		TE	CHNICAL	SPECIFIC	CATION	No.	I-ET-3010	.00-5140-	741-P4X-0	003
1:	72	CLIENT:				I			SHEET: 1	_{of} 29
		PROJEC	CT:							,
PEIRO	UBKAS	UNIT:								
		TITLE:	POWER			ISTORIZE			INTEF	RNAL
SR	GE		FOWLR						FSI	IP
		MICR	OSOFT WC)RD / V 365	/ I-ET-3010	00-5140-74	1-P4X-003		LO	
		MICIN		JND / V. 300	// I-E I-5010	.00-01-0-7				
				IND	EX OF R	EVISION	S			
REV.			D	ESCRIPT		D/OR RE	VISED SI	HEETS		
0	ORI	GINAL	ISSUE							
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	EXC	LUDED	ITEMS I	NDICATI	ED IN TE	XT.				
В	REV	IEWED	WHERE	INDICAT	ED					
С	ADE	DED ITE	M 4.4.14							
D	REV	IEWED	ITEM 4.1	8.9.3						
Е	REVISED ITEM 4.4.3, ACCORDING TO CLARIFICATION NOTICE DUE TO BIDDER									
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	AND) III								
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Н	REV	ISED W	HERE IN	IDICATE	D					
DATE		REV.0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
		SET/17/18	FEB/04/20	MAR/24/20	MAR/31/20	JUN/17/20	NOV/25/20	FEB/12/21	AUG/01/22	DEC/02/22
EXECUTION	۱ C	CAVALIERE	CAVALIERE	CAVALIERE	BAYO	BAYO	BAYO	CSJP	CLT0	U4BY
CHECK	M	ARCELO BP	T.ELIAS	T.ELIAS	T.ELIAS	T.ELIAS	THAYSE	U4RD	U5AL	CLT0
APPROVAL	I	MATTOSO	REGGIANI	REGGIANI	REGGIANI	REGGIANI	REGGIANI	UQBK	UQBE	UQBE
		TAINED IN THIS		TROBRAS PROPE	RTY AND MAY NO	F BE USED FOR PL	JRPOSES OTHER	THAN THOSE SPE		ED HEREIN.
THIS FORM IS	PARIOFP	EIKUBKAS N-3	OIKEV.K.							

	TE		PECIFICATIO	DN ^{No.}	I-ET-3010.00-51	40-741	-P4X-003	^{REV.} H
BR	UNIT:						SHEET: 2	_{of} 29
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			OFFSI	HORE (JNITS		ES	UP
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	OFFSHORE	EUNITS	ESU	IP
1. OBJECT	TIVE			
1 1 751			•	

- 1.1. This specification establishes the necessary technical requirements for the design, construction, tests, and supply of power panels for thyristorized electrical heaters, hereinafter called "Power Panel" in this document, for offshore units.
- 1.1.1. This specification applies to thyristor electrical power regeneration heater panels used for:
 - Regeneration systems, TEG or Molecular sieves applications included in the scope of I-ET-3010.00-1200-498-P4X-002 – ELECTRIC PROCESS HEATERS.
 - Heating power application that results in a panel similar to the types indicated in Table 1.
- 1.1.2. Any other heating system panels shall comply with requirements indicated in I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.
- 1.2. Additional requirements for Power Panel can be included in PETROBRAS documentation for heated equipment.
- 1.3. This specification does not define requirements for control panels for thyristorized electrical heaters, hereinafter called "Control Panel" in this document. However, it defines interface signals between "Power Panels" and "Control Panel". For requirements about Control Panel, see PETROBRAS documentation for heated equipment and I-ET-3010.00-1200-800-P4X-002
 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and AUTOMATION INTERFACE OF PACKAGE UNITS.
- 1.4. This specification does not define communication requirements between Control Panel and Automation and Control System (A&C). For these requirements, see and I-ET-3010.00-1200-800-P4X-002 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and AUTOMATION INTERFACE OF PACKAGE UNITS.
- 1.5. Medium-voltage switchgears and medium-voltage MCCs requirements are defined in specific Technical Specification, see I-ET-3010.00-5140-741-P4X-002 MEDIUM-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS, and respective Data-sheet, in I-LI-3010.00-5140-700-P4X-001 ELECTRICAL EQUIPMENT DATA-SHEET MODELS.
- 1.6. Low-voltage switchgears and low-voltage MCCs requirements are defined in specific Technical Specification, see I-ET-3010.00-5140-741-P4X-001 LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS, and respective Datasheet, in I-LI-3010.00-5140-700-P4X-001 ELECTRICAL EQUIPMENT DATA-SHEET MODELS.
- 1.7. Low voltage panels not included in the scope Low-voltage switchgears and low-voltage MCCs are defined in specific Technical Specification, see I-ET-3010.00-5140-741-P4X-004 SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.
- 1.8. A&C (Automation and Control System) Panels requirements are defined in specific Technical Specification see I-ET-3010.00-5520-888-P4X-001 AUTOMATION PANELS.
- 1.9. This specification does not define TAGs, names, and connections for each equipment. These definitions are available in PETROBRAS documentation for heated equipment.



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2. CODES, STANDARDS AND REFERENCE DOCUMENTS

2.1. GENERAL

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

2.2. CODES, STANDARDS AND REFERENCE DOCUMENTS

2.2.1. IEC - INTERNATIONAL ELECTROTECHNICAL COMMISSION

[1]	IEC 60079	Explosive Atmospheres – All parts IEC 60079	
[2]	IEC 60092-302	Electrical Installations in Ships - Part 302: Low-Voltage Switchgear and Controlgear Assemblies	
[3]	IEC 60092-302-2	Electrical Installations in Ships – Part 302-2: Equipment – Low- Voltage Switchgear and Controlgear Assemblies – Marine power;	
[4]	IEC 60309	Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 4: Switched socket-outlets with or without interlock	
[5]	IEC 60417 D.S.	Graphical symbols for use on equipment (DATABASE SNAPSHOT);	
[6]	IEC 60445	Basic and Safety Principles for Man-Machine Interface, Marking and Identification - Identification of Equipment Terminals, Conductors Terminations and Conductors;	
[7]	IEC 60529	Degrees of Protection Provided by Enclosures (IP Code);	
[8]	IEC 60533	Electrical and Electronic Installations in Ships – Electromagnetic Compatibility (EMC) – Ships with a Metallic Hull.	
[9]	IEC 60721-3-1	Classification of environmental conditions - Part 3-1 Classification of groups of environmental parameters and their severities – Storage	
[10]	IEC 60721-3-2	Classification of environmental conditions - Part 3-2: Classification of gro environmental parameters and their severities – transportationand handling	up ç
[11]	IEC 60947-2	Low-Voltage Switchgear and Controlgear - Part 2: Circuit-Breakers;	
[12]	IEC 60947-4-1	Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactor and Motor-Starters;	
[13]	IEC 60947-4-2	Low-Voltage Switchgear and Controlgear - Part 4-2: Contactors and Motor-Starters - AC Semiconductor Motor Controllers and Starters;	
[14]	IEC 61180	High-Voltage Test Techniques For Low-Voltage Equipment - Definitions, Test And Procedure Requirements, Test Equipment	
[15]	IEC 61439-1	Low-Voltage Switchgear and Controlgear Assemblies - Part 1: General Rules;	
[16]	IEC 61439-2	Low-Voltage Switchgear and Controlgear Assemblies - Part 2: Power switchgear and controlgear assemblies;	
[17]	IEC 61850	Communication networks and systems for power utility automation – All Parts	

	TECHNIC	AL SPECIFICATION No. I-ET-3010.00-5140-741-	P4X-003 REV. H				
BR	UNIT:		SHEET: 5 of 29				
PETROBRA	s TITLE: POW	ER PANEL FOR THYRISTORIZED HEATER FOR	INTERNAL				
		OFFSHORE UNITS	ESUP				
[18] IEC 6	51892	Mobile and Fixed Offshore Units – Electrical Install	lations (All Parts);				
[19] IEC 6	51892-1	Mobile And Fixed Offshore Units - Electrical Installations - Part 1: General Requirements and Conditions					
[20] IEC 6	51892-3	Mobile And Fixed Offshore Units - Electrical Installations - Part 3: Equipment					
[21] IEC 6	52262	Degrees of protection provided by enclosures for ele against external mechanical impacts (IK code)	ectrical equipment				
[22] IEC	FR 61000-5-2	Electromagnetic Compatibility (EMC) - Part 5: Insta Mitigation Guidelines - Section 2: Earthing and Cab	allation and ling:				
[23] IEC	ΓR 61641	Enclosed low-voltage switchgear and controlgear as for testing under conditions of arcing due to internal	semblies – Guide fault				
2.2.2. IEEH	E – INSTITUT	E OF ELECTRICAL AND ELECTRONIC ENGI	NEERING				
[24] IEEE	Std. 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems					
2.2.3. AST	M - AMERICA	AN SOCIETY FOR TESTING AND MATERIAL					
[25] ASTI	M F1166	Standard Practice for Human Engineering Design for Equipment and Facilities.	or Marine System,				
2.2.4. LAB STA	OUR SECRI NDARDS FOR	ETARY - MINISTRY OF ECONOMY - COCCUPATIONAL SAFETY AND HEALTH	REGULATORY				
[26] NR-1	0	Segurança em Instalações e Serviços em Eletricidad	e.				
[27] NR-1	2	Segurança no Trabalho em Máquinas e Equipament	os				
[28] NR-3	80	Segurança e Saúde no Trabalho Aquaviário					
[29] NR-3	87	Segurança e Saúde em Plataformas de Petróleo					
2.2.5. IMO	- INTERNAT	IONAL MARITIME ORGANIZATION					
[30] IMO	EA811E	Code for the Construction and Equipment of Mobi Drilling Units (MODU CODE)	le Offshore				
[31] IMO	MODU CODE	International Maritime Organization for the; design and other safety measures for mobile drilling units	n, construction				
2.2.6. ABN	T – ASSOCIA	ÇÃO BRASILEIRA DE NORMAS TÉCNICAS					
[32] ABN	T NBR 14136	Plugues e tomadas para uso doméstico e análogo a corrente alternada - Padronização	té 20 A/250 V em				
2.3. REFE	ERENCE DOO	CUMENTS					
[33] I-E'	T-3010.00-1200)-498-P4X-002 – ELECTRIC PROCESS HEATERS					
[34] I-E GE	T-3010.00-5140 NERIC ELECT)-741-P4X-004 - SPECIFICATION FOR LOW-VOL RICAL PANELS FOR OFFSHORE UNITS	TAGE				
[35] AU	TOMATION I	NTERFACE OF PACKAGE UNITS					

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		OFFSHOR		ESUP
[36] I-DE-3 ARCH	010.00-5140-797-P4X-001 - ELEC ITECTURE DIAGRAM	TRICAL SYSTEM AUTOM	ATION
[37] I-ET-3 INSTR	010.00-1200-800-P4X-002 - AUTO UMENTATION ON PACKAGE U	DMATION, CONTROL AND	
[38] I-ET-3	010.00-1200-956-P4X-002 - GENE	RAL PAINTING	
[39] I-ET-3 FOR O	010.00-5140-700-P4X-001 - SPECI DFFSHORE UNITS	FICATION FOR ELECTRIC	CAL DESIGN
[40] I-ET-3 FOR O	010.00-5140-700-P4X-002 - SPECI DFFSHORE UNITS	FICATION FOR ELECTRIC	CAL MATERIAL
[41] I-ET-3 DESIG	010.00-5140-700-P4X-005 - REQU IN FOR ELECTRICAL SYSTEMS	IREMENTS FOR HUMAN OF OFFSHORE UNITS	ENGINEERING
[42] I-ET-3 MATE	010.00-5140-700-P4X-009 - GENE RIAL AND EQUIPMENT FOR OF	RAL REQUIREMENTS FO FFSHORE UNITS	R ELECTRICAL
[43] I-ET-3 AND S	010.00-5140-741-P4X-001 - LOW- SWITCHGEAR FOR OFFSHORE U	VOLTAGE MOTOR CONT UNITS	ROL CENTER
[44] I-ET-3 CENTI	010.00-5140-741-P4X-002 - MEDI ER AND SWITCHGEAR FOR OFI	UM-VOLTAGE MOTOR CO FSHORE UNITS	ONTROL
[45] I-ET-3 ARCH	010.00-5140-797-P4X-001 - ELEC ITECTURE	TRICAL SYSTEM AUTOM	ATION
[46] I-ET-3 CRITE	010.00-5143-700-P4X-001 - ELEC CRIA	TRICAL SYSTEM PROTEC	TION
[47] I-ET-3	010.00-5400-947-P4X-002 - SAFE	TY SIGNALLING	
[48] I-ET-3	010.00-5520-888-P4X-001 - AUTO	MATION PANELS	
[49] I-LI-30 MODE	010.00-5140-700-P4X-001 - ELECT ELS	TRICAL EQUIPMENT DAT	A-SHEET
[50] I-LI-30 INTER)10.00-5140-797-P4X-001 - ELECT RFACE SIGNALS LIST	TRICAL SYSTEM AUTOMA	ATION
[51] ONE-L	LINE DIAGRAM for the Project		
I	Note: Do cha doo	ocuments without code in the list are aracteristics. Verify in project docu cuments.	e documents with variations a umentation list the reference	according to project for codes of these
3.	GENERA	AL CONDITIONS		
3.1. I	Power Par system, an	nel shall contain thyristors suitable ad all necessary components for the	e for the requested power, th temperature control.	e thyristors control
3.2. T	The Powe	er Panel shall be designed, const on.	ructed, tested, and supplied	according to this

 3.3. For information about requirements for upstream panels, see I-ET-3010.00-5140-741-P4X-001
 - LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS or I-ET-3010.00-5140-741-P4X-002 - MEDIUM-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.

_	TECHNICAL SPECIFICATION	No. I-ET-3010.00-5140-741-	P4X-003 REV. H
BR	UNIT:		SHEET: 7 of 29
PETROBRAS	TITLE: POWER PANEL FOR THYRI	STORIZED HEATER FOR	INTERNAL
	OFFSHOR	E UNITS	ESUP

- 3.4. Manufacturer is responsible for detailed electrical design and engineering within the Power Panel and shall perform all functions required to interface with the design of electrical system, as well as guarantee the control and monitoring from Control Panel.
- 3.5. All material and equipment supplied to the Power Panel shall meet applicable standards, Classification Society rules, NR-10.
- 3.6. Power Panel shall comply with safety interlock requirements defined in IEC 60079 when driving equipment installed in hazardous areas.
- 3.7. Manufacturer shall supply all electrical devices, including specific tools, which are necessary for the operation and maintenance of the Power Panel.
- 3.8. Unless otherwise stated in PETROBRAS documentation, Power Panel shall be installed inside a panels' room in a safe area.
- 3.9. Power Panel shall be packed properly for the foreseen transportation, so that no damage occurs during transport, storage and lifting operations.
- 3.10. Instruments sizes, deflection, type (analogue or digital), position orientation and quantity shall be according to I-ET-3010.00-5140-700-P4X-005 REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.
- 3.11. 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.
- 3.12. This specification considers two types of Power Panels. The following table relates the differences:

Characteristics	Power Pa	anel Type
Characteristics	Туре І	Туре П
Fad from	CDC, or MCC, or 1	2 dedicated redundant power
Fed Holli	dedicated power transformer	transformers
Quantity of incoming circuits	1	2
Tie Circuit Breaker	No	Optional
Incoming feeder switching device	MCB, or none	Air circuit-breaker
Incoming circuit remote monitoring	Yes	Yes
Outgoing circuit remote monitoring	Yes	Yes
Insulation monitoring device	Yes, when fed from	Yes
(IMD)	transformer	
Ground fault detectors (EFI)	Yes	Yes

Table 1 - Power Panel Types

Note: EFI and IMD requirements are specified in section 4.14.5.

4. CONSTRUCTIVE CHARACTERISTICS

4.1. GENERAL REQUIREMENTS

- 4.1.1. Power Panel shall be designed, manufactured, and tested according to standards listed on item 2.2 and according to reference documents listed on item 2.3.
- 4.1.2. All materials used, shall be non-hygroscope, flame retarding and resistant to corrosion caused by maritime environment and contact with hydrocarbons.

		TECHNICAL SPECIFICATION	^{№.} I_FT-3010 00-5140-741.	P4X-003	REV. H			
	-7-1		1-21-3010.00-3140-741-	SHEET: 8	29			
			STORIZED HEATER FOR	INTER	of 20 RNAL			
PETK	UBRAS	OFFSHOR	E UNITS	ESUP				
4.1.3.	The arrangement	ngement of equipment and compone ng heat shall not damage or reduce th	nts shall be defined in order t he service capacity of the adj	hat the corr acent eleme	ponents			
4.1.4.	1.4. In order to avoid electrolytic corrosion contacts between different metallic materials shall be prevented. Galvanic isolation shall be implemented where the contact between different metallic materials is necessary.							
4.1.5.	Power Patto I-ET-2 MATER	anel shall be suitable for operation 3010.00-5140-700-P4X-009 - GEN IAL AND EQUIPMENT FOR OFF	with voltage and frequency v ERAL REQUIREMENTS F SHORE UNITS.	ariations ad OR ELECT	cording			
4.1.6.	Unless c short-tim rated wit	otherwise stated in Project documer ne withstand current Icw for 1s (acc thstand peak current Ipk (according t	ntation, Power Panel shall ha ording to IEC 61439-1) of 2 to IEC 61439-1) of 52.5 kA.	ave minimu 5 kA and m	ım rated iinimum			
4.1.7.	In case of monitor submitte	of minimum rated short-time current protection device shall be installe and to PETROBRAS approval. Control	tts are above the values defined in Power Panel. This sol of Panels do not need arc mor	ned in 4.1.6 ution this nitor devices	5, an arc shall be s.			
4.1.8.	Unless of solutions required	otherwise stated in PETROBRAS d s included upstream the Power Panel in 4.1.6, are not in the scope of the 1	ocumentation, reactor limitin to keep it within the indicated Manufacturer.	ng devices l short-circu	or other at limits			
4.1.9.	Unless of shall be	otherwise stated in PETROBRAS do proper for operation in system with	ocumentation, Power Panel in neutral point isolated from gr	nternal com ound (IT sy	ponents /stem).			
4.1.10	Power F. documer Detailed approval	Panel rated voltage (3 phases 60 H ntation for each equipment and sha Design. Other voltages can be accept.	$Hz \pm 5\%$) shall be according ll be confirmed by heater N oted, but this shall be submitted	g to PETR Ianufacture ed to PETR	OBRAS r during OBRAS			
4.1.11	. Manufac standard	cturer shall install at least 2(two) sock ization defined by ABNT NBR 1413	ket-outlets inside the Panel that 36, and, where applicable IEC	at shall com C 60309.	ply with			
4.2.	ENVIR VIBRA	ONMENTAL CONDITIONS, TION REQUIREMENTS	INCLINATION REQUI	REMENT	S AND			
4.2.1.	The Pow accordin ELECTR	ver Panel shall be designed to ope g to I-ET-3010.00-5140-700-P4X RICAL MATERIAL AND EQUIPM	rate on closed room with a -009 - GENERAL REQU IENT FOR OFFSHORE UN	mbient tem IREMENT TS.	perature 'S FOR			
4.2.2.	Power Pa 009 - GE FOR OF	anel and equipment shall be tropical ENERAL REQUIREMENTS FOR E FSHORE UNITS.	ized, according to I-ET-3010 LECTRICAL MATERIAL A	.00-5140-70 AND EQUI)0-P4X- PMENT			
4.2.3.	Power Pa by I-ET- MATER	anel shall be suitable to operate unde 3010.00-5140-700-P4X-009 - GEN IAL AND EQUIPMENT FOR OFF	r vibration and acceleration re ERAL REQUIREMENTS F SHORE UNITS.	equirements OR ELECT	defined			
4.2.4.	When in to operat MODU	stalled in mobile units and ships (FF e normally under motion and inclina CODE, IEC 61892 and Classificatio	PSO and FSO), the Power Partition limits (static and dynamic n Society.	nel shall be c) specified	suitable by IMO			
4.3.	CLASS	IFICATION OF ASSEMBLIE	S					
	ת ת	anal shall be alogsified according to	IEC 61/30 1					

		TF	CHNIC	CALS	PEC	IFIC		N No.	· -	ET-3	010.0	0-514	0-741	-P4X-0	03	REV	· H
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FEIN	ODNAS		_			0	FFSH	IORE	UN	ITS			-	ESUP			
4.3.2.	Power Pa	anel	shall b	e teste	d acc	cordi	ing to	IEC 6	5143	39-1.							
4.3.3.	Power Pa installation	anel on.	shall t	e a m	etalli	ic M	Iulti-C	Cubicle	е Ту	pe st	ationa	ary as	sembly	, prope	er f	or ir	ıdoor
4.3.4.	Power P 60529.	anel	shall	have r	minir	mum	n mec	hanica	al p	rotect	ion d	egree	IP-42	, accor	din	g to	IEC
4.3.5.	Power Pa	anel	shall b	e form	ed by	y fix	ked, re	movał	ble	or wit	hdrav	vable	parts.				
	Note: Wi	ithdr	awable	parts	shall	l con	nply v	vith IE	EC 6	51439	-2.						
4.3.6.	Protectio barriers o	on ag or en	ainst e closure	lectric s.	al sh	lock	by di	rect co	onta	ct sha	ll be	ensur	ed by 1	means	of p	orote	ctive
4.3.7.	Protectio circuits (on ag earth	ainst el bar), a	ectrica accord	al sho ling t	ock l to IE	by ind EC 614	irect c 39-1.	cont	act sh	all be	ensu	red by	means	of p	orote	ctive
4.3.8.	Adjacent protectio stated in	t fun on de IEC	ctional gree at 61439	units least -2.	shall IP21	be s B, a	separa as state	ted fro ed in 1	om IEC	each (6052	other 29, an	by me d acce	eans of ording	barries to For	rs, j ns	prov 3b o	iding vr 4b,
4.3.9.	Controlle with the	er an form	d contr of seg	ol mo regatio	dules on 4b	s sha b.	all be	consid	dere	d as s	separa	ted fu	inction	al units	5, C	omp	lying
4.4.	STRUC	TU	RE														
4.4.1.	The maxic cooling e	imur exhau	n heigh 1st duc	it, incluts, and	uding 1 the 0	g the exha	e plintl aust di	h, shal ucts fo	ll no or ey	ot exce kpansi	eed 24	100 m gases	m (exc s from	luding short-c	coo ircu	ling uits).	fans,
4.4.2.	Power Pa the flame	anel s e reta	hall be rdatio	comp of a j	orised possi	d of v ible f	vertica fire fr	al secti om on	ions le fu	, form	ned by nal ur	y meta nit to a	llic com another	mpartm r.	ent	ts, ai	ming
4.4.3.	The base (skid) usi	e of tl ing s	ne Pow crews	er Pan throug	nel sh gh the	nall b e hol	be dril les.	led, ar	nd t	he pai	nel sh	all be	fixed	to one 1	net	allic	base
4.4.4.	The skid to suppo access of the floor, the floor,	shal rt th f hun . Ma	l be din e whol nidity t nufactu	nensio e pane o the l irer sh	oned el we Powe nall s	just eight er Pa suppl	like a t. The anel's ly the	bi-suj skid lower skid a	ppo shal por and	rted b ll hav rtion. all ne	e am a e side The s cessa	along es cov skid sł ry acc	the lor vered v nall be cessori	ngitudir vith pla drilled es to fi	nal ntes and x tł	direct to a d fix ne sk	ction, avoid ed to cid to
4.4.5.	To avoid and insta also have access an previousl	l a da Illatio e tran nd a ly su	angero on, the sversa ny oth bmitte	us incl two po l direc er ins d and a	linati oints tiona stallat appro	ion o supp al bea tion oved	of Pov ported ams. 7 requi l by Pl	wer Pa l beam These t remen ETRO	anel 1 on tran 1ts. 0BR	when the lo sversa Other AS.	n man ongitu al bea r solu	ioeuvi idinal ims sh ition	ing it directi all not may b	during on fixin interfe be acce	cor ng l re v pte	nstru base vith d if	ction shall cable it is
4.4.6.	Maximur I-ET-301 DESIGN	m he [0.00 [FO]	ight fo -5140- R ELE	r insta 700-P CTRIC	llatio 4X-0 CAL	on of 005 SYS	f push - RE STEM	-buttor QUIR IS OF	ns a REM OF	nd ins IENT FSHC	strum S FC DRE U	ents s DR H JNITS	hall be UMAI S.	in acco N ENC	orda SIN	ance EER	with XING

- 4.4.7. Power Panel shall be self-supported and provided with lifting eyelets.
- 4.4.8. The panels shall be designed in such a way that a minimum number of columns are connected for mechanical handling. Mechanical handling partition shall be informed to PETROBRAS in documentation for approval (section 6.2).

Note: if possible, it is desired a maximum of 2 columns.

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- 4.4.9. Power Panel shall be designed and constructed so that all services, including operation, installation, maintenance, configuration, etc. can be done from the front side, so that Power Panel could be installed with the rear side close to walls.
- 4.4.10. Power Panel shall have isolated handrails along the front side.
- 4.4.11. Vertical sections shall have hinged doors on their front sides.

Note: Hinged doors shall have an open position lock device.

- 4.4.12. The equipment that allows either set, or calibration, shall be installed in such a way that it shall not be necessary to open the door to proceed the calibration.
- 4.4.13. The panels shall be constructed so that thermal inspection by optical infrared thermographic devices could be safely performed with the circuits energized. This facility shall not compromise arc withstand capability to comply with IEC TR 61641.

4.5. PAINTING

- 4.5.1. 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.
- 4.5.2. The last coat colour shall be Light Green (MUNSELL notation 5 G 8/4). Inner components mounting plates, internal faces of doors and safety barriers shall be Safety Orange (MUNSELL notation 2.5 Y R 6/14).

4.6. MAIN BUSBARS

- 4.6.1. Busbars shall be three-phase, of electrolytic copper.
- 4.6.2. Busbars shall have capacity to continuously conduct the rated current InA (as defined in IEC 61439-1) of the Power Panel defined by Project documentation, with the temperature rise limited to the standard values.
- 4.6.3. Busbars and supporting systems shall be dimensioned to withstand the mechanical and thermal stresses resulting from short-circuit currents indicated in Data-Sheet or other document.
- 4.6.4. The busbars shall be identified with coloured strips as follows:
 - Phases (R S T): red, white, and black, respectively.
 - Neutral: blue according to IEC 60445
 - Ground: bicolour combination green-yellow according to IEC 60445.
- 4.6.5. The main busbars and the derivations to the circuit-breakers shall be fully insulated.

4.7. GROUNDING BARS

- 4.7.1. A safety grounding bar (PE) shall be installed in the whole Power Panel length, through the internal lower or upper part.
- 4.7.2. All 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 safety grounding bar (PE), using bonding jumpers with cross section according to criteria defined in I-ET-3010.00-5140-741-P4X-001 LOW-VOLTAGE MOTOR CONTROL CENTER AND SWITCHGEAR FOR OFFSHORE UNITS.

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- 4.7.3. A label note shall be included in panel doors indicating the grounding system used for power and control circuits.
- 4.7.4. Bolt Grounded Systems

For these systems, the cross section of the safety grounding bar (PE) 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, stranded and with cross-sectional area according to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

4.7.5. Ungrounded Systems and High Resistance Grounded Systems (IT systems)

For these systems, the minimum cross section of the safety grounding bar (PE) 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.

4.7.6. Electronic Reference Bar (IE)

Power Panel shall have an electronic reference bar (IE) to grounding of instruments and intelligent devices signals circuits, according to requirements of the IEC TR 61000-5-2 and to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

4.8. WIRING AND CONDUCTORS

- 4.8.1. Cables shall comply with requirements of I-ET-3010.00-5140-700-P4X-002 SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.
- 4.8.2. All internal wiring shall be duly identified through plastic rings, at the ends, with the codification shown on the wiring drawings.
- 4.8.3. The insulation colour of cables used for D.C. circuits shall be red for wiring with positive voltage and black for wiring with negative voltage.
- 4.8.4. Power Panel shall be delivered with all connections between installed components done.
- 4.8.5. The wiring between sections separated for transport shall finish on terminal blocks, so that the final interconnection could be easily completed with jumpers, by the time the sections are assembled.
- 4.8.6. The channels shall be made of material not producing toxic fumes in case of fire on the panel.
- 4.8.7. Each set of control terminal blocks shall have 10% of spares for future application.
- 4.8.8. Power Panel shall be supplied with cable glands and terminal connectors for power and grounding cables.
- 4.8.9. All incoming and outgoing cables shall enter through the bottom side. For this purpose, the manufacturer shall provide removable plates with a minimum thickness of 2.8 mm, made of copper free aluminium or non-magnetic material.
- 4.8.10. Metallic cable-glands made with material compatible with the removable plates' material shall be supplied with the Power Panel.
- 4.8.11. MCT system is also acceptable for wiring and conductor entrance, but it shall be designed and installed in a way that no force is transferred to internal terminals or isolators.

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4.9.	HEATI	NG RESISTORS		
4.9.1.	Power P 220VAC heating r Panel sh storage p	anel shall be provided with an in 2, 2 ph, 60 Hz isolated from ground resistors automatically controlled by all have externally accessible term period. These terminals shall have a TERMINAIS PARA RESISTÊNCIAS	ternal heating circuit, fed fro (IT). Each vertical section sha y thermostat, with maximum inals to energize the heating label with: ENERGIZAÇÃO DE AQUECIMENT	om external source all be provided with range 60°C. Power circuits during the
 4.9.2. 4.9.3. 4.10. 4.10.1 4.10.2 	The heat (about 30) The auxi FUNC1 . For all in for the P . Power P	ing resistors shall be protected agai 0 cm) shall have special insulation is liary circuit branches shall be suital TONAL UNITS' MAIN COM I ncoming and outgoing connections roject. anel functional units shall have, at 1	inst accidental contacts. The v n order to avoid damage due t bly protected with miniature c PONENTS , it shall be verified the ONE east, the components listed be	wiring next to them to high temperature. Fricuit-breakers. E-LINE DIAGRAM
4 10 3	Incomin	o Feeders:	cust, and components listed be	
т.10.3	• Mot	Ilded-case circuit-breakers (MCB); Required for Power Panels Types I	,	

- May be excluded, if the Power Panel is fed from a CDC or MCC installed in the same room and the outgoing circuit of this upstream panel has a protective circuit-breaker.
- For exceptional cases, if PETROBRAS approves calculated equivalent thermal short-circuit current at Power Panel above 25 kA, the MCB shall be replaced by air circuit-breaker (ACB) with a dedicated MMR (Microprocessor-based Multifunction Relay) with communication capabilities. ACBs with incorporated relays are not acceptable.
- For reference, see ANNEX I POWER PANEL TYPE I SIMPLIFIED SCHEMATIC DIAGRAM.
- Air circuit-breakers (ACB) with a dedicated MMR (Microprocessor-based Multifunction Relay) with communication capabilities (ACBs with incorporated relays are not acceptable) for the required remote control and monitoring.
 - Required for Power Panel Type II.
 - For reference, see ANNEX II POWER PANEL TYPE II SIMPLIFIED SCHEMATIC DIAGRAM.
- Current transformers (CT).
- Ammeter with selector switch.
- Green/Red operation status leds.

4.10.4. Main busbar:

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• Curi	rent limiting fuses (for VTs).									
• Dry-	• Dry-type voltage transformers (VT).									
• Volt	meter with selector switch.									
4.10.5. Outgoing	g circuits:									
• Mou	Ilded Case Circuit-Breakers.									
• Thy	ristors sets.									
Con	tactors.									
• Gree	en/Red operation status leds.	ible to turn on the								
outg	joing circuits from Power Panel).									
• Grou	und fault sensors.									
• Fast	(high-speed) fuses to protect thyristors (which shall be incorp	porated in Power								
Elec	tronics / 1 nyristor modules).									
4.10.6. Each rest	istor bank shall be fed individually by one outgoing circuit as descr	ribed in item 4.10.5.								
4.10.7. Each res	istor bank shall have a 10% reserve.									
4.10.8. Alternati	ve proposals shall be submitted to PETROBRAS approval.									
4.10.9. The num equipme	ber of resistors banks will be defined in PETROBRAS documnt.	entation for heated								
4.10.10. All fun	ctional units shall have labels indicating:									
• prot	ection adjusted values and the reference documents for detailing and the reference documents for detailing and interval and the reference documents for detailing and the reference documents for details and the reference documents for do	ils of adjustment								
• max	imum continuous operating current.									
• upst	ream feeding panel, or transformer.									
• the l	JPS autonomy time, if control system is fed by UPS system.	in assa of isolated								
• IIIO syste	em (IT).	III case of isofated								
4.10.11. Test blo provide disconr	ocks in power panels for protection relay (MMR) secondary injected to allow relay testing and calibration from the front of necting wiring.	tion testing shall be the panel without								
4.11. THYRI	STORS CONTROL AND COOLING SYSTEMS									
4.11.1. Thyriston modulate continuo	rs control system shall receive an external set point signal (see ite e the semiconductors conduction time. The thyristors and their us control from 0% up to 100% of rated capacity, following the s	m 4.12), in order to control shall allow set point value.								
4.11.2. Thyristor gradually	rs control system shall be able to allow the programming of a r y increase temperature.	amp up in order to								
4.11.3. Thyristor instant th	rs triggering shall be controlled in such way to synchronize th ne sine wave has a zero value, avoiding undesirable transients in th	is triggering to the ne electrical system.								
Note: Ha	rmonic content shall be kept within IEEE Std. 519 and on IEC	C 61892-1 limits as								

Note: Harmonic content shall be kept within IEEE Std. 519 and on IEC 61892-1 limits as required in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

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- 4.11.4. The control system shall be constructed in a modular way, in order to make easy the installation and maintenance.
- 4.11.5. Power Panel shall be fitted with a double cooling system with automatic changeover and alarm, so that in case of failure of a set, the remaining units shall be enough to permit the panel operation without derate.
- 4.11.6. Thyristor protection devices, such as snubbers and MOVs, shall be installed in order to avoid failure due to di/dt spikes. Design of protection devices shall be informed in report annex to documentation. Thyristors and respective protection devices datasheets shall be sent to Petrobras.
- 4.11.7. Power and control panels for thyristorized electrical heaters shall allow that controlled resistive elements be preserved in order to avoid low insulation when not operating.

4.12. INTERFACE WITH CONTROL PANEL

- 4.12.1. All external control (ON / OFF) and set point signals shall be received from Control Panel, besides any other interface defined by heated equipment Manufacturer and from A&C, according to interface requirements defined in I-ET-3010.00-1200-800-P4X-002 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and I-LI-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.12.2. Power Panel shall be controlled by Control Panel of heated equipment, or from A&C, according to PETROBRAS documentation for heated equipment. The communication standard (network or hardwired) between Power Panel and Control Panel shall be according to PETROBRAS documentation for heated equipment.
- 4.12.3. Power Panel shall have local visual alarms for internal malfunction and shutdown. Resume alarm signals shall be sent to Control Panel according to PETROBRAS documentation for heated equipment and to A&C according to interface requirements defined I-ET-3010.00-1200-800-P4X-002 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and I-LI-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST. All signals from the heated equipment to A&C shall be sent by Control Panel.
- 4.12.4. Emergency shutdown signals from A&C shall be sent to Control Panel that shall be responsible to turn off the Power Panel.
- 4.12.5. For communication requirements between Control Panel and A&C, see I-ET-3010.00-1200-800-P4X-002 - AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS and I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.12.6. All panels expected to receive ESD or other wet signals from A&C or Package Control Panels shall have interposing relays with enough quantity to convert discrete 24 VDC signal in discrete voltage-free signal.

4.13. INTERFACE WITH ELECTRICAL SYSTEM AUTOMATION

4.13.1. Power Panels Type I MCB of incoming circuits shall have voltage-free contacts for remote monitoring of status (ON / OFF).

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- 4.13.2. Power Panels Type II Incoming MMRs shall have communication capability with the Electrical System Automation according to I-ET-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.13.3. The outgoing circuits shall have voltage-free contacts for remote signalling of status (ON / OFF).
- 4.13.4. Trip in outgoing feeders due to ground fault (see item 4.14.5) shall generate an alarm, for remote signalling, using voltage-free contacts.
- 4.13.5. For electrical system automation interfaces, criteria and requirements see I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE and I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.13.6. Power Panels Type I shall include an IED (IR) in order to obtain all signals from internal components as required by I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.13.7. The IED (IR) shall communicate with protocols according to I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM.
- 4.13.8. Power Panel Type II Incoming MMRs shall obtain all signals from internal components as required by I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.
- 4.13.9. In type I, where MMR exists, it shall substitute IED (IR) functions above.
- 4.13.10. The Power Panel shall have its internal clock synchronized with Electrical System Automation Time Server through the time protocol according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE. All devices with logging or communication capabilities internal to the Power Panel shall have their internal clock synchronized with Electrical System Automation. All internal devices connected to Electrical System Automation networks shall be synchronized with the Electrical System Automation Time Server through the time protocol according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE. All events and alarms shall be logged in the equipment with the time stamp synchronized with the internal clock, which shall be synchronized with the Electrical System Automation Time Server.

4.14. PROTECTION

- Requirements applicable for Power Panels Type II: 4.14.1.
- 4.14.1.1. The minimum protection functions for Power Panel incoming feeders shall be according to Table 2. Protection requirements shall follow I-ET-3010.00-5143-700-P4X-001 ELECTRICAL SYSTEM PROTECTION CRITERIA.
- 4.14.1.2. The MMRs (Microprocessor-based Multifunction Relay) shall have the function of circuitbreakers coils monitoring activated and sending alarm signal to Electrical System Automation Operational Workstation.

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INTERNAL

Trip

				_00.		
	Table	2 - Minimum Protection Functions for Incoming Feeders	(Power Panel	Type III)		
	Protection Function Incom					
Nº		Description	ACB	+ MMR ^{(1) (2)}	I	
27		Undervoltage	A	larm/Trip		
50		Instantaneous Overcurrent		Trip ⁽³⁾		
51		Temporized Overcurrent		Trip		

Notes: (1) ACB = Air Circuit-Breaker; MMR = Microprocessor-based Multifunction Relay.

Lockout

- (2) Protective functions and communication capability required shall be through a MMR.
- (3) Instantaneous overcurrent shall be activated only when selector switch is in "Manutenção" position. See item 4.14.1.3 and 4.14.1.4.
- 4.14.1.3. The Power Panel 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 functional unit shall be activated or its set points changed, overriding the protection coordination, and minimizing damage in case of internal fault.
- 4.14.1.4. There shall be a local signalling lamp, turned on with the switch in "Manutenção" position (Maintenance Position), indicating "Coordenação Desativada" (Deactivated Coordination).
- 4.14.1.5. A network remote signalling of the position of the switch shall be sent to Electrical System Workstation, through Electrical System Controllers Panel, from the incoming circuit-breaker MMRs.
- 4.14.1.6. There shall be a label beside the switch with following warning text:



- 4.14.2. Unless otherwise defined in Project Documentation, communication failure, watchdog, and self-diagnosis routine failure indications in MMRs and IRs shall be signalled as an alarm to Electrical System Automation, and they shall not be used as trip signal.
- 4.14.3. The protection for outgoing circuits shall be executed by thermomagnetic moulded case circuit-breakers and contactors.
- 4.14.4. High-speed fuses shall be provided to protect power semiconductors.

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4.14.5.	GRO	UND FAULT PROTECTION			

- 4.14.5.1. Ground fault protection shall be provided by an insulation monitoring device (IMD) for Power Panels Type I fed from transformers and for Power Panels Type II, as defined in Table 1. Protective devices based in residual current shall not be accepted.
- 4.14.5.2. The IMD shall indicate the measured insulation resistance value between phases and ground. The trip value shall be adjustable, and the device shall be capable to detect simultaneous faults, even in three different circuits.
- 4.14.5.3. The IMD shall be capable to measure the insulation level and to detect the ground fault in systems with cable total length (three phases) of one hundred kilometres (100 km), without any failure or nuisance actuation.
- 4.14.5.4. Outgoing feeders shall have individual ground fault detector (EFI) devices EFIs shall be used to disconnect the power supply whenever the insulation resistance is not greater than 50 ohms per volt of rated voltage, in accordance with IEC 60079-14. The trip signals shall be sent to the respective contactor of the faulty feeder. This trip actuation shall generate an alarm signal, to be sent to Electrical System Workstation, through Electrical System Automation.
- 4.14.5.5. For Power Panels Types I, when the IMD is installed in the upstream panel, the EFI shall be connected to this IMD and shall be fully compatible.
- 4.14.5.6. Power Panels Type I without dedicated transformer shall be monitored for ground fault by the IMD at outgoing circuit in the upstream panel. As defined in Table 1, EFI shall be installed in outgoing circuits, connected and fully compatible with the IMD of upstream panel.
- 4.14.5.7. Ground fault protection shall have an alarm signal indicating if panel insulation monitoring device (IMD) is turned off. This signal is to be sent to Electrical System Automation.
- 4.14.5.8. The insulation monitoring devices shall send a discrete alarm signal to an IED (IR) or MMR inside the panel, through a voltage free contact (1A @ 220VAC PF 0.4).
- 4.14.5.9. To indicate that the ground fault detection device is turn off, an alarm shall be sent to IED (IR) or MMR installed inside the panel through a voltage free contact (1A @ 220VAC PF 0.4).
- 4.14.5.10. In case of use of ground fault location devices, it is forbidden the use of voltage transformers connected YNyn (two neutral grounded).

4.15. INCOMING FEEDERS INTERLOCKS

- 4.15.1. Requirements applicable for Power Panels Type II:
- 4.15.1.1. It shall not be allowed simultaneous closing of both incoming circuit-breakers and it shall be installed an internal mechanical interlock to avoid this operation. Load transference from one incoming circuit-breaker to the other shall be carried out with momentary blackout.

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4.15.1.2.	In case the optional tie circuit breaker is installed, it shall not be all closing of both incoming circuit breakers unless the tie circuit breaker installed a logical interlock to allow the connection of 2 out of 3 circuit transference from one incoming circuit breaker to the other shall be momentary blackout.	owed simultaneou is open. It shall be cuit-breakers. Load be carried out with			
4.15.1.3.	It shall be possible to close each incoming circuit breaker only if the r circuit breaker (installed in primary side of the power transformer) is c	espective upstrean losed.			
4.15.1.4.	The incoming circuit breakers shall open when the respective upstree (installed in primary side of the power transformer) opens.	eam circuit breake			
4.15.2.	All panels expected to receive ESD or other wet signals from A&C or Panels shall have interposing relays with enough quantity to conver- signal in discrete voltage-free signal.	or Package Contro rt discrete 24 VDC			
4.15.3.	Power Panels Type I shall include an IED (IR) in order to obtain all si components as required by I-LI-3010.00-5140-797-P4X-001 - ELEC AUTOMATION INTERFACE SIGNALS LIST.	ignals from interna TRICAL SYSTEM			
4.15.4.	The IED (IR) shall communicate with protocols according to I-DE- P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTU	3010.00-5140-797 RE DIAGRAM.			
4.15.5.	Power Panels Type II MMR shall provide the monitoring functions at the IR.	pove in the place o			
4.16. E	LECTROMAGNETIC COMPATIBILITY (EMC)				
4.16.1.	The panels and all their components shall comply with the emiss requirements for electromagnetic compatibility stated in IEC performance criterion A.	sion and immunity 60533, presenting			
4.17. C	ONTROL VOLTAGES				
4.17.1.	Power Panel sections internal control voltages shall be designed to rec supply for the powering of all common control equipment (ARC, Ins HMI, CB control, etc.) as well as powering the contactor coils in the th	eive internal powe ulation monitoring pyristor sections.			
4.17.2.	The internal control voltages for the Power Panel types I shall be suppauxiliary transformer (VT) connected to the main power supply, with 120Vac.	lied by one interna secondary voltage			
4.17.3.	The internal control voltages for the Power Panel types II shall b redundant internal auxiliary transformers (VTs) connected to the main secondary voltage 120Vac. There shall be a selector switch to select the operation.	e supplied by two power supply, with e VT that will be in			

- 4.17.4. The primary windings of the VTs shall be protected by fuses. The secondary winding and each control circuit branch shall be suitably protected with miniature circuit- breakers.
- 4.17.5. The secondary windings of the VTs shall have one terminal bolted grounded.

4.18. NAMEPLATES AND MARKINGS

4.18.1. Power Panel's characteristics nameplates shall be made with AISI-316 stainless steel and shall include all items listed in IEC 61439-1.

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							0	FFSH	ORE	UN	ITS					ESUP		
4.18.2.	Power the fo	r Par ollow	nel s ving	nall b data:	e out	tfitte	ed wi	th plat	te of s	supp	oleme	ental	identi	ification	conta	aining	, at le	east,
	a) PE	ETRÓ	ÓLE) BR	ASI	LEIF	RO S	S.A. - 1	PETR	ROE	3RAS	5.						
	b) na	me c	of the	e depa	artme	ent o	of the	PETI	ROBI	RAS	S.							
	c) na	me c	of the	e ente	rpris	se (pl	latfo	rm).										
	d) TA	∖ G n	ıumb	er of	the p	panel	1.											
	e) nu	mbe	er of	he R	M.													
	f) nu	mbe	er of	he O	rder	of P	urch	ase of	Mate	eria	I (PC)	M).						
	g) nu	mbe	er of	he A	utho	rizat	tion o	of Mat	terial	Sup	oply (AFN	M).					
	h) in acc	alte quisi	rnati ition	ve to built) par -in ir	ragra n con	uph f	f) and t of th	lg), etype	the e lu	num mp sı	ıber um (of the "Turn	e contra Key", "	ict, in 'Lump	the o Sum	cases	s of c.).
4.18.3.	Powe	r Par	nel's	nam	eplat	te sha	all ir	ıclude	e its fe	eede	ers/tra	ansfo	ormers	s feeder	TAG.			
4.18.4.	Powe instru identi	r Pa iction	nel ns, c tion	shall ares, plates	have war iste	e its rning ed in	com gs, a n AS	ipartm ind ale TM F	nents ert of 1166	sig f da and	nallec angers IEC	d wi s ac 604	th lite cordir 17 D.S	eral and ng to th S	graph ne req	nical l Juirem	abels ients	s of for
4.18.5.	Black	a acr	ylic	plates	with	h wh	nite le	etters	shall	ideı	ntify a	all o	utgoin	ng and v	ertica	l secti	ons.	
4.18.6.	For o	utgo	oing i	denti	ficat	ion,	the f	ollow	ing in	nfor	matic	on sh	all be	include	ed:			
	 at 1 at 1 at 1 	the f the s the t	first l secor third	ine, t Id line line,	he lo e, the the r	oad ta e loa ated	ag nu Id na Curr	umber me in ent of	: Portu the lo	igue oad	ese. and (circu	iit nun	nber.				
4.18.7.	Intern acryli docur	nally ic pl ment	' to H lates, ts (lis	ower with st of r	Pan wł natei	nel, a nite rials,	all ec lette , diaş	quipm rs, co gram,	ent a ontain etc.).	nd ing	comp the	oonei codi	nts sh ficatio	all be ic on comj	dentifi patible	ied wi e with	ith bl n de	lack sign
	Note:	for rel ad	r sm lays) lhesi	all in when ve lat	iterna e aci oels a	al co rylic are al	ompo : labe llow:	onents els are ed.	s (i.e. not f	: sr easi	nall c ible d	circu lue to	iit-brea o cons	akers, c strict size	contactes and	tors, a l smal	auxil 1 spa	iary ices,
4.18.8.	The c	ircui	it-br	eaker	s lab	els sl	hall	includ	le rate	ed c	urren	nt and	d trip	current	set.			
4.18.9.	4.18.9. The Power Panels shall have warning labels following the model below, with the values rated voltage (in field "Nível de Tensão"), arc fault incident energy (in field "Energy Incidente") and arc-flash hazard distance (in field "Distância Segura de Aproximação pa Atividades Sujeitas a Arco Elétrico"). The values to be filled in will be informed to Pa Manufacturer during Detailed Design.							es of rgia para anel										
4.18.9.1	I. All rega by N	elect urdles NR-1	trica ss of 10.	l equ the a	ipme irea v	ent, f wher	flour re it i	moun moun	nted, alled,	pan sha	iels, d ill hav	or si ve th	milar ne foll	in cons owing v	tructio varnin	on to 1gs as	a pa requ	inel, ired
4.18.9.2	2. War elec SAF	ning trica FET	gs sh il pa Y SI(all fo nels GNA	ollov risk LLIN	v the of s NG.	e sta shoc!	andard k also	l labe o info	els orm	as re ed in	equire 1 I-E	ed in ET-30	ABNT 10.00-54	NBR 400-94	t 1343 47-P4	34-2 X-00	for 02 -

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4.18.9.3	3. The for the for the formation of the	thyristor panels shall have warning labels following the model bel e protective clothing risk category (in field "Nível de Proteção do field "Nível de Tensão"), arc-flash hazard distance (in field "D eximação para Atividades Sujeitas a Arco Elétrico") and arc fault "Energia Incidente"). The values to be filled in will be ufacturer during Detailed Design.	ow, with the values EPI") rated voltage Distância Segura de incident energy (in informed to Panel							
		PERIGO								
		RISCO DE ARCO ELÉTI E CHOQUE UTILIZE O EPI RECOMEN	RICO							
	NÍVEL DE PROTEÇÃO DO EPI: TENSÃO NOMINAL DO PAINEL:V DISTANCIA SEGURA DE APROXIMAÇÃO PARA ATIVIDADES SUJEITAS A ARCO ELÉTRICO:cm ENERGIA INCIDENTE:cal/cm ²									
	 Notes: (1) Power Panels shall have warning labels indicating the protective clothing risk category that shall be used for technical intervention. (2) Power Panels shall have warning labels indicating that any technical intervention in the panels shall be executed only for authorized people. 									
4.18.10.	There breake heater	shall be provided warning plates at all incomings of Power Pane ers that shall be extracted to permit the maintenance of the resp	el listing the circuit- ective Power Panel							
4.18.11.	Other 5400-9	warning labels may be required by NR-10, those shall be verifie 947-P4X-002 - SAFETY SIGNALLING.	ed in I-ET-3010.00-							
4.18.12.	No ad	hesives shall be used to fix plates or labels, except, as indicated i	n 4.18.7 note.							
5. TE	STS									
5.1. GE	ENERA	AL								
5.1.1.	The M perfor applic	Ianufacturer or an independent inspection authority accepted by l m all inspections and tests, in conformity with the specificati able rules.	PETROBRAS shall on documents and							
5.1.2.	Manu: equipi	facturer shall be responsible for obtaining all necessary certific ment.	ation related to the							

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- 5.1.3. Manufacturer shall be responsible for contact the Classification Society, in order to define the procedures to be followed, related to the submission of documents, and to carry out the necessary inspections and tests to certificate the Power Panel.
- 5.1.4. All related costs for tests, inspections and certificates shall be included in prices.
- 5.1.5. Manufacturer shall be present at site, after the panel assembly and transport, to verify, together with PETROBRAS, if the Power Panel is at the same conditions as it was when factory delivered it and to verify if the Power Panel is ready to start operation.

5.2. DESIGN VERIFICATION (TYPE TESTS)

- 5.2.1. Type tests, or Design verification shall follow the requirements of IEC 61439-1, IEC 61439-2, IEC 60092-302 and IEC 61892-3. According to IEC 61439-1, the methods that check design verification are testing, comparison with a tested reference design or assessment (confirmation of the correct application of calculations and design rules, including use of appropriate safety margins). Design verification and methods are summarised in Table 3, where they are identified as "D".
- 5.2.2. Certified test reports for design verification tests performed for identical panels or a panel tested reference design (when applicable, according to IEC 61439-1) and approved and witnessed by Classification Society are accepted. These reports shall be included al proposal by manufacturer.

5.3. ROUTINE VERIFICATION

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

5.4. SPECIAL TESTS

5.4.1. Special tests shall be carried out according to Table 3 where they are identified as "S".

5.5. MINIMUM TEST LIST

5.5.1. The manufacturer shall perform for panels all tests indicated below:

Table 3 - Minimum Tests List

Test	D	R	S	Method and Acceptance Criteria
Examination of technical documentation ⁽¹⁾	Х	х	Х	
Verification of certificate of accuracy for measurement instruments to be used in tests ⁽¹⁾	x	х	x	
Dimensional verification		х		Panel Data-sheet
Visual inspection, verification of data on nameplates and labels and Marking Tests		х		IEC 61439-1 and this ET
Painting (colour, thickness and adhesion)		х		I-ET-3010.00-1200-956- P4X-002 - GENERAL PAINTING and this ET
Verification by testing of the resistance to corrosion	x			Severity Test B – IEC 61439-1
Verification by testing of thermal stability of enclosures	х			IEC 61439-1

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	Test	D	R	S	Method and Acceptance Criteria
Verification by abnormal heat an	testing of resistance of insulating materials to d fire due to internal electric effects	x			IEC 61439-1
Verification by radiation	assessment of resistance to ultra-violet (UV)	х			IEC 61439-1
Lifting test		Х			IEC 61439-1
Verification by a and components	assessment of incorporation of switching devices	x			IEC 61439-1
Verification by c temperature rise	omparison of a reference design or by testing of limits	x			IEC 61892-3 and IEC 61439-1
Verification by te	esting of dielectric properties	x			IEC 61439-1, IEC 61439-2 and IEC 61180
Verification by te	esting of short-circuit withstand strength ⁽⁶⁾	Х			IEC 61439-1
Verification by integrity of prote	testing of protection against electric shock and ctive circuits	x	х		IEC 61439-1
Verification by te	esting of clearance and creepage distances	Х	Х		IEC 61439-1
Verification by te	esting of mechanical operation	x	х		IEC 61439-1 and IEC 61439-2
Verification by as	ssessment of degree of protection of enclosure (IP)	x	х		IEC 61439-1, IEC 61439-2 and IEC 60529
Wiring, operation	nal performance and function		Х		IEC 61439-1
Mechanical impa	cts tests	x			IEC 61439-1 and IEC 62262
Verification by connections	assessment of internal electrical circuits and	x	x		IEC 61439-1
Verification by a	ssessment of terminals for external conductors	Х	Х		IEC 61439-1
Inspection of a	ssembly, inspection of wiring and electrical		х		IEC 61439-1
EMC – Conducte	ed emission test ⁽²⁾	X			IEC 60533
EMC - Radiated	emission test ⁽²⁾	х			IEC 60533
EMC – Conducte	ed low frequency interference ⁽²⁾	х			IEC 60533
EMC – Power su	pply variation ⁽²⁾	Х			IEC 60533
EMC – Power su	pply failure ⁽²⁾	х			IEC 60533
EMC – Surge vo	ltage test ⁽²⁾	Х			IEC 60533
EMC – Electrical	fast transient test ⁽²⁾	х			IEC 60533
EMC – Electrom	agnetic field test ⁽²⁾	х			IEC 60533
EMC – Electrost	atic discharges (ESD) ⁽²⁾	Х			IEC 60533
EMC – Conducte	ed radio frequency interference test ⁽²⁾	Х			IEC 60533
Dielectric test or	verification of insulation resistance		Х		IEC 61439-1
Complete function	onal tests (including interlocks) ⁽⁴⁾		х		Project documents and IEC 61850
Verification of m	easuring instruments		х		Project documents
Verification of re	lays parametrization and operation (5)		х		Selectivity study and IEC 61850
Verification of si	gnalling devices		Х		Project documents
Verification of he	eating resistors operation		Х		This ET and Data-sheet
Test of interchan	geability of drawers		Х		This ET
Temperature rise	for circuit-breakers	Х			IEC 60947-2
Tripping limits a	nd characteristics for circuit-breakers	Х			EC 60947-2
Dielectric for circ	cuit-breakers	Х			EC 60947-2

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Test	D	R	S	Method and Acceptance Criteria
Operation performance capability for circuit-breakers, where applicable	х			EC 60947-2
Overload performance for circuit-breakers, where applicable	Х			EC 60947-2
Short-circuit breaking capability for circuit-breakers, where applicable	x			EC 60947-2
Short-time withstand current for circuit-breakers, where applicable	Х			EC 60947-2
Voltage and current harmonic measurement up to 50 th component		х		This ET ⁽⁸⁾
Thyristors efficiency measurement	Х			Manufacturer standard (7)

Notes: 1. For all witnessed tests;

UNIT:

- 2. EMC tests shall be carried out when required in IEC 60533 for the equipment installed in the Panel;
- 3. Manufacturer shall be present at site, after the panel assembly and transport, to verify, together with PETROBRAS, if the Panel is at the same conditions as it was when factory delivered it and to verify if the Panel is ready to start operation;
- 4. These tests shall include all tests related to network communication among devices (alarms, interlocks, GOOSE, etc.). For IEC 61850 networks, these tests shall use calibration boxes certified for IEC 61850;
- 5. These tests shall include check of A/D converters of relays. For relays specified for IEC 61850 protocol, these tests shall use calibration boxes certified for IEC 61850.
- 6. Design verification by comparison with a reference design for short-circuit withstand strength of the protective circuit can be submitted for PETROBRAS analysis and approval.
- 7. Thyristors measured efficiency shall be equal to or higher than efficiency informed in documents for proposal.
- 8. For this measurement either, a power quality meter shall be incorporated to panel, or a safe access to internal voltage and current transformers shall be available. See Note in section 6.3.1 i).

6. MANUFACTURER DOCUMENTATION

Documents provided by Manufacturer shall be delivered in an electronic format (original version and PDF version), the original documents shall be editable, and the PDF documents shall be searchable.

6.1. DOCUMENTS TO PROPOSAL

- 6.1.1. The following documents and information shall be annexed to the proposal:
 - a) Documents list.
 - b) Dimensional drawings including frontal and upper views, estimated weight and thermal dissipation at full and half load.
 - c) Full thyristors and heatsinks data, including i²t.
 - d) Technical catalogues with information about all components.
 - e) Spare parts list for two years of operation, including item, part number, quantity, description, MTBF (Mean Time Between Failure) and prices for each part.
 - f) Technical assistance prices and representative address.
 - g) Panel Data-sheet fulfilled with Manufacturer data and with identification of the person responsible for the filling. This Data-sheet shall be submitted to PETROBRAS approval.

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	h) Lis	st of applicable standards.						
	i) Ins	spection and test schedule, including acceptance criteria for each	test.					
	j) Ty	pe tests certificates.						
	 k) Time-current curves, current peak limiting curves and maximum i²t values of th moulded case circuit-breakers. 							
	l) On	e-line electrical drawings.						
	m)Ot	her documents required in project documentation.						
6.2. DC)CUM	ENTS FOR APPROVAL						
6.2.1.	The fo	ollowing documents and information shall be submitted for PET	ROBRAS approval:					
	a) Do	ocuments list.						
	b) Di ey	mensional drawings including frontal and upper views, details velets and area for incoming cables, fixing base details.	, location of lifting					
	c) We	eight and volume for each unit for transportation.						
	d) To	tal weight and thermal dissipation at half load and full load.						
	e) Ele	ectrical drawings, including one-line, three-lines and functional c	liagrams.					
	f) Co	nnection diagrams, including all terminal blocks.						
	g) Sa	turation curves of current transformers.						
	h) Co	mponents and material list per functional unit.						
	i) Tii m	me-current curves, current peak limiting curves and maximum oulded case circuit-breakers.	m i ² t values of the					
	j) Pa	ckage and transportation instructions.						
	k) Wa	arranty certificate and declaration of availability of spare parts for	or 10 (ten) years.					
	l) Vo	oltage and current harmonic contents spectrum up to 50th compo	nent.					
	m)Ne	twork architecture internal to the Panel (if applicable).						
	n) Ne eç	twork configuration, parameterization, screens, and monitoring d uipment that will be connected by network (if applicable).	ocumentation for all					
	o) Ex co	pected MTTR (Mean Time to Repair) for each functional omponent.	unit and for each					
	p) Ty	pe tests certifications.						
6.3. DO)CUM	IENTS AFTER APPROVAL						
6.3.1.	The f	ollowing documents shall be provided by Panel Manufacturer, w	ith the Panel:					
	a) Da	ta-sheet fulfilled "as built".						
	b) Sto	prage, lifting and unpacking instructions.						
	c) Ins	stallation and assembly instructions.						
	d) Op	peration instructions.						

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e) M	laintenance instructions, including list of necessary equipment, ac	cessories and tools.
f) Sj	pare parts lists.	
g) "A	As built" technical catalogue for all components.	
h) C	omplete tests report, including type, routine and special tests.	
i) V c	oltage and current harmonic contents spectrum measurement component.	report, up to 50 th
N	ote: This test measurement shall be done at factory. A power qualit shall be issued presenting: currents and voltages rms and wave of voltage and current peaks. Analysis of dV/dt and di/d comparing to installed maximum thyristor acceptance value devices (MOV, Snubber, tec) shall also be submitted.	y monitoring report values, and records t maximum values s and its protection
	Provisions shall be provided (safe access to internal vertices transformers or a power quality meter) for repeating this test meter, with loads installed.	oltage and current neasurement later at
j) O c tu t f	nly for parallel circuits with incoming air circuit-breaker incom- complete version of configuration, parameterization, and monitorin o communication capability of incoming air circuit-breaker and a hat could be configured or monitored by software. These software acilities for full diagnosis of respective device.	ing circuits case: a ng softwares related ny other equipment vares shall provide
k) C	omplete manuals for installation and configuration of all software	
Note: A la re Sl	t least, two copies in English language and two copies in Banguage shall be provided for all reference manuals. Manuals shall coquirements of NR-12 as defined in I-ET-3010.00-514 PECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORM	razilian Portuguese comply with content 40-700-P4X-001 - E UNITS.
7. PACKA	GE, TRANSPORT, AND STORAGE	
7.1. Panels sh transport.	all be packed properly for the foreseen transportation, so that no da , storage and lifting operations.	mage occurs during
7.2. Each volu	ume shall be properly identified with:	
a) 1 b) 1 c) 1	Storage position. PETROBRAS unit, achievement, and business unit. Delivery address. Material Requisition number	

- e) Transformer PETROBRAS TAG.
- f) Manufacturer name and address.
- g) Weight.
- h) Contract number.
- 7.3. Equipment transport shall be indicated das defined in IEC 60721-3-2.
- 7.4. Equipment storage conditions shall be indicated das defined in IEC 60721-3-1.

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8. TRAINING

- 8.1. Manufacturer shall provide training for at least 10 (ten) PETROBRAS personnel, about Panels system and components.
- 8.2. Training shall be provided in Brazil, during commissioning period, in Portuguese language.
- 8.3. Training plan shall include at least control diagram analysis, storage, transportation, installation, operation, corrective maintenance, preventive maintenance, disassembly, assembly, extraction and insertion of drawers, use of tools and accessories, interface with automation, use of software, configuration, parameterization and adjustment, equipment, and devices.
- 8.4. Manufacturer shall provide training record file (audio and video) and training material file (pdf, powerpoint or word) within 5 days after training.

9. SPARE PARTS AND TOOLS

- 9.1. Manufacturer shall provide a spare, not installed set of thyristors with local control board (set related to one outgoing feeder). Any control board common to all thyristors shall also be included as spare.
- 9.2. Manufacturer shall provide the necessary spare parts for the commissioning and pre-operation periods.
- 9.3. Manufacturer shall provide a list of spare parts for all electrical equipment, for at least 2 (two) years of continuous operation, including prices and part number codes.
- 9.4. Manufacturer shall provide all unusual tools necessary for maintenance, assembly or disassembly of the equipment.
- 9.5. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.

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10. ACR(ONYMS				
AC	Alternate current	IEEE	Institute of Electric Engineers, Inc	al and Electronics	
ACB	Air circuit-breaker	IR	Intelligent Relay		
A&C	Automation and Control System	IT	Isolated system, o earthed system	r impedance	
ANSI	American National Standards Institute, Inc	IMD	Insulation Monitoring Device		
ASTM	American Society for Testing and Materials	МСВ	Moulded-case circuit-breaker		
CDC	Switchgear (<i>Centro de Distribuição</i> de Cargas)	МСС	Motor Control Cen	iter	
CT	Current transformer	MCT	Multi-cable transit		
CSS	Control System Station	MMR	Microprocessed-bar relay	ased multifunction	
DC	Direct current	MODU	Mobile Offshore D	rilling Units	
EFI	Ground fault detector (Earth Fault Indicator)	MOV	Metal Oxide Varistor		
EMC	Electromagnetic Compatibility	MTBF	Mean time betwee	en failure	
ESD	Emergency shut-down	MTTR	Mean time to repair		
FPSO	Floating Production Storage and Operation Unit	NEMA	National Electrical Association	Manufacturers	
FSO	Floating Storage and Operation Unit	PE	Protective earth (b	bar)	
IE	Instrument earth (bar)	PF	Power factor		
IEC	International Electrotechnical Commission	VT	Voltage transforme	er	



Notes:

- 1- Rated voltage, indicated as "X", shall be according to PETROBRAS documentation for the heated equipment and to be confirmed by Detailed Design.
- 2- External control could be Control Panel or CSS, depending on each equipment. Communication according to PETROBRAS documentation for the heated equipment and I-ET-3010.00-1200-800-P4X-002 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.
- 3- Incoming circuit-breaker may be excluded, depending on requirements of item 4.10.3.
- 4- ONE-LINE DIAGRAM for the Project shall be verified for Power Panel incoming connections.
- 5- Push-button to open and block upstream circuit-breaker.
- 6- Quantity of outgoing circuits according to PETROBRAS documentation for the heated equipment.
- 7- Signal from temperature sensors installed in resistive elements, to avoid overtemperature at these elements. Installed (including quantity) when required in PETROBRAS documentation for the heated equipment and when required by Manufacturer. Mandatory installation for flammable gas heaters.
- 8- Signal from temperature sensors installed in heated equipment, to control the temperature. Installed (including quantity) when required in PETROBRAS documentation for the heated equipment and when required by Manufacturer. Mandatory installation for flammable gas heaters.
- 9- Other signals, devices and connections may be included according to PETROBRAS documentation for the heated equipment and when required by Manufacturer.
- 10- The IMD (Insolation Monitoring Device) is installed in the CDC/MCC upstream of the Power Panel for Thyristorized Heater. Manufacturer shall guarantee full compatibility between EFI and upstream CDC's IMD. When the Power Panel is fed by dedicated transformer, the Power Panel shall be supplied with its own IMD within the Power Panel.
- 11- EFIs shall be used to disconnect the power supply whenever the insulation resistance is not greater than 50 ohms per volt of rated voltage, in accordance with IEC 60079-14. The trip signals shall be sent to the corresponding faulty feeder contactors.
- 12- Low insulation shall generate an alarm signal to be sent to topside electrical system automation controllers.
- 13- Status signals (ON / OFF) to remote monitoring from Electrical System Workstations.
- 14- Power Electronics / Thyristor modules shall include fast (high-speed) fuses to protect thyristors.



Notes:

- 1- Rated voltage, indicated as "X", shall be according to PETROBRAS documentation for the heated equipment and to be confirmed by Detailed Design.
- 2- External control could be Control Panel, or CSS, depending on each equipment. Communication according to PETROBRAS documentation for the heated equipment and I-ET-3010.00-1200-800-P4X-002 AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS.
- 3- Communication capability for incoming circuit-breaker according to I-ET-3010.00-5140-797-P4X-001 ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.
- 4- ONE-LINE DIAGRAM for the Project shall be verified for Power Panel incoming connections.
- 5- Interlock to avoid simultaneous closing of both circuit-breakers.
- 6- Quantity of outgoing circuits according to PETROBRAS documentation for the heated equipment.
- 7- Signal from temperature sensors installed in resistive elements, to avoid overtemperature at these elements. Installed (including quantity) when required in PETROBRAS documentation for the heated equipment and when required by Manufacturer. Mandatory installation for flammable gas heaters.
- 8- Signal from temperature sensors installed in heated equipment, to control the temperature. Installed (including quantity) when required in PETROBRAS documentation for the heated equipment and when required by Manufacturer. Mandatory installation for flammable gas heaters.
- 9- Other signals, devices and connections may be included according to PETROBRAS documentation for the heated equipment and when required by Manufacturer.
- 10- Alarm signal (ground fault) to remote monitoring from Electrical System Workstations.
- 11- EFIs shall be used to disconnect the power supply whenever the insulation resistance is not greater than 50 ohms per volt of rated voltage, in accordance with IEC 60079-14. The trip signals shall be sent to the corresponding faulty feeder contactors.
- 12- Incoming circuit-breaker of Power Panel shall open in case of actuation of protection function 49 (overload) in upstream transformer.
- 13- Interlock with circuit-breaker in transformer primary. Secondary circuit-breaker shall open when primary circuit-breaker opens.
- 14- "Operação / Manutenção" selector switch and respective signalling. See 4.14.1.
- 15- Individual Status SIGNAL from each output to be sent to MMR, as defined in 4.13.3 and 4.13.4.
- 16- Power Electronics / Thyristor modules shall include fast (high-speed) fuses to protect thyristors.