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1. OBJECTIVE

This specification establishes the technical requirements for the design, construction, and tests of Low-Voltage Motor Control Centers (MCCs), as defined at IEEE 1683 and Low-Voltage Switchgears (CDCs), as defined at IEC 61439 for Offshore Units.

2. REFERENCE DOCUMENTS, STANDARDS AND CODES

Panel design shall comply with requirements of Classification Society, Brazilian Legislation, applicable regulatory rules and Supplementary Requirements to IEC 61439-1 & 2 LV Switchgear & Controlgear (version 2.0, November 2016) which is attached at this specification. At the design development and for equipment specification, this technical Specification shall be complied with. Exceptionally, where it is clearly justifiable, the ANSI, NEMA, IEEE, VDE and other internationally recognized standards may be used. Their use shall be restricted to specific cases and approved by PETROBRAS.

2.1 Complementary PETROBRAS Documents

The following documents shall be issued by PETROBRAS and used to get complementary information

[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 AND EQUIPMENT FOR
OFFSHORE UNITS
[3] I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR
PACKAGES FOR OFFHORE UNITS
[4] I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN
ENGINEERING DESIGN FOR ELECTRICAL
SYSTEMS OF OFFSHORE UNITS
[5] I-ET-3010.00-5143-700-P4X-001 - ELECTRICAL SYSTEM PROTECTION
CRITERIA
[6] I-LI-3010.00-5140-700-P4X-001 - ELECTRICAL EQUIPMENT DATA-SHEET
MODELS
[7] I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION
INTERFACE SIGNALS LIST
[8] I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION
ARCHITECTURE
[9] I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION
ARCHITECTURE DIAGRAM
[10] I-ET-3010.00-0000-91A-P4X-001 - TECHNICAL DOCUMENTATION
REQUIREMENTS
[11] I-ET-3010.00-5520-888-P4X-001 - AUTOMATION PANELS
[12] I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND
INSTRUMENTATION ON PACKAGE UNITS
[13] I-ET-3010.00-1200-940-P4X-002 - GENERAL TECHNICAL TERMS
[14] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING

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2.2	IEC -	Interna	ational Electrotechnical Commission	
	TS600	034-25	Rotating Electrical Machines - Part 25: AC electrical power drive systems – Application guide;	machines used in
	60092	2-201	Electrical Installation in Ships - Part 201: System Design	n – General;
	60092	2-302	Electrical Installation in Ships - Part 302: Low Volta, Controlgear Assemblies;	ge Switchgear and
	60076	5-6	Power Transformers - Part 6 - Reactors;	
	60079)-7	Explosive Atmospheres - Part 7: Equipment Protection b "e"	by Increased Safety
	60079	9-14	Explosive Atmospheres - Part 14: Electrical Installation and Erection	s Design, Selection
	60332	2-3-22	Tests on Electric Cables under Fire Conditions - Part 3-2 Flame Spread of Vertically-Mounted Bunched Wires or A	2: Test for Vertical Cables – Category
	60364	-4-41	Low-voltage electrical installations –Part 4-41: Prote Protection against electric shock	ction for safety -
	60417	'-SN	Graphical Symbols for Use on Equipment - Database Sn	apshot
	60445	j	Basic and Safety Principles for Man-Machine Interf Identification – Identification of Equipment Terr Terminations and Conductors;	ace, Marking and ninals, Conductor
	60529)	Degrees of Protection Provided by Enclosures (IP Code));
	60533	}	Electrical and electronic installations in ships - compatibility (EMC) – Ships with a metallic hull;	- Electromagnetic
	60617	'-SN	Graphical Symbols for Diagrams - Data Snapshot;	
	60754	-1	Test on gases evolved during combustion of materials fr Determination of the halogen acid gas content;	om cables – Part 1:
	60754	-2	Test on gases evolved during combustion of materials fr Determination of acidity (by pH measurement) and cond	om cables – Part 2: luctivity;
	60909)	Short-Circuit Currents in Three-Phase A.C. Systems – A	All Parts;
	60947	7-2	Low-Voltage Switchgear and Controlgear - Part 2 - Circ	cuit-Breakers;
	60947	/-4-1	Low-Voltage Switchgear and Controlgear - Part 4-1 Motor-Starters - Electromechanical Contactors and Mote	- Contactors and or-Starters;
	60947	/-4-2	Low-Voltage Switchgear and Controlgear – Part 4-2: Con Starters – AC Semiconductor Motor Controllers and Sta	ntactors and Motor- rters;
	TR-61	1000-5-2	2 Electromagnetic Compatibility (EMC) - Part 5: Installat Guidelines - Section 2: Earthing and Cabling;	tion and Mitigation
	61439)-1	Low-Voltage Switchgear and Controlgear Assemblies Rules	– Part 1: General
	61439)-2	Low-voltage switchgear and controlgear assemblies switchgear and controlgear assemblies	– Part 2: Power

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		TR-6 2	1641	Enclosed Low-Voltage S Testing under Conditions	witcl	chge Arci	ar and	Control e to Inter	gear Ass rnal Faul	semblies - C lt;	Juide	for
		61034	4-2	Measurement of smoke d – Part 2: Test procedure a	lensit and r	ity o requ	of cable	es burni nts	ng under	r defined co	onditi	ons
		6118(0	High-voltage test techniq	ues f	for	low-vo	oltage ec	quipment	t – All parts	3	
		6185(0	Communication Network	cs and	nd S	ystems	s in Subs	station -	All parts;		
		61892	2-1	Mobile and Fixed Offsho Requirements and Condi	re Ui tions	Jnits s;	s - Elec	ctrical In	stallation	ns - Part 1 -	Gene	eral
		61892	2-3	Mobile and Fixed Offs Equipment;	hore	e U	nits -	Electric	al Insta	llations -	Part 3	3 -
		62262	2	Degrees of protection protection protection impacts (IK code	ovide e)	led l	by enc	losures o	electrical	l equipmen	t agai	inst
	2.3	IEEE	E - Insti f	cute of Electrical and Elec	ctror	nics	s Engi	neers (o	nly whe	re specifie	d)	
		IEEE	Std 168	3 [™] -2014 IEE including 600 V AC or 10 Reduce Electrical Hazard	E Gu)00 V ls	uide V D	for M C with	otor Cor Recomi	ntrol Cen mendatic	iters Rated i	ıp to a d to H	and [elp
	2.4	Brazi	ilian La	bour and Employment N	linis	stry						
		NR-1	.0	Segurança em Instalaçõe	s e S	Serv	icos er	n Eletric	cidade			
		NR-1	.2	Segurança no Trabalho e	em M	Máq	uinas e	e Equipa	imentos			
	2.5	ASTI	M – Am	erican Society for Testin	g an(nd N	Aateri :	al				
		F1166	6	Standard Practice for H Equipment and Facilities	Iuma	an 1	Engine	ering D	Design fo	or Marine	Syste	em,
	2.6	IMO	– Inter	national Maritime Organ	izati	tion						
		IMO	IA811E	Code for the Construction (MODU CODE)	1 and	d Eg	luipme	nt of Mo	obile Off	shore Drilli	ng Ui	nits
	2.7	IOGI	P – The	International Association	n of (Oil	& Ga	s Produ	cers			
		Suppl 2.0, N	lementar Novembe	ry Requirements to IEC 61 er 2016)	439-	-1 8	2 2 LV	Switch	gear & C	Controlgear	(vers	ion
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	3.2	Panels Class HUM	s shall ification IAN EN	be designed and manu Society rules, I-ET-3010. GINEERING DESIGN F	factu .00-5 OR	urec 514(EL	1 com 0-700-1 ECTR	plying P4X-00: ICAL S	with th 5 - REQ ³ SYSTEM	e requiren UIREMEN IS OF OFF	nents TS F FSHO	of OR RE

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- 3.3 The specific characteristics of the Panel shall be indicated in the Data-sheet.
- 3.4 The Manufacturer shall supply all the electrical materials, accessories (connection cables, connectors, softwares, software licenses, calibration boxes etc.), equipment and specific tools (including a truck to extract circuit-breakers from CDCs), which are necessary for the assembly, start-up, commissioning, operation, disassembly and maintenance of the Panel.
- 3.5 The final assembly of Panels on the Unit shall be done by Manufacturer personnel.
- 3.6 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.
- 3.7 The use of switchgear and controlgear assemblies and sub-components with less than 3 years proven operational service shall be approved by PETROBRAS.
- 3.8 For terms and definitions, refer to I-ET-3010.00-1200-940-P4X-002 GENERAL TECHNICAL TERMS.
- 3.9 The following items of the Supplementary Requirements to IEC 61439-1 & 2 LV Switchgear & Controlgear (version 2.0, November 2016), from IOGP shall not be applicable to this specification:

Items 5.1, 5.4, 6.1, 6.2.1, 6.3, 7.1.1.1, 8.0.102, 8.0.103, 8.2.101, 8.4.1, 8.5.2.101, 8.5.3,

8.5.3.101, 8.5.3.102, 8.5.3.104, 8.5.3.105, 8.5.3.106, 8.5.3.107, 8.5.3.109, 8.5.3.110, 8.5.3.112, 8.5.8, 8.5.9.1, 8.5.9.2.4, 8.5.10, 8.6.1.1, 8.6.2, 8.6.2.2, 8.6.2.3, 8.6.5 and 8.7.

4. CONSTRUCTIVE CHARACTERISTICS

4.1 General Requirements

The following items shall have priority over similar ones which are included at Supplementary Requirements to IEC 61439-1 & 2 LV Switchgear & Controlgear. The Supplementary Requirements is an IOGP (The International Association of Oil & Gas Producers) Specification which was prepared by a Joint Industry Project 33 Standardization of Equipment Specifications for Procurement. The Joint Industry Project 33 was organized by IOGP with support by the World Economic Forum (WEF).

- 4.1.1 Unless otherwise stated in Project Documentation, MCCs shall be designed to withstand the thermal stresses due to a thermal equivalent short-circuit current (I_{th} according to IEC 60909) of 25kA for 1s and the dynamic stresses due to a peak current (i_p according to IEC 60909) of 52.5kA. The rated short-time withstand current (I_{cw} according to IEC 61439-1) for 1s of the MCC shall be equal to or bigger than the informed I_{th} and the rated withstand peak current (I_{pk} according to IEC 61439-1) of the MCC shall be equal to or bigger than the informed I_{th} and the rated withstand the informed I_{pk} according to IEC 61439-1) of the MCC shall be equal to or bigger than the informed I_{pk} .
- 4.1.2 CDCs shall be designed to withstand the thermal stresses due to the thermal equivalent short-circuit current (Ith according to IEC 60909) informed in Data-Sheet for 1s and the dynamic stresses due to the peak current (ip according to IEC 60909) informed in Data-Sheet. The rated short-time withstand current (Icw according to IEC 61439-1) for 1s of the CDC shall be bigger than the informed Ith and the rated withstand peak current (Ipk according to IEC 61439-1) of the CDC shall be bigger than the informed Ith and the informed in Data-Sheet (Ipk according to IEC 61439-1) of the CDC shall be bigger than the informed in the inform

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4.1.3 Unless otherwise stated in Project documentation, the MCCs rated current shall be limited to 800A.						

4.1.4 Panels using flammable liquids in their components shall not be accepted.

4.2 Spare Drawers and Functional Units

- 4.2.1 Spare drawers shall not have immediate use. However, they shall be supplied completely mounted and wired, installed with all components in the Panels and ready for operation, including all hardwired and network interface signals regarding interlock, protection, control and supervision according to I-LI-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST considering the Spare Drawer Functional Unit Classification.
- 4.2.2 Unless otherwise stated in Project Documentation, each MCC shall have the following minimum spare drawers:
 - a) 3 (three) spare drawers for motor with rated power 11kW, and;
 - b) 2 (two) spare drawers for motor with rated power 30kW, and;
 - c) 1 (one) spare drawer for motor with rated power 55kW, and;
 - d) the necessary quantity of spare drawers for motor with rated power 11kW, to complete 15% of spare drawers (relating to total number of drawers, including spare drawers listed on items a to c).
- 4.2.3 Unless otherwise stated in Project Documentation, each CDC shall be furnished with 2 (two) spare drawers for motor loads for each semi-bar, with the rated current equal to or bigger than the rated current of the biggest motor load outgoing feeder (not considering back-feeders).
- 4.2.4 Spare Functional Units classification shall be according to control mode shall comply with I-ET-3010.00-5140-700-P4X-003 ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFHORE UNITS.

4.3 Environmental Conditions, Inclination Requirements and Vibration Requirements

- 4.3.1 The ambient temperature design for the panels shall be 45°C as stated in IEC 61892-1.
- 4.3.2 The design humidity, as a function of temperature, shall be 95% up to 45°C and 70% above 45°C, as stated in IEC 61892-1.
- 4.3.3 Panels and internal equipment and materials shall be suitable for storage, service and installation on marine and petrochemical environment, complying with requirements related to these conditions defined in I-ET-3010.00-5140-700-P4X-002 SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 4.3.4 When installed in mobile units and ships (FPSO and FSO), the Panels shall be suitable to operate under inclination variations (static and dynamic) and acceleration conditions specified IMO MODU CODE, IEC 61892 and Classification Society.
- 4.3.5 Panels shall comply with vibrations requirements defined in I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and Classification Society rules.

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4.4 (Classification of Assemblies			
4.4.1	The external protection degree shall be defined according to IEC 6052	9 with a minimum:		
	a) IP42W, for Panels installed in panel rooms;			
	b) IP44W, for Panels installed in machinery rooms;			
	c) IP56SW, for Panels installed outdoors.			
	Notes:			
	a) W means Panel suitable for saline, hot and damp atmosphere; b) S means that the test for ingress of water is carried out with the	a movable parts at		
	stationary conditions;	le movable parts at		
	c) Outdoors installations shall be submitted to PETROBRAS installation in hazardous areas shall not be permitted.	for approval and		
4.4.2	Panel shall be designed to keep the external protection degree with the isolated positions and during transfer from one position to another, a IEC 61439-2. If, after the removal of a withdrawable part, it is not p original degree of protection manufacturer shall provide measures to adequate protection (e.g. removable cover). Such measures shall PETROBRAS for approval.	drawers in test and in compliance with possible to keep the be taken to ensure l be presented to		
4.4.3	Each functional unit of MCC and each air circuit-breaker of CDC sh withdrawable part. The withdrawable parts shall slide over rails.	all be one separate		
4.4.4	Protection against electrical shock by direct contact shall be ens protective barriers or enclosures;	ured by means of		
4.4.5	Protection against electrical shock by indirect contact shall be energy protective circuits (earth bar), according to IEC 61439-1;	sured by means of		
4.4.6	The grounding of the withdrawable metallic non-current carryi guaranteed at all times, even during insertion/extraction operations.	ng parts shall be		
4.4.7	Adjacent functional units shall be separated from each other by providing protection degree at least IP2X, as stated in IEC 60529, sh 4b, stated in IEC 61439-2.	means of barriers, all be a Form 3b or		
4.4.8	Panels shall be composed by withdrawable parts with the following p	ositions:		
	a) Connected or inserted;			
	b) Test;			
	c) Isolated or extracted;			
	d) Removed.			
4.4.9	According to their characteristics under arcing conditions define in IE shall be classified as Arcing Class A. The permissible current under a arc) shall be equal to or greater than the rated short-time withstand cu permissible arc duration (tarc) shall be at least 0.3s, during tests.	C TR 61641, CDCs arcing condition (Ip arrent (Icw) and the		
4.4.10	According to IEC TR 61641, for determining the position of arc igniti the following points along the main circuit shall be considered:	on in arc fault tests.		
	a) load side of the outgoing functional unit;			

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	b) supply side of the outgoing functional unit and any associated are zone;	c ignition protected	
	c) along the distribution busbar (when applicable);		
	d) along the main busbar;		
	e) load side of the incoming functional unit;		
	f) supply side of the incoming functional unit		
4.5	Structure		
4.5.1	The maximum height, including the skid, shall not exceed 2400 exhaust ducts for expansion of gases from short-circuits).	mm (excluding the	
4.5.2	The base of the Panel shall be drilled and the panel shall be fixed to (skid) by screws passing through the holes.	o one metallic bas	
4.5.3	The skid shall be dimensioned just like a bi-supported beam alor direction, to support the whole Panel weight. The skid shall have sides to avoid access of humidity to the Panel's lower portion. The skid welded to the floor. Panel Manufacturer shall supply the skid a necessary to fix the skid to the floor.	ng the longitudina covered with plate shall be drilled o and all accessorie	
4.5.4	To avoid a dangerous the inclination of equipment when manoeuvrin construction and installation, the two points supported beam on the lo fixing base shall also have transversal directional beams. These tran	g equipment durin ngitudinal directio sversal beams sha	

4.5.5 Maximum height for installation of push-buttons and instruments shall be in accordance with I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.

may be accepted if it is previously submitted and approved by PETROBRAS.

not interfere with cable access and any other installation requirements. Other solution

- 4.5.6 Panels shall be self-supported and shall have lifting devices.
- 4.5.7 The panels shall be designed in such a way that a maximum of 2 columns are connected for mechanical handling. All main busbars connections shall have access for torque without disassemble any internal wiring in order to allow torquing after lifting.
- 4.5.8 MCCs shall have extension possibility on the opposite end to the incoming reactor. CDCs shall have extension possibility on both ends.
- 4.5.9 For CDCs, the back doors shall be provided with hinges and locks to keep them in open position. CDCs shall have access possibilities for installation and maintenance through the front and rear sides.
- 4.5.10 CDCs shall have frontal and back doors with hinges and locks to keep them in open position.
- 4.5.11 For MCCs, all kind of access for installation, maintenance and operation shall be through the front side. MCC's with maintenance and operation through the rear side shall be submitted to PETROBRAS approval.
- 4.5.12 Panels shall be comprised of vertical sections, formed by metallic compartments, aiming the flame retardation of a possible fire from one functional unit to another.

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4.5.13	CANCELLED.	
4.5.14	CANCELLED.	
4.5.15	For MCCs, the hardware assembly, busbar, fittings, etc. shall allow interchange among drawers with the same characteristics. Refer also to item 4.14.7.11.	eability
4.5.16	For CDCs, the hardware assembly, busbars, fittings, etc. shall allow interchange among all circuit-breakers and contactors with the same characteristics.	ability
4.5.17	All removable parts and components of same type, rating and construction simechanically and electrically interchangeable.	hall be
4.5.18	For MCCs, terminal blocks shall be located at the upper or lateral portion (cable co of each vertical section.	olumn)
4.5.19	The arrangement shall enable easy access for external wiring installation maintenance, including space to manipulate necessary tools.	n and
4.5.20	Each withdrawable part shall be provided with mechanical blocking to avoid its ext or insertion when its circuit-breaker is closed.	raction
4.5.21	It shall be provided mechanical interlocks to avoid the drawer to be inadve extracted beyond "Test" position.	rtently
4.5.22	Functional Unit in "Test" position shall allow local and remote test of main sw device without energize the load (motor, feeder etc.).	itching
4.5.23	The structures of the withdrawable parts shall be dimensioned to support their weil all positions.	ghts in
4.5.24	Equipment that allows either set or calibration shall be installed in such a way that not be necessary to withdraw or to open the drawer to operate them. Exceptions s submitted to PETROBRAS approval.	it shall hall be
4.5.25	The grips and drawers connection systems to busbars shall be protected against and they shall be able to support, without deformations, the electrical, mechanic thermal stresses due to short-circuit current.	rusting cal and
4.5.26	Connections between grips and connection systems to fuses or circuit-breakers ter shall be preferably made through isolated bars.	minals
4.5.27	When installed in mobile units and ships (FPSO and FSO), the Panels shall have in handrails along the front and rear sides (rear side only when accessible).	sulated
4.5.28	The panels shall be constructed so that thermal inspection by optical in thermographic devices could be safely performed with the circuits energized. This shall not compromise arc withstand capability to comply with TR IEC 61641.	nfrared facility
4.6 I	Busbars	
4.6.1	Main and Auxiliary Busbars	
4.6.1.1	Busbars shall be three phase, of electrolytic copper.	
4.6.1.2	MCCs shall be provided with one horizontal main busbar.	

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- 4.6.1.3 CDCs shall be provided with two horizontal main busbars, connected by a tie circuitbreaker.
- 4.6.1.4 The busbars shall have capacity to continuously conduct the rated current In of the Panel (as defined in IEC 61439-1) defined by Project documentation, with the temperature rise limited to the standard values.
- 4.6.1.5 Busbars and supporting systems shall be dimensioned to withstand the mechanical and thermal stresses resulting from short-circuit currents indicated in Data-Sheet.
- 4.6.1.6 Each vertical column shall be provided with a vertical busbar branched from the main busbar. The rated current of each vertical busbar shall be indicated in Data-Sheet.
- 4.6.1.7 Flame retarding and non-hygroscope insulators shall support the busbars. Celeron and fiberglass shall not be accepted. Insulators shall be resistant to degradation due to pollutant agents.
- 4.6.1.8 The strength applied on supports shall not exceed the rupture loads guaranteed by Manufacturers of insulators.
- 4.6.1.9 In case where parallel bars are used for a same phase, shims shall be used, suitably spaced, along the longitudinal axis of these bars.
- 4.6.1.10 Junction plates, at bars joints, shall be coated with silver and placed in such manner to guarantee a perfect alignment and high-pressure contact.

Note: PETROBRAS preferred option is to have both sides of contact bus bar silver coated; however, if manufacturing procedures can achieve the same results (one side only or other procedure) it shall be submitted to PETROBRAS approval.

- 4.6.1.11 Each busbar phase shall have a permanent identification, using one colour per phase, according to:
- For A.C. systems:
 - a) phase (R-S-T): red, white and black, respectively;
 - b) neutral: light blue according to IEC 60445;
 - c) ground: bicolour combination green-yellow according to IEC 60445.
- For D.C. systems:
- a) positive: red;
- b) negative: black.
- 4.6.1.12 Busbars insulation for CDCs and busways shall completely cover each bar, except at the connection points with adjacent units, or at the connection points with disconnecting devices. These joints shall be covered by insulation plates, fixed to the bar and filled in with insulation mass to guarantee a homogeneous insulation.
- 4.6.1.13 MCCs busbars shall have insulation cover.
- 4.6.1.14 All busbars connections and all outgoing bars for connection of cables shall be silver coated. The junctions shall be placed in such a manner to guarantee a perfect alignment and high-pressure contact.
- 4.6.1.15 Panels shall not have neutral bar.

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- 4.6.1.16 All busbars connections shall use bolts, nuts and Belleville spring washers made with AISI 316 stainless steel.
- 4.6.2 Grounding bars
- 4.6.2.1 A grounding bar shall be installed in the whole Panel length, through the internal lower or upper part.
- 4.6.2.2 All Panel metallic parts not intended for current conduction (such as movable parts, panel structure, doors, secondary of instrument transformers, cables armours, cables shields and others) shall be interconnected to the grounding bar, using bonding jumpers with cross section according to Table 1 of IEC 61892-3.

Cross-section Q of associated current-carrying conductor (one phase or pole) (mm2)	Minimum cross-section of earth conductor
Q ≤ 16	Q
Q ≥ 16	50 % of the current-carrying conductor, but not less than 16 mm2
Earth conductors for hinged doors	Not less than 4mm2

- NOTE: All doors shall be provided with supplemental equipotential bonding.
- 4.6.2.3 Grounded Systems
- 4.6.2.4 The cross section of the grounding bar shall be according to Table 3 of IEC 61439-1. Each end shall be provided with non-welded type connectors, suitable for bare copper cables with cross-sectional area according to I-ET-3010.00-5140-700-P4X-001 -SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.
- 4.6.2.5 Ungrounded Systems
- 4.6.2.6 The minimum cross section of the grounding bar shall be according to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS. Each end shall be provided with non-welded type connectors, suitable for bare copper cables.
- 4.6.3 Electronic Reference bar
- 4.6.3.1 The electronic reference terminals grounding of the instruments and intelligent devices shall comply with the requirements of the IEC 61000-5-2.

4.7 Current Limiting Reactors

4.7.1 A current-limiting reactor shall be provided connected in series with the MCC incoming feeder, with reactances calculated to limit the calculated thermal equivalent short-circuit current at 1s (Ith according to IEC 60909) at MCC busbar to 18kA (18kA is not the rated thermal short-circuit current of the reactor, this value is defined in item 4.7.8) and to limit the calculated peak short-circuit current (ip according to IEC 60909) to 52kA (52kA is not the rated withstand peak current of the panel - Ipk, according to IEC 61439-1, defined in item 4.1.1, neither the rated mechanical short-circuit current of the reactor, defined in item 4.7.8).

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4.7.2 The r	eactors shall comply with the requirements of	Standards IEC 600)76-6.
4.7.3 React iterat	tors reactance's shall be defined and optimi ive calculations in short-circuit and load-flow	zed combining the analysis.	best solution af
4.7.4 Mech	anical Characteristics:		
4.7.5 The r 1000 limiti	eactor shall be installed in the MCC incoming mm. The same protection degree specified fo ng reactor.	g column. The max r the MCC shall be	imum width shall e applied for curre
4.7.6 React	tor shall be provided with mobile base for easy	y disconnection fro	m enclosure.
4.7.7 React magn indoc	tors shall have dry-type insulated coils, construction concerning the shall be cooled by natural coor use.	ructed with bars or onvection of air an	wires, with air-co d shall be proper f
4.7.8 Elect	rical characteristics:		
	• Conductor material:	copper or alumini	um;
	Insulation Class:	F;	
	• Temperature rise limit:	According to sta for insulation Cla	ndard IEC 61892 ss B;
	• Quality Factor (X/R):	$15 \leq X/R \leq 20;$	
	• Rated continuous current:	equal to MCC rate	ed current;
	• Rated thermal short-circuit current:	25kA;	
	• Rated thermal short-circuit duration:	1s;	
	• Rated mechanical short-circuit current:	52.5kA	
4.7.9 Toler	ances:		
	• System rated voltage:	±10%;	
	• Impedance:	-0% +20%;	
	• Losses:	+10% for reactor	inside the enclosu
	• Impedance (each phase):	$\pm 5\%$ from measure	ed medium value
4.7.10 M (X/R)	Manufacturer shall inform in Panel Datashee) of the reactor.	t the impedance (Z	2) and quality fact
4.7.11 H contin SPEC OFFS	Reactors shall operate satisfactorily with the vanuous and transitory conditions as stated in CIFICATION FOR ELECTRICAL MAT SHORE UNITS.	oltage and frequend in I-ET-3010.00-5 ERIAL AND E	y variation limits 140-700-P4X-002 QUIPMENT FO

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4.8	Internal Wiring and Conductors	
4.8.1 2	Unless otherwise stated, all internal cables shall comply with the requir 3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.	ements of the I-ET MATERIAL ANI
4.8.2	All cables shall be flame retardant according to IEC 60332-3-22, Cat	egory A.
4.8.3	Internal wiring shall have low emission of smoke and halogen gases according to IEC 61892-3. The following minimum requirements sho	in the case of fire ould be met:
	a) A minimum light transmission value of 60 %, according to IEC 61	034-2;
	b) A maximum halogen gas emission of 0,5 %, according to IEC 6075 2.	4-1 and IEC 60754
4.8.4	Power conductors shall be provided with EPR or XLPE insulation, v voltage $(U0/U) 0.6/1.0$ kV.	vith minimum rate
4.8.5	Power cables for motors fed from VSD shall be shielded and they sh recommendations of IEC TS 60034-25.	all comply with th
4.8.6	Control and signal conductors shall be provided with EPR, XLPE Control and signal circuits with rated voltage up to 220V with neutral shall use cables with minimum rated voltage (U0/U) 150/250(300)V circuits with rated voltage up to 220V with isolated neutral shall use carated voltage (U0/U) 450/750V.	or PVC insulation ral bolted grounde . Control and signa- ables with minimum
4.8.7	Discrete signals cables shall be collectively shielded. Analog signal twisted pairs/triads with a shield for each pair/triad and a collective external cover.	ls cables shall hav ve shield under th
4.8.8	All internal wiring shall be duly identified through plastic rings, codification shown on the wiring drawings.	at the ends, with
4.8.9	The insulation colour of cables used for D.C. circuits shall be red for voltage and black for wiring with negative voltage.	wiring with positiv
4.8.10	The outer sheath (protective cover) colour of cables used in groundi the combination green-and-yellow according to IEC 60445.	ing circuits shall b
4.8.11	Panels shall be delivered with all connections between installed comp	ponents done.
4.8.12	The wiring between sections separated for transport shall finish on that the final interconnection could be easily completed with jumps sections are assembled.	terminal blocks, sers, by the time th
4.8.13	Power cables shall be suitable for the drawer rated power and withstan resulting from short-circuit currents.	d the thermal effe
4.8.14	Components assembled on doors shall be connected through extra-fle	exible conductors.

4.8.15 The minimum cross-section area for internal cables shall be of 0.5mm² for control circuits (120VAC or 220VDC discrete signals), 1.0mm2 for instrumentation circuits (4-20mA), 2.5mm² for power, lighting, socket-outlet and VTs circuits and 4mm² for CTs circuits.

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4.9 External Wiring and Conductors Entrance			
4.9.1 All incoming and outgoing cables entrance in low-voltage CDCs and MCCs shall be according to project documentation.			
4.9.2 F	or single core cables, the Manufacturer shall provide removable shee	ets, with a minimum	

- 4.9.2 For single core cables, the Manufacturer shall provide removable sheets, with a minimum thickness of 2.8mm, made of copper free aluminium or non-magnetic material. For all other cases, the removable sheets shall be of painted galvanized steel, with galvanization thickness for 30 years lifetime. The removable sheets shall be provided with neoprene rubber gaskets. MCTs can be used as an alternative.
- 4.9.3 Cable-glands made with material compatible with the removable sheets' material shall be supplied with the Panel.
- 4.9.4 Unless otherwise stated in Project Documentation, if bus trunking connections are used, the Panel shall have appropriate edges and flexible connectors for entrance through the top.

4.10 Cable Lugs and Terminals

- 4.10.1 Control circuits shall use pin cable lugs. CTs and power circuits shall use ring cable lugs.
- 4.10.2 Terminals for control circuits shall be indirect pressure screw pillar terminal type and shall be covered with melamine or other similar equivalent material, which shall not have organic and toxic substances.
- 4.10.3 Terminals for power circuits shall be screw type. Lugs for power circuits shall be compression type.
- 4.10.4 Sizes of terminals for power circuits shall be defined according to feeders' cross-sectional area that shall be determined during the Detailed Design execution.
- 4.10.5 All cable lugs for power and control circuits shall be supplied within the Panel.

4.11 Terminal Blocks

- 4.11.1 Only one cable shall be connected to each cable lug and only one cable lug shall be connected to each terminal. Jumpers between terminals by external conductors shall not be accepted. For this purpose metallic bridges shall be used.
- 4.11.2 Each control terminal block shall have at least 10% of reserve, for future application.
- 4.11.3 Terminal blocks installation shall permit enough space to perform the cable termination, their fitting, easy access to terminals and easy reading of identification.

4.12 Channels

- 4.12.1 The internal conductors shall be installed in channel type cable trays with covers.
- 4.12.2 The power cables shall be segregated from control and data cables, by installation, in separated cable trays, placed as far as possible.
- 4.12.3 In order to prevent damage in internal cables during construction, commissioning and maintenance cable channels filling shall not exceed 75% of their capacity.

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4.13 Hea	ting Resistors	
4.13.1 Fo	r Panels	
4.13.1.1	Each vertical section shall be provided with heating resistors j installed at the lower part and protected by circuit-breakers.	proper to 220VA
4.13.1.2	In order to avoid damage due to high temperature the wiring next (closer than 30cm), shall have proper insulation.	to heating resiste
4.13.1.3	One miniature circuit-breaker shall be provided per bar for interr cubicle heaters circuits of the panel.	uption of all relat
4.13.2 Fo	or Motors	
4.13.2.1	For motors with heating resistors, as required in the PETROBR functional units shall be suitable to feed these heating resistors, turned on when the motors are turned off.	AS documentation being automatica
4.13.2.2	Cancelled.	
4.13.2.3	One circuit-breaker shall be provided for each vertical section or d motors' heating resistors circuits.	rawer, to protect
4.13.2.4	For motors installed in hazardous areas Zone 1 and circuits for cross hazardous areas Zone 1, the circuit-breaker for protection of shall have thermomagnetic unit with integrated or additional o current protection.	loads which cab the heating resisted lifferential reside
4.13.2.5	Auxiliary circuits for motor space heaters shall be energized w starter functional unit main circuit switching device is open, when o or the test position;	whenever the mo either in the insert
4.13.2.6	Auxiliary circuits for motor space heaters shall be deenergized isolated position.	when drawer is
4.13.3 Fo	or Generators	
4.13.3.1	All motogenerators shall have circuits to feed heating resistors source (same source of item 4.13.1), being automatically turned of functional unit when the motogenerators are turned off. The ger shall be obtained from the generator control panel according to 797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTE LIST.	a fed from extern on by the respective nerator status sign I-LI-3010.00-514 RFACE SIGNA
4.13.3.2	One circuit-breaker shall be provided in each vertical secti motogenerators' heating resistors circuits.	on, to protect t
4.13.3.3	For motogenerators installed in hazardous areas Zone 1 or v hazardous areas Zone 1, the circuit-breaker for protection of the h have thermomagnetic unit with integrated or additional different protection.	which cables cro eating resistor sh tial residual curro
4.14 Fun	actional Units	

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4.14.1.1	Starters for motors in MCCs, when per moulded-case circuit-breakers, contact	erforming direct-on-line start, etors and Intelligent Relays (I	shall be formed by R).
4.14.1.2	Starters for motors in MCCs, when moulded-case circuit-breaker, fuses contactor, soft-starter and IR. It shall b bypass contactor) in case of failure in	n soft-starter is required, sh s (proper to soft-starter p be possible to carry out direct- soft-starter. Refer to item 4.1	all be formed by rotection), bypass on-line start (using 4.16.
4.14.1.3	Starters for motors in MCCs, when VS circuit-breaker, fuses (proper for VSI shall be foreseen to allow trip by ESD	SD is required, shall be forme D protection), VSD and IR. T D." Refer to item 4.14.17.	d by moulded-case 'he Shunt trip coils
4.14.1.4	Starters for motors in CDCs, when per air circuit-breakers ("power" of multifunction relays (MMR), unless of	rforming direct-on-line start, circuit-breakers) and mic otherwise stated in Project Do	shall be formed by croprocessor-based cumentation.
4.14.1.5	Cancelled.		
4.14.1.6	Starter for motors in CDCs, when soft- breaker ("power" circuit-breakers), for contactor, soft-starter and MMR. It so (using bypass contactor) in case of fair	-starter is required, shall be fouses (proper for soft-starter phall be possible to carry out allore in soft-starter.	rmed by air circuit- protection), bypass direct-on-line start
4.14.1.7	Starter for motors in CDCs, when V breaker ("power" circuit-breakers), MMR.	SD is required, shall be form fuses (proper for VSD prot	ned by air circuit- tection), VSD and
4.14.1.8	The utilization category for non-moto defined in Table 1 of IEC 60947-4-1. be AC-3 according to IEC60947-4-1.	r loads shall be selected accor The utilization category for	ding to the load, as motor starters shall
4.14.1.9	Functional units for non-motor loads off shall be formed by moulded-case for non-motor loads in MCCs shall be trip coil (to allow trip by ESD) and IR	in MCCs foreseen to be remo circuit-breaker, contactor and e formed by moulded-case cir R.	otely turned on and IR. Other drawers cuit-breaker, shunt
4.14.1.10	Functional units for non-motor loads shall be formed by moulded-case cir trip coils shall be foreseen to allow tri	in MCCs, when classified as reuit-breakers and IRs. When ip by ESD.	S EA02 and EA03, applicable, Shunt
4.14.1.11	Functional units for non-motor loads, back-feed sections in CDCs shall be circuit-breakers) and microprocessor-	incoming sections, interconn e formed by air circuit-brea based multifunction relays (N	ection sections and kers and ("power" /IMR).
4.14.1.12	Outgoing feeders for fire-fighting pu elements and protection against locke	imps, if any, shall have only d-rotor overcurrent.	instantaneous trip
4.14.1.13	Functional Units for essential non-me transformers, feeders for UPSs and pa the Emergency Generator starting. In the be kept closed and shall not have under for these loads.	otor loads in MCCs and CD anels, etc., shall be energized this way, the circuit-breakers ervoltage trip coils. Contactor	Cs, i.e. distribution l immediately after of these loads shall rs shall not be used
4.14.1.14	Manufacturer shall dimension all fu defined by Detailed Design.	unctional units according to	the loads powers

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4.14.1.15	The co-ordination with short-circuit protective devices for direct on-line starters shall be type "2", as defined in IEC 60947-4-1. The Manufacturer shall attach to the technical proposal a test certificate, issued by a recognised Laboratory, proving co-ordination type.
4.14.2 Pro	otective Devices
4.14.2.1	Circuit-breakers shall be used as protective devices, for the power conductors and power equipment.
4.14.3 Ma	ain Contactors
4.14.3.1	Main contactors shall be three-poles, dry and suitable for direct-on-line start of three- phase induction motors.
4.14.3.2	Nominal operating voltage for contactor coils for Turbogenerators low-voltage MCCs shall be 220VDC. These devices shall close satisfactorily their contacts at voltage variation between 85% and 110% of rated voltage. The maximum voltage limit for drop out, as defined in IEC 60947-4-1, shall be 70% of rated voltage, without tolerance.
4.14.3.3	Cancelled.
4.14.3.4	For outgoing feeders of essential motor loads, electric closing control for contactors shall be possible through buttons installed in the front door of the cubicle. See also item 4.14.14.1.
4.14.4 Cir	rcuit-Breakers
4.14.4.1	Circuit-breakers for power circuits shall be A.C., three-poles, 60Hz, 600V minimum, with trip-free switching mechanism.
4.14.4.2	Circuit-breakers shall be provided with compensation of effects of variation of ambient temperature over tripping devices.
4.14.4.3	Circuit-breakers shall be suitable for short-circuit prospective current. It shall not be acceptable the use of circuit-breaker accessories (e.g. short-circuit limiters devices) to achieve this limit.
4.14.4.4	Circuit-breakers shall not have under-voltage trip (UVT) coil.
4.14.4.5	Circuit-breakers for generator incoming feeders shall not have primary trip element.
4.14.4.6	Circuit-breakers' electrical characteristics shall be suitable for the parameters defined in Data-Sheet for the electrical system.
4.14.4.7	Circuit-breakers shall be lockable in open position with a padlock. It shall not be possible to change the drawer position if its circuit-breaker is closed.
4.14.4.8	Circuit-Breakers for MCCs
4.14.4.8.1	MCCs' incoming feeder shall have an Air circuit-breaker ("power" circuit-breakers type), MMR and lockout relay when the MCC and its upstream panel are not in the same room.
4.14.4.8.2	For non-motor loads each phase shall be outfitted with direct-action thermomagnetic device. For motor loads, they shall be outfitted only with direct-action magnetic device and it shall be possible to adjust the trip value at 13 times the motor full load current.

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- 4.14.4.8.3 Circuit-breakers shall have hand lever command and shall be mounted in a way that the levers can be directly handled from outside of the drawers. Hand lever shall be provided with indication of its position.
- 4.14.4.9 Circuit-Breakers for CDCs
- 4.14.4.9.1 The circuit breakers shall be Air circuit-breakers ("power" circuit-breakers) type.
- 4.14.4.9.2 Circuit-breakers shall not have undervoltage trip (UVT) coil as opening mechanism by ANSI 27 function.
- 4.14.4.9.3 Mechanical opening (turn off) shall be executed through mechanical actuator in the front plate of all circuit-breakers. Mechanical closing (turn on) shall be executed through mechanical actuators, only for incoming, back-feeders and tie circuit-breakers of CDCs, outgoing feeders for transformers, for non-motor loads classified as EA03 and for non-motor loads classified as EA02. These actuators shall be accessible with the front door of the compartment closed. For functional units classification according control mode, refer also to I-ET-3010.00-5140-700-P4X-003 ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFHORE UNITS.
- 4.14.4.9.4 Electric control shall be executed by closing and opening contacts of buttons or switches installed in the front door of the cubicle or by remote signals, energizing the closing and opening coils. STOP action (turn off) shall be available through frontal push-buttons for all circuit-breakers, actuating in their trip coils. START action (turn on) shall be delayed to close and available through frontal push-button for incoming, back-feeders and tie circuit-breakers of CDCs, outgoing feeders for transformers, nonmotor loads classified as EA03 and non-motor loads classified as EA02. For the other kind of loads the closing action from front door buttons or switches shall be active only with functional unit in test position. For functional units classification according control mode, refer also to I-ET-3010.00-5140-700-P4X-003 ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFHORE UNITS.
- 4.14.4.9.5 Indicators for the contacts position and for the spring position shall be provided at the front cover of the circuit-breaker.
- 4.14.4.9.6 Cancelled.
- 4.14.4.9.7 Trip coil circuit monitoring shall be supplied in order to provide signalling in the front side of the panel according to each functional unit of CDC shall be provided with signalling LEDs for indication of: as per item 4.14.12.2. The status of trip coil circuit shall be available to the MMR in order to send an alarm through network.
- 4.14.4.9.8 Circuit-breakers shall be provided with a number of operations counter.
- 4.14.4.9.9 Springs shall be charged by electric motor and by a manual lever installed in the circuit-breaker. The motor shall be controlled by limiting-switches to charge the spring whenever it is discharged.
- 4.14.5 Microprocessor-Based Multifunction Relays (MMR)
- 4.14.5.1 MMRs are kind of IED (Intelligent Electronic Device, as defined by IEC 61850) and shall comply with the requirements of I-ET-3010.00-5140-700-P4X-002 SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

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	SWITCHGEAR FOR OFFSHORE UNITS	ESU	P	
4.14.5.2	Unless the digital inputs of MMRs are checked by self-diagnosis rou inputs shall not be used to control the load by signals from external pr devices (e.g. high temperature of bearings, high pressure of vessels e	itine, these cotective o etc.).	e digit or safe	tal ty
4.14.5.3	The MMRs shall have the function of circuit-breakers coils monitor sending alarm signal to Electrical System Automation Operational W	ing activa Vorkstatic	ited ar m.	nd
4.14.5.4	Starting button of MMRs for functional units shall be enabled or feeders, back-feeders, tie and outgoing feeders for non-motor no control mode EA02 and EA03 and all outgoing feeders for essential	nly for in ormal loa loads.	comir ds wi	ng .th
4.14.5.5	MMRs shall be capable of distinguishing between fuse failure and at in busbar.	bsence of	voltag	ge
4.14.5.6	A "Wachdog Alarm" shall be foreseen, and its signal shall be sent to Automation and comply with I-ET-3010.00-5140-797-P4X-001 - SYSTEM AUTOMATION ARCHITECTURE and I-DE-3010.00-51 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIA	o Electric - ELECT 40-797-P AGRAM.	Syste ïRICA ï4X-0(m 1 01
4.14.6 Lo	ockout Relays			
4.14.6.1	Lockout relays shall comply with requirements of I-ET-3010.00-514 SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUOFFSHORE UNITS.	0-700-P4 UIPMEN	X-002 T FO	2 -)R
4.14.6.2	To reduce failure probability, in circuits to activate the trip coils of the trip contacts of lockout relays shall be connected in parallel with the respective MMRs and Arc Monitoring Relays.	circuit-b h trip cor	reaker	rs, of
4.14.7 Int	telligent Relays (IRs) for MCCs			
4.14.7.1	IRs are kind of IED (Intelligent Electronic Device, as defined by necessarily using this protocol) which shall be three-poles and with m shall be provided with ambient temperature compensation and p overload due to phase loss. The regulation and calibration devices sha scale.	IEC 618 nanual reso rotection all have gr	50, n et. The again aduate	ot ey ist ed
4.14.7.2	IRs shall have communication facilities through one Ethernet comusing the protocols specified in I-ET-3010.00-5140-797-P4X-001 SYSTEM AUTOMATION ARCHITECTURE and I-DE-3010.00-51 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE In port shall also be capable of communicating with the comparameterization software of the IR. Means for communicating with the Ethernet Network communication in front of the panel, without doors, and with the drawers inserted shall be available.	nmunicati - ELECT 40-797-P DIAGRAI onfiguration the relay bout openin	On pc 'RICA '4X-00 VI. Th on ar oy usin g pan	ort AL 01 nis nd ng iel
4.14.7.3	In order to protect the motor and to control the start and stop command digital inputs and shall be programmable.	ds, IRs sh	all hav	ve
4.14.7.4	For motors with protection function 49 (by temperature sensors) rehave inputs for PTC.	equired, II	Rs sha	all
4.14.7.5	When protection function 50GS is required (for non-isolated systems input for ground sensor CT.	s), IRs sh	all hav	ve
4.14.7.6	IRs shall provide full registry of faults through the communication p	orts.		

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4.14.7.7 H	For loads with duty types S1, S2 and S3, the relays shall be adjustant of 115% of the motor rated current. For other duty types, the resultable for the duty characteristic.	ble up to a maximum relays range shall be
4.14.7.8 I	t shall be provided an external reset button for the IR at the drav	vers' front door.
4.14.7.9 T r	The IR shall be able to calculate the motor thermal state. The active restarts shall be dependent on previous thermal image of the mot	uation time of IRs on or.
4.14.7.10 T a i	The IR as described above shall be compatible, including its taccelerating and permissible locked rotor times. Detailed Designformation for MCC Manufacturer.	olerances, with load ign shall supply this
4.14.7.11 F e F	Each IR shall have a fixed IP address to network communication electrical interlock to avoid operation of a functional unit if it is place, so that remote commands do not command wrong loads.	on. There shall be an s inserted in a wrong
4.14.8 Aux	kiliary Contactors, Auxiliary Relays and Interposing Relays	
4.14.8.1 T r	The use of auxiliary contactors, auxiliary relays and interposin nultiplication shall be avoided, being mainly limited to the follo	g relays for contacts wing cases:
a) whe	en the original output contact has no capacity to switch the load;	
b) con	tacts multiplication in CDCs for circuit-breaker closing coil bloc	cking;
c) CD	C/MCC signalling (refer to 4.14.12);	
d) IED) input signals.	
e) Wh the PAI INS	en required by interface signals with A&C and Package Control interface requirements from I-ET-3010.00-5520-888-P4X-002 NELS and I-ET-3010.00-1200-800-P4X-002 - AUTOMATION STRUMENTATION ON PACKAGE UNITS.	l Panels according to l - AUTOMATION N, CONTROL AND
4.14.8.2 A	All output contacts shall be sized for the making and breaking cap respective load.	pacity required by the
4.14.8.3 A	Auxiliary contactors and auxiliary relays shall be able to work con without economy resistance.	ntinuously energized,
4.14.8.4 M t	Multiplication of trip signals for safety functions and interlock hrough approved lockout (86) relays.	s shall be done only
4.14.9 Arc	Protection	
4.14.9.1 F c F F	For CDCs, all busbars compartments (horizontal and vertical), compartments and all compartments with coupling parts of switc provided with arc flash optical sensors connected to "Arc Me protection against short-circuit with electrical arcs.	, all outgoing cables hing devices shall be onitoring Relay" for
4.14.9.2 A t	Arc Monitoring Relay shall consider optical and current signals ripping.	to prevent nuisance
4.14.9.3 " c t	'Arc Monitoring Relay" shall be fitted with solid state output capable to send trip signal to circuit-breakers in no more than 4m busbar. They shall also have outputs to trip the related upstream	relays and shall be s to isolate the faulty circuit-breakers.

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4.14.9.4	One lockout relay shall be provided to block all circuit-breakers is circuit-breaker in case of arc detection in any functional unit of bus relay shall be provided to block all circuit-breakers in busbar B and in case of arc detection in any functional unit of busbar B. Locko Arc Monitoring Relays shall send a status signal to the relay assoc breaker where current sensor is connected. For lockout relays, refe	n busbar A and tie bar A. One lockout d tie circuit-breaker out relays related to triated to the circuit- er to 4.14.6.
4.14.9.5	Arc detection in tie compartments shall trip and block all circuit-bree A and B.	eakers from busbars
4.14.10	Instrument Transformers	
4.14.10.1	All transformers shall be dry-type.	
4.14.10.2	VTs, CTs and auxiliary transformers characteristics shall be Manufacturer, regarding the perfect operation of devices connect complying with requirements of I-ET-3010.00-5140 SPECIFICATION FOR ELECTRICAL MATERIAL AND EPOFFSHORE UNITS.	defined by Panel ected to them and -700-P4X-002 - QUIPMENT FOR
4.14.10.3	VTs and auxiliary transformers with primary voltages higher the protected by fuses in their primaries when installed in CDCs; other protected by circuit-breakers in their primaries. Secondary circuits by miniature circuit-breakers.	han 220V shall be prwise they shall be s shall be protected
4.14.10.4	CTs for protection purposes shall not saturate for the foreseen shore	rt-circuit currents.
4.14.10.5	CTs for differential protection of Auxiliary Generator, installed in shall be bus-type, supplied by Generators' Manufacturer. Detailed information about these CTs to Panel Manufacturer.	i incoming cubicle, Design will update
4.14.11	Measurement Instruments	
4.14.11.1	Instruments sizes, deflection, type (analogue or digital), positive quantity shall be according to I-ET-3010.00-5140-700-P4X-005 - FOR HUMAN ENGINEERING DESIGN FOR ELECTRICA OFFSHORE UNITS.	on orientation and REQUIREMENTS L SYSTEMS OF
4.14.11.2	Active energy meters, when required, shall have maximum dema (fifteen) minutes.	nd indicator for 15
4.14.11.3	For MCCs with entrance reactors, the voltage measurements shall busbar, downstream the reactor.	l be taken from the
4.14.11.4	Digital measuring devices having capacity for data gathering ar through digital communication port shall be able to indicate a revers of the rated power.	nd data availability se power up to 15%
4.14.11.5	"Shore supply" incoming column shall be equipped with amm (measurements taken from shore feeding side).	eter and voltmeter
4.14.12	CDC/MCC Signalling	
4.14.12.1	Each functional unit of MCC shall be provided with signalling LED	Os for indication of:
	 Red (R) - Energized equipment; Yellow (Y) - tripped by protection from IR (see 4.14.7.8); Green (G) - non-energized equipment; 	

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\checkmark	Blue (B) - Tripped by emergency s Flashing Red (FR) - Ground fault	shut-down. detected.	
4.14.12.2 E	Each functional unit of CDC shall be	provided with signalling LEI	Ds for indication of:
	Red (R) - circuit-breaker closed; Yellow (Y) - circuit-breaker open Green (G) - circuit-breaker open - White (W) - Functional unit extrace Blue (B) - circuit-breaker tripped White(W) - Trip coil circuit fault.	by protection; ready to close; cted; by emergency shut-down.	
4.14.12.3 C le	On each heating resistor circuit, for red shall be provided, which shall be	notors and for vertical section activated when the heating re-	ons, a red signalling esistor is turned-on.
4.14.12.4 S a si s v	ignalling LEDs shall be installed to installed to installed. For CDCs and turbogenerate hall be installed upstream the configural shall be installed in the oltage MCCs 2 (two) signalling LEI	indicate control voltage availator low-voltage MCCs 2 (two ntrol voltage decoupling multicondecoupling multicondecoupling multicondecoupling the control voltage busbar of the Ds shall be installed in each V	able after protection 70) signalling LEDs odule and 1 (one) 10 CDC and for low- VT secondary.
4.14.12.5 S si d	ignalling LEDs shall be provided w hall be performed without the need rawer.	ith bayonet type base. The re d to open the compartment	placement of LEDs door or extract the
4.14.13 R	Remote Commands, Signalling and N	Aeasurements	
4.14.13.1 T ft S	The list of remote interface signals unctional unit is described in I-LI AYSTEM AUTOMATION INTERFA	s that shall be implemented I-3010.00-5140-797-P4X-00 ACE SIGNALS LIST.	1 for each kind of 1 - ELECTRICAL
4.14.13.2 R in in A C c	Remote ESD signals shall be throug nterposing relays installed in the nterposing relays shall actuate dir additional auxiliary contacts shall be CDCs or IR for MCCs, provide signa ontactor.	th wet contacts (24 Vdc) and functional unit. The auxilia rectly opening contactors of used to replicate the trip signalling and to avoid closing the	d through auxiliary ary contacts of the or circuit-breakers. nal to the MMR for he circuit-breaker or
4.14.13.3 R E E	Remote ESD signals shall follow Electrical Loads from I-ET-3010.00 ELECTRICAL DESIGN FOR OFFS	the Emergency Shutdown)-5140-700-P4X-001 - SPE HORE UNITS.	(ESD) Criteria for CIFICATION FOR
4.14.13.4 F P	Functional units for loads with contro Panels by means of hardwired signals	l mode EA04 shall be comma s.	anded from Package
4.14.13.5 H in P M - U	Hardwired interface signals between nterface requirements from I-ET-3 PANELS. Hardwired interface signal MCCs shall follow the interface require AUTOMATION, CONTROL A JNITS.	n A&C and CDCs or MC0 3010.00-5520-888-P4X-001 s between Package Control I irements from I-ET-3010.00- ND INSTRUMENTATION	Cs shall follow the - AUTOMATION Panels and CDCs or 1200-800-P4X-002 N ON PACKAGE

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4.14.13.6	For EA04 functional units, "Turn on" signals shall be pulsed to "On signals shall remain in "On State" while normal operation and put when required to turn off or prevent starting. The functional functional units shall be submitted to PETROBRAS approval. Sign among EA04 functional units and Package Panels shall follow 1797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTELIST. Refer to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL AUTOMATION ARCHITECTURE for more details.	n State". "Turn off" lsed to "Off State" diagrams of these als to be exchanged I-LI-3010.00-5140- RFACE SIGNALS RICAL SYSTEM
4.14.13.7	Functional units that feed battery rooms' fans or exhausts shall battery chargers and UPSs related to batteries of that rooms to inhi of stoppage of these fans or exhausts.	send signals to the bit recharge in case
4.14.13.8	CDC outgoing functional for package panels shall be prepared to r in case of arc detection in these panels. This signal shall actuate in	eceive a trip signal lockout relay.
4.14.14	CDC/MCC Push Buttons	
4.14.14.1	Functional units for essential loads shall have a "Habilita/Desabil (Enable/Disable Panel Start) selector switch enabling electrical sta panel front side. These functional units shall have a start button a coil. However, this switch is not applicable to MCC essential funct contactors.	ita Liga no Painel" rting function from ctuating in closing tional units without
4.14.14.2	Functional units for normal loads in MCCs shall have start buttons rules established in item 4.14.3.4. Stop button shall be provided for	only if required in all functional units.
4.14.14.3	Functional units for normal loads in CDCs shall have start buttons rules established in items 4.14.3 and 4.14.4. Stop button shall b functional units.	only if required in be provided for all
4.14.14.4	Functional units for loads that are spare of essential loads (e.g. air c but installed in normal panels (e.g. auxiliary panels) sha "Habilita/Desabilita Liga no Painel" selector switches and start but	ompressors, UPSs) ll also have the ttons.
4.14.14.5	START push-button (TURN ON function) shall be with automatic push). STOP push-button (TURN OFF function) shall be mushroot (retain after push) and with protective cover.	return (return after m type with release
4.14.14.6	Push buttons shall be externally operated, with no necessity to operate or to extract the drawer.	en the cubicle door
4.14.15	Switches	
4.14.15.1	The ammeter and voltmeter selector switches shall be externally in	stalled.
4.14.15.2	All control switches used at the Panel shall be rotary type.	
4.14.16	Soft-starters	
4.14.16.1	For technical specification about soft-starters, refer to I-ET-3010. 002 - SPECIFICATION FOR ELECTRICAL MATERIAL AND FORFSHORE UNITS	00-5140-700-P4X- EQUIPMENT FOR
4.14.16.2	When required in Project documentation, electronic soft-starter auxiliary starting devices.	s shall be used as

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4.14.16.3	For MCCs, the selection between the installation of soft-starters we drawers shall be done trying to minimise the area occupied by pane	ithin or outside the els.
4.14.16.4	For MCCs, when the soft-starters are installed outside MCC in a moulded-case circuit breaker and the IR shall be installed within the MCC. All other components shall be installed in the fixed panel. Refer to I-ET-3010.00-5140-700-P4X-002 - SPECI ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHOP	separate panel, the le functional unit in (not withdrawable) (FICATION FOR RE UNITS.
4.14.16.5	Soft-starters to drive turbogenerator and turbocompression auxiliary be supplied by respective Packager and shall be installed outside M specification about VSDs and soft-starters, refer to I-ET-3010.00- - SPECIFICATION FOR ELECTRICAL MATERIAL AND E OFFSHORE UNITS.	y loads, if any, shall ICCs. For technical 5140-700-P4X-002 QUIPMENT FOR
4.14.16.6	For CDCs, soft-starters shall be installed in a separate panel. Refe 5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL ME EQUIPMENT FOR OFFSHORE UNITS for further details.	r to I-ET-3010.00- MATERIAL AND
4.14.16.7	For CDCs, when the functional unit uses soft-starter, the air circ MMR shall be installed within the functional unit in the CDC. All shall be installed in the fixed panel.	uit-breaker and the l other components
4.14.16.8	Compartments with soft-starters shall have adequate ventilation, starter manufacturer requirements.	according to soft-
4.14.16.9	For soft-starters feeding essential loads not installed in hazard protection functions "ground fault" (50GS) shall be disabled or i soft-starters protection or panels (CDC or MCC) protection, for impedance systems.	ous areas Zone 1, nhibited in built-in or isolated or high
4.14.16.10	For soft-starters that feed essential loads, it shall be possible bypass contactor in case of soft-starter malfunction.	start them through
4.14.16.11	Soft-starters installed in MCCs shall be operated, set and Ethernet Network communication. Refer to I-ET-3010.00-514 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.	monitored through 40-797-P4X-001 -
4.14.17	Variable Speed Drives (VSDs)	
4.14.17.1	For technical specification about VSDs, refer to I-ET-3010.00-51 SPECIFICATION FOR ELECTRICAL MATERIAL AND E OFFSHORE UNITS.	.40-700-P4X-002 - QUIPMENT FOR
4.14.17.2	When required in Project documentation, VSDs shall be used as dr	rive devices.
4.14.17.3	For MCCs, the selection between the installation of VSDs within separated panel shall be done trying to minimise the area occu CONTRACTOR chooses to install VSD inside the MCC, MANU provide a temperature rise test report for this functional ur PETROBRAS approval.	the drawers or in a pied by panels. If JFACTURER shall nit and submit to
4.14.17.4	For MCCs, when the VSDs are installed in a separated panel, the me breaker and the IR shall be installed within the functional unit in t incoming switches, incoming fuses and incoming reactors shall be in (not withdrawable) panel.	oulded-case circuit- he MCC. Rectifier, nstalled in the fixed

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4.14.17.5	VSDs to drive turbogenerator and tur supplied by respective Packager and specification about VSDs and soft-sta - SPECIFICATION FOR ELECTRI OFFSHORE UNITS.	bocompression auxiliary loa shall be installed outside Mu arters, refer to I-ET-3010.00-5 ICAL MATERIAL AND E	ds, if any, shall be CCs. For technical 5140-700-P4X-002 QUIPMENT FOR
4.14.17.6	For CDCs, VSDs shall be installed in	a separate panel.	
4.14.17.7	For CDCs, when the functional unit shall be installed within the functional be installed in the separated VSD pane	feeds VSDs, the air circuit- unit in the CDC. All the other el.	breaker and MMR or components shall
4.14.17.8	Compartments with VSD shall har manufacturer requirements.	ve adequate ventilation, a	ccording to VSD
4.14.17.9	For VSDs feeding essential loads not functions "ground fault" (50GS) sh protection or panels (CDC or MCC systems.	installed in hazardous areas all be disabled or inhibited C) protection, for isolated of	Zone 1, protection 1 in built-in VSD or high impedance
4.14.17.10	VSDs installed in MCCs shall be Network communication. Refer to I-E SYSTEM AUTOMATION ARCHITH	operated, set and monitored T-3010.00-5140-797-P4X-00 ECTURE.	1 through Ethernet)1 - ELECTRICAL
4.14.18	Temporary grounding		
4.14.18.1	For MCCs, drawers shall be supplie stated in Data-Sheet, Manufacturer minimum drawers for temporary grou	ed for temporary grounding. shall supply, for each MC anding :	Unless otherwise CC, the following
	 a) 1 (one) drawer for temporary group b) 1 (one) drawer for temporary group c) 1 (one) drawer for temporary group 	unding for motor with rated p unding for motor with rated p unding for motor with rated p	oower 11kW, and; oower 30kW, and; oower 55kW.
4.14.18.2	The short-time withstand current shall	l be compatible with the syste	em characteristics.
4.14.18.3	CDCs shall be provided with circuit-b shall supply, for each CDC, 1 (on temporary grounding downstream temporary grounding in CDCs shall be	breakers for temporary ground (1e) circuit-breakers for outgoing of circuit-breaker. Alternation (1e) submitted to PETROBRAS	ling. Manufacturer going sections for tive solutions for approval.
4.14.18.4	Cancelled		
4.14.18.5	Mechanical interlocks shall be provid outgoing sections for temporary gro solutions shall be presented to PETRC	led to avoid the insertion of o bunding in incoming section OBRAS for approval.	circuit-breakers for is. Other interlock
4.14.18.6	Related to item 4.14.18.5, circuit-bre warning labels indicating where they s	eakers for temporary ground shall be used and shall not be	ling shall be have used.
4.14.18.7	Drawers and circuit-breakers for temp with the doors closed and to provide a Means shall be provided to assure th grounding never can be left in an inter	orary grounding shall be dest a clear indication of its positi hat drawers and circuit-breal rmediary position.	igned for operation on to the operator. kers for temporary
4 14 18 8	Drawers and circuit-breakers for temp	orary grounding shall be loc	kable inserted with

4.14.18.8 Drawers and circuit-breakers for temporary grounding shall be lockable inserted with a padlock.

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4.14.18.9	Incoming functional units for panels shall not have grounding systemporary grounding of these functional units shall be supplied.	witches. Means for		
4.14.19	Synchronization Interfaces			
4.14.19.1	All signals from VTs required by EGCP and AGCP for the synchro according to project documentation, shall be available in terminal and Auxiliary CDCs, to be connected to EGCP and AGCP.	onization operation, blocks of Essential		
4.14.19.2	Essential and Auxiliary CDCs shall have terminal blocks to receive EGCP and AGCP to close the circuit-breakers in the synchronization of	the signals sent by on operation.		
4.14.19.3	The switches to select the circuit-breakers of the Essential or Au closed in the synchronization operation will be located at the respectively.	xiliary CDCs to be EGCP and AGCP		
4.14.20	Interlocks			
4.14.20.1	Refer also to items 4.5.20, 4.5.21, 4.5.22, and 4.16.3			
4.14.20.2	All interlocks related to Essential and Auxiliary CDCs (such as con circuit-breakers, "dead-bus" monitoring to send engine starting starting devices installed inside these para and devices shall be scope of panel supplier.	trol of transformers ignal to EGCP and nels. The interlocks		
4.14.20.3	Temporary parallel operation of transformers shall allow the operation of low-voltage CDCs, from "II" (the incoming cintransformers closed and the tie circuit-breaker opened) to "L" (on breaker from transformer plus the tie circuit-breaker closed and circuit-breaker from transformer opened) and return it to "II".	erator changing the ccuit-breakers from e incoming circuit- the other incoming		
4.14.20.4	Temporary parallel operation of transformers (secondaries or tertiation "U" configuration (two incoming circuit-breaker plus the tie circushall be possible momentarily, since synchronization conditions ar function 25). Refer to I-ET-3010.00-5143-700-P4X-001 - ELEC PROTECTION CRITERIA for more information.	ries), with the panel cuit-breaker closed) e guaranteed (relay FRICAL SYSTEM		
4.14.20.5	The "U" operation shall only be allowed for the time require configuration from one to the other.	red to change the		
4.14.20.6	Low-voltage CDCs shall have two selector switches for Temporar of transformers. The first one will allow Temporary parallel operation will allow operator to select the circuit-breaker that will open (or from transformers or the tie circuit-breaker), after the load transfer third circuit-breaker).	y parallel operation on. The second one le of the incomings ence (closing of the		
4.14.20.7	For other interlocks refer to the project documentation.			
4.15 Bush	4.15 Busbar Trunking (Busways)			
4.15.1 Bus 514 EQ	sbar trunkings, when applied, shall comply with the requirements of 40-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATE UIPMENT FOR OFFSHORE UNITS.	of I-ET-3010.00- RIAL AND		

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4.16 Ex	traction Truck	
n 4.16.2 C d	naintenance facility. Fircuit-breakers extraction shall be executed on a safe way, being the imensioned to support the circuit-breaker weight even when totally set to be a support the circuit-breaker weight even when totally set to be a support the circuit-breaker weight even when totally set to be a support the circuit-breaker weight even when totally set to be a support to be a	he drawer structure extracted.
4.16.3 T a	he extraction system shall be provided with a blocking structure of llow the drawer introduction only with the circuit-breaker opened.	r function that shall
4.16.4 A I r F	It least one extraction truck for each type of panel shall be provided an extraction truck can be used for more than one type of panel in pom, this capability shall be demonstrated by CONTRACTOR as ETROBRAS approval.	per electrical room. stalled in the same nd be submitted to
1 16 5 E	struction truck shall be adjustable to safely carry all types of given	it brookers foreseen

- 4.16.5 Extraction truck shall be adjustable to safely carry all types of circuit-breakers foreseen in the project.
- 4.16.6 Extraction truck wheels shall be able to allow the device to move freely in all directions.
- 4.16.7 Extraction truck wheels shall have a lock to guarantee the stability of the device during the extraction operation.

4.17 Nameplates and Markings

- 4.17.1 The Panels' characteristics nameplates shall be made of AISI-316L stainless steel and shall include all items listed in IEC 61439-1.
- 4.17.2 The Panel shall be outfitted with plate of supplemental identification containing, at least, the following data:
 - a) PETRÓLEO BRASILEIRO S.A. PETROBRAS;
 - b) name of the department of the PETROBRAS;
 - c) name of the enterprise (platform);
 - d) TAG number of the panel;
 - e) number of the RM;
 - f) number of the Order of Purchase of Material (PC);
 - g) in alternative to paragraph e) and f) the number of the contract, in the cases of acquisition built-in in contract of the type lump sum ("Turn Key ", "Lump Sum" etc.).
- 4.17.3 MCC incomers label shall include the number of the functional unit of the CDC and the TAG of CDC that feeds the MCC.
- 4.17.4 CDC incomers label shall include the TAG of the transformer or Generator that feed the CDC. CDC back-feeds label shall include the TAG of the other linked CDC.
- 4.17.5 When accessible, back doors shall have identification plates identical to the plates identifying the front sections.
- 4.17.6 The panels shall have their compartments signalled with literal and graphical labels of instructions, cares, warnings and alert of dangers according to the requirements for identification plates listed in ASTM F1166 and IEC 60417.

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4.17.7 Fu	inctional Units Markings	
4.17.7.1	Black acrylic plates with white letters shall identify all functional sections.	units and vertica
4.17.7.2	For functional units identification the following information shall be	e included:
	a) at the first line, the equipment tag number;	
	b) at the second line, the equipment name in Portuguese;	
	c) at third line, the rated current of the load and circuit number.	
	d) at fourth line, the electrical functional unit classification acc mode, according to I-ET-3010.00-5140-700-P4X-003 - REQUIREMENTS FOR PACKAGES FOR OFFHORE UNITS	ording to contro ELECTRICA S;
	e) at fifth line, the IP address of the functional unit.	
4.17.7.3	At spare cubicles, the plates shall be supplied with the word "Resersub-items a) and b), maximum continuous current allowed of the sub-item c), the functional unit classification of the spare functional d) and the IP address of the spare functional unit for sub-item e) of it	rva" engraved for functional unit t unit for sub-iter tem 4.17.7.2.
4.17.7.4	Removable drawers of MCCs shall have an identification label on its body to track the drawer position in the MCC.	
4.17.7.5	No adhesives shall be used to fix the plates.	
4.17.8 C	omponents Markings - Labels	
4.17.8.1	Internally to Panels, all equipment and components shall be iden acrylic plates, with white letters, containing the codification compa documents (list of materials, diagram, etc.). Deviations on materi identification shall be submitted to PETROBRAS for approval.	ntified with blac atible with desig als and means c
4.17.8.2	The circuit-breakers labels shall include rated current, trip current cubicle in CDC.	t settings and it
4.17.8.3	The IRs labels shall include the trip current settings.	
4.17.8.4	No adhesives shall be used to fix the labels.	
4.17.8.5	The Panels shall have warning labels following the model below, we the protective clothing risk category (in field "Nível de Proteção voltage (in field "Tensão Nominal do Painel"), arc-flash hazard "Distância Segura de Aproximação para Atividades Sujeitas a Arco fault incident energy (in field "Energia Incidente"). The values to b	with the values of o do EPI"), rate distance (in fiel Elétrico") and ar



4.18.1 All electrical materials, equipment and supports shall be painted. Painting process shall be proper for offshore installations, and shall comply with the requirements of I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

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4.18.2 The last coat colour shall be Light Green Munsell 5G8/4. Inner components mounting plates, internal faces of doors and safety barriers shall be Safety Orange Munsell 2.5YR6/14.

4.19 Protection

- 4.19.1 General Protection
- 4.19.1.1 For general protection, minimum protection functions for each functional unit and adjustments criteria, refer to I-ET-3010.00-5143-700-P4X-001 ELECTRICAL SYSTEM PROTECTION CRITERIA.
- 4.19.1.2 In case any air circuit breaker is supplied with a built-in electronic trip unit (BETU), the BETU protection functions shall be disabled since the MMR protection functions shall have priority.
- 4.19.1.3 Each semi-bar of CDCs shall have one key activated selector switch in its front side, with the positions "Operação / Manutenção" (Operation / Maintenance). When this selector switch is in "Manutenção" position, the instantaneous overcurrent protection (function 50) of the relays of incoming and tie functional units shall be activated or their set points changed, overriding the protection coordination and minimizing damage in case of internal fault.
- 4.19.1.4 CDCs shall have one key activated selector switch in each MCC outgoing feeder (including package MCC's) front side, with the positions "Operação / Manutenção" (Operation / Maintenance). When this selector switch is in "Manutenção" position, the instantaneous overcurrent protection (function 50) of the relay of the respective outgoing feeder shall be activated or their set points changed, overriding the protection coordination and minimizing damage in case of internal fault.
- 4.19.1.5 CDC outgoing functional units for package panels shall have one key activated selector switch in its front side, with the positions "Operação / Manutenção" (Operation / Maintenance). When this selector switch is in "Manutenção" position, the instantaneous overcurrent protection (function 50) of the relay of CDC outgoing functional unit shall be activated or their set points changed, overriding the protection coordination and minimizing damage in case of internal fault in package panel.
- 4.19.1.6 There shall be a local signalling lamp, turned on with the switch in "Manutenção" position, indicating "Coordenação Desativada".
- 4.19.1.7 A network remote signalling of the position of the switch shall be sent to Electrical System Automation, from the respective incoming, tie circuit-breakers or outgoing MMRs.
- 4.19.1.8 It shall be possible to close the functional units circuit-breakers listed in this item bypassing all necessary interlocks and protections (such as ESD and protection function 27) in a dead-ship scenario. The interlocks shall be overridden by a "OVERRIDE PROTECTIONS" switch installed in the front external part of each CDC or MCC functional unit. There shall be a label in this control switch with the following text "Atenção! Na posição "OVERRIDE" o sinal externo de ESD e várias proteções são desativadas. Usar apenas em cenário de dead-ship". The following functional units shall have this switch:
 - Essential CDC incoming transformers;



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4.19.2 Gr	ound Fault Protection for High Impedance Grounded Systems	
4.19.2.1	Ground fault protection shall be provided by 50GS function devoutgoing circuits. Local alarm signalling shall be provided for each	rices, installed in all ch circuit.
4.19.2.2	Circuits for loads installed in hazardous areas Zone 1 and circu cables cross hazardous areas Zone 1 shall be tripped by 50GS relay network alarm signal indicating trip by earth fault shall be sent by (CDC) to A&C (Automation and Control System), through Automation.	its for loads whic y and one individua IR (MCC) or MMI Electrical Syster
4.19.2.3	One network resume alarm signal (Low Insulation - Ground Fa A&C, through Electrical System Automation, for each Panel, i circuits that are not tripped. For CDCs, this signal shall be sent MMR. For MCCs, this signal shall be sent by outgoing feeder MM	ult) shall be sent t n case of failure i by incoming feede R of upstream CDC
4.19.3 Gr	ound Fault Protection for Ungrounded Systems	
4.19.3.1	Ground fault protection shall be provided by isolation monitori Protective devices based in residual current shall not be accepted.	ng devices (IMDs
4.19.3.2	One isolation monitoring device shall be installed in each bus isolation monitoring devices shall be capable to operate with tie ar breakers of CDC in close or open position.	bar of CDC. Thes nd back-feed circui
4.19.3.3	The isolation monitoring devices shall indicate the measured isola between each phase and ground or between the three phases group trip and alarm values shall be adjustable and the device shall be simultaneous faults even in three different circuits.	tion resistance valu ped and ground. The pe capable to detect
4.19.3.4	The isolation monitoring device shall be capable to measure the is the ground fault in systems with cable total length (three phas kilometers (100km), without any failure or nuisance actuation.	olation and to detected es) of one hundre
4.19.3.5	All outgoing circuits of CDC shall have individual ground fault de (Earth Fault Indicator). For loads installed in hazardous areas Zor cross hazardous areas Zone 1, these devices shall instantaneou breakers. A network alarm signal indicating trip by Earth Fault sh to A&C, through Electrical System Automation. For loads tha network alarm signal indicating Earth Fault, shall be sent by MM Electrical System Automation.	etector devices - EF ne 1 or which cable asly trip the circuit all be sent by MMI t are not tripped, IR to A&C, throug
4.19.3.6	In MCCs, only outgoing circuits of loads installed in hazardous ar cables cross hazardous areas Zone 1 shall have individual ground f (EFI) that shall instantaneously trip the circuit-breakers. A ne indicating trip by earth fault shall be sent by IR to A&C, throug Automation.	eas Zone 1 or whic ault detector device twork alarm signa h Electrical Syster

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4.19.3.7	7 O fi fa th bo ea A A	ther loads fed from MCCs shall be nding in outgoing cables for these ci- ault detector. These cables shall be in the with a portable ground fault dete is installed according to the detector of arth fault shall be sent by each IR to lternatively, this signal may be sent b utomation, located in the control cul	e grouped per column in a sa rcuits in MCCs shall be throu nstalled in a way to enable ea ector, with the circuit energize requirements. A network alar to A&C, through Electrical Sy by a single IR to A&C, through bicle of this panel.	ume EFI. The fault gh portable ground isy access to clamp d. The shields shall m signal indicating ystem Automation. h Electrical System
4.19.3.8	8 N E tr sł	etwork alarm signal (Low Insulation lectrical System Automation, for each ipped. For CDCs, this signal shall be nall be sent by the outgoing function	n - Ground Fault) shall be ser ch Panel, in case of failure in e sent by incoming MMR. Fo al unit that feeds the MCC.	nt to A&C, through circuits that are not or MCCs, the signal
4.19.3.9	9 W si	Then isolation monitoring device is d gnal shall be sent to Electrical Autor	lisabled or turned off, a dedic mation System by the Income	ated network alarm ers MMRs.
4.19.3.1	10 Ir w	Turbogenerators MCCs, ground faith the insulation monitoring devices	ault detector devices (EFI) s s installed in upstream switch	hall be compatible agear.
4.19.3.1	11 C in	ONTRACTOR shall supply to Panel hazardous areas Zone 1 or which ca	l MANUFACTURER a list o ables cross hazardous areas Z	f all loads installed Cone 1.
4.19.3.1	12 M la bi th	ICCs shall be supplied with devices imps connected between phases and utton. This system shall be compatib he CDC, in order to eliminate spuriou	s to indicate defective phase d ground through a NO (nor ble with insulation monitoring us alarms or trips.	by means of three mally open) push- device installed in
4.19.3.1	13 T	wo portable ground fault detector per	r insulation monitoring syster	n shall be supplied.
4.20 E	lecti	romagnetic Compatibility (EMC)		
4.20.1	All e imm requ A.	equipment having electronic compor unity EMC (Electromagnetic Compa irements according to IEC 61000 an	nents or circuits shall comply atibility) and RFI (Radio Frequend IEC 60533, presenting Per	with emission and uency Interference) formance Criterion
4.20.2	Rega 4-6 c	arding induced disturbances, all elec class 3.	tronic equipment shall compl	y with IEC 61000-
4.20.3	Rega wave	arding surges, all electronic equipme e forms 1.2/50µs and 10/700µs and p	nt shall comply with IEC 610 peaks up to 4kV.	00-4-5 class 4 with
4.20.4	Rega class Data same	arding oscillatory waves, all electron 3 and common mode disturbances 4 communications and signal circuits 5 e surge magnitude as specified for tra-	ic equipment shall comply wi up to 150 kHz as per IEC 6 shall be tested only in comm ansverse mode tests, accordin	th IEC 61000-4-12 51000-4-16 level 4. on mode, but at the ng to IEC 61850-3.
4.20.5	Rega 4, or appli	arding fast transients, all electronic ed r above. In addition, power supply ied voltages, according to IEC 61850	quipment shall comply with Il circuits shall be tested wit 0-3.	EC 61000-4-4 class h transverse mode
1 20 6	Daci	udin a ala stuana anatia dista-di-	all algoments a graining+ -1	11 an anna les suith IEC

4.20.6 Regarding electromagnetic disturbances, all electronic equipment shall comply with IEC 61000-4-3 class 3.

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- 4.20.7 Regarding damped oscillatory magnetic, all electronic equipment shall comply with IEC 61000-4-10 level 5.
- 4.20.8 Regarding power frequency magnetic field, all electronic equipment shall comply with IEC 61000-4-8 level 5 for continuous and short duration fields.
- 4.20.9 All electronic equipment shall operate correctly in the presence of a power frequency voltage in accordance with table 1 of IEC 61850-3

4.21 Control Voltages

4.21.1 MCCs

- 4.21.1.1 Control voltages for Turbogenerators low-voltage MCCs shall be the same as for CDCs. Refer to item 4.21.2 for details.
- 4.21.1.2 For Turbogenerators low-voltage MCCs, decoupling modules, including blocking diodes, shall be foreseen to each control voltage source in order to avoid backfeeding control voltage sources. These decoupling modules shall monitor continuously the decoupling path. Failure in any component of the decoupling module shall generate a network alarm signal to A&C, through Electrical System Automation by Incomers IRs.
- 4.21.1.3 Outgoing functional units with contactors for Turbogenerators low-voltage MCCs shall be tripped by temporized undervoltage relay (ANSI Function 27) in order to avoid automatic restarting of turbogeneration auxiliary loads after a blackout event.
- 4.21.1.4 Except for Turbogenerators low-voltage MCCs, the control voltage for each MCC shall be supplied by two withdrawable auxiliary transformers 480-120VAC, each one connected to one busbar end. Each auxiliary transformer shall be dimensioned to 125% of the MCC control circuits' total power.
- 4.21.1.5 The primary winding of the auxiliary transformers in MCCs shall be protected by circuit-breakers. The secondary winding and each control circuit branch shall be suitably protected with miniature circuit-breakers.
- 4.21.1.6 The control busbar shall be split in two semi-bars, each one provided with a rotary selector switch of at least 20A for selection of the auxiliary transformer. During the transference from different sources there shall not be power supply interruption.
- 4.21.1.7 If it is necessary the addition of 24VDC sources to feed the IRs, the same criteria shall be adopted and two switched power supply, each one with capacity for supply the entire control system shall be installed. Blocking diodes shall be added to the output of each DC source.
- 4.21.1.8 The secondary winding of the auxiliary transformers shall have one terminal bolted grounded.
- 4.21.1.9 Undervoltage at any 120Vac or 220 VDC control semi-bars shall generate a network alarm signal (Control Voltage Failure) to A&C through Electrical System Automation by redundant IRs, each one fed from one control voltage source, both located at control section of the MCC. Each IR shall detect Control Voltage Failure from both semi-bars simultaneously. These IRs may be used to group general MCC discrete signals (not from specific functional units) and send to Electrical System Automation through network.

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4.21.1.10	Outgoing Functional Units for motors located in MCCs with supplied together with the motor as, for example, bearing over tem shall supply 220 VDC to the protective device by using a dedica installed in the functional unit. Protective devices supplied together are fed by MCCs with control voltage of 120 VAC shall be independently from the MCC.	protective devices perature protection ited circuit breaker with motors which fed by 220 VDC
4.21.2 CI	DCs	
4.21.2.1	The control voltage for each Panel shall be in 220VDC achieved fro battery-chargers.	m Unit's redundant
4.21.2.2	The Panels shall have two control busbars, one for loads connected and other for loads connected to main busbar B.	d to main busbar A
4.21.2.3	Each control busbar shall be fed by both control voltage sources chargers) continuously in parallel.	(redundant battery
4.21.2.4	CDCs connected to Emergency and Auxiliary Generators shall have control voltage supply, by means of an auxiliary rectifier with inco- in 480VAC and outgoing rated voltage in 220VDC, connected incoming feeders of Emergency or Auxiliary Generator. The aux be installed in the CDC (included in CDC Manufacturer scope o have the proper capacity to supply control loads of the CDC. In the be a switch in order to select the control voltage source from Auxiliary Generator or from the main control voltage sources battery chargers).	re a third option for oming rated voltage to the terminals of iliary rectifier shall f supply) and shall se cases, there shall the Emergency or (Unit's redundant
4.21.2.5	Decoupling modules, including blocking diodes, shall be forese voltage source in order to avoid backfeeding control voltage sources modules shall monitor continuously the decoupling path. Failure in the decoupling module shall generate a network alarm signal Electrical System Automation by Incomers MMRs.	en to each control 3. These decoupling 1 any component of to A&C, through
4.21.2.6	Control incoming circuits from the external power supply shall had evices (SPD) with a maximum discharge current of 10 kA in 8/2 required by NFPA 780.	ve surge protective 0 microseconds, as
4.21.2.7	Each control busbar incoming shall be protected by miniature cir control busbars shall be connected by miniature circuit-breakers.	cuit- breakers. The
4.21.2.8	Undervoltage at any 220 VDC control voltage sources at the par remote network alarm signal (control voltage failure) to A&C, System Automation by Incomers MMRs. Each Incomer MMR s voltage failure from both control voltage sources redundantly.	el shall generate a through Electrical shall detect control
4.21.2.9	Functional Units shall not be tripped for lack of control voltage in	MMRs.
4.21.2.10	Outgoing Functional Units for motors located in CDCs with supplied together with the motor as, for example, bearing over tem shall supply 220 VDC to the protective device by using a dedica installed in the functional unit.	protective devices perature protection ated circuit breaker

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4.22 Auxiliary Voltages

- 4.22.1 The power supply for heating resistors shall be achieved from 220VAC three phase external source. The circuits for heating resistors shall be two phases and shall be balanced among three phases internally.
- 4.22.2 Each panel division for transport shall be provided with externally accessible terminals to energize the heating circuits during storage periods. These terminals shall have a label with:

TERMINAIS PARA ENERGIZAÇÃO DAS RESISTÊNCIAS DE AQUECIMENTO

- 4.22.3 The power supply for internal lighting and sockets outlets shall be achieved from the same 220VAC three phase external source that feeds the heating resistors. The circuits for internal lighting and sockets outlets shall be two phases and shall be balanced among three phases internally.
- 4.22.4 The auxiliary circuit branches for internal lighting and internal sockets shall have miniature thermomagnetic circuit-breakers with integrated or additional differential residual current protection.
- 4.22.5 Internal lighting shall turned on by the door opening detection devices. Internal lighting shall be installed at least in the following compartments:
 - Control cubicle;
 - Cable compartments;
 - Other compartments where PETROBRAS understands that lighting is poor.

4.23 Interface with Automation

- 4.23.1 Panel Manufacturer shall propose the internal network architecture among IEDs, complying with requirements of I-ET-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE. This internal network architecture and configuration shall be submitted to PETROBRAS approval.
- 4.23.2 Devices connected to the networks shall have the time synchronized with Electrical System Automation Time Servers actual time. Refer to I-ET-3010.00-5140-797-P4X-001
 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-DE-3010.00-5140-797-P4X-001
 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM.
- 4.23.3 Minimum Interface Signals to be exchanged are listed in I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.23.4 Switches internal to the panel shall be manageable.

5. MANUFACTURER DOCUMENTATION

5.1 The following documents shall be provided by Panel Manufacturer, at proposal:

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	a) I	Documents list;				
	b) I t	Dimensional drawings including frontal and upper views, esti hermal dissipation;	mated weight and			
	c) 7	Fechnical catalogues with information about all components;				
	d) Spare parts list for two years of operation, including item, part number, quantity, description, MTBF and prices for each part;					
	e) 7	Fechnical assistance prices and representative address;				
	f) F v s	Panel Data-sheet issued by PETROBRAS completely filled in with with identification of the person responsible for the filling. This submitted to PETROBRAS approval.	1 Manufacturer data Data-sheet shall be			
	g) I H H t	Data Sheet following template defined in I-LI-3010.00-514 ELECTRICAL EQUIPMENT DATA-SHEET MODELS, whe PETROBRAS, completely filled in, with identification of the per he filling. This Data-Sheet shall be submitted to PETROBRAS ap	40-700-P4X-001 - en not issued by son responsible for pproval;			
	h) List of applicable standards;					
	i) I	nspection and test schedule, including acceptance criteria for each	ı test;			
	j)]	Гуре tests certificates;				
	k) (Certificate for testing under conditions of arcing due to internal fat	ult for CDCs;			
	l) I	Dimensional drawing for connections to bus trunking, when applic	cable;			
	m) T	Fime-current curves, current peak limiting curves and i ² t minimum he limiting fuses;	ı and total values of			
	n) (Dne-line electrical drawings;				
	o) (Other documents required in project documentation.				
5.2	The f	following documents shall be provided by Panel Manufacturer, for	r approval:			
	a) I	Documents list;				
	b) I e	Dimensional drawings including frontal and upper views, details eyelets, area for incoming cables and fixing base details;	, location of lifting			
	c) V	Weight and volume for each unit for transportation;				
	d) 7	Fotal weight;				
	e) T t	Thermal dissipation at half load and full load, of portion of panel hat is independent of electrical system loading and the compone his dissipation;	thermal dissipation ents responsible for			
	f) I	Dimensional drawing for connections to bus trunking, when applic	able;			
	g) E	Electrical drawings, including one-line, three-lines and functional	diagrams;			
	h) (Connection diagrams, including all terminal blocks;				
	i) H j) S	Electrical Functional Units Classification List according to control Saturation curves of current transformers;	mode;			
	k) (Components and material list per functional unit;				

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	l) T	Time-current curves, current peak limiting curves and i ² t minimum the limiting fuses;	and total v	alues	s of
	m) I	Package and transportation instructions;			
	n) V	Warranty certificate and declaration of availability of spare parts for	or 10 (ten)	years	,
	o) I	Extraction and insertion instructions;			
	p) 1	Network architecture internal to the Panel;			
	q) 1 a	Network configuration, parameterization, screens, and monitoring all equipment that will be connected by network;	document	ation	for
	r) N	Memory map;			
	s) (Communication List, including IP list and I/O for each Functional U	Unit;		
	t) I	Expected MTTR for each type of functional unit and for each comp	ponent;		
	u)]	Гуре tests certifications.			
	v) I	Relays parameterization report.			
5.3	The f	following documents shall be provided by Panel Manufacturer, with	h the Pane	:l:	
	a) I	Data-sheet full-filed "as built";			
	b) S	Storage, lifting and unpacking instructions in Portuguese language;			
	c) I	Installation and assembly instructions in Portuguese language;			
	d) (H	Operation instructions in Portuguese language, according to I-ET-30 P4X-001 - TECHNICAL DOCUMENTATION REQUIREMENTS	010.00-00 S;	00-91	lA-
	e) M i	Maintenance instructions, including list of necessary equipment, acc n Portuguese language, according to I-ET-3010.00-0000- FECHNICAL DOCUMENTATION REQUIREMENTS;	cessories a -91A-P4X	ind to -001	ols -
	f) 5	Spare parts lists;			
	g) "	'As built" technical catalogue for all components;			
	h) (Complete test report, including type, routine and special tests;			
	i) C s t f	Complete version of configuration, parameterisation and monitor switches, concentrators, gateway devices, IRs, MMR, VSDs and an that could be configured or monitored by software. These software facilities for full diagnosis of respective devices;	ring softw y other equations of the second s	vares uipm prov	for ent ide
	j) (Complete manuals for installation and configuration of all softwal anguage;	ares in Po	rtugu	ese
	k) (r	Components list, including at least, item, description, draw, unit, number.	quantity	and p	oart
	l) (Constructive details about baseplate fixation screws, such as quant position in baseplate.	tity, size, 1	type a	and
5.4	Docu (origi docu	iments provided by Panel Manufacturer shall be delivered in an inal version and PDF version), the original documents shall be edi ments shall be searchable.	electronic table and	the P	nat DF

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5.	PAC	KAGI	E AND TRANSPORT			
	6.1	Panel durin	s shall be packed properly for the foreseen transportation, so tha g transport, storage and lifting operations;	t no dam	age occ	curs
	6.2	Each	volume shall be properly identified with:			
		a) S	torage position;			
		b) P	ETROBRAS unit, achievement, and business unit;			
		c) [Delivery address			
		d) N	Aaterial Requisition number;			
		e) P	Panel TAG;			
		f) N	Aanufacturer name and address;			
		g) V	Veight;			
		h) (Contract number.			
	7.1	Gene	ral Monufacturer or on independent inspection outhority accented by	ρετροι		ha
	7.1.1	The perf appl	Manufacturer or an independent inspection authority accepted by form all inspections and tests, in conformity with the specificat licable rules.	PETROE tion docu	BRAS slaments	ha an
	7.1.2	Mar equi	nufacturer shall be responsible for obtaining all necessary certific pment.	cation rel	ated to	th
	7.1.3	Mar defi out	nufacturer shall be responsible for contacting the Classification ne the procedures to be followed, related to the submission of doc the necessary inspections and tests to certificate the Panels.	Society, auments, a	in orde nd to ca	r t arr
	7.2	Desig	n Verification			
	7.2.1	Des 600 veri (con appr whe	ign verification shall follow the requirements of IEC 61439-1 92-302 and IEC 61892-3. According to IEC61439-1, the method fication are testing, comparison with a tested reference des firmation of the correct application of calculations and design ru- ropriate safety margins). Design verification and methods are sum re they are identified as "D".	, IEC614 ls that ch sign or a les, inclue nmarized	439-2, 1 eck des assessm ding us in Tabl	IE sig ner e c
	7.2.2	Cert teste witr	tified test reports for design verification tests performed for identi- ed reference design (when applicable, according to IEC 61439-1 nessed by Classification Society are accepted. These reports s	cal panels) and app hall be i	s or a pa proved ncludeo	ane an 1 a

7.3 Routine Verification

- 7.3.1 Routine tests shall follow the requirements of IEC 61439-1, IEC 61439-2, IEC 60092-302 and IEC 61892-3. They are summarized in Table 1, where they are identified as "R".
- 7.3.2 Routine tests shall be carried out for all Panels.

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7.4 Speci 7.4.1 Spec	al Tests cial tests shall be carried out according to Table Table 1 – Minimum Tests Req	e 1, w uired	here'	e the	ey are identified as "S".
	Test	D	R	S	Method and Acceptance Criteria
Examination of	f technical documentation ⁽¹⁾	X	Х	Х	Receptunce orneriu
Verification of	of certificate of accuracy for measurement	v	v	v	
instruments to	be used in tests ⁽¹⁾	X	Λ	λ	
Dimensional v	verification ⁽²⁾		X		Panel Data-sheet
Visual inspect labels and Mai	tion, verification of data on nameplates and thing Tests		х		IEC 61439-1 and this ET
Painting (colo	ur, thickness and adhesion)		X		I-ET-3010.00-1200-956- P4X-002 - GENERAL PAINTING and this ET
Verification by	y testing of the resistance to corrosion	x			Severity Test B - IEC61439-1
Verification by	y testing of thermal stability of enclosures	X			IEC 61439-1
Verification by abnormal heat	y testing of resistance of insulating materials to and fire due to internal electric effects	X			IEC 61439-1
Verification by	y assessment of resistance to ultra-violet (UV)	x			IEC 61439-1
Lifting test		X			IEC 61439-1
Verification b devices and co	by assessment of incorporation of switching proponents	x			IEC 61439-1
Verification by of temperature	y comparison of a reference design or by testing rise limits ⁽²⁾	x			IEC 61892-3 and IEC 61439-1
Verification by	y testing of dielectric properties ⁽²⁾	x			IEC 61439-1, IEC
Varification by	$r_{\rm resting}$ of short singuit withstand strong th (7)				61439-2 and IEC 61180
Verification b and integrity o	y testing of protection against electric shock f protective circuits	X	x		IEC 61439-1
Verification by	y testing of clearance and creepage distances	X	X		IEC 61439-1
Verification by	y testing of mechanical operation	x	х		IEC 61439-1 and IEC 61439-2
Verification b enclosure (IP)	by assessment of degree of protection of	x	X		IEC 61439-1, IEC 61439-2 and IEC 60529
Wiring, operat	ional performance and function		Х		IEC 61439-1
Mechanical in	npacts tests	X			IEC 61439-1 and IEC 62262
Verification by connections	y assessment of internal electrical circuits and	x	X		IEC 61439-1
Verification conductors	by assessment of terminals for external	X	X		IEC 61439-1

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Test	D	R	S	Method and
	2			Acceptance Criteria
Inspection of assembly, inspection of wiring and electrical operation test		х		IEC 61439-1
EMC - Conducted emission test (3)	Х			IEC 60533
EMC – Radiated emission test ⁽³⁾	Х			IEC 60533
EMC – Conducted low frequency interference $^{(3)}$	Х			IEC 60533
EMC – Power supply variation ⁽³⁾	Х			IEC 60533
EMC – Power supply failure ⁽³⁾	Х			IEC 60533
EMC – Surge voltage test ⁽³⁾	Х			IEC 60533
EMC – Electrical fast transient test ⁽³⁾	Х			IEC 60533
EMC – Electromagnetic field test ⁽³⁾	Х			IEC 60533
EMC – Electrostatic discharges (ESD) ⁽³⁾	Х			IEC 60533
EMC – Conducted radio frequency interference test ⁽³⁾	Х			IEC 60533
Measurement of impedance at rated continuous current for current limiting reactors		х		IEC 60076-6
Measurement of loss for current limiting reactors		Х		IEC 60076-6
Winding overvoltage test for current limiting reactors		Х		IEC 60076-6
Temperature rise test at rated current for current limiting reactors	x			IEC 60076-6
Short-circuit current test for current limiting reactors, with rated mechanical short-circuit current			x	IEC 60076-6
Short-circuit current test for current limiting reactors, with rated thermal short-circuit current and rated thermal short- circuit duration			x	IEC 60076-6
Measurement of acoustic sound level at rated continuous current for current limiting reactors			х	IEC 60076-6
Measurement of coupling factor for current limiting reactors			х	IEC 60076-6
Measurement of Ohmic resistance, reactive inductance and losses at rated current and frequency for limiting reactor		х		Panel Data-sheet
Condition of Arcing due to internal fault for CDCs			X	All assessment criteria of IEC TR 61641
Complete functional tests (including interlocks) ⁽⁵⁾		х		Project documents and IEC 61850
Verification of measuring instruments		Х		Project documents
Verification of relays parametrization and operation ⁽⁶⁾		х		Selectivity study and IEC 61850
Verification of signalling devices		Х		Project documents
Verification of heating resistors operation		Х		This ET and Data-sheet
Test of interchangeability of drawers		Х		This ET
Temperature rise for circuit-breakers	Х			IEC 60947-2
Tripping limits and characteristics for circuit-breakers	Х			IEC 60947-2
Dielectric for circuit-breakers	Х			IEC 60947-2
Operation performance capability for circuit-breakers	Х			IEC 60947-2
Overload performance for circuit-breakers, where applicable	Х			IEC 60947-2
Short-circuit breaking capability for circuit-breakers	Х			IEC 60947-2
Short-time withstand current for circuit-breakers, where applicable	X			IEC 60947-2

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			SWITCHGEAR FOR OFFSHORE UNITS	ESI	JP
No	tes:	1. Fe	or all witnessed tests;		
		2. Fo	or MCCs, this test includes the current limiting reactors, installed in	n the enclos	sure;
		3. E. th	MC tests shall be carried out when required in IEC 60533 for the ec e Panel;	quipment in	stalled in
		4. M to de	lanufacturer shall be present at site, after the panel assembly and gether with PETROBRAS, if the Panel is at the same conditions as elivered it and to verify if the Panel is ready to start operation;	transport, it was whe	to verify, n factory
		5. T (a ca	hese tests shall include all tests related to network communical larms, interlocks, GOOSE, etc.). For IEC 61850 networks, the libration boxes certified for IEC 61850;	tion among nese tests	g devices shall use
		6. T	hese tests shall include check of A/D converters of relays. For rela 1850 protocol, these tests shall use calibration boxes certified for IB	ys specifie EC 61850.	d for IEC
		7. D st ap	esign verification by comparison with a reference design for she rength of the protective circuit can be submitted for PETRO pproval.	ort-circuit BRAS ana	<i>w</i> ithstand lysis and
8.	TR	AININ	٨G		
	8.1	Mar Pan	nufacturer shall provide training for at least 10 (ten) PETROBRA els system and components.	AS personne	el, about
	8.2	Trai	ning shall be provided in Brazil, during commissioning period, in Po	ortuguese la	inguage.
	8.3	Trai insta asse auto equi	ning plan shall include at least control diagram analysis, stora allation, operation, corrective maintenance, preventive mainten mbly, extraction and insertion of drawers, use of tools and accesse mation, use of softwares, configuration, parameterization and ac append and devices.	age, transp ance, disas pries, interf djustment o	ortation, sembly, ace with of IEDs,
9.	SP.	ARE P	PARTS AND TOOLS		
	9.1	Mar oper	nufacturer shall provide the necessary spare parts for the comr ration periods;	nissioning	and pre
	9.2	Mar (two	nufacturer shall provide a list of spare parts for all electrical equip b) years of continuous operation, including prices and part number	ment, for a codes.	t least 2
	9.3	Mar disa	nufacturer shall provide all unusual tools necessary for mainter ssembly of the Panel.	nance, asse	mbly or
10.	DA	TA SI	HEETS FORMS		
	For P42	data-S K-001	Sheet models for low-voltage MCCs and switchgears, refer to I-LI- - ELECTRICAL EQUIPMENT DATA-SHEET MODELS.	3010.00-51	40-700-
11.	AB	BREV	VIATIONS AND ACRONYMS		
			ABBREVIATIONS AND ACRONYMS		
	A	kC	Automation and Control System		

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	ABBREVIATIONS AND ACRONYMS			
AISI	American Iron and Steel Institute			
BETU	Built-in Electronic Trip Unit (a type of IED)			
CDC	Switchgear			
CT	Current Transformer			
EA01 to EA04	Electric Actuation Type 01 to Electric Actuation Type 04			
EFI	Earth Fault Indicator			
EMC	Electromagnetic Compatibility			
EPR	Ethylene Propylene Rubber			
ESD	Emergency Shut-Down			
ET	Technical Specification			
FPSO	Floating, Production, Storage and Offloading Unit			
FSO	Floating, Storage and Offloading Unit			
Icw	Rated Short-Time Withstand Current (as defined in IEC 61439-1)			
IEC	International Electrotechnical Commission			
IED	Intelligent Electronic Device (as defined in IEC 61850)			
IEEE	Institute of Electrical and Electronics Engineers			
IMD	Isolation Monitoring Device			
l _n	Rated Current (as defined in IEC 61439-1)			
İp	Peak Short-Circuit Current (as defined in IEC 60909)			
I _{p arc}	Permissible Current under Arcing Conditions (as defined in IEC TR 61641)			
I _{pk}	Rated Withstand Peak Current (as defined in IEC 61439-1)			
IR	Intelligent Relay			
Ith	Thermal Equivalent Short-Circuit Current (as defined in IEC 60909)			
MCC	Motor Control Center			
MMR	Microprocessor-Based Multifunction Relay (a type of IED)			
MTBF	Mean Time Between Failures			
MTTR	Mean Time to Repair			
PVC	Polyvinyl Chloride			
r.m.s	Root Mean Square			
<u>RM</u>	Material Requisition			
R	Routine Test			
S	Special Test			
	Permissible Arc Duration (as defined in IEC TR 61641)			
	Total Harmonic Distortion			
I	Type Test Deted Dewer Frequency Veltage Detween Conductors for which the Coble			
U	is Designed			
Uo	Rated Voltage Between Conductor and Earth or Metallic Screen for which Cable is Designed			
UAM	Unit Alarm Malfunction			
UAS	Unit Alarm Shutdown			
UPS	Uninterruptible Power Supply			
UVT	Undervoltage Trip Coil			

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	SWITCHGEAR FOR OFFSHORE UNITS					
	ABBREVIATIONS	AND ACRONYMS				
VSD	Variable Speed Drive					
VT	Voltage Transformer					
XLPE	Crosslinked Polyethylene					
12. ANNEX						
PDE						
2						
Phase 1 S560 v2.00 Supplementary Reg						
oupprenentary neg						