PETROBRAS	**TECHNICAL SPECIFICATION**	No. I-ET-3010.00-5140-773-P4X-003	
	CLIENT:		SHEET: 1 of 45
	JOB:		--
	AREA:		
SRGE	TITLE: **SPECIFICATION FOR A.C. UPS FOR OFFSHORE UNITS**		INTERNAL
			ESUP

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1 OBJECTIVE

1.1 This Technical Specification establishes the minimum requirements demanded for manufacture and supply of Uninterruptible Power Supply System (UPS). This system shall include at least associated equipment such as rectifiers, inverters, static switches, bypass transformers, batteries, distribution panels and protection devices.

1.2 Classification Society requirements shall prevail over requirements of this document.

2 REFERENCE STANDARDS AND DOCUMENTS

2.1 GENERAL

2.1.1 The Uninterruptible Power Supply system shall conform in design, material and performance, except where otherwise specified, with the current issues and amendments of the following Standards. Compliance with this Standard shall not relieve the supplier of its responsibility to supply UPS suited to meet the specified service conditions and applicable regulations.

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

2.2 CODES, STANDARDS AND RECOMMENDED PRACTICES

IEC – INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60044-3	Instrument Transformers - Part 3: Combined transformers Second Edition
IEC 60044-7	Instrument Transformers - Part 7: Electronic Voltage Transformers First Edition
IEC 60044-8	Instrument transformers - Part 8: Electronic Current Transformers First Edition
IEC 60051	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories, All Parts;
IEC 60076-1	Power transformers – Part 1: General;
IEC 60076-11	Power transformers – 11: Dry-type transformers IEC 60092 (all parts) Electrical Installation in Ships;
IEC 60076-12	Power transformers – Part 12: Loading guide for dry-type power transformers;
IEC 60085	Electrical insulation – Thermal evaluation and designation;
IEC 60092	All Parts – Electrical installation in ships;
IEC 60146-1-3	Semiconductor convertors requirements and line commutated convertors Part 1-3: Transformers and reactors;
IEC 60255	Electrical Relays, All Parts;
IEC 60269	Low Voltage Fuses;
IEC 60332-3-22	Tests on Electric and Optical Fibre Cables Under Fire Conditions - Part 3-22: Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cables - Category A;
IEC 61439	Low-Voltage Switchgear and Controlgear Assemblies;

IEC 60529	Degrees of Protection Provided by Enclosures (IP Code);
IEC 60664-1	Insulation Coordination for Equipment within Low Voltage Supply Systems; Part 1 Principles Requirements and Tests;
IEC 60664-3	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting, or moulding for protection against pollution
IEC 60947-2	Low-voltage switchgear and controlgear – Part 2: Circuit-breakers
IEC 60947-4-1	Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters
IEC 61000	Electromagnetic Compatibility (EMC);
IEC 61086	Coatings for Loaded Printed Wire Boards (Conformal Coatings) - All parts;
IEC 61378	Converter Transformers;
IEC 61892	Mobile and Fixed Offshore Unis - Electrical Installations, parts 1, 2 3, 4 and 6;
IEC 62040-1	Uninterruptible power systems (UPS) – Part 1: Safety requirements
IEC 62040-2	Uninterruptible Power Systems (UPS) - Part 2: Electromagnetic Compatibility (EMC) Requirements;
IEC 62040-3	Uninterruptible Power Systems (UPS) - Part 3: Method of Specifying the Performance and Test Requirements;
IEC CISPR 16-1-1	Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-1: Radio Disturbance and Immunity Measuring Apparatus - Measuring Apparatus;

IOGP – INTERNATIONAL ASSOCIATION OF OIL & GAS PRODUCERS

IOGP S-701	Supplementary Requirements to IEC 62040-3 AC Uninterruptible Power Systems (UPS).

IEEE - INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERING

IEEE Std 485	Recommended Practice for Sizing Lead-Acid Batteries for Stationary Application;
IEEE Std 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems;
IEEE Std 1115	Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications;

NEMA - NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA PE1	Uninterruptible Power Systems (UPS) – Specification and Performance Verification;

ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIAL

ASTM F 1166	Standard Practice for Human Engineering Design for Marine, Equipment, and Facilities;

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

NR-10	Segurança em Instalações e Serviços em Eletricidade
NR-17	Ergonomia
NR-12	Segurança no Trabalho em Máquinas e Equipamentos
NR-26	Sinalização de Segurança
NR-30	Segurança e Saúde no Trabalho Aquaviário
NR-37	Segurança e Saúde em Plataformas de Petróleo

IMO - INTERNATIONAL MARITIME ORGANIZATION

IMO IA811E	Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU CODE)

ISO - INTERNATIONAL STANDARDIZATION ORGANIZATION

ISO 9000	Quality Management Systems

Note: If requirements mandated by the International Maritime Organization (IMO), International Association of Classification Societies Ltd. (IACS) or any other classification societies, contradicts or conflicts with the requirements of IEC standards, the most stringent shall be applied.

2.3 REFERENCE DOCUMENTS

[1] UPS AND DC SYSTEMS ONE-LINE DIAGRAM

[2] I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS

[3] I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS

[4] I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEM OF OFFSHORE UNITS

[5] EMERGENCY LOADS LIST

[6] DR-ENGP-M-I-1.3 - SAFETY ENGINEERING GUIDELINES

[7] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING

[8] I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST

[9] I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE

[10] METOCEAN DATA

[11] I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS

[12] I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE

[13] I-LI-3010.00-5140-700-P4X-001 - ELECTRICAL EQUIPMENT DATASHEET MODELS

[14] I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS

[15] I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS

[16] I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS

Note: Documents without code in the list are documents with variations according to project characteristics. Verify in project documentation list the reference for codes of these documents.

3 PERFORMANCE

3.1 AC UPS with its rectifiers, inverters, switches, static switches and energy storage devices shall maintain continuity of AC rated output for the consumers indicated in EMERGENCY LOADS LIST.

3.2 AC UPS autonomy time in case of failure of rectifier or main supply is defined in DR-ENGP-M-I-1.3 - SAFETY ENGINEERING GUIDELINES, EMERGENCY LOADS LIST and Project Documents.

3.3 Under all operating and main failure conditions, the UPSs shall continue to supply the rated output power, within the specified output voltage and frequency variations without interruption or loss of performance on normal mode and storage mode conditions, including the following non-simultaneous events:

a) Failure of rectifiers;
b) Switching rectifier control between float and boost modes;
c) Switching manually between normal and bypass operation;
d) Automatic transfer from bypass branch to inverter supply;
e) Automatic transfer from inverter to bypass branch supply;
f) Failure of the main supply to the system;
g) Battery failure;
h) Failure of the alternative supply to the system;
i) Inverter failure;
j) Transformers failure

3.4 AC UPS shall be able to simultaneously, keep the batteries on floating duty, as well as recharge the bank on deep charge (and boost charge), while it feeds all consumers associated to it, with stabilized voltage and current limitation. It shall also be provided with automatic reset to the charging duty when the AC supply is re-established after a failure.

3.5 Irrespective of its configuration, the AC UPS shall achieve Reliability Integrity Level 1 (RIL 1) in accordance with IEC 62040-3.

3.6 The UPS shall be designed to minimize the Mean Time to Repair (MTTR) by using self-diagnostics, comprehensive alarm descriptions and easy accessibility to components and circuits.

3.7 The rated output power of the UPS shall consider the actual loads for the consumers indicated in EMERGENCY LOADS LIST and additionally 20% of future loads.

3.8 UPS shall have capacity to charge the battery bank to 80% of its full load, within a period of 10 hours in accordance with IEC 61892-3.

3.9 UPS shall have capacity to charge the battery bank to 90% of its full load, within a period of 24 hours.

3.10 Static regulation of the output voltage shall be ±1 %, as per test conditions. During battery discharging voltage will decrease until reaches the minimum operational voltage at the battery terminals.

3.11 The UPS shall be capable of supplying Main AC UPS Distribution Panels with the batteries disconnected and the output voltage remaining within the specified static regulation.

3.12 UPS output voltage shall have a ripple limited to below values:

3.1.1 UPS with battery connected: 1% of output voltage, RMS.

3.1.2 UPS with battery disconnected: 1% of output voltage, RMS.

3.13 The supply of the UPS with battery shall be provided as a limiting characteristic to ripple AC current, in RMS values, in the value specified / limited, in 2% of C10 for lead-acid, VRLA type or 5% C10 if battery is ventilated. Thus, the total AC ripple at the battery terminals shall not exceed the tolerance limits given by battery manufacturer. Or, within the limits specified by the manufacturer of the used/supplied battery.

3.14 The UPS system shall provide rated output power, including all systems (converters, inverters, switches, static switches and batteries) under steady state and transient variations of the input voltage and frequency, as I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

3.15 The UPS system shall provide rated output power, including all systems (rectifier, inverter, switches, static switches and batteries) with output power factor ranging from 0.80 to 1.00, in all operation range.

3.16 The UPS system shall provide rated output power, including all systems (rectifier, inverter, switches, static switches and batteries) with UPS power factor seen by the upstream electrical system equal or higher than 0.75. Capacitors banks for power factor correction shall not be acceptable.

3.17 The radio frequency interference from the equipment shall not exceed the limits specified in IEC 62040-2.

3.18 The equipment performance shall not be affected by externally produced electromagnetic fields.

3.19 The UPS system shall be suitable for supplying non-linear loads up to its continuous nameplate rating.

3.20 The UPS efficiency, under any operational condition, and including all components (rectifier, inverter, static switch, input transformer, output transformer etc.) shall not be lower than:

a) 86% for UPS with a DC link voltage up to 220V;
b) 88% for UPS with a DC link voltage from 220V up to 360V;
c) 91% for UPS with a DC link voltage higher than 360V.

3.21 The UPS shall be capable of supplying 125% for 10 minutes and 150% for 60 seconds of rated power.

3.22 The UPS shall be designed to deliver a short-circuit current of 200% of rated current for 0.1 second without transfer to bypass and with no damage.

3.23 The UPS system shall provide rated output power, including all systems (rectifier, inverter, static switch, input transformer, output transformer etc.) under faults with duration lower than 100ms.

3.24 The UPS system noise level shall not exceed 65dB (A) measured at 1m from the equipment, at any position and at any load current between zero and 100%.

3.25 In case a modular type UPS, the sizing, performance, technical requirements and comprising with this document shall be equal to standalone (monolithic) UPS.

3.26 Redundant UPS shall have ability to temporary parallel operation for loads transference.

3.27 The UPS shall be immune to voltage transients, voltage dips and power supply distortion, according to IEC 62040-2 and IEC 61892.

3.28 The UPS shall be able to withstand transient high frequency voltages of 2kV peak superimposed on the input system voltage as a result of system short-circuit.

3.29 The Total Harmonic Distortion (THD) of the input voltage shall not exceed the limits stated in Table 10.1 of IEEE 519, considering a Short-Circuit Ratio at PCC equal to 20.

3.30 In the event of a failure of the HMI and/or of the equipment internal supervision plates, the UPS shall remain in normal operation supplying the loads.

3.31 The UPS shall be proper for the calculated short-circuit level at UPS incoming point. Detailed Design shall inform these values to Packager.

4 GENERAL

4.1 ENVIRONMENTAL, INCLINATION AND VIBRATION REQUIREMENTS

4.1.1 The ambient temperature design for the UPS shall be 45°C.

4.1.2 The design humidity, as a function of temperature, shall be 95% up to 45°C and 70% above 45°C.

4.1.3 The UPS 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-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

4.1.4 The UPS shall be suitable to operate under inclination variations (static and dynamic) and acceleration conditions specified by the IMO MODU CODE and by the Classification Society.

4.1.5 The UPS shall comply with vibrations requirements defined in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS and Classification Society rules.

4.2 GENERAL REQUIREMENTS

4.2.1 Each equipment of UPS system shall comply with I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEM OF OFFSHORE UNITS.

4.2.2 Modular UPS shall comply with the following additional requirements:

a) The UPS shall be formed by a set of “N” modules and redundancy formed by “R” modules, where “R” shall be at least 2 for “N” ≤6 and “R” shall be 33% of “N” round up for “N”>6;

b) The UPS shall have “hot swap” and “hot stand by” capability for modules replacing;

c) The modules shall be mounted in self-supporting cabinets;

d) Each module shall have dedicated ventilation;

e) In case of failure in any module, an alarm shall be sent to the CSS.

4.2.3 UPSs and their auxiliaries shall be constructed in compliance with the requirements of the Classification Society.

4.2.4 UPS input voltage shall be three-phase type and specified according to the requirements of IEC 60146-1-1, IEC TR 60146-1-2, IEC 60146-2, IEC 62040-3, and IEEE std 519.

4.2.5 UPS electrical components shall be type tested according to IEC standards. These components shall be selected in order to exclude combustible materials and to minimize heat generation.

4.2.6 All internal circuits of the UPS, with the exception of auxiliary circuits (heating resistor, socket, lighting, etc.), shall have at least two redundant hot stand by sources. Each source shall have power from the main branch, power from alternate branch circuit and power from DC link.

4.2.7 The UPS system configuration shall be as UPS AND DC SYSTEMS ONE-LINE DIAGRAM.

4.2.8 All assembly accessories and components shall be immune against electromagnetic and radio frequency interference, (EMI/RFI).

4.2.9 The UPS load neutral shall be isolated from the neutral of the incoming supply, from earth and from the frame of the equipment.

5 CONSTRUCTIONAL REQUIREMENTS

5.1 GENERAL REQUIREMENTS

5.1.1 The UPSs shall be housed in free-standing, floor-mounting, compartmented enclosures. The access shall be possible in both frontal and rear side for any kind of service. Maintenance videos shall be provided with UPS manual.

5.1.2 For redundant systems, each UPS shall be furnished complete and assembled in separate enclosures.

5.1.3 The equipment shall be designed to minimize risk of an internal short-circuit. It shall also provide safety to personnel and safe operation during inspection and maintenance. Under extreme conditions of major short-circuits or equipment failure, there shall be no danger to people in the vicinity of the equipment. Interlocks, barriers and covers shall be provided to prevent incorrect or unsafe operation and to prevent access to energized parts.

5.1.4 The protection degree of UPS enclosure, with doors closed, shall comply with I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS

5.1.5 All terminals and door-mounted components shall be shrouded or otherwise protected by barriers providing a minimum protection degree IP21 with the enclosure door(s) open. This shall apply to all doors or frames giving access to internal components.

5.1.6 The enclosure shall be constructed from folded and welded mild sheet not less than 14 USG thick. The foundation base frame and lifting lugs shall be provided.

5.1.7 It shall be provided an isolated handrail in fixed parts of the frontal side of the UPS enclosure. Cable entry shall be via 3mm thickness removable gland plate(s). Gland plate(s) size shall be adequate to accommodate the cables required. They shall be made of non-magnetic material. The removable sheets shall be provided with neoprene rubber gaskets. MCTs can be used as an alternative. Both solutions MCT and cable gland shall be provided by manufacturer of UPS. The use of any type of sealing mass for cable entrance is forbidden.

5.1.8 Frontal access doors shall be fitted with neoprene sealing gaskets and documents folders. Hinged doors shall not exceed a width of 900mm and shall be provided with lockable handles.

5.1.9 The control circuits and power circuits for each equipment (rectifier, inverter, static switch etc.) shall be segregated in different compartments.

5.1.10 The bypass transformer and the power switches or circuit-breakers shall be segregated from the control and power electronics compartments.

5.1.11 Sufficient internal lighting shall be provided for inspection and maintenance suitable for 220VAC isolated two phases supply from an external source and shall be protected by 2 pole circuit-breakers.

5.1.12 Cooling fans shall be installed with a redundant (N+1) configuration.

5.1.13 The start of standby fans shall be automatic. Particular attention shall be paid to the location of ventilation louvers and their arrangement. Dust filters shall be provided on all louvers and shall be easily replaceable during operation.

5.1.14 It shall be possible to replace the fans without having to dismantle any other subsystems (rectifier, inverter, static switch, transformers, power modules etc.) of the UPS.

5.1.15 In the event of a cooling fan being out of service, the UPS shall continue to deliver the rated load without switching to bypass mode until the alarm temperature of UPS defined by manufacturer.

5.1.16 Fans shall be equipped with monitoring facilities to provide an alarm in the event of a fan failure.

5.1.17 The UPSs shall comply with the general human engineering design criteria for its enclosure, components and Human-Machine interface, according to the recommendations stated in ASTM F1166.

5.1.18 It shall not be necessary to open the UPSs doors to operate the circuit-breakers or any other devices during operation of the system.

5.1.19 Protection devices that cause the UPS to trip shall not be mounted on the door.

5.1.20 Power Main circuit switches and moulded case circuit-breakers (MCCBs) shall have padlocking facilities.

5.1.21 Circuit-breakers shall comply with IEC 60947-2.

5.1.22 Transformers and reactors used for input and output isolation shall be air-cooled type.

5.1.23 The UPS shall be constructed so that thermal inspection by optical infrared thermographic devices could be safely performed with the circuits energized.

5.1.24 Capacitors (DC link and outgoing) shall be protected of internal overpressure.

5.1.25 Busbars shall be of electrolytic copper, dimensioned to rated current in steady state condition. Insulators duly dimensioned, for the specified voltage class shall support bars.

5.1.26 An engraved instruction notice shall be affixed to the equipment in a document holder location. The notice shall list procedures to be employed in switching for start-up, shutdown, load transference (synchronized), maintenance, and test operation.

5.1.27 UPS shall have simple construction and easy maintenance.

5.2 ELECTRONIC EQUIPMENT

5.2.1 The UPS system electronic equipment shall be the solid-state type and air cooled.

5.2.2 All connections to subassemblies, (e.g. transformers, semiconductor heat-sink assemblies, control modules etc.), shall be made via centralized termination or connection blocks.

5.2.3 Printed circuit boards shall be according to requirements of I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS. They shall also have a clear identification of the mounted components and external interfaces.

5.2.4 All external connections of the printed circuit boards shall be made through polarized non interchangeable terminal blocks. Gold plated terminal blocks shall be selected for the signal paths.

5.2.5 Printed circuit control boards shall be independent for each stage: rectifier, inverter and static switches, and their interfaces designed shall make impossible a fault at one stage to cause damages in the others.

5.2.6 Useful points and adjustment points shall be placed in such a way that it shall not be necessary to reach exposed live parts for access them during live measurements/testing.

5.2.7 All exposed live parts shall be shrouded and provided with warning labels.

5.2.8 The electronic components of the automatic regulation device shall be assembled on a single chassis, with an easily removable protecting casing. The electrical connections shall be “plug-in” type.

5.2.9 Diodes or thyristors shall be fitted with heat sinks, cooled by natural convection or by forced ventilation.

5.2.10 UPS electronic components shall be perfectly insulated from any contact with ground, in order to minimize the radio-interference effects.

5.3 GROUNDING

5.3.1 A grounding bar shall be provided along the full length of each enclosure. All metallic non-current-carrying parts shall be bonded together and connected to the grounding bar. Grounding terminals shall be provided to facilitate connection of the enclosures to grounding system, according to requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS

5.3.2 Panel-mounted equipment with exposed metal parts such as indicating lights, push buttons and relays shall be adequately grounded.

5.3.3 Provisions shall be made for connecting the grounding conductors and the cable armouring of all outgoing circuits.

5.3.4 Doors and hinged parts shall be bonded to the UPS structure by means of flexible copper connections having a minimum cross-sectional area of 6mm2 and arranged so that they cannot be trapped as the door is opened or closed.

5.3.5 Grounding cables shall be according with to requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

5.3.6 Connections from the main grounding bar to components shall consist of green/yellow sheathed stranded copper conductors. Termination lugs shall be compression type.

5.4 WIRING AND TERMINALS

5.4.1 All the internal wiring shall be of stranded copper, with EPR, XLPE or PVC insulation, flame retardant according to IEC 60332-3-22, Cat. A. Power cables shall be class 0.6/1kV. The minimum cross sections shall be 2.5mm^2 for current control circuits. Solid conductors shall not be used. Also, the internal wires shall be non-toxic and have a low smoke index.

5.4.2 The UPS and panels shall be delivered with all devices completely connected. Wiring shall be arranged so that the insulation shall not be subject to injurious temperature.

5.4.3 Internal wiring shall be adequately supported by clamping of loomed runs or installed in plastic cable tray. Self-adhesive fixing is not acceptable. The supporting arrangements for wiring shall be such that they are not liable to cause permanent physical damage or deformation to the conductor insulation. Wiring shall not be bent to a radius lesser than the permissible value given by the approved manufacturers. Cable channels fill shall not exceed 75% of their capacity.

5.4.4 Internal panel wiring shall be identified by heat-shrinkable ferrules, at each end, with numbers allocated by the Manufacturer. All wiring drawings shall clearly identify the appropriate reference numbers. All wiring shall be terminated with pin-crimped terminations.

5.4.5 Terminal blocks shall be arranged to facilitate accessibility for cable cores termination and inspection of terminal identification numbers. Terminals shall be of the pinch-plate type.

5.4.6 Terminal blocks shall be logically grouped, indelibly marked and provided with removable plastic shrouds. Segregation of different voltage levels within terminal blocks shall be achieved by barriers. Voltage levels shall be clearly identified by labels.

5.4.7 No more than one wire shall be inserted into any one terminal. Looping between terminals, when required, shall be carried out using proper bridges.

5.4.8 Terminal blocks associated with external sources of supply shall be fully shrouded and fitted with a danger warning label.

5.4.9 Terminals associated with external current monitoring signals shall be provided with easily removable shorting plugs.

5.4.10 At least 300mm clearance shall be allowed between the gland plate and any internal equipment to permit easy cable installation and connection.

5.4.11 Panel wiring shall be arranged so that, front access to the connecting stems of relays and other apparatus and to contacts of control and other switches is not impeded.

5.4.12 Wiring looms crossing from fixed to hinged panels shall be mechanically supported on both adjacent panels. The hinged side shall be fixed by means of saddles or compression-type supports.

5.4.13 Wiring colors shall be as defined in I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

5.4.14 Spare Terminals equal to at least 10% of the total used and shall be provided to enable any spare multicore cable conductors to be terminated.

5.5 CABLE TERMINATION

5.5.1 All cable entries shall be from bottom side, otherwise stated in Project Documentation and all connections shall be made from the front of the panel. Cable entry shall be via 3mm thickness removable gland plate(s).

5.5.2 Undrilled removable non-magnetic gland plates shall be provided on cable termination compartments. Gland plate(s) size shall be adequate to accommodate the cables required. The removable sheets shall be provided with neoprene rubber gaskets. MCTs can be used as an alternative. Both solutions MCT or cable gland shall be provided by manufacturer of UPS or Main AC UPS Distribution Panels. The use of any type of sealing mass for cable entrance is forbidden.

5.5.3 The terminals shall be arranged so that connection of cables can be done safely and without exposure to adjacent live parts.

5.5.4 Inside the compartments, separate terminals or bolts of adequate dimensions, one for each cable, shall be fitted for cable armouring grounding purposes.

5.6 ANTI-CONDENSATION HEATERS

5.6.1 Space heaters, controlled by thermostats shall be provided for each column and shall have minimum protection degree IP20, in accordance with IEC 60529.

5.6.2 Heaters shall be suitable for 220VAC isolated two phases supply from an external source and shall be protected by 2 pole circuit-breakers.

5.6.3 External power supply to the heating resistor shall be possible during the transportation and storage period without having to open the packaging.

5.6.4 The temperature shall be controlled by an adjustable thermostat with a maximum adjustment value of 60°C, supplied with the UPS. Surface temperature of all heaters shall not exceed 60°C.

5.6.5 An indication lamp shall be provided with a label “RESISTOR DE AQUECIMENTO LIGADO”.

5.6.6 The power supply voltage of heating resistor shall be clearly indicated in the external side of package.

6 MAIN COMPONENTS

6.1 RECTIFIER

6.1.1 The incoming circuit-breaker shall be a MCCB and shall have a load breaking, fault-making capacity in accordance with IEC 60947, utilization category AC-23. Fast action fuses compatible with the A^2s characteristic of the power semiconductors shall be added to the system if the circuit-breaker shall not provide this protection.

6.1.2 The rectifier shall be minimum of 6 pulses type, with constant voltage and current limiting control circuits and soft start philosophy. The components within the rectifier shall be capable to operate independently from the remaining system.

6.1.3 The rectifier shall be formed by a thyristorized semiconductor rectifier bridge or switching rectifier.

6.1.4 The rectifier shall operate with battery types indicated in I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS with constant voltage and current limiting control circuits.

6.1.5 UPS shall be provided with switch(es) considering the following operation modes:

a) Floating
b) Equalization
c) Boost Charge
d) Manual
e) Automatic

6.1.6 The float or boost charge voltage shall be adjustable while the UPS is in operation without requiring the outage of the UPS.

6.1.7 The boost charge selection shall be automatically cancelled after a timed period if it is likely to cause harm to the batteries. Boost-charging shall only be used when the battery characteristic permits in manual and automatic mode.

6.1.8 The duration of the boost charging shall be controlled by:

a) automatic timer; or
b) feedback of the battery current and voltage indicating that adequate battery charge has been achieved.

6.1.9 After batteries undergo a period of discharge, boost charging shall be automatically initiated and continue until the batteries are fully recharged if in auto mode.

6.1.10 The rectifier unit shall revert automatically to float charging upon completion of the boost charging or equalization charging if in auto mode.

6.1.11 The rectifier shall be provided with on-line battery capacity monitoring system and test facilities to continuously assess individual cell condition of the battery bank.

6.1.12 The rectifier shall be provided with on-line battery capacity testing facilities to perform on-line battery capacity testing by discharging of the battery into the load.

6.1.13 The circuits shall have means to avoid accidental contact to energized parts.

6.1.14 The rectifier input, battery output and consumer output shall be provided with suitable overcurrent protection with short-circuit capacity suitable to the short-circuit conditions indicated on the datasheet. These devices shall be selective with the UPS internal protection devices.

6.1.15 The rectifier unit shall restart automatically upon restoration of the mains power supply following a power interruption.

6.1.16 An additional inductor shall be provided by the UPS manufacturer to meet the current ripple limitations in the battery if it is necessary to reduce the current ripple in the battery to values within the specified above.

6.2 BATTERY

6.2.1 Regarding batteries specification, see I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS.

6.3 DC LINK

6.3.1 The DC LINK shall reduce the ripple content of the DC supply, eliminate voltage peaks and maintain a constant DC input voltage to the inverter.

6.3.2 DC Link circuit shall not be grounded.

6.3.3 A filter shall be provided on the DC link output to minimize high frequency spikes and prevent voltage ripple feedback from the inverter. Filtering shall be designed to suppress a transient of 4,000 volts, with 10 micro-second duration, occurring at the battery input terminals.

6.3.4 The rectifier output steady state voltage shall not change more than ±0.5% at the battery output terminals from no-load to full-load, with input voltage and frequency variations in accordance with I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

6.4 INVERTER

6.4.1 The static inverter shall be of pulse-width-modulation (PWM) type, generating three-phase AC power. The inverter shall provide continuous and uninterruptible AC power while operating from any DC source within the operating input range. The angles between phases shall have a precision of ±1% for balanced loads and ±3% for 100% unbalanced loads.

6.4.2 The inverter shall be controlled by sine-triangle PWM modulation and use Insulated Gate Bipolar Transistors (IGBTs), to synthesize a clean sinusoidal output.

6.4.3 The inverter rated output voltage shall be 220Vac 3ph. The output voltage shall be adjustable in a range from 95% to 105% of the rated value.

6.4.4 The free-running, steady state output frequency of the inverter shall not deviate more than ±0.1% within the following conditions:

a) 0% to 100% load;

b) Minimum to maximum ambient temperature;

c) Minimum to maximum DC bus voltage.

6.4.5 The output frequency of the inverter shall be controlled by a crystal-controlled oscillator, which can be operated as a free-running unit or synchronized with an AC source. The inverter shall operate normally synchronized, tracking the AC reference source until a deviation of ±3.0Hz. Upon failure of the reference source or frequency deviation from 60Hz greater than ±3.0Hz, the oscillator shall automatically revert to its free-running mode.

6.4.6 The inverter shall control the output voltage to maintain synchronism with the bypass voltage during reference frequency variations, up to the synchronization limits specified.

6.4.7 The inverter shall revert to the internal frequency control if frequency variations exceed the allowable synchronization limits.

6.4.8 The inverter voltage transient response shall not exceed +5% to -5% due to a 100% step load change. The output voltage, following the step load changes listed above, shall begin to recover immediately. Return to within ±1% of the steady state output voltage shall occur within 3 cycles.

6.4.9 In the event of a fault on the outgoing circuit of the UPS distribution, the inverter shall operate the downstream protection:

a) within 20 milliseconds;

b) without damage; and

c) without transfer to the bypass supply.

6.4.10 The inverter shall limit the Total Harmonic Distortion of the output voltage to less than 3% RMS total with 100% linear load or less than 5% RMS with 100% nonlinear load. No individual harmonic shall exceed 3% as defined in standard IEC 62040-3.

6.4.11 The inverter shall be capable of withstanding a three-phase short-circuit at its terminals without equipment damage.

6.4.12 The inverter(s) shall be provided with On-Off control switch.

6.4.13 Inverter(s) shall be complete, with internal protection and current-limiting devices to prevent damage to components and voltage surges at the output.

6.4.14 With the DC input voltage varying between battery high-rate charge and end of discharge voltage, the inverter shall keep the output voltage and frequency within the operational tolerances.

6.4.15 The inverter shall be capable of supplying non-linear loads exhibiting a crest factor up to 3.0 at full load without additional filtering or increasing the size of the system.

6.4.16 The inverter frequency rate of change shall not exceed 1 Hz/second when synchronizing to the bypass reference.

6.4.17 During an overtemperature on the inverter heat sinks, the UPS shall automatically transfer the load according to the transfer static switch operation described on item 6.5. A Manual re-transfer of the load to the inverter shall be permitted when the temperature returns to normal.

6.4.18 If the inverter Gate Drive senses a de-saturation on an IGBT, it shall automatically turn off its gate drive and all other gate drives. A de-saturation condition occurs when a high over-current (overload) condition develops or there is a power supply failure to the inverter gate drives. The Static Switch shall sense this condition and automatically transfer the load according to the transfer static switch operation described on item 6.5.

6.4.19 When the DC voltage rises above or drops below a predetermined set point the inverter drive shall shut off, protecting the inverter. The Static Switch will sense this condition and automatically transfer the load according to the transfer static switch operation described on item 6.5.

6.4.20 The inverter shall be able to feed the load when the batteries were switched off since the DC link voltage is available from de rectifier. Proper alarm and signalization shall be performed in this condition.

6.5 STATIC TRANSFER SWITCHES

6.5.1 The static switches shall be designed to comply with the requirements defined on IEC 62040-3.

6.5.2 The complete static bypass circuit shall have a short time current rating suitable for 1000% of the UPS current rating for 50 milliseconds.

6.5.3 Basic operation of Redundant UPS configurations is in normal operation the loads will be fed through the main supply (rectifiers/inverters circuits). After transference the loads will be fed through alternative supply (bypass transformer).

6.5.4 Static switch transference requirements:

6.5.4.1 Static switch transference is in manual or automatic and in synchronism or out of synchronism condition.

6.5.4.2 Features shall be provided for manual transference from the main supply to the alternative supply and vice-versa.

6.5.4.3 The load shall only be transferred manually or automatically from main supply to alternative supply under steady state and transient variations of the input voltage and frequency, as I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

6.5.4.4 The transfer in synchronism mode shall be accomplished with no interruption of the supply to the load. The transfer shall be completed in less than 4ms.

6.5.4.5 The static switch shall automatically transfer the load from the main supply to alternative supply, whenever any of the following events occur:

a) Inverter failure;
b) The battery is approaching the end of the cell voltage;
c) The inverter is subject to an overload beyond its capacity;
d) Short-circuit at inverter terminals;
e) Rectifier failure.

6.5.4.6 In case of failure in the main supply upstream of the inverter and if the alternative supply output voltage is out of range, if the battery bank is ready for operation, the loads shall be kept fed by the battery bank.

6.5.4.7 When the loads are being fed by the alternative supply, in case of failure in the alternative supply and simultaneously failure in the main supply upstream of the inverter the static switch shall transfer to main supply, if the battery bank is ready for operation.

6.5.4.8 The load shall automatically be re-connected to the inverter after restoration of inverter output and synchronization. The Static Switch shall not allow a transfer from Bypass to the Inverter when one of the following conditions exist:

a) Lack of synchronism;
b) Inverter or Charger heat sinks over temperature.

6.5.5 It is not permitted the parallel operation between the inverters and the transformer sources, even if momentary.

6.5.6 The static switch shall be completed with internal protection devices to prevent damage to components. They shall be able to withstand at least twice the rated voltage peak value without damage or operation failure.

6.6 TRANSFORMERS

6.6.1 Transformers shall be installed as indicated in the TOPSIDE UPS AND AC SYSTEMS ONE-LINE DIAGRAM OF THE PROJECT.

6.6.2 Transformers shall be designed according to IEC 60076 and shall have insulation class F with temperature rise class B.

6.6.3 Transformers construction shall be of the dry type, with electrostatic shield, double wound, with a grounded shield between windings, configured to suit the uninterruptible power supply system.

6.6.4 Windings shall be moulded/encapsulated in epoxy resin under vacuum (cast-resin), pre-impregnated with end-packing sealed with epoxy resin, encapsulated with glass fiber epoxy resin under vacuum or resin impregnated windings. Other solutions shall be submitted to PETROBRAS for approval.

6.6.5 The input transformer shall be sized for the harmonic content according to IEC 61378-1.

6.6.6 The input transformer shall have rated primary as UPS AND *D*C SYSTEMS ONE-LINE DIAGRAM.

6.6.7 The bypass transformer shall be provided with an individual incoming.

6.6.8 The bypass transformer shall be rated for continuous operation with 125% the rated power of the inverter.

6.6.9 The bypass transformer shall be furnished with the following taps: ±2.5%, ±5% and 0% at the higher voltage side.

6.6.10 The bypass transformer shall be capable of operating at its rated power output on any tap.

7 PROTECTION

7.1 The UPS shall be fully protected to prevent damage to any internal component. All circuits shall be adequately protected by means of circuit-breakers or fuses. The protective device shall be readily accessible.

7.2 MCCB shall have asymmetrical making and breaking capacity according to IEC 60947, with externally adjustable thermal and magnetic elements. The thermal element shall be compensated up to a maximum ambient temperature of 50°C. Magnetic trip indication shall be provided.

7.3 MCCB protection shall be provided in the battery charging circuit inside UPS.

7.4 Fuses shall comply with IEC 60269 and shall be fitted in fully insulated carriers and bases.

7.5 Current transformer shall comply with the requirements of IEC 60044. The secondary winding of current transformer shall be grounded and short-circuited through a removable link, with provision for attaching test links. Current transformer shall be rated to withstand the thermal and magnetic stresses resulting from fault current.

7.6 The rectifier shall be protected against overvoltages.

7.7 Another MCCB or fuses in the battery charging circuit shall be provided to protect the cables. It shall be installed inside a box, in a safe place, closer to the batteries room.

7.8 Batteries shall be protected according with UPS AND DC SYSTEMS ONE-LINE DIAGRAM and batteries manufacturer limits.

7.9 Protection against inadequate application of battery polarity shall also be provided.

7.10 The inputs of the static switch shall be protected by ultra-rapid fuses. The output shall be provided with circuit-breaker or connected to a bypass switch.

7.11 The static bypass circuit shall not have fast acting fuses.

8 MONITORING AND SUPERVISION

8.1 GENERAL

8.1.1 The UPS system monitoring, control, annunciation and diagnostics shall be microprocessor based with an HMI including display and keypad entry. The display shall give comprehensive information on the equipment status and full diagnostic information.

8.1.2 In general, the following key(s) actuation devices with its respective visual indication shall be available:

a) “ON”;
b) “OFF”;
c) “PARAMETERS SELECTION”;
d) “ADJUSTING AND PARAMETERS PROGRAM”;
e) “INCREASING OF FUNCTIONS OR CONTROL VALUES”;
f) “DECREASING OF FUNCTIONS OR CONTROL VALUES”;
g) “RESET”;
h) MANUAL COMMAND OF STATIC SWITCH;
i) PRE-SETS AND ADJUSTING PARAMETERS VALUE.

8.1.3 In general, devices for status monitoring, in the form of synoptic or graphical representation, to present a real-time operation of the system with at least the following indications shall be available:

a) Presence of voltage at the main source and within normal parameters;
b) Rectifier in operation;
c) Inverter in operation;
d) DC bus energized and within normal limits;
e) Battery in discharge;
f) UPS by main supply;
g) UPS by alternative supply;
h) Presence of voltage at the alternative source and within normal parameters;
i) Normal static switch;
j) Battery in boost charging;
k) Battery in floating;
l) Battery equalizing;
m) Disconnected battery;
n) Discharged battery;
o) Common AC UPS alarm (necessarily LED signalling light);
p) Power flow pattern through the units;
q) Controls, annunciations and indications described in this specification.

8.1.4 For Conventional synoptic LED brightness shall be such that they are clearly visible in normal artificial lighting levels as requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

8.1.5 In general, HMI shall have at least the monitoring and events (alarms, interlocks and trips) presented in the document I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST for “A.C. UPS SYSTEM”.

8.1.6 The HMI shall have password protected multiple levels of access:

a) for viewing (No password);
b) settings (by trained operating personnel);
c) service (by the manufacturer’s personnel).

8.1.7 The HMI shall have storage for retaining:

a) historical data;
b) event/alarm logging with time, date stamping;
c) historical trending for assisting troubleshooting and failure analysis.

8.1.8 At a minimum, the historical record of the last 2000 events, faults and alarms shall be stored in non-volatile memory.

8.1.9 At least 10 events at a time shall be easily visible on the HMI screen.

8.1.10 All configuration adjustments shall be implemented in the UPS system in non-volatile memory.

8.1.11 The data from the HMI shall be stored in non-volatile memory, to allow recovery of the parameterizations, alarms and the event records even after the battery chargers of UPS system is completely de-energized.

8.1.12 UPS system shall be able to be configured for operation without interrupting the supply of the Main AC UPS Distribution Panels.

8.1.13 Failure of the HMI display or indicating equipment on the UPS shall not compromise the operation of UPS.

8.2 MEASURING INSTRUMENTS

8.2.1 The UPS shall be provided with the following local analogue or digital instrumentation:

a) AC input voltage with changeover switch (RS-ST-TR) for main supply;
b) AC input current with changeover switch (R-S-T) for main supply;
c) AC input frequency with change for main supply;
d) AC input voltage with changeover switch (RS-ST-TR) for alternative supply;
e) AC input current with changeover switch (R-S-T) for alternative supply;
f) AC input frequency for alternative supply;
g) AC output voltage with changeover switch (RS-ST-TR) downstream output transformer;
h) AC output current with changeover switch (R-S-T) downstream output transformer;
i) AC output frequency downstream output transformer:
j) AC output voltage with changeover switch (RS-ST-TR) downstream inverter and upstream static switch;
k) AC output current with changeover switch (R-S-T) downstream inverter and upstream static switch;
l) AC output frequency downstream inverter and upstream static switch;
m) DC link voltage;
n) DC link current;
o) Battery charge/discharge current;
p) Battery voltage;
q) Remaining autonomy time of the battery (percentage or minutes);
r) AC input power for main supply;
s) AC input power for alternative supply
t) AC output power.

Note: If the instruments are digital type, they shall be individual. The precision class shall be 1.5%.

8.2.2 The battery current metering shall clearly indicate the direction of the current flow.

8.3 SIGNALS, ALARMS, TRIPS, AND INTERLOCKS

8.3.1 The I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST presents the minimal electrical interface signals to be implemented by Detailed Design for communication, control, monitoring, alarm and design of screens related to Electrical System, and related to external interfaces among Electrical System and other systems and UPS.

8.3.2 Trip function shall be provided in accordance with Table 1 as a minimum from the document I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST for “A.C. UPS SYSTEM”.

8.3.3 Trip function shall be provided in accordance with Table 1 as a minimum from the document I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST for “A.C. UPS SYSTEM”.

Table 1 – Trip functions

Trouble Description	Rectifier Trip	Inverter Trip
A.C. INPUT MAIN SUPPLY FAILURE	X [1, 2]	-
RECTIFIER FAILURE	X	
DC OVERVOLTAGE	X	-
DC UNDERVOLTAGE	-	X [3]
BATTERIES OVERCHARGING	X	
CAPACITANCE MEASUREMENT	X	
INVERTER FAILURE	-	X
RECTIFIER POWER MODULE OVERTEMPERATURE	X	
INVERTER POWER MODULE OVERTEMPERATURE		X

Notes: 1 In case of the A.C. input voltage falls below allowable limits.

2 When the A.C. input voltage resumes and remains within allowable limits; the rectifier shall start automatically, and no reset is required.

3 The UPS electronic protection shall turn off the batteries for final discharge voltage in the minimum inverter operation range, lower than batteries minimum voltage.

4 Trip functions shall be reset manually, locally, or remotely, except for the A.C. input failure.

8.3.4 It shall be provided auxiliary interposing relays for each UPS to receive different remote signals from A&C presented in the document I-LI-3010.00-5140-797-P4X-001 – ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST for “A.C. UPS SYSTEM”.

8.3.5 The wet signals from A&C shall have interposing relays with enough quantity to convert discrete 24 VDC signal in discrete voltage-free signal. The rectifier shall execute the following actions:

a) Inhibition of batteries recharging when the ventilation of the battery room is turned off;
b) Inhibition of batteries boost recharging when the detection of H_2 occurs.

8.3.6 All UPS alarms shall be visual and Detail design shall define which alarms will be audible from the document I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST for “A.C. UPS SYSTEM”. Test and reset pushbuttons shall be provided.

8.3.7 All the alarms indications shall be latched until reset by means of a reset command. Test and reset push buttons shall be provided.

8.3.8 Alarms shall be arranged so that their operation may be checked by simulation, which shall be as close as possible to the alarm condition.

8.3.9 Alarms related to failure in main supply shall be time delayed for 30 seconds, to avoid alarm during load transference and during temporary power failures.

8.3.10 Alarms and changes in operation modes shall be time stamped and stored chronologically in a non-volatile memory of the HMI in a “first in – first out” rolling manner.

9 COMMUNICATION REQUIREMENTS

9.1 UPS system shall communicate with Electrical System Automation by Ethernet based protocol according with I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

9.2 For UPS, it shall be supplied the memory map for the communication between equipment and Electrical System Automation considering, at least, signals listed in I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST and protocols according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

9.3 UPS system shall be able to be remotely accessed for maintenance, configuration and diagnose using interface according with item 9.1.

9.4 All software for maintenance, configuration and diagnose and their respective licenses for all equipment which will be part of UPS system shall be included in the scope of supply and shall be compatible with the Windows platform.

9.5 It shall be provided an additional license of maintenance software to be installed at ESA Maintenance workstation.

9.6 A list of mapping addresses of the data communication and signaling circuits intended to be exchanged with the information technology equipment (e.g., SCADA system, local area networks (LAN) or telecommunication networks) shall be provided.

9.7 All signals of controllers and peripherals shall be available in the memory map.

9.8 It shall be provided a switch to carry out the network interface between ESA and UPS system.

9.9 General alarms initiators of UAM and UAS shall be available and clearly identified in the event record even if several alarms being generated simultaneously.

9.10 The UPS system shall have its internal clock synchronized with Electrical System Automation Time Server through the time protocol according I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

9.11 All devices with logging or communication capabilities internal to the UPS system shall have its internal clock synchronized with Electrical System Automation. Manufacturer is responsible to provide means of synchronization among internal components which are not connected to Electrical System Automation networks. All other 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.

9.12 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.

10 NAMEPLATES AND LABELS

10.1 The UPSs' first nameplate shall be in accordance with IEC 62040-1 and made with AISI-316L stainless steel.

10.2 The UPS second nameplate shall be outfitted with AISI-316L stainless steel plate of supplemental identification containing, at least, the following data in Portuguese language:

a) PETRÓLEO BRASILEIRO S.A. - PETROBRAS;
b) Fornecedor (Vendor name);
c) Número de série (Equipment serial number);
d) Ano de fabricação (Year of Manufacture);
e) Número do pedido de compra (Purchase order number);
f) Nome do departamento da Petrobras (PETROBRAS department);
g) Nome da plataforma (Name of the platform);
h) Número do TAG da UPS (TAG number of the UPS);
i) Número da RM (number of the RM);
j) Grau de proteção IP (IP protection degree according with IEC 60529).

Note: In alternative to paragraph f), the number of the contract, in the cases of acquisition built-in in contract of the type of lump sum ("Turn Key ", "Lump Sum", etc.).

10.3 UPS shall have their compartments signaled with literal and graphical labels of instructions, cares, warnings and alert of dangers according to the requirements for identification plates listed in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

10.4 Internally to UPS all equipment and components, shall be identified with black acrylic labels, with white letters, containing the codification compatible with design documents (list of materials, diagram, etc.). Alternative methods of equipment and component identifications shall be submitted to PETROBRAS approval.

10.5 Components, printed circuit boards (PCBs), connectors, terminals, instruments, selector switches, indicators and the associated locations of these items shall be identified with labels in accordance with IEC 62040-1.

10.6 Circuit-breakers labels shall include rated current and trip current set.

10.7 All labels and plates shall be secured with non-corrodible screws. Adhesive or self-tapping screws are unacceptable.

10.8 All components incorporated within the unit shall be indelibly marked with the component circuit reference. Handwritten stickers or dynotape labels are unacceptable.

11 PAINTING

11.1 The UPS and the Main AC UPS Distribution Panels shall be painted in accordance with requirements of I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

12 QUALITY ASSURANCE

12.1 The manufacturer shall demonstrate that it has a quality system that ensures that the requirements of this Specification will be achieved. The quality system shall be based on ISO 9000 series of standards and the manufacturer shall demonstrate compliance by providing a copy of the accredited certificate.

12.2 The UPS manufacturer shall furnish the accredited certificate (TYPE APPROVAL) issued by a Classification Society.

12.3 Manufacturer shall warranty the technical assistance at installation site performed by qualified maintenance staff, when requested. These maintenance staff shall have its offices/installation in Brazil for at least one year.

12.4 An obsolescence management plan in accordance with an industry recognized system (e.g. IEC 62402) shall be provided for all UPS assembly components.

13 DOCUMENTATION

13.1 All drawings, instructions, data sheets, design calculations or any written information shall be furnished in English language. All manuals shall be provided in English and Brazilian Portuguese language and comply with NR-12 requirements.

13.2 Manufacturer’s documentation is an integral part of the order, which shall not be considered complete until the full documentation has been delivered as required in the purchase requisition.

13.3 Manufacturer is obliged to deliver the documentation together with, or before delivery of the equipment to allow proper checking before final acceptance of the equipment. If any part of the documentation is not completed, Petrobras will not release the whole payment for the equipment.

13.4 Documentation to be sent attached to the Proposal for Technical Analysis, shall contain, at least, the following documents:

Table 2 - Proposal Technical Documents

Item	Description
1	Documents list with issue deadlines
2	List of deviations or alternatives to specifications
3	Fabrication schedule
4	Reference list of similar installations (note 1)
5	List of technical norms and standards applicable to manufacturing and testing design
6	Warranty and conditions
7	Scope of supply
8	Sub-suppliers list

Item	Description
9	Materials list (note 2)
10	General arrangement (note 3)
11	Layout (note 4)
12	Equipment and accessories performance curves
13	Electric one line diagram
14	Block diagram (note 5)
15	Equipment data-sheet (note 6)
16	Enclosure ventilation requirements
17	UPS calculation memory (note 7)
18	Thermal dissipation (note 8)
19	Complete and detailed scheme of sheet treatment and painting including chemical and physical performance indices
20	Center of gravity and weight
21	UPS operation and description
22	Cause and effect matrix
23	UPS internal automation architeture
24	Installation and assembly procedures
25	Unpacking and preservation procedures
26	Handling and shipping procedures
27	Pre-commissioning and commissioning procedure
28	Storage recommendations before and after assembly
29	List of special tools for assembly and maintenance
30	Recommended spare parts list for installation, commissioning and start-up (note 9)
31	Recommended spare parts list considering the entire life cycle of the equipment (note 9)
32	Quality plan
33	Inspection and test plans
34	ISO 9001 certificate of conformity
35	Factory acceptance test procedure
36	Classification Society certificates (for offshore units)
37	Type approval certificates by the Classification Society (for offshore units)
38	Maritime Authority certificates (for offshore units)
39	Type test reports (note 10)

Note 1: The UPS manufacturer shall present a supply list of similar equipment with a minimum operation of 3 years.

Note 2: Catalogs of UPS parts and components, containing the characteristics and technical specifications, shall be part of this document.

Note 3: The design of all panels, cabinets and equipment that compose the UPS, with dimensions, shall be part of this document.

Note 4: The general distribution of the internal components in the equipment shall be part of this document.

Note 5: The block diagram shall identify the basic UPS systems and their interconnections.

Note 6: The design data sheet shall be fully completed and authenticated by the manufacturer, including the fields referring to the standards applicable to the design, fabrication and testing of the UPS.

Note 7: For batteries calculation memory see I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS.

Note 8: The maximum heat dissipation to the environment of the set of equipment and components in the various operating possibilities with nominal load (normal mode, with battery charging; or stored energy mode, or alternative source power mode) shall be informed.

Note 9: Manufacturer shall provide lists of tools and accessories necessary for maintenance and installation and list of recommended spare parts. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency. The list of spare parts shall be as required in the RM, with a breakdown of the respective codes ("part-number") and unit prices.

Note 10: The UPS manufacturer shall submit a copy of the Type Tests.

13.1 Documents to be sent for Approval shall be, at least:

Table 3 – Technical Documents to be approved

Item	Description
1	Documents list with issue deadlines
2	Fabrication schedule
3	List of technical norms and standards applicable to manufacturing and testing design
4	Warranty and conditions
5	Scope of supply
6	Sub-suppliers list
7	Materials list (note 1)
8	Fabrication progress report
9	General arrangement (note 2)
10	Layout (note 3)
11	List of interfaces and connections
12	Dimensional drawing (note 4)
13	Arrangement of subsets
14	Detailed fabrication drawings
15	Nameplates drawings
16	Electric one line diagram
17	Connections and wiring diagrams/schemes
18	Block diagram (note 5)
19	Equipment data sheet (note 6)
20	UPS Calculation memory (note 7)
21	Center of gravity and weight
22	Cause and effect matrix
23	Detail drawing of load distribution panel (note 8)
24	Functional diagram (note 9)
25	Network communication protocol
26	UPS internal automation architecture
27	List of parts with weight more than 30 kg
28	List of components to be assembled and installed at the installation site (including charging procedure)
29	List of items provided separately
30	Installation and assembly procedures
31	Unpacking and preservation procedures
32	Handling and shipping procedures
33	Pre-commissioning and commissioning procedures
34	Storage recommendations before and after assembly
35	List of special tools for assembly and maintenance

Item	Description
36	Recommended spare parts list for installation, commissioning and start-up (note 10)
37	Recommended spare parts list considering the entire life cycle of the equipment (note 10)
38	Quality plan
39	Inspection and test plans
40	Factory acceptance test procedure
41	Factory acceptance test report
42	Acceptance test at site
43	Instruments testing and calibration certificates
44	ISO 9001 certificate of conformity
45	Classification Society certificates
46	Type approval certificates by the Classification Society
47	Maritime Authority certificates
48	Training program
49	Preservation, installation and operation manuals in Portuguese (note 11)
50	Maintenance manual in Portuguese (note 11)
51	Protection Selectivity and Coordination Analysis

Note 1: List of all UPS components, indicating at least the manufacturer's description, quantity and full coding shall be part of this document.

Note 2: The design of all panels, cabinets and equipment that compose the UPS, with dimensions, shall be part of this document.

Note 3: The general distribution of the internal components in the equipment shall be part of this document.

Note 4: This document shall contain the cross section, exploded view and other views, sections, free area for entry/exit of power and ground cables, location drawings, fixing devices, input and output terminal strip of grounding, power and control circuits.

Note 5: The block diagram shall identify the basic UPS systems and their interconnections.

Note 6: The design data sheet shall be fully completed and authenticated by the manufacturer, including the fields referring to the standards applicable to the design, fabrication and testing of the UPS.

Note 7: For batteries calculation memory see I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS.

Note 8: This document is required in case of supplying the distribution panel together with the UPS.

Note 9: Electrical terminations, electrical connection diagram, all terminal strips with clear identification, alarms, trips, local and remote commands shall be part of this document.

Note 10: Manufacturer shall provide lists of tools and accessories necessary for maintenance and installation and list of recommended spare parts. Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency. The list of spare parts shall be as required in the RM, with a breakdown of the respective codes ("part-number") and unit prices.

Note 11: These manuals shall contain, at least, the information described in item 10.7 of this Technical Specification and the design documentation duly completed as built.

13.2 Documents to be sent in Data Book:

Table 4 – Data Book Technical Documents

Item	Description
1	Documents list with issue deadlines
2	Fabrication schedule
3	List of technical norms and standards applicable to manufacturing and testing design
4	Warranty and conditions

Item	Description
5	Scope of supply
6	Sub-suppliers list
7	Materials list
8	Fabrication progress report
9	Catalog of instruments, materials and components
10	General Arrangement
11	Layout
12	List of interfaces and connections
13	Dimensional drawing
14	Arrangement of subsets
15	Nameplates drawings
16	Electric one line diagram
17	Block diagram
18	Equipment data sheet
19	Calculation memory
20	Center of gravity and weight
21	Cause and effect matrix
22	Detail drawing of load distribution panel
23	Functional diagram
24	Network communication protocol
25	UPS internal automation architecture
26	List of parts with weight more than 30 kg
27	List of components to be assembled and installed at the installation site (including charging procedure)
28	List of items provided separately
29	Installation and assembly procedures
30	Unpacking and preservation procedures
31	Handling and shipping procedures
32	Pre-commissioning and commissioning procedures
33	Storage recommendations before and after assembly
34	List of special tools for assembly and maintenance
35	Recommended spare parts list for installation, commissioning and start-up
36	Recommended spare parts list considering the entire life cycle of the equipment
37	Fabrication registries
38	Data sheets, calculations and adjustments
39	Quality plan
40	Inspection and test plans
41	Factory acceptance test procedure
42	Factory acceptance test report
43	Acceptance test at site
44	Instruments testing and calibration certificates
45	ISO 9001 certificate of conformity
46	Classification Society certificates
47	Type approval certificates by the Classification Society
48	Maritime Authority certificates
49	Training program

Item	Description
50	Preservation, installation and operation manuals in Portuguese
51	Maintenance manual in Portuguese
52	Protection Selectivity and Coordination Analysis

13.5 The UPS and Main AC UPS Distribution Panels assembling, operation and maintenance manual shall be sent for approval before factory acceptance test.

13.6 The UPS operation manual shall contain, at least, the following information:

a) Theoretical foundations;
b) Detailed description of all the features, isolation and switching components, alarms, signals and commands of the UPS;
c) Operating procedures in normal condition, in events of failure and shutdown due to protection action (“trip”);
d) List of error messages, occurrence conditions and respective corrective actions;
e) Procedures for implementing adjustment and parameterization functions;
f) Commissioning instructions;
g) Functional priority logic in all operating situations.

13.7 The UPS assembling, and preventive/corrective maintenance manual shall contain, at least, the following information:

a) Diagrams and physical arrangements of electronic cards;
b) Detailed description of electronic cards operation, including waveforms and adjustments;
c) Procedures necessary to carry out the UPS adjustments, configuration of control boards and tests, as well as the list of materials and resources necessary for its execution;
d) Maintenance procedures to be performed for each failure symptom presented;
e) Preventive maintenance procedures;
f) Troubleshooting methods, using information obtained from the self-diagnosis system and test and measurement instruments;
g) Schematics and identification of internal components and printed circuit boards;
h) Copy of all test reports that have been carried out on the UPS;
i) All characteristics and technical specifications of the UPS, as well as all components and accessories used, in compliance with:

— all approved requirements of the original proposal;

— all revisions that have been made on the technical clarifications and/or technical opinion.

j) Replacement times for components with known UPS failure times;
k) Transport and packaging procedures in accordance with IEC 62040-3;
l) Assembly and installation manual containing, at least, the following information:

— procedures for storing the UPS as well as any spare parts;

— assembly and mechanical installation procedures and details of the UPS and accessories;

— procedures and details of electrical power and ground connections.

m) Maintenance videos containing the way to remove and reinstall the UPS components from front and rear part (when applicable).

14 SPARE PARTS AND UNUSUAL TOOLS

14.1 Manufacturer shall further include in his quotation a proposed list of spares for two (2) years operation with separate prices for each item. Manufacturer shall furnish a list of recommended spare parts.

14.2 Manufacturer shall recommend the Classification Society required spares, if any.

14.3 Manufacturer shall provide the necessary all spare parts for start-up, commissioning and pre operation periods.

14.4 Manufacturer shall supply the accessories, tools recommended by its own experience or by the component manufacturer and recommendations for operation and maintenance .

14.5 Manufacturer shall supply all unusual tools required for installation, commissioning, operation, and maintenance of the equipment.

15 TRAINING

15.1 Vendor shall furnish trainings level 1 and level 2.

15.2 Training Level 1:

a) UPS training level 1 shall be done at factory installation.

b) This training shall be offered for 5 (five) Petrobras's personnel Engineers and Technicians.

c) This course shall be complete in UPS technology, operation and maintenance including theory and field.

15.3 Training Level 2:

a) UPS training level 2 shall be done in Brazil in Portuguese language.

b) This training shall be offered for 15 (fifteen) Petrobras' personnel Engineers and Technicians.

c) This course shall be in UPS technology, operation and maintenance including theory and field.

16 TESTING

16.1 Electronic modules, including spares, shall be submitted to a "burn-in" test to prevent failures occurring at early stage. The equipment shall be subject to an equivalent of 48h at 70°C with power connected to the device. Other solutions of burn in tests shall be submitted to PETROBRAS for approval.

16.2 Main AC UPS Distribution Panels shall be fully tested with UPS during FAT and SAT, including interlocks and load transference.

16.3 It shall be provided by the UPSs Manufacturer tests of opening time, closing time and trip test in circuit-breakers with current injection considering at least 3 points of the thermal curve and the instantaneous curve.

16.4 All alarms and status signals that will be sent to the Electrical Workstation and the CSS shall be verified during both FAT and TAP Tests.

16.5 For batteries tests see I-ET-3010.00-5140-714-P4X-001 - SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS

16.6 Main AC UPS Distribution Panel tests shall be according with the document I-ET-3010.00-5140-741-P4X-001 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS.

16.7 During the Load Test in accordance with IEC 62040-3, all connection points on the UPS shall be checked by the thermography inspection during SAT tests.

16.8 It shall be executed the measurement of voltage THDv at the UPS output, operating by the inverter and the measurement of the current of each capacitor. As reference values: THDv <5% and capacitor current should be similar, within the capacitor tolerance limit (typical ± 10%). A suitable power quality meter shall be used with sufficient bandwidth (> 720 Hz minimum) and true RMS.

16.9 The table below lists the minimum tests that shall be carried out:

Table 5 – FAT and SAT tests

ITEM	MINIMUM TEST LIST	METHOD CRITERIA	SCHEDULE
1	EXAMINATION OF TECHNICAL DOCUMENTATION	TECHNICAL DOCUMENTATION ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
2	ACCURACY CERTIFICATE OF MEASUREMENT INSTRUMENTS TO BE USED IN TESTS	COMPONENT AND MANUFACTURER STANDARD	1-2
3	VISUAL, DIMENSIONAL AND STRUCTURAL INSPECTION	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
4	MARKING, IDENTIFICATION, DATA ON NAMEPLATE AND SAFETY WARNINGS CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
5	MATERIAL LIST INVENTORY CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
6	CHECKING OF INTERCHANGEABLE DEVICES	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
7	PAINTING (COLOR, THICKNESS AND ADHESION)	ACCORDING WITH I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING	3
8	MECHANICAL ENDURANCE TESTS FOR COMPONENTS (CIRCUIT-BREAKERS, SWITCHES, ETC.)	COMPONENT STANDARD	3
9	DEGREE OF PROTECTION PROVIDED BY ENCLOSURE	ACCORDING WITH IEC 60529	3
10	GROUND FAULT PROTECTIVE DEVICE AND ISOLATION MONITORING SYSTEM ACTUATION Note: For this test, at least three different circuits shall be grounded simultaneously.	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
11	BATTERY CHARGE INHIBITION BY EXTERNAL SIGNAL (BATTERY ROOM VENTILATION FAILURE)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
12	BATTERY DEEP CHARGE INHIBITION BY EXTERNAL SIGNAL (BATTERY ROOM WITH H_2 DETECTION)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
13	BURN-IN TEST (MINIMUM 72h WITH 70°C) WITH POWER CONNECTED TO THE DEVICE	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
14	COMPLIANCE OF PRINTED CIRCUIT BOARD CONFORMAL COATING WITH CLASS 2	ACCORDING WITH IEC 61086	1
15	COMPLIANCE OF PRINTED CIRCUIT BOARD CONFORMAL COATING WITH FUNGI RESISTANCE	ACCORDING WITH IEC 60664-3	1
16	GROUNDING CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
17	SOFTWARE TESTS (INCLUDING SUPERVISORY AND REMOTE TESTS)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
18	SOFTWARES LICENSES INVENTORY CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
19	BACK UP SOFTWARES INSTALLATION VERIFYING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
20	OPERATION AND SUPERVISION SCREENS RUNNING AND FULLY OPERATIONAL	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
21	COLOR CODE CHECK WITH ALL ELECTRICAL EQUIPMENT ANIMATED	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
22	SCREENS NAVIGATION CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1
23	VERIFICATION OF DATA, TIME, COMPANY IDENTIFICATION, UNIT, ETC. AT SCREENS	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
24	USER ACCESS AND CHANGE PROFILE CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
25	GENERAL TURN OFF, TURN ON AND RESET CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
26	ALL COMPONENTS (CIRCUIT-BREAKERS, SWITCHES, RELAYS, RECTIFIER, CONTROL BOARDS TURN OFF/TURN ON CHECKS (AUTOMATIC INITIALIZATION)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
27	GENERAL SYSTEM FUNCTIONS INCLUDING HARDWARE REDUNDANCY AND DIAGNOSTIC CHECK;	ACCORDING WITH I-ET-3010.00-5140-773-P4X-003 AND UPS DESIGN	1-2
28	CABLE AND INTERCONNECTION CHECK	ACCORDING WITH IEC 62040-3	1-2
29	LIGHT LOAD AND FUNCTIONAL TEST	ACCORDING WITH IEC 62040-3	1-2

ITEM	MINIMUM TEST LIST	METHOD CRITERIA	SCHEDULE
30	NO LOAD	ACCORDING WITH IEC 62040-3	1-2
31	FULL LOAD	ACCORDING WITH IEC 62040-3	1-2
32	SYNCHRONIZATION	ACCORDING WITH IEC 62040-3	1-2
33	AC INPUT POWER FAILURE AND VFD INPUT DEPENDENCY	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1-2
34	AC INPUT POWER RETURN	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1-2
35	TRANSFER TO BYPASS MODE	ACCORDING WITH IEC 62040-3	1-2
36	INPUT – SUPPLY COMPATIBILITY – INPUT VOLTAGE TOLERANCE, VI TEST	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
37	INPUT – SUPPLY COMPATIBILITY – COMBINED INPUT VOLTAGE AND FREQUENCY TOLERANCE, VFI TEST	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
38	INPUT – SUPPLY COMPATIBILITY – RATED INPUT CURRENT	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
39	INPUT – SUPPLY COMPATIBILITY – MAXIMUM INPUT CURRENT	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
40	INPUT – SUPPLY COMPATIBILITY – INRUSH CURRENT	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
41	INPUT – SUPPLY COMPATIBILITY – TOTAL HARMONIC DISTORTION OF INPUT CURRENT	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
42	INPUT – SUPPLY COMPATIBILITY – INPUT POWER FACTOR	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
43	INPUT – SUPPLY COMPATIBILITY – EFFICIENCY	ACCORDING WITH IEC 62040-3 WITH 100% OF FULL LOAD	1
44	INPUT – SUPPLY COMPATIBILITY – NO LOAD LOSSES	ACCORDING WITH IEC 62040-3	1
45	INPUT – SUPPLY COMPATIBILITY – STANDBY GENERATOR COMPATIBILITY	ACCORDING WITH IEC 62040-3	1
46	OUTPUT – LOAD COMPATIBILITY – NORMAL MODE	ACCORDING WITH IEC 62040-3	1
47	OUTPUT – LOAD COMPATIBILITY – STORED ENERGY MODE	ACCORDING WITH IEC 62040-3	1
48	OUTPUT – LOAD COMPATIBILITY – UNBALANCED LOAD	ACCORDING WITH IEC 62040-3	1
49	OUTPUT – LOAD COMPATIBILITY – DC VOLTAGE OFF-SET	ACCORDING WITH IEC 62040-3	1
50	OUTPUT – LOAD COMPATIBILITY – LOAD SHARING	ACCORDING WITH IEC 62040-3	1
51	OUTPUT – LOAD COMPATIBILITY – OUTPUT OVERVOLTAGE	ACCORDING WITH IEC 62040-3	1
52	OUTPUT – LOAD COMPATIBILITY – PERIODIC OUTPUT VOLTAGE MODULATION	ACCORDING WITH IEC 62040-3	1
53	OUTPUT – LOAD COMPATIBILITY – OVERLOAD CAPACITY	ACCORDING WITH IEC 62040-3	1
54	OUTPUT – FAULT CLEARING CAPACITY	ACCORDING WITH IEC 62040-3	1
55	OUTPUT – LOAD COMPATIBILITY – INVERTER CURRENT LIMIT	ACCORDING WITH IEC 62040-3	1
56	DYNAMIC OUTPUT PERFORMANCE – NORMAL MODE TO STORED ENERGY MODE	ACCORDING WITH IEC 62040-3	1
57	DYNAMIC OUTPUT PERFORMANCE – STORED ENERGY MODE TO NORMAL MODE	ACCORDING WITH IEC 62040-3	1
58	DYNAMIC OUTPUT PERFORMANCE –NORMAL MODE TO BYPASS MODE – OVERLOAD	ACCORDING WITH IEC 62040-3	1
59	DYNAMIC OUTPUT PERFORMANCE – STEP LOAD	ACCORDING WITH IEC 62040-3	1
60	ENERGY STORAGE DEVICE – STORED ENERGY TIME	ACCORDING WITH IEC 62040-3	1
61	ENERGY STORAGE DEVICE – RESTORED ENERGY TIME	ACCORDING WITH IEC 62040-3	1
62	ENERGY STORAGE DEVICE – BATTERY RIPPLE CURRENT	ACCORDING WITH IEC 62040-3	1
63	ENERGY STORAGE DEVICE – RESTART TEST	ACCORDING WITH IEC 62040-3	1
64	ENERGY STORAGE DEVICE – CHARGER CURRENT LIMIT	ACCORDING WITH IEC 62040-3	1
65	ENVIRONMENTAL – SHOCK DURING TRANSPORTATION	ACCORDING WITH IEC 62040-3	3
66	ENVIRONMENTAL – FREE FALL DURING TRANSPORTATION	ACCORDING WITH IEC 62040-3	3
67	ENVIRONMENTAL – STORAGE IN DRY HEAT, DAMP HEAT AND COLD ENVIRONMENTS	ACCORDING WITH IEC 62040-3	3
68	ENVIRONMENTAL – OPERATION IN DRY HEAT, DAMP HEAT AND COLD ENVIRONMENTS	ACCORDING WITH IEC 62040-3	3
69	ENVIRONMENTAL – ACOUSTIC NOISE	ACCORDING WITH IEC 62040-3	1
70	UPS FUNCTIONAL UNIT TESTS – UPS RECTIFIER	ACCORDING WITH IEC 62040-3 AND IEC 60146	3
71	UPS FUNCTIONAL UNIT TESTS – UPS INVERTER	ACCORDING WITH IEC 62040-3 AND IEC 60146	3
72	UPS FUNCTIONAL UNIT TESTS – UPS SWITCHES	ACCORDING WITH IEC 62040-3 AND IEC 60146	3
73	CONVERTER - TEMPERATURE RISE	ACCORDING WITH IEC 60146-1-1	3
74	CONVERTER - MEASUREMENT OF THE INHERENT VOLTAGE REGULATION	ACCORDING WITH IEC 60146-1-1	1

ITEM	MINIMUM TEST LIST	METHOD CRITERIA	SCHEDULE
75	CONVERTER - RADIO FREQUENCY GENERATED INTERFERENCE AND CONDUCTED NOISE	ACCORDING WITH IEC 60146-1-1	1
76	TRANSFORMER - MEASUREMENT OF WINDING RESISTANCE	ACCORDING WITH IEC 60076-1	1
77	TRANSFORMER - MEASUREMENT OF VOLTAGE RATIO AND CHECK OF PHASE DISPLACEMENT	ACCORDING WITH IEC 60076-1	1
78	TRANSFORMER - MEASUREMENT OF SHORT-CIRCUIT IMPEDANCE AND LOAD LOSS	ACCORDING WITH IEC 60076-1AND IEC 60076-11	1
79	TRANSFORMER - MEASUREMENT OF NO-LOAD LOSS AND CURRENT	ACCORDING WITH IEC 60076-1	1
80	TRANSFORMER - SEPARATE SOURCE AC WITHSTAND VOLTAGE TEST	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	1
81	TRANSFORMER - INDUCED AC WITHSTAND VOLTAGE TEST	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	1
82	TRANSFORMER - LIGHTNING IMPULSE TEST (Ll)	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	1
83	TRANSFORMER - TEMPERATURE RISE TEST (1)	ACCORDING WITH IEC 60076-2 AND IEC 60076-11	3
84	TRANSFORMER - DETERMINATION OF SOUND LEVEL	ACCORDING WITH IEC 60076-10 AND IEC 60076-11	1
85	TRANSFORMER - SHORT-CIRCUIT WITHSTAND TEST	ACCORDING WITH IEC 60076-5 AND IEC 60076-11	1
86	TRANSFORMER - MEASUREMENT OF HARMONIC CONTENTS OF THE NO-LOAD CURRENT	ACCORDING WITH IEC 60076-1	3
87	TRANSFORMER - MEASUREMENT OF INSULATION RESISTANCE OF WINDINGS TO EARTH AND/OR OF DISSIPATION	ACCORDING WITH IEC 60076-1	1
88	TRANSFORMER - FACTOR (TAN d) OF INSULATION SYSTEM CAPACITANCES AND RESISTANCE TEST (USING THE MICRO OHMITER INSTRUMENT)	ACCORDING WITH IEC 60076-1	1
89	EMC TESTS	ACCORDING WITH IEC SERIES 61000 STANDARDS.	1
90	CHECK OF FLOATING VOLTAGE, CHARGE VOLTAGE AND CURRENT LIMITING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
91	COMMUNICATION TESTS (INTERNAL AND EXTERNAL)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
92	CARDS AND CONTROL BOARDS ARRANGEMENT CHANGEOVER	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
93	INTERLOCKS AND TROUBLESHOOTING CHECKING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
94	ALL FUNCTIONAL TESTS	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
95	ALARMS AND EVENT RECORD CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2

1 - Carry Out during Factory Acceptance Test (FAT)
2 - Carry Out during Site Acceptance Test (SAT)
3 - Type Test Report is accepted if conformity test has been performed on one or more items representative of the production in accordance with IEC 62040-3.

17 MAIN AC UPS DISTRIBUTION PANEL

17.1 GENERAL

17.1.1 All panels shall be designed, manufactured, and tested according to reference standards presented in item 2.

17.1.2 Environmental, inclination and vibration requirements shall comply with item 4.1.

17.1.3 All panels shall comply with the requirements of the I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEM OF OFFSHORE UNITS.

17.1.4 All panels shall be designed to conditions (including voltage and frequency variations) defined in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

17.1.5 Panels shall be built according to I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

17.1.6 There shall be an identification label, next to each circuit-breaker, with identification of the circuit and of the load fed by the circuit-breaker.

17.1.7 Outgoing circuits shall be protected by thermomagnetic moulded-case circuit-breakers, suitable to interrupt short-circuit and overload currents. For lighting panels, miniature type circuit-breakers shall be used.

17.1.8 The outgoings shall be connected through non-welded type connectors appropriated to the cross-section of the specified cables.

17.1.9 Panel shall be supplied with enough space for future inclusion of new circuits.

17.1.10 The bipolar circuit-breakers shall be identified, using the respective numbers of each bar.

17.1.11 The panel shall be furnished with a metallic skid base to be welded in the Vessel/Platform structure.

17.1.12 The manufacturer shall provide removable plates made of copper-free aluminium with a minimum thickness of 2.8mm for installation of cable glands. The removable plates shall be provided with neoprene rubber gaskets and shall be solidly grounded. Cable entry shall be from the bottom side.

17.1.13 The distribution panel components access shall be from the front side for any kind of service, through doors provided with hinges and lock, allowing also, the removal of any component without interference.

17.1.14 All metallic parts that compose the distribution panel not foreseen for current conduction shall have electrical continuity, being supplied with a connector for grounding. Unless otherwise indicated, this connector shall be appropriate to the copper cable connection, stranded, with rated section of 25mm^2. The door(s) shall be interconnected to the shell through the copper cordage.

17.1.15 The local signalling shall be done with LED bulbs and a test button.

17.1.16 It shall be provided at least 20% of spare complete outgoing circuits, including the terminal blocks.

17.1.17 The rated voltage (Un), the rated operational voltage (Ue), the rated insulation voltage (Ui) and the rated impulse withstand voltage (Uimp) shall comply with the requirements of IEC 61439-1.

17.1.18 All panels shall be provided with lifting eyelets.

17.1.19 Panels shall be able to operate on structures subject to vibrations up to the limits stated in IEC 61892.

17.1.20 Suitable sheet or removable covers shall be provided to avoid contact with energized parts in the interior of the panels, during operation of circuit-breakers.

17.1.21 On panels with circuit-breakers, the assembly, hardware, busbars, fittings, etc., shall be built in order to allow the interchange, respectively, with all circuit-breakers of the same characteristics.

17.1.22 The whole structure, including doors, shall withstand the thermal (for a minimum period of one second) and dynamic effects due to short-circuit currents calculated.

17.1.23 Vertical sections shall have hinged front door. Doors shall be bonded to the panel structure through flexible copper cable. Hinged doors shall have an open position lock device.

17.1.24 When rear access is required, screwed rear doors shall be fitted with handles to ease their remove and installation.

17.1.25 Sensible equipment panels and control panels shall be installed in structures free of vibration. It shall be avoided installation of these types of panels in the structure base, or skid of the controlled equipment.

17.1.26 For floating units, the floor-mounted panels shall be provided with an insulating handrail in the fixed frontal side. Cable entry shall be via 3mm thickness removable gland plate(s). Gland plate(s) size shall be adequate to accommodate the cables required. They shall be made of non-magnetic material. The removable sheets shall be provided with neoprene rubber gaskets. MCTs can be used as an alternative. Both solutions MCT and cable gland shall be provided by manufacturer of Main DC UPS Distribution Panels. The use of any type of sealing mass for cable entrance is forbidden.

17.1.27 For auxiliary relays requirements, see I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.

17.1.28 Unless otherwise defined in project documentation or panel datasheet, panels shall be provided with internal (220VAC, two phases) outlet to energize the internal lighting circuits.

17.1.29 Each compartment shall have high luminosity signalling LEDs, with colours according to I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEM OF OFFSHORE UNITS.

17.1.30 All necessary terminals for connection with external power cables shall be supplied with the Panel.

17.1.31 Facilities shall be provided to allow temporary grounding by means of ground cables, through screwed connectors, separately, to the panel frame to the terminal block box and to the enclosure.

17.1.32 Channels shall be made of non-fire propagating material.

17.1.33 It shall not be necessary to open the Main DC UPS Distribution Panel doors to operate the circuit-breakers or any other devices during operation of the system.

17.2 BUSBAR

17.2.1 Panels shall have three electrolytic copper busbars (two poles and grounding) dimensioned for rated current and to withstand the thermal and mechanical strength of the short-circuit current.

17.2.2 Main DC Distribution Panels for emergency lighting shall have, besides the main busbar, a second busbar, connected to the main busbar by circuit-breaker, to split the loads according to the lighting autonomy time requirements (see DR-ENGP-M-I-1.3 - SAFETY ENGINEERING e EMERGENCY LOADS LIST).

17.2.3 Panel shall have busbars of electrolytic copper in A.C. systems, identified with coloured strips as follows:

a) Phase: red, white, and black (R – S – T, respectively).

b) Neutral: light blue according to IEC 60445.

c) Ground: bi-colour combination green-and-yellow according to IEC 60445.

17.2.4 The panels busbars shall be sized to conduct the rated current related to the rated power under steady state condition, with the temperature rise limited to the values specified on standards.

17.2.5 Busbar shall be dimensioned to support the mechanical and thermal stresses due to short-circuit currents. The space between supports shall not exceed the insulators minimum clearance and creepage distances guaranteed by the respective manufacturers.

17.2.6 Bars at junction points shall be silver-coated according to ASTM B700 with minimum thickness of 2.5µm and placed in such manner to guarantee a perfect alignment and high-pressure contact. Both sides of contact bus bar shall be silver coated.

17.2.7 The insulation of bars, supports and junction pieces, shall be of non-hygroscopic and non-fire propagating material. Fiberglass or Celeron shall not be accepted.

17.2.8 The strength applied on supports shall not exceed the minimum rupture load of insulators, guaranteed by respective manufacturers.

17.2.9 GROUNDING BUSBARS

17.2.9.1 All panels shall be supplied with internal grounding busbars.

17.2.9.2 Floor-mounted panels shall have the grounding bar installed in the lower part and supplied with non-welded type connectors, suitable for bare stranded copper cable with cross-sectional area according to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

17.2.9.3 Wall-mounted panels shall have an external terminal with non-welded type connector, suitable for connection to bare stranded copper cable, with cross-sectional area according to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS, installed in one of the lateral sides of the panels. The grounding busbar shall be internally connected to this terminal.

17.2.9.4 In solidly grounded neutral systems, the neutral busbar, when required, shall be internally connected to the grounding busbar.

17.2.9.5 All panel metallic parts, which are not intended for current conduction, shall be interconnected to the grounding bar, including movable parts.

17.2.9.6 All panels with signal circuits shall have dedicated PE, IE and IS grounding bars, when required, as defined in I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

17.2.9.7 Panels with electronic components shall have an “Electronic Reference Bar” (IE), duly identified, complying with requirements of IEC 61000-5-2, for connection of electronic reference grounding terminals of instruments, sensors, and intelligent devices.

17.3 INSULATION MONITORING DEVICE

17.3.1 One insulation monitoring device shall be installed in each DC Main Distribution Panels up to 240V (see HULL UPS AND DC SYSTEMS ONE-LINE DIAGRAM OF THE PROJECT).

17.3.2 The insulation monitoring devices shall indicate the measured ohmic value between poles and between poles and ground.

17.3.3 For panels with possibility to operate in "L" configuration with interconnection circuit-breakers closed, it shall be provided a logic to disable one of insulation monitoring devices in this condition. It shall also be provided a logic to enable both of insulation monitoring devices during the return to open “U” configuration.

17.3.4 Earth fault protection shall be according to UPS AND DC SYSTEMS ONE-LINE DIAGRAM.

17.3.5 One portable ground fault detector shall be supplied by BIDDER to detect faults through specific portable current-clamp meter, proper for D.C. and A.C. systems. This device shall be capable to detect all faults when until three different sensors are simultaneously activated by faulted circuits.

17.3.6 The outgoing cables for all circuits shall be installed in a way to enable easy access to clamp them with a portable ground fault detector, with the circuit energized. The shields shall be installed according to the detector requirements.

17.4 CIRCUIT-BREAKERS

17.4.1 Circuit-breakers shall be manufactured and tested according to recommendations of IEC 60947-2 and IEC 61439-2.

17.4.2 Power circuit-breakers shall have test certificate, furnished by a recognized laboratory in accordance with standards IEC 61439-2 and IEC 60947-2.

17.4.3 The control circuits auxiliary contacts and changeover switches shall be connected to the fixed part by plugs.

17.4.4 The rated ultimate short-circuit breaking capacity (Icu), the rated service short-circuit breaking capacity (Ics), the rated short time withstand current (Icw) and the rated short-circuit making capacity (Icm) shall be higher than the maximum short-circuit current indicated in the short-circuit calculation reports.

17.4.5 Circuit-breakers shall be provided with the interlocking and parallel operation mentioned in one-line diagram and in this specification. A label with reference to interlocking and parallel operation allowed and not allowed document and a resume of main circuit-breaker interlocking and parallel operation, allowed and not allowed, shall be provided.

17.4.6 For circuit-breakers with RCD see I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.

17.4.7 It shall be possible to block the circuit-breaker in open position with padlock for panel incoming and primary outgoing circuit-breakers.

17.4.8 Circuit-breakers for DC panels shall protect both circuit poles.

17.4.9 Incoming panel circuit-breakers shall be located near panel cable entrances.

17.5 WIRING AND TERMINALS

17.5.1 All internal conductors shall comply with requirements of I-ET-3010.00-5140-700-P4X-002 - SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS.

17.5.2 The minimum conductor cross section inside panels shall be:

a) $1mm^2$ for discrete signals cables;

b) $0.5mm^2$ for analogue signal cables;

c) $2.5mm^2$ for power and VT (Voltage Transformer) circuits;

d) $4mm^2$ for CT (Current Transformer) circuits.

17.5.3 Equipment assembled on the doors shall be connected with extra flexible conductors.

17.5.4 For panels installed outdoors, all cables entrances shall be through panels' bottom side.

17.5.5 For cable entrance, the manufacturer shall provide removable aluminium or non-magnetizing material plates for installation of cable glands or MCT for floor mounted panels. The use of any type of sealing mass for cable entrance is forbidden.

17.5.6 Panel shall be delivered with all connections for instruments, transformers, controls and wiring between the units and sections installed. The interconnection wiring between sections needing to be separated for transportation shall end on terminal blocks, in order that jumpers shall complete the interconnection, when the sections are assembled.

17.5.7 The cables shall be grouped in lugs strips, properly identified at the ends. The panel shall be provided with all connections between installed components done.

17.5.8 Every wiring shall be placed in electrical channels with removable covers, in plastic flame retardant type material, whenever necessary, containing lateral splits for wiring passages. The channel system may run in horizontal and vertical plans and shall not have sharp edges that may damage the wiring insulation.

17.5.9 Every control wiring shall be composed by tin-plated copper flexible cables.

17.5.10 The connections shall be done at the devices terminals or terminal blocks, not allowing splices at the wiring.

17.5.11 Every internal component, including terminals, shall have identification. The wiring shall be identified by plastic rings in conformity to the manufacturer wiring drawing, in a way to make it ease the equipment maintenance.

17.5.12 Every control wiring shall be composed by tin-plated copper flexible cables.

17.6 ANTI-CONDENSATION HEATERS

17.6.1 Panels shall be provided with heating resistors, (one for each vertical section or compartment), in 220VAC (two phases, grounded isolated). The resistors shall be automatically controlled by means of a thermostat with scale up to 60ºC maximum. A circuit-breaker shall be provided on each resistor circuit.

17.6.2 Panels shall be provided with external (220VAC, two phases, grounded isolated) outlet to energize the heating circuits during the storage period.

17.6.3 Space heaters shall be protected against accidental contacts. The wiring next to them (about 300mm) shall have proper insulation to avoid damages due to overtemperature.

17.7 THERMAL INSPECTION FACILITIES

17.7.1 The panels shall be constructed so that thermal inspection by optical infrared thermographic devices could be safely performed with the circuits energized.

17.8 PROTECTION

17.8.1 It shall be provided protective circuit-breakers for the electrical control components in the distribution panels.

17.8.2 UPS manufacturer shall carry out the dimensioning of distribution panel mini circuit-breakers of control system considering the load rated power, the maximum in-rush of the system and that the mini-circuit-breakers be maximized.

17.8.3 All outgoing shall be assembled with 2 pole circuit-breakers.

17.8.4 Those circuit-breakers which will feed loads installed in Zone 1 or crossing Zone 1 shall be provided with shunt trip coil.

17.9 MONITORING AND SUPERVISION

17.9.1 All instruments shall comply with requirements of I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEM OF OFFSHORE UNITS.

17.9.2 All discrete input/output signals for instrumentation shall be voltage free (dry-contacts).

17.9.3 All indicating instruments shall have external zero adjustment, accuracy of 1.5%, white scale, black markings.

17.9.4 They shall be immune to electromagnetic interference and radio interference according to IEC 61000.

17.9.5 The active energy meters shall have a maximum demand indicator ranging for the last 15 (fifteen) minutes.

17.9.6 Preference shall be given to discrete measuring devices, having the capacity of data gathering and data availability through digital communication port.

17.9.7 These meters shall be able to indicate a reverse power up to 15% of the rated power.

17.9.8 For instrument transformers see I-ET-3010.00-5140-700-P4X-007 - SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS.

17.10 SIGNALS, ALARMS, TRIPS, INTERLOCKS AND COMMUNICATION REQUIREMENTS

17.10.1 Panels shall include an IED (IR) to obtain all signals from internal components as required by I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.

17.10.2 The IED (IR) shall communicate with protocols according to I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

17.10.3 Minimum signals foreseen to be sent from Distribution Panel to Electrical System Automation shall comply with I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST.

17.10.4 Each distribution panel shall have control voltage from both UPS, selected by a specific two position switch.

17.10.5 For panels with possibility to operate in "L" configuration with interconnection circuit-breakers closed, it shall be provided a logic to disable one of insulation monitoring devices in this condition. It shall also be provided a logic to enable both of insulation monitoring devices during the return to open "U" configuration.

17.10.6 The insulation monitoring devices shall send a discrete alarm signal to an IED (IR) installed inside the panel, through a voltage free contact (1A @ 220VDC PF 0.4).

17.10.7 To indicate that the ground fault detection device is turn off, an alarm shall be sent to IED (IR) installed inside the panel through a voltage free contact (1A @ 220VDC PF 0.4).

17.11 NAMEPLATES AND LABELS

17.11.1 The identification plate (or supplementary plate) shall be made of corrosion resistant material (stainless steel AISI 316), located externally at fixed part, containing, further the indicated information in IEC 62040 Standard, the following item:

c) Petróleo Brasileiro S/A - PETROBRAS;

d) Abbreviation of the operational organization to which the equipment belongs;

e) Distribution panel tag number;

f) Material requisition number (RM);

g) Number of material purchase request (PCM).

17.11.2 All drawers, compartments, columns, and internal components shall be identified by means of black acrylic labels engraved with white letter. For small internal components (i.e.: small circuit-breakers, contactors, auxiliary relays) where acrylic labels are not feasible due to constrict sizes and small spaces, adhesive labels are allowed.

17.11.3 All panels shall have a label identifying the grounding system for the power and control systems.

17.11.4 All panels' incoming functional units shall have a label identifying the panel TAG of the feeding circuit.

17.11.5 All panels fed by uninterrupted power systems shall have a label informing expected autonomy in hours and minutes.

17.11.6 All functional units in panels that are in isolated ground system shall have a label informing if they will or not be shut down in case of fault to ground.

17.11.7 Warning labels for electrical equipment shall follow requirements informed in I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

17.12 PAINTING

17.12.1 The painting of electrical panels shall be according to I-ET-3010.00-5140-700-P4X-009 - GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

17.13 DOCUMENTATION

17.13.1 Panels documentation shall comply with item13.

17.13.2 The UPSs manufacturer shall be responsible for executing a coordination protection study for the whole system and to specify the protection devices for each outgoing.

17.14 SPARE PARTS AND UNUSUAL TOOLS

17.14.1 Panels spare parts and unusual tools shall comply with item 14.

17.15 TESTING

17.15.1 Manufacturer shall carry out all tests indicated in Table 6 and all tests foreseen in applicable standards listed in item 2.

Table 6 - Reference Test Requirements for Panels

Test Description
Visual inspection, with verification of construction in general, surfaces, structures and supports finishing and dimensions.
Mechanical tests, with verification of suitable operation of mechanical parts, such as circuit-breakers connection devices, interlock mechanisms, doors, etc.
Withstand voltage test, at 60 Hz, dry, on the main insulation components.
Verification of wiring continuity according to the last approved wiring diagrams.
Wiring insulation test.
Complete operational test, with verification of measuring instruments and relays regarding calibration and operation. After assembled, all components of control circuits and auxiliaries shall be energized with the respective rated voltages to verify the perfect operation of all concerned components (relays, measuring instruments, signalling lamps, heating resistors, etc). Instrument transformer polarities shall be verified.
Verification of painting procedures for internal and external surfaces.
Verification of nameplates arrangement, internally and externally.
Verification of the instruments and components assembled on panel.
Test of electrical insulation for 1 (one) minute, between conductors and grounding, which shall have a value above of 100 Megaohms.
Note: Short-Circuit test supportability test certificate shall be issued for 220VAC low-voltage panels with short-circuit current rating ≥ 10 kA, as required by IEC 61439-1.

17.16 TRANSFERENCE OF LOADS

17.16.1 Normal operation (Opened “U” or Island)

17.16.1.1 This item consists of to operate each UPS feeding its suitable distribution panel with interconnection circuit-breakers between distribution panels opened.

17.16.1.2 In this condition each distribution panel ground fault monitoring analyses its respective busbar.

17.16.2 Contingency operation (“L” Operation)

17.16.2.1 This condition consists of operate one UPS feeding both distribution panels with tie circuit-breakers between distribution panels closed.

17.16.2.2 In this condition ground fault monitoring of both distribution panels shall be compatible with this operation.

17.16.3 It shall be provided means to transfer loads automatically without losing loads:

a) From Normal operation to Contingency operation (Both UPS);
b) From Contingency operation (both UPS) to Normal operation;
c) From Contingency operation (one UPS) to Contingency operation (Other UPS).

17.16.4 The basic following steps shall be considered to execute the load transference between UPS:

17.16.4.1 From Normal operation to Contingency operation (Both UPS):

1) Transfer the loads from both UPS inverter to respective bypass transformers (alternative supply), at each UPS;
2) Choose which UPS will feed both distribution panels, across selection from specific switch for this function, at defined distribution panel;
3) Close each interconnection circuit-breaker, at defined distribution panel, if both AC UPS are in alternative supply;

4) With four circuit-breakers closed, after 2 seconds, one circuit-breaker shall open so as to comply with step 2 above;
5) Transfer the loads from remaining UPS bypass transformer to respective UPS inverter;
6) If the automatic operation does not occur the manual operation shall be possible any time with the permission of synchronizing relays (25).

17.16.4.2 From Contingency (Both UPS) operation to Normal operation:

1) Select bypass transformer to the UPS out of service;
2) Transfer the loads from remaining UPS inverter to respective bypass transformer;
3) Choose Normal operation (Both UPS feeding its respective distribution panel), across selection from specific switch for this function, at defined distribution panel;
4) Close the respective circuit-breaker opened (UPS out of service), at defined distribution panel;
5) With four circuit-breakers closed, after 2 seconds, both Tie circuit-breakers shall open so as to comply with step 3 above;
6) Transfer the loads from both UPS to respective bypass transformers, at each UPS;
7) If the automatic operation does not occur the manual operation shall be possible any time with the permission of synchronizing relays.

17.16.4.3 From Contingency (An UPS) to Contingency (Other UPS):

1) Select bypass transformer to the UPS out of service;
2) Transfer the loads from remaining UPS inverter to respective bypass transformer;
3) Choose Contingency operation (By other UPS), across selection from specific switch for this function, at defined distribution panel;
4) Close the respective circuit-breaker opened (UPS out of service), at defined distribution panel;
5) With four circuit-breakers closed, after 2 seconds, one circuit-breaker shall open so as to comply with step 3 above;
6) Transfer the loads from remaining UPS bypass transformer to respective UPS inverter, at remaining UPS;
7) If the automatic operation does not occur the manual operation shall be possible any time with the permission of synchronizing relays.

18 ANNEX I - DATASHEETS FORMS

18.1 All existing data sheet templates are available at I-LI-3010.00-5140-700-P4X-001 - ELETRICAL EQUIPMENT DATASHEET MODELS.

18.2 The Datasheets are models and do not refer to any equipment. The manufacturer shall fill in a Datasheet for each equipment.

18.3 For equipment without Datasheet model, Manufacturer shall fill in Datasheets according to its own standard and submit to PETROBRAS approval.

19 ANNEX II – ABBREVIATIONS AND ACRONYMS

A.C.	Alternating Current
A&C	Automation and Control System
ANSI	American National Standards Institute
D.C.	Direct Current
ESA	Electrical System Automation
ET	Technical Specification
FAT	Factory Acceptance Test
HMI	Human-Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent electronic device
IEEE	Institute of Electrotechnical and Electronic Engineers
IE	Electronic Reference Bar
IR	Intelligent Relay
LED	Light Emitting Diode
MCCB	Moulded-Case Circuit-Breaker
MTTR	Mean Time To Repair
NEMA	National Electrical Manufacturers Association
PE	Protective Earth
PF	Power Factor
RCD	Residual Current device
RM	Material Requisition
RMS	Root Mean Square
SAT	Site Acceptance Test
UAM	Unit Alarm Malfunction
UAS	Unit Alarm Shutdown
UPS	Uninterruptible Power Supply