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DESIGN	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP	
EXECUTION	MARCELO BP	UR6X	UR6X	BD36	BD36	U5AL	CSJP	UR6X	UR6X	
CHECK	HEITORFAVO	U4RD	BD36	UR7U	UR7U	CSJP	UR7U	CSJP	U4BY	
APPROVAL	MATTOSO	UQBE	UQBE	UQBE	UQBE	UQBE	UQBE	BD36	UQBE	
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INTERNAL

ESUP

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1. OBJECTIVE

The objective of this specification is to establish the main technical requirements for the design, supply and manufacturing of the electrical components and assembly of the Package Units for PETROBRAS offshore Units.

This specification shall be forwarded to all suppliers and sub-suppliers for Package procurement.

2. DEFINITIONS

2.1. For definitions, refer to I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

3. REFERENCE DOCUMENTS, STANDARDS AND CODES

3.1. PETROBRAS Documents

- [1] I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS
- [2] I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS
- [3] I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING
- [4] PROJECT AREA CLASSIFICATION – GENERAL.
- [5] I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS
- [6] I-ET-3010.00-5140-741-P4X-003 - POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS
- [7] I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
- [8] I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST
- [9] I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS
- [10] I-DE-3010.00-5140-700-P4X-002 - POWER INSTALLATION TYPICAL DETAILS
- [11] I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS
- [12] I-ET-3010.00-1350-940-P4X-001 - SYSTEMS OPERATION PHILOSOPHY
- [13] DR-ENGP-M-I-1.3 - SAFETY ENGINEERING
- [14] I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS
- [15] AUTOMATION INTERFACE OF PACKAGE UNITS
- [16] EMERGENCY LOADS LIST

- [17] I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS
- [18] I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
- [19] I-ET-3010.00-5140-773-P4X-001 - SPECIFICATION FOR D.C. UPS FOR OFFSHORE UNITS
- [20] I-ET-3010.00-5140-772-P4X-002 - SPECIFICATION FOR LOW-VOLTAGE FREQUENCY CONVERTERS, SOFT-STARTERS AND INVERTERS FOR OFFSHORE UNITS
- [21] I-DE-3010.00-5140-797-P4X-002 - ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS
- [22] I-ET-3010.00-5140-773-P4X-002 - SPECIFICATION FOR GENERIC D.C. UPS FOR OFFSHORE UNITS
- [23] I-ET-3010.00-5140-773-P4X-003 - SPECIFICATION FOR A.C. UPS FOR OFFSHORE UNITS
- [24] I-ET-3010.00-5140-772-P4X-001 - MEDIUM-VOLTAGE FREQUENCY CONVERTER FOR OFFSHORE UNITS
- [25] I-ET-3010.00-5140-700-P4X-008 - SPECIFICATION FOR LIGHTING AND ELECTRICAL SIGNALLING FOR OFFSHORE UNITS
- [26] I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS
- [27] I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
- [28] I-ET-3010.00-5140-713-P4X-001 - SPECIFICATION FOR TRANSFORMERS FOR OFFSHORE UNITS

3.2. IEC - International Electrotechnical Commission


- 60079 Explosive Atmospheres - All parts
- 60092-502 Electrical Installations in Ships - Part 502: Tankers - Special Features
- 61439 Low-Voltage Switchgear and Controlgear Assemblies - All Parts
- 61892 Mobile and Fixed Offshore Units - Electrical Installations - All Parts

3.3. INMETRO - Instituto Nacional de Metrologia, Normalização e Qualidade Industrial

Portaria 115 Mar 21st 2022

3.4. Brazilian Labour and Employment Ministry

NR-10 Segurança em Instalações e Serviços em Eletricidade

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NR-12	Segurança no Trabalho em Máquinas e Equipamentos		
NR-17	Ergonomia		
NR-26	Sinalização de Segurança		
NR-37	Segurança e Saúde em Plataformas de Petróleo		
3.5. IMO - International Maritime Organization			
EA811E	Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU CODE)		
4. APPLICABLE STANDARDS AND RECOMMENDATIONS			
4.1. The Package and its installations shall comply with all rules and regulations stated by Brazilian Authorities, Classification Society and International Standards. Following these mandatory requirements, the Package shall comply with requirements of documents listed in 3.1 (second priority in case of conflict). Any deviation shall be submitted to PETROBRAS approval.			
4.2. During the design development and for equipment specification IEC standards (international standards) shall be used, all on their latest revisions.			
4.3. Exceptionally, where it is clearly justifiable, ANSI, NEMA, IEEE and others recognized foreign standards may be used. Their use shall be restricted to specific cases and shall be previously approved by PETROBRAS.			
5. GENERAL CONDITIONS			
5.1. Packager is responsible for detailed electrical design and engineering within the Package and shall perform all functions required to interface with the design of electrical system, as well as guarantee the control and monitoring by A&C (Automation and Control System), when required.			
5.2. All electrical installations within the Package shall be Packager responsibility. Packager is also responsible for supervising the installation of equipment that will be installed out of the Package skid, if any.			
5.3. Packager shall clearly indicate on design documents the interface which will delimitate its scope of supply and Module Supplier (for Topside installations) or Hull Contractor (for Hull installations) scope of supply.			
5.4. For electrical equipment, it shall be considered the reference temperatures stated in specific Technical Specification issued by PETROBRAS, documents included in its Material Requisition (RM), standard IEC 61892-1 and applicable rules and regulations of Classification Society.			

- 5.5. Since the exact Manufacturer for each equipment can not be defined at Basic Design, since each Manufacturer has different auxiliary loads, different rated powers and different arrangement for their packages, different control panels, this document considered several estimated auxiliary loads for package units, based on previous projects. Detailed Design shall revise these estimations according to actual auxiliary loads off all packages. In case of packages with internal MCCs (Motor Control Center) not foreseen by Basic Design, Detailed Design shall evaluate the best solution among keep the package MCCs or inclusion of new functional units in Units MCCs for these auxiliary loads, aim to minimize the impacts (area in panels rooms, weight, etc). This kind of revisions shall be considered as included in Detailed Design scope of supply and shall not be acceptable as motivation for change orders or claims.

6. ELECTRICAL INSTALLATIONS CHARACTERISTICS

6.1. Explanation about Loads Classification

6.1.1. The following definitions shall be considered for all Electrical Design:

6.1.1.1. **Essential Loads** are those loads that shall remain energized by Emergency Generation System during shutdown stop ESD3-T (ESD = Emergency Shutdown) and during Main Generation System failure. Temporary black-out for these loads is acceptable after Main Generation shut-down until complete start of Emergency Generation. Essential Loads shall include:

- Loads defined as “loads essential for safety in an emergency”, with requirement to be “fed from emergency source of power in an emergency” by IMO MODU CODE or by Classification Society;
- Loads defined as “Essential Consumers for Safety” by DR-ENGP-M-I-1.3 - SAFETY ENGINEERING.

6.1.1.2. **Emergency Loads** are those loads which shall remain energized by batteries (DC (Direct Current) or AC (Alternate Current) UPS (Uninterruptible Power Supply System)) during Emergency Generation System failure and Main Generation System failure. Temporary black-out for these loads is not acceptable. Emergency Loads shall include:

- Loads defined as “fed from transitional sources of power in an emergency” by IMO MODU CODE or by Classification Society;
- Loads defined as “Emergency Consumers” by DR-ENGP-M-I-1.3 - SAFETY ENGINEERING.
- Loads defined in EMERGENCY LOADS LIST in the Basic Design.

6.1.1.3. **Normal Loads** are the loads not classified as Emergency Loads nor as Essential Loads. Normal loads shall remain de-energized during emergency shutdown ESD3-T.

6.2. Package Internal Electrical Installations Design

- 6.2.1. All electrical installations, equipment, materials and components which are part of the Package, shall comply with the requirements of the documents included in its Material Requisition (RM), I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS and I-DE-3010.00-5140-700-P4X-002 - POWER INSTALLATION TYPICAL DETAILS.
- 6.2.2. The application of electrical equipment, instruments and accessories on hazardous areas shall follow the requirements of IEC series 60079, 61892-6 and 61892-7 and approved by Classification Society.
- 6.2.3. Electrical equipment and accessories installed in external safe or hazardous areas, which shall be kept operating during emergency shutdown ESD-3P or ESD-3T shall be certified for installation in hazardous areas Zone 2 Group IIA temperature T3 (IEC 61892-7), unless they are automatically de-energized in case of confirmed gas in its area.
- 6.2.4. All equipment and the outgoing feeders of the Package shall be supplied with connectors and terminals for power, control, heating and grounding.
- 6.2.5. Each Package shall have a field emergency stop push-button, located in safe area (area with easy access in case of emergency condition in Package) in Package skid, or closer to Package skid, to stop the Package. Refer to I-DE-3010.00-5140-797-P4X-002 - ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS for more information.
- 6.2.6. Compliance with the requirements of IEC 60079 is mandatory for all electrical and electronic equipment to be supplied. Equipment certified to NEMA, based on NFPA 497 or API 505 shall be evaluated for application according to IEC 60079 hazardous area classification criteria. For equipment certified by other standards, it shall be equivalent or superior to area classification defined in PROJECT AREA CLASSIFICATION – GENERAL.

6.3. External Electrical Power Supply

- 6.3.1. For FPSOs and FSOs Units the available electrical system voltages are according to Table 1.

Table 1 – Electrical System Voltages and Grounding – FPSO or FSO

System Voltage	System Grounding	Source
13800Vac 3ph 60Hz	High Impedance	Main Generation
4160 Vac / 6600Vac 3ph 60Hz ⁽¹⁾	High Impedance	Main or Hull Generation
480Vac / 690Vac 3ph 60Hz ⁽¹⁾	Ungrounded	Main, Hull, Auxiliary, Emergency, or Generic Generation
220Vac 3ph 60Hz	Ungrounded	Main, Hull, Auxiliary, Emergency, or Generic Generation

System Voltage	System Grounding	Source
220V/127Vac 3ph 60Hz	Solidly Grounded	Main, Hull, Auxiliary, Emergency, or Generic Generation (only inside accommodation module)
220Vdc	Ungrounded	Batteries + DC UPS
220Vac 3ph 60Hz	Ungrounded	Batteries + AC UPS or Batteries + DC UPS + DC/AC Inverter.
125Vdc	Ungrounded	Batteries + DC UPS

Notes: 1 – See specific project documents for definition of rated voltage in these systems.

6.3.2. For Fixed and SS Units the available electrical system voltages are according to Table 2 .

Table 2 – Electrical System Voltages and Grounding – Fixed or SS Unit

System Voltage	System Grounding	Source
13800Vac 3ph 60Hz	High Impedance	Main Generation
4160Vac / 6600Vac 3ph 60Hz ⁽¹⁾	High Impedance	Main or Hull Generation
480Vac / 690Vac 3ph 60Hz ⁽¹⁾	High Impedance	Main, Hull, Auxiliary, Emergency, or Generic Generation
220V/127Vac 3ph 60Hz	Solidly Grounded	Main, Hull, Auxiliary, Emergency, or Generic Generation
220Vdc	Ungrounded	Batteries + DC UPS
220Vac 3ph 60Hz	Ungrounded	Batteries + AC UPS or Batteries + DC UPS + DC/AC Inverter.
125Vdc	Ungrounded	Batteries + DC UPS

Notes: 1 - See specific project documents for definition of rated voltage in these systems.

6.3.3. Packages shall have external electrical power and control supply and internal control voltages, according to the ANNEX I. When the quantity of internal electrical loads is bigger than the quantity of external power supplies defined in ANNEX I, Packager shall provide MCC with starters (functional units) for each internal electrical load.

6.3.4. Unless otherwise stated in specific Technical Specification or Material Requisition, if a lighting system is required for the Package, external electrical power supply for normal and essential lighting shall be fed by Bidder (in Topsides) or Hull Contractor (in Hull), in 220Vac, 3ph, 60Hz, from Unit normal and essential lighting panels respectively. Junction boxes shall be provided by Packager for lighting cable interface.

6.3.5. Unless otherwise stated in specific Technical Specification or Material Requisition, if an emergency lighting system is required for the Package, external electrical power supply for emergency lighting shall be fed by Bidder (in Topside installations) or Hull Contractor (in Hull installations), in 220Vdc, from Unit emergency lighting panels. Junction boxes shall be provided by Packager for lighting cable interface.

- 6.3.6. Unless otherwise stated in specific Technical Specification or Material Requisition, external electrical power for navigation aid for Packages including equipment related to these systems shall be fed by Bidder (in Topside installations) or Hull Contractor (in Hull installations), in 125Vdc, from Navigation Aid Distribution Panel of the Unit.
- 6.3.7. Unless otherwise stated in specific Technical Specification or Material Requisition, external electrical power for and aircraft warning lighting for Packages including equipment related to these systems shall be fed by Bidder (in Topside installations) or Hull Contractor (in Hull installations), in 220Vac, from essential lighting panels of the Unit.
- 6.3.8. Unless otherwise stated in specific Technical Specification or Material Requisition, external electrical power for heating resistors for motors, MCC, Switchgears and Control Panels shall be provided by Bidder (in Topside installations) or Hull Contractor (in Hull installations) in 220Vac 2ph 60Hz, from Unit normal panels.
- 6.3.9. Lighting panels (normal, essential or emergency) internal to the Package shall be furnished by Packager.
- 6.3.10. Packages with external redundant AC UPS or DC UPS or battery-charger or DC/AC inverter supply (according to ANNEX I) shall be fed with two redundant feeders, each one from a distinct Unit AC UPS or DC UPS or battery-charger or DC/AC inverter distribution panel respectively. The Package shall remain functional after a failure of anyone of the power supplies. For DC power supplies, packager shall provide blocking diodes to each control voltage source in order to avoid backfeeding control voltage sources. For AC power supplies, since the Unit UPSs and DC/AC inverters are not guaranteed to operate in synchronism, the Package shall have interlocks to avoid connection in parallel of these feeders inside the Package.
- 6.3.11. Available external autonomy of 220Vdc Unit Emergency DC UPS (Automation and Safety control, Electrical control, and emergency lighting) is 30 minutes. Available external autonomy of 220Vac Unit Emergency AC UPS (Subsea, Cranes, and Telecommunication control) is 30 minutes. Depending on necessary autonomy time to complete gas depressurizing in emergency conditions (value varies in each project), longer autonomy times may be defined in project documentation for these UPS systems.
- 6.3.12. Available external autonomy of 125Vdc Unit UPS (navigation aids) is 78 hours. The required autonomy for Navigation Aid System is 96 hours. The remaining autonomy is obtained from Emergency Generator autonomy, which is 18 hours.
- 6.3.13. The autonomy times of items 6.3.11 and 6.3.12 shall not be exceeded. Any deviation shall be submitted to PETROBRAS approval. Inclusion of UPSs, or battery-chargers (and their batteries) in Package to increase autonomy shall be also submitted to PETROBRAS approval, due to impacts (area, weight, demand, heat dissipation, etc.).
- 6.3.14. Any other Package electric power or control voltage shall be obtained using a suitable converters and rectifiers installed internally to the Package.
- 6.3.15. For telecommunication packages, see Telecommunication documentation.

6.4. Electrical Installations Interfaces

- 6.4.1. The electrical interconnection (power, control, protection, lighting, heating, etc.) between equipment located in the same Package shall be sized, purchased and installed under the complete responsibility of the Packager.
- 6.4.2. Electrical material and equipment necessary for interconnection between the Package and the Module (where the Package is installed) shall be furnished by Module Supplier. It shall be installed by Module Supplier under the supervision (technical assistance) of the Packager.
- 6.4.3. Electrical material and equipment necessary for interconnection between the Package and another Module (different than where the package is installed) shall be furnished by Bidder. It shall be installed by Bidder under the supervision (technical assistance) of the Packager.
- 6.4.4. Electrical material and equipment necessary for interconnection between the Package and the Unit Hull shall be furnished by Hull Contractor. It shall be installed by Hull Contractor under the supervision (technical assistance) of the Packager.
- 6.4.5. Unless otherwise stated in project documentation, the sizing, purchase and installation of electrical cables interconnecting equipment located in Packages physically separated shall be Module Supplier responsibility (in case of equipment installed in the same Module), Bidder responsibility (in case of equipment installed in different Modules) or Hull Contractor responsibility (in case of equipment installed in Unit Hull). The Packager shall inform all necessary data and approve the calculated cable.
- 6.4.6. Module Supplier (in case of equipment installed in the same Module), Bidder (in case of equipment installed in different Modules) or Hull Contractor (in case of equipment installed in Unit Hull) shall provide additional cable glands for Package equipment not provided with enough quantity.
- 6.4.7. Cables from the Unit panels feeding motor loads inside the Package or cables from generators inside the Package to the unit panels shall be furnished and installed by Bidder. The interface points between Unit and Package for motors and generators are the connection terminals inside terminal boxes. Cables shall be dimensioned until the interface point. For generators and Packages installed in Hull, this is scope of Hull Contractor.
- 6.4.8. Cables from the Unit panels feeding panels, junction boxes or non-motor loads inside the Package shall be furnished and installed by Bidder. The interface points between Unit and Package for panels, junction boxes and non-motor loads are the connection terminals inside them. Cables shall be dimensioned until the interface point. There shall be independent junction boxes for systems with different voltages (according to items 6.3.1 or 6.3.2) and load classification (according to item 6.1). For Packages installed in Hull, this is scope of Hull Contractor.
- 6.4.9. For packages with motorical and non-motorical loads which feeder panel is located far from them, implying in cables with large cross-section and non-compatibility with terminal boxes or busbars, Bidder (for Topside Installations or Hull Interface) or Hull Contractor (for Hull Installations) shall provide junction-boxes for appropriate interface between panels and loads.

- 6.4.10. For internal loads supplied externally, the mechanical path from Package battery limits, for power, control, protection and heating cables shall be scope of Packager.
- 6.4.11. All Packages classified as normal loads shall have an interposing relay suitable for 24Vdc ESD signal.
- 6.4.12. The design of the power and the control panels included in Packages shall consider a sufficient number of hardwired and network external communication and interface signals between Package and Electrical System, in order to comply with requirements of I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE, I-DE-3010.00-5140-797-P4X-002 - ELECTRICAL SYSTEM AUTOMATION TYPICAL ACTUATION DIAGRAMS and I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 6.4.13. For each interface point, Packager shall guarantee full compatibility of type, voltage and grounding system, including, if necessary, converters and galvanic isolators for control signals.

6.5. Electrical Panels and MCC for Packages

- 6.5.1. Panels shall comply with safety requirements of Brazilian Labour Authority. Each panel shall be of metallic construction (structure and steel sheets), following the correspondent IEC rules.
- 6.5.2. Panels for control, lighting, AC UPS distribution, DC UPS distribution and DC/AC inverters distribution shall comply with requirements of I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS, I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS, I-ET-3010.00-5140-773-P4X-001 - SPECIFICATION FOR D.C. UPS FOR OFFSHORE UNITS, I-ET-3010.00-5140-773-P4X-002 - SPECIFICATION FOR GENERIC D.C. UPS FOR OFFSHORE UNITS or I-ET-3010.00-5140-773-P4X-003 - SPECIFICATION FOR A.C. UPS FOR OFFSHORE UNITS, according to the type of UPS.
- 6.5.3. Panels for heating shall comply with I-ET-3010.00-5140-741-P4X-003 - POWER PANEL FOR THYRISTORIZED HEATER FOR OFFSHORE UNITS, or I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS, according to definition of Package specific technical specification.
- 6.5.4. Panels shall be proper for the calculated short-circuit level at Package incoming point. Detailed Design shall inform these values to Packager.
- 6.5.5. Panels shall be provided with a general incoming circuit-breaker (moulded-case or power, according to Package power), current limiting type, for each external incoming power supply.
- 6.5.6. The incoming circuit-breaker handles shall allow padlocking in “off” position. The opening of door giving access to live parts shall be interlocked with main power disconnection.

- 6.5.7. Motor Control Centers (MCCs) included in Packager scope of supply, shall comply with requirements of IEC 61439-1 and I-ET-3010.00-5140-741-P4X-001 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS. Any deviation from these specifications shall be submitted to PETROBRAS for approval.
- 6.5.8. For MCCs fed from switchgears and included in Packager scope of supply, a short-circuit limiting reactor shall be installed in series with the panel incoming feeder, which shall be sized and provided by Bidder (or Hull Contractor for Packages installed in Hull). This short-circuit limiting reactor may be furnished loose or integrated in the MCC. It shall be evaluated, together by Bidder (or Hull Contractor for Packages installed in Hull) and Packager, the convenience or not to install this reactor integrated to the MCC.
- 6.5.9. Unless otherwise stated in project documentation, at MCCs incoming point, the calculated thermal equivalent short-circuit current (I_{th}) for 1s shall be 18kA and the calculated peak short-circuit current (I_p) shall be 52.5kA. Detailed Design shall confirm these values to Packager. This calculation shall consider the balance between short-circuit limits and voltage-drop during motor starting. MCC rated withstand currents shall comply with (be higher than) these values.
- 6.5.10. Alternatively to items 6.5.8 and 6.5.9, reactors are exempted for MCCs with internal arc fault monitoring devices and certified for internal arc, according to IEC 61641 to at least Arcing Class A (personnel protection, complying with criteria 1 to 5), with Arc Thermal Performance Value (ATPV) lesser or equal 8cal/cm². It is acceptable to use internal arc fault monitoring devices to reach the Arc Thermal Performance Value (ATPV). For these cases, trip shall be instantaneous and sent to upstream panel. The withstand arc current value shall be defined by Detailed Design. The arc withstand time shall be at least 300ms. The calculated thermal equivalent short-circuit current (I_{th}) for 1s and the calculated peak short-circuit current (I_p) of MCCs shall be defined by Detailed Design.
- 6.5.11. Shutdown circuits are to be arranged to operate independently from other monitoring, control and alarm systems.
- 6.5.12. Panels shall be designed to have frontal access for installation, maintenance and inspection with no necessity of rear access.
- 6.5.13. When installed outdoors, Panels shall be IP56W (where W means proper for corrosive saline damp and hot environment), constructed in stainless steel sheets AISI-316 or FRP (Fiber Reinforced Plastic) resistant to UV (Ultraviolet), installed in a protected area.
- 6.5.14. The internal partitioning of control panels of Package Unit shall use metallic barriers, at least in the form 3b of IEC 61439-1.
- 6.5.15. In order to separate the risk zone (power circuits) and to avoid human contact with live parts, as stated in NR-10 rules, insulated and transparent polycarbonate barriers shall be installed. Totally screwed plates shall not be used. Alert indicating plates shall be provided, with the indication of risk and the rated voltage of circuits, as stated in NR-10 and I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING.
- 6.5.16. Low-voltage MCC included in Package scope of supply, with motor loads functional units, shall comply with the following additional requirements:

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6.5.16.1. Unless otherwise stated in PETROBRAS documentation, Bidder for Topside installations or Hull Contractor for Hull installations, shall guarantee the starting of all motors included in the Package with maximum voltage drop at MCC busbar of 15% of MCC rated voltage. If this value cannot be reached by direct online start, and the motor is in safe area (non-classified area) a soft-starter shall be provided by Bidder (or Hull Contractor), to be furnished loose, as an independent unit. Bidder (or Hull Contractor) shall be responsible to calculate and verify the motor starting voltage-drop, as stated on item 6.5.9.

6.5.16.2. For motors installed in hazardous area and for motors installed in external safe areas, but required to operate during ESD-3P or ESD-3T, when a soft-starter or frequency converter is required to comply with voltage drop or operation requirements, the supply of the set, motor and drive, shall be included in the Packager scope of supply, which shall also be responsible for the certification of this set. It shall be given preference to the use of circuit-breakers as protection devices for soft-starters and frequency converters. The use of fuses shall only be considered if strictly indicated by manufacturer. Soft-starter and frequency converters in these cases may be supplied loose, as an independent unit, or integrated in the MCC supplied by Packager.

Note: Standards require certificate of set (motor and soft-starter) when the motor is certified for operation in hazardous areas. Packager shall supply the soft-starter in these cases, being the only responsible to provide the certificate.

6.5.16.3. Requirements for soft-starters and frequency converters shall comply with I-ET-3010.00-5140-772-P4X-001 - MEDIUM-VOLTAGE FREQUENCY CONVERTER FOR OFFSHORE UNITS and I-ET-3010.00-5140-772-P4X-002 - SPECIFICATION FOR LOW-VOLTAGE FREQUENCY CONVERTERS, SOFT-STARTERS AND INVERTERS FOR OFFSHORE UNITS.

6.5.16.4. For redundant or dual loads, the control devices of each load shall be fed from independent circuits, internally separated by physical barriers, in order to avoid unavailability of both loads due to the same damage. The installation of starters for redundant or dual loads in geminated panels shall be accepted.

6.5.16.5. Panels shall be installed in areas free of vibration and far from heavy maintenance areas. It shall be avoided the installation of panels on the same skid of the driven/controlled equipment.

6.5.16.6. Package Panels fed by redundant emergency distribution panels 220Vdc shall have diodes downstream of the incoming circuit-breaker in order to block reverse supply. It shall be provided means for continuous monitoring of the diodes healthy condition.

6.5.17. Any deviation from these requirements shall be submitted to PETROBRAS approval.

6.5.18. Electrical equipment shall be painted in accordance with requirements of I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

6.6. Safety Grounding Installation

Package internal safety grounding system (equipment, accessories, piping and structure) shall comply with the requirements of IEC 61892-6, IEC 60092-502, applicable Classification Society's rules, I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS and I-DE-3010.00-5140-700-P4X-003 - GROUNDING INSTALLATION TYPICAL DETAILS. Besides these standards, for installations in hazardous areas, grounding requirements of IEC 61892-7 shall be complied with.

6.7. Lighting Installation

Package internal lighting equipment, when required, shall comply with the requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS, I-ET-3010.00-5140-700-P4X-008 - SPECIFICATION FOR LIGHTING AND ELECTRICAL SIGNALLING FOR OFFSHORE UNITS, I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS, I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS and I-DE-3010.00-5140-700-P4X-001 - LIGHTING INSTALLATION TYPICAL DETAILS.

6.8. Electrical Panels Functional Units Classification according to Control Mode

6.8.1. Functional units of medium-voltage and low-voltage switchgears and MCCs can be remotely controlled and/or supervised by A&C (Automation and Control System) in four different control modes (EA01, EA02, EA03 and EA04). The explanation about each control mode is detailed in I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE. It was defined in ANNEX 1 the classification of control mode to be applied by Bidder (for Topside installations) or Hull Contractor (for Hull installations) for each functional unit, according to the load fed from it.

Note: Automation and Control System refers to CSS (Control and Safety System) controllers and not to Topside Electrical System Automation Panel or Hull Electrical System Automation Panel. For requirements about remote control and supervision from Electrical System Automation, refer to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

- 6.8.2. This classification is not applied for panels with rated voltage lesser than 480Vac.
- 6.8.3. Any change in this classification during Detailed Design shall be submitted to PETROBRAS approval.
- 6.8.4. Bidder (for Topside Installations) or Hull Contractor (for Hull Installations) shall convert functional units control mode from EA01, EA02 or EA03 to control mode EA04 whenever the Package includes control panel to control circuit-breakers or contactors in switchgears or MCCs of the Unit.
- 6.8.5. When the Basic Design foresaw functional units for the loads of the Package fed from Units switchgears or MCCs and Detailed Design includes a MCC in the Package, transferring these loads to the Package MCC, Bidder (for Topside Installations) or Hull Contractor (for Hull Installations) shall convert the functional unit that will feed the Package MCC from control mode EA04 to control mode EA02.

6.8.6. For definition about electrical equipment operation modes based on the Automation level and Operation philosophy of each equipment/package unit, refer to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-ET-3010.00-1350-940-P4X-001 - SYSTEMS OPERATION PHILOSOPHY.

6.8.7. A&C classifies the Packages according to some requirements defined in I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS. The general relation between the electrical functional units control mode classification and the A&C Packages classification is shown in Table 3 - A&C Package x Control Mode Classifications. This relation is a general rule, but deviation may occur since A&C classifies the Packages (a whole set of equipment) e Electrical classifies each functional unit of switchgears and MCCs and in some cases, it is necessary to make adjustments in the general rule to fulfil the required controls. ANNEX I presents the detailed evaluation of this general rule.

Table 3 - A&C Package x Control Mode Classifications

A&C Package Classification	Electrical Functional Units Control Mode	Remarks
P0 - Without control panel, all control by CSS and operation by SOS	EA01	Functional units for Package loads
P1 - With control panel	EA02	Functional unit that feeds Package MCC, if any
	EA04	Functional units for Package loads
P2 - With control panel + supervision by SOS	EA02	Functional unit that feeds Package MCC, if any
	EA04	Functional units for Package loads
P2C - With control panel + control and supervision by SOS	EA02	Functional unit that feeds Package MCC, if any
	EA04	Functional units for Package loads
P2S - With control panel + supervision by dedicated HMI in the CCR	EA02	Functional unit that feeds Package MCC, if any
	EA04	Functional units for Package loads
P2SC - With control panel + control and supervision by SOS + control and supervision by dedicated HMI in the CCR	EA02	Functional unit that feeds Package MCC, if any
	EA04	Functional units for Package loads
Other loads, which are not packages by A&C	EA02 or EA03	According to the ANNEX I

7. INSPECTION AND TESTS

- 7.1. Electrical components and equipment with Technical Specification or Data Sheet issued by Detailed Design and installed in Packages shall be inspected and tested according to the applicable reference documents.
- 7.2. It shall not be acceptable out of date or obsolete equipment or components. Technical support and supply of replacement parts shall be guaranteed for ten (10) years.
- 7.3. All Electrical components and equipment installed in Packages in hazardous areas or installed in safe outdoors areas, but kept turned on during ESD-3P or ESD-3T situation, shall be individually inspected and tested, and Certification Reports shall be issued according to item 6.2.2 and 6.2.3.

Note: The inspections related to Ex apparatus shall comply with requirements of IEC 60079-17.

- 7.4. Classification Society and PETROBRAS may witness and approve all tests.
- 7.5. Individual visual inspection shall be provided for each item.
- 7.6. General checking like humidity inside equipment, screw pressing of explosion proof enclosures, enclosures joint tightness, cables electrical continuity and insulation resistance test shall be provided.
- 7.7. When required, manufacturer shall perform inspections and tests during manufacturing process of the equipment, witnessed by PETROBRAS and Classification Society, in order to fulfil all requirements stated on tests lists detailed in the specifications and respective data sheets.
- 7.8. For type tests, certified test reports for tests performed in identical equipment and approved and witnessed by Classification Society are accepted.

8. SPARE PARTS AND TOOLS

- 8.1. Packager shall provide a list of spare parts for all electrical equipment, for at least 2 (two) years of continuous operation, including prices and part number codes. Components requiring periodic replacement shall be listed by Packager in the spare parts list with the recommended replacement frequency.
- 8.2. Packager shall provide all unusual tools necessary for maintenance, assembly, or disassembly of all electrical equipment.
- 8.3. Packager shall provide the necessary spare parts for the commissioning and pre-operation periods.

9. DOCUMENTATION

- 9.1. A complete set of documentation, as required on Package Material Requisition (RM), shall be provided. These documents shall be issued for the Package and for internal equipment and components.

- 9.2. For Packages with MCC, Packager shall issue a protection coordination study including graphical plotting for all protective devices of the panel. The graphical plotting shall include equipment limit curves and points. The study shall include block diagrams for implemented logics and tables with configuration data (all configuration parameters) for all protective devices.
- 9.3. Packager shall provide complete documentation according to Brazilian Labour and Employment Ministry NR-10. This documentation shall be issued and signed by legally qualified personnel. The documentation shall include the items listed below and all items foreseen in NR-10 (see details in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS):
- a) Conformity Technical Appraisal regarding applicable standards for all internal equipment and installations, including tests, inspections, and measurement reports;
 - b) Project Technical Report, including internal protection, installation, safety grounding, etc.;
 - c) Manuals with safety and health procedures and instructions regarding electrical equipment and installations, and all contents required in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS;
 - d) List with electrical and electronic equipment installed in hazardous areas, including for each equipment, the classification Ex, nameplate data, number of Conformity Certificate and name of entity that issued the certificate, as defined in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.
 - e) Conformity Certificate for all electrical and electronic equipment proper for installation in hazardous areas, according to INMETRO Portaria nº 115, Mar 21st 2022.
 - f) Safety electrical signalling, where applicable, according to specification I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING
- 9.4. Packager shall present interface cables list and interconnection diagrams, clearly indicating the cables supplier (Packager, or Module Supplier, or Bidder).
- 9.5. Packages with programmable electronic devices shall issue documentation with the logic and the code source.
- 9.6. Packages with configurable electronic devices shall issue documentation with all parameters settings.
- 9.7. For items 9.5 and 9.6, software shall be furnished in their most recent versions at purchase time, accompanied by their corresponding licensing, access passwords, source code, installation media(s) and manuals, as well as with one year of technical support and maintenance. Demo versions and under development shall not be accepted.
- 9.8. Packager shall present a list of deviations from PETROBRAS documentation requirements.
- 9.9. Packager shall provide complete manuals and documentation. MTTR (Mean Time To Repair) shall be informed for electrical equipment inside package.

Note: Manuals shall comply with content requirements of NR-12 as defined in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.



TECHNICAL SPECIFICATION

No. I-ET-3010.00-5140-700-P4X-003

REV. N

AREA:

SHEET: 18 of 18

TITLE:

ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS

INTERNAL

ESUP

10. ANNEX I



Annex I - Packages List.xlsx