature not exceeding of 90°C.

4.17.3 CONSTRUCTIVE FORMATION


4.17.3.1 Cables shall have the following formation sequence:


- a) Stranded circular non-compacted conductor, Class 2 according to IEC 60228, formed by tinned copper, soft temper.


Note 1: flexible conductors, Class 5 according to IEC 60228, may be accepted if the same ampacity (current rating) and voltage drops are considered.

Note 2: compacted conductor shall be accepted only if:

- (i) comply with requirements above.
 - (ii) conduction capacity in Amperes at conductor nominal temperature 90°C (environmental temperature is 45°C as defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS) is equal or superior to the conduction capacity defined in IEC 61892-4 (a comparative table is required).
 - (iii) Manufacturer shall prove that the curvature radius complies with in IEC 61892-6 and cable installations affected by the proposal will not need any modifications (a comparative table is required).
 - (iv) Manufacturer shall prove that cable impedance values are similar to those of non-compact cables and electrical studies will not be affected (a comparative table is required).
 - (v) there will not be any impact, modification, or any need of change in any previous contracts, services, activities, and etc., resulting of this modification.
- b) Insulation:
- HF-EPR (halogen-free ethylene propylene rubber) or HF-XLPE (halogen-free cross-linked polyethylene reticulate) for accommodations.
 - EPR, HEPR, XLPE or PVC for control and signal cables installed inside panels.
 - EPR, HEPR or XLPE for other areas.
- c) Filling: polychloroprene or halogen free materials.
- d) Shield or Braid:
- Non-magnetic using copper, bronze, or brass threads for single-core cables in A.C. system and D.C. system with high ripple content.
 - Low irradiation, non-magnetic for single-core cables between VSD-FCs and motors.
 - Low irradiation, metallic for multi-core cables between VSD-FCs and motors.
 - Metallic for each pair in multicore cables for IS (intrinsically safe) circuits. For type-approved multicore cables for IS circuits, the individual shields are not required.
 - Common metallic for cables for IS (intrinsically safe) circuits.

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<ul style="list-style-type: none"> • Multiple cables for discrete signals (on/off) shall have at least overall shielding. • Multiple cables (multiterns or multiquad) for analogical signals shall have individual shielding by pair (tern or quad) and also, the general shielding involving the whole set. All shielding, individual or general shall have a drain wire. <p>e) Armour:</p> <ul style="list-style-type: none"> • Galvanized steel threads braid protected by anti-corrosive cover for multi-core signal or power cables installed in, or crossing, hazardous areas Zone 0 or Zone 1, and for other cables when required by Classification Society. • Copper or other non-magnetic metal threads braid protected by anti-corrosive cover for single-core cables installed in, or crossing, hazardous areas Zone 0 or Zone 1, and for other cables when required by Classification Society. • Galvanized steel shall be used for multi-core signal or power cables • Copper or other non-magnetic metal threads braid protected by anti-corrosive cover shall be used for single-core cables. • Armour cables shall be installed in, or near: <ul style="list-style-type: none"> i. cargo handling or cargo storage areas. ii. permanent maintenance areas. iii. main deck areas near human transit walkways. iv. submerge, non-movable bilge pumps, as defined in IEC 60092-201. v. other defined locations as required by Classification Society. <p>f) Outer sheath insulation (protective cover) type shall be as below, according to IEC 60092-360:</p> <ul style="list-style-type: none"> • SHF1 or SHF2 – for accommodation and internal areas without hydrocarbon. • SE or SH or SHF2 – for external areas with hydrocarbon. • ST2 or SE or SHF2 – for external areas without hydrocarbon. <p>4.17.3.2 For cables to be installed only inside the accommodation areas, all materials used on their formation shall be halogen free.</p> <p>4.17.3.3 Control cables shall be shaped according to the quantity of conductors per cable, standardized as 3, 5, 7, 10, 15 or 20 conductors per cable.</p> <p>4.17.3.4 In control cables where there is traffic of analogue signals and in control cables with interface/interconnection with PLC, control cables shall follow the specification of cables for instruments, with twisted pair, individual shielding for each pair and general shielding under the outer cover.</p> <p>4.17.4 FLARE CABLE SPECIFIC REQUIREMENTS</p> <p>4.17.4.1 These requirements are applicable to all cables installed in high temperature used for flare ignition, thermocouple, or similar applications, but not data bus protocol cables.</p> <p>4.17.4.2 Cable conductor shall be 27% nickel-plated copper (27% NPC) to reduce corrosion in high heat environments and extends cable life.</p> <p>4.17.4.3 Cable shall have a mica wrap to provide strong dielectric properties and good tensile</p>						

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<p>strength and to resist heat and harsh chemicals such as alkali and acids.</p> <p>4.17.4.4 Cable shall be suitable for virtually all flare stack igniter applications and be voltage rated for up to 25 kV.</p> <p>4.17.4.5 Cable for power and control shall be voltage rated 0.6/1 kV.</p> <p>4.17.4.6 Cable shall provide superior heat and voltage protection and resistance to chemicals and weather an also flexibility through high voltage silicone mica insulation system.</p> <p>4.17.4.7 Cable shall provide insulation and jacketing protection in the most extreme temperature environments rated from 250°C up to an extreme of 800°C.</p> <p>Note: Cable minimum and maximum temperature ratings shall comply with project requirements.</p> <p>4.17.4.8 Cable shall provide braided fiberglass over-coated with a fluoropolymer to provide additional weather and chemical protection based in a fluoropolymer or fiberglass jacketing system, or a combination of both systems.</p>						
<p>4.18 OPTICAL FIBER CABLES AND ACCESSORIES</p> <p>4.18.1 Optical fibre cables used in network systems shall be according to requirements of IEC 60794 and IEC 60793 including maximum temperature operation of 85°C (IEC 60793-1-52).</p> <p>4.18.2 Optical fibre cables shall comply with indicated test standards IEC 60332-1-2, IEC 60332-1-3, IEC 60332-3-10 and IEC 60332-3-22.</p> <p>4.18.3 All other requirements for optical fiber cables and accessories shall comply with I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS and I-ET-3010.00-5520-800-P4X-004 - AUTOMATION NETWORK REQUIREMENTS.</p>						
<p>4.19 NETWORK CABLES AND ACCESSORIES</p> <p>4.19.1 All network cables characteristics, construction and accessories shall comply with I-ET-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.</p>						
<p>4.20 CONDUITS</p> <p>4.20.1 Conduits shall be of galvanized steel and supplied painted according to I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.</p> <p>4.20.2 Conduits to be applied on hazardous areas shall be SCHEDULE 40, seamless.</p> <p>4.20.3 For other areas, including indoor living quarters, conduits shall be medium seamless type.</p> <p>4.20.4 All conduits shall have their paint finished after their installation.</p>						

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4.21 ANALOGUE TRANSDUCERS

- 4.21.1 When required, to transmit analogue signals (voltage, current, power, power factor, etc.) to A&C through Electrical System Automation Panel, it shall be used transducers with rated output signal 4-20mA.
- 4.21.2 When transducers require auxiliary voltage, it shall be used 220VDC, when control voltage is obtained from D.C. UPS or 120VAC for other cases.

4.22 HEAT TRACING

- 4.22.1 Equipment and material for heat tracing shall comply with the requirements of IEC 60519 and IEC 62395.
- 4.22.2 Equipment and material for heat tracing in hazardous areas shall additionally comply with the requirements of IEC 60079-30-1 and IEC 60079-30-2.
- 4.22.3 PVC insulate cables susceptible to damage at low temperatures shall be avoided or freeze protection provided as required in IEC 62395.

4.23 PRINTED CIRCUIT BOARDS

- 4.23.1 Printed circuit-boards, circuit cards and their accessories shall be designed and constructed in a tropicalized version, as defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 4.23.2 For the achievement of such ruggedness, the cards shall be protected with a special varnish film, suitable for offshore industrial environment. Other corrosion resistant materials solutions shall be submitted to PETROBRAS for approval.
- 4.23.3 Besides the coating of the cards, the varnish is also to be furnished separately, in adequate quantity, for maintenance purposes.
- 4.23.4 Additionally, printed circuit-boards, circuit cards and their accessories shall comply with the following requirements:
- conformal coating treatment, according to IEC 61086.
 - application of reinforced protective resin Class 2 (high reliability), according to IEC 61086.
 - test for dry heat, according to IEC 60068-2-2.
 - test for mould growth, according to IEC 60068-2-10.
 - test for salt mist, according to IEC 60068-2-11.
 - test for change of temperature, according to IEC 60068-2-14.
 - test for damp heat, according to IEC 60068-2-30.
- Either test report certificates or manufacturer similar test report certificates are acceptable.
- 4.23.5 Printed circuit boards shall be replaceable without the use of a soldering iron.

5 ANNEX I – ABBREVIATIONS AND ACRONYMS

A.C.	Alternating Current
ABNT	ASSOCIAÇÃO BRASILEIRA DE NORMALIZAÇÃO TÉCNICA
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
D.C.	Direct Current
DNV	DET NORSKE VERITAS
DPC	Departamento de Portos e Costas
EMC	Electrical Magnetic Compatibility
EPR	Ethylene Propylene Rubber
ESD	Emergency Shutdown
ET	Technical Specification
Ex	Hazardous area classification equipment
FPSO	Floating, Production, Storage and Offloading Unit
FRP	Fibre Reinforced Plastic
FSI	Flame Spread Index
FSO	Floating, Storage and Offloading Unit
HDG	Hot Dipped Galvanized
HF-EPR	Halogen-Free Ethylene Propylene Rubber
HF-XLPE	Halogen-Free Cross-Linked Polyethylene Reticulate
IACS	INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES
IE	Instrumentation Earth Grounding
IEC	International Electrotechnical Commission
IED	Intelligent electronic device
IEEE	Institute of Electrotechnical and Electronic Engineers
IMO	INTERNATIONAL MARITINE ORGANIZATION
INMETRO	Instituto Nacional de Metrologia Normalização e Qualidade Industrial
IRS	Intelligent relays
IS	Intrinsically Safe Grounding
ISO	INTERNATIONAL STANDARDIZATION ORGANIZATION
ISO	INTERNATIONAL STANDARDIZATION ORGANIZATION
JB	Junction Box
LED	Light Emitting Diode
MCC	Motor Control Centre
MCCB	Moulded-Case Circuit-Breaker
MCT	Multi cable transit
MMR	Microprocessor-based multifunction protection relays
NEMA	National Electrical Manufacturers Association
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NPT	National pipe taper
NR	NORMA REGULAMENTADORA (Labour secretary regulating standards)
PBJ	Power Junction Box
PE	Protective Earth Grounding
PF	Power Factor
PJB	Power Junction Box

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**SPECIFICATION FOR ELECTRICAL MATERIAL FOR
OFFSHORE UNITS**

INTERNAL

ESUP

PVC	Polyvinyl Chloride
RCD	Residual Current Protective Device
RFI	Radio Frequency Interference
RFID	Radio Frequency Identification
RM	Material Requisition
RM	Request for Material
RMS	Root Mean Square
RT	Routine Test
SPD	Surge Protective Devices
SPDA	System of Electrical Protection against Atmospheric Discharges
ST	Special Test
SWL	Safe Working Load Test
TT	Type Test
UL	UNDERWRITERS LABORATORIES INC
Un	Rated Voltage
UPS	Uninterruptible Power Supply
UV	Ultra Violet
VSD	Variable Speed Drive
VSD-FC	Variable Speed Drive – Frequency Converter
XLPE	Cross-Linked Polyethylene Reticulate