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	CLIENT:		SHEET: <b>1</b> of <b>28</b>
	JOB:		--
	AREA:		
TITLE:		<b>SPECIFICATION FOR GENERIC DC UPS FOR OFFSHORE UNITS</b>	
		ESUP	
		INTERNAL	

MICROSOFT WORD / V. 365 / I-ET-3010.00-5140-773-P4X-002\_B

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## 1 OBJECTIVE

- 1.1 This specification establishes the minimum technical requirements for design, manufacture, and supply electrical equipment and material for Generic Direct Current Uninterruptible Power Supply System (GENERIC DC UPS) for PETROBRAS Offshore Units.
- 1.2 CLASSIFICATION SOCIETY requirements shall prevail over requirements of this document.
- 1.3 For terms and definitions, refer to I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

## 2 REFERENCE STANDARDS AND DOCUMENTS


### 2.1 GENERAL

- 2.1.1 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

#### 2.2.1 IEC – INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories – All parts
IEC 60146-1-1	Semiconductor Convertors - General Requirements and Line Commutated Convertors - Part 1-1: Specification of Basic Requirements
IEC TR 60146-1-2	Semiconductor Convertors - General Requirements and Line Commutated Convertors - Part 1-2: Application Guide
IEC 60146-2	Semiconductor Convertors - Part 2 - Self-Commutated Semiconductor Convertors Including Direct D.C. Convertors
IEC 60269-1	Low-voltage fuses – Part 1: General requirements
IEC 60269-2	Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K
IEC 60269-4	Low-voltage fuses – Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices
IEC 60947-2	Low-Voltage Switchgear and Controlgear - Part 2: Circuit-Breakers
IEC 60947-3	Low-voltage switchgear and Controlgear - Part 3: Switches, disconnectors, switch-disconnectors, and fuse-combination units
IEC 61188-5-1	Printed Boards and Printed Boards Assemblies – Design and Use – Part 5-1: Attachment (land/joint) Considerations – Generic Requirements
IEC 61378-1	Converter Transformers - Part 1: Transformers for Industrial Applications
IEC 61439-1	Low-Voltage Switchgear and Controlgear Assemblies – General Rules
IEC 61892	Mobile and Fixed Offshore Units - Electrical Installations - All parts

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IEC 61869	Instrument transformers – All Parts		
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 62040-5-3	Uninterruptible Power Systems (UPS) - Part 5-3: DC output UPS – Performance and test requirements		
<p>Note: When all parts are informed, all applicable parts shall be used as reference. If a specific part is mentioned in text, it will be listed following the general code reference.</p>			
<b>2.2.2 IEEE – INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERING</b>			
Std 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems		
<b>2.2.3 LABOUR SECRETARY - MINISTRY OF ECONOMY - REGULATORY STANDARDS FOR OCCUPATIONAL SAFETY AND HEALTH</b>			
NR-10	Segurança em Instalações e Serviços em Eletricidade		
NR-12	Segurança no Trabalho em Máquinas e Equipamentos		
NR-17	Ergonomia		
NR-26	Sinalização de Segurança		
NR-37	Segurança e Saúde em Plataformas de Petróleo		
<b>ISO – INTERNATIONAL ORGANIZATION FOR STANDARDIZATION</b>			
ISO 9000	Quality Management Systems		
<b>CLASSIFICATION SOCIETY</b>			
CS	Rules and Regulations of the CLASSIFICATION SOCIETY		
<b>IMO – INTERNATIONAL MARITIME ORGANIZATION</b>			
IMO EA811E Code for Construction and Equipment of Mobile Offshore Drilling Units (MODU CODE)			
<b>2.3 REFERENCE DOCUMENTS</b>			
[1]	I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS		
[2]	I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS		
[3]	I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS		



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- [4] I-ET-3010.00-5140-700-P4X-007 – SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE EQUIPMENT
- [5] I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
- [6] I-ET-3010.00-5140-714-P4X-001 – SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS
- [7] I-ET-3010.00-5140-741-P4X-004 - SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
- [8] I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM
- [9] I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE
- [10] I-LI-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION INTERFACE SIGNALS LIST
- [11] UPS AND DC SYSTEMS ONE-LINE DIAGRAM
- [12] EMERGENCY LOAD LIST
- [13] DR-ENGP-M-I-1.3 - SAFETY ENGINEERING
- [14] I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
- [15] I-LI-3010.00-5140-700-P4X-001 - ELECTRICAL EQUIPMENT DATASHEET MODELS
- [16] I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS
- [17] I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING

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 GENERIC DC UPS with its converters, switches and energy storage devices shall maintain continuity of DC rated output for the consumers.
- 3.2 GENERIC DC UPS autonomy time in case of failure of rectifier or main supply is defined in DR-ENGP-M-I-1.3 - SAFETY ENGINEERING, EMERGENCY LOAD LIST and project documents.
- 3.3 Under all operating and main failure conditions, 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 rectifier;
  - b) Switching rectifier control between float and boost modes;
  - c) Failure of the main supply to the system;
  - d) Battery failure.
- 3.4 GENERIC DC UPS shall be able to simultaneously, keep the batteries on floating duty, as well as recharge the bank on boost charge, while it feeds all consumers associated to it, with stabilized voltage and current limitation.
- 3.5 GENERIC DC UPS shall be provided with automatic reset to the charging duty when the AC supply is re-established after a failure.
- 3.6 Irrespective of its configuration, the GENERIC DC UPS shall achieve Reliability Integrity Level 1 (RIL 1) in accordance with IEC 62040-5-3.
- 3.7 **GENERIC DC** 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.
- 3.8 **GENERIC DC** 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 **GENERIC DC** UPS shall have capacity to charge the battery bank to 90% of its full load, within a period of 24 hours.
- 3.10 **GENERIC DC** UPS shall be capable of supplying loads with the batteries disconnected and the output voltage remaining within as specified.
- 3.11 **GENERIC DC** UPS output voltage shall have a ripple limited to below values:
- a) UPS with battery connected: 1% of output voltage, RMS.
  - b) UPS with battery disconnected: 2% of output voltage, RMS.
- 3.12 The supply of **GENERIC DC** 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 **vented type**. 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.
- 3.13 **GENERIC DC** UPS system shall provide rated output power, including all systems (rectifier 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.

- 3.14 **GENERIC DC UPS** shall comply with the electromagnetic emission and immunity levels of IEC 62040-2.
- 3.15 Equipment performance shall not be affected by externally produced electromagnetic fields.
- 3.16 **GENERIC DC 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%.
- 3.17 In case a modular type **GENERIC DC UPS**, the sizing, performance, technical requirements and comprising with this document shall be equal to standalone (monolithic) UPS.
- 3.18 Redundant UPSs shall have ability to continuous parallel operation of output.
- 3.19 **GENERIC DC UPS** shall be immune to voltage transients, voltage dips and power supply distortion, according to IEC 62040-2 and IEC 61892.
- 3.20 **GENERIC DC 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.
- 3.21 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.
- 3.22 In the event of a failure of the HMI and/or of the equipment internal supervision **printed circuit boards**, **GENERIC DC UPS** shall remain in normal operation supplying the loads.
- 3.23 **GENERIC DC 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 **GENERIC DC 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 **GENERIC DC 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 **GENERIC DC 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 **GENERIC DC 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 component of **GENERIC DC** UPS system shall comply with I-ET-3010.00-5140-700-P4X-005 - REQUIREMENTS FOR HUMAN ENGINEERING DESIGN FOR ELECTRICAL SYSTEMS OF OFFSHORE UNITS.
- 4.2.2 Modular UPS shall comply with the following additional requirements:
- a) **GENERIC DC** 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” $\leq$ 6 and “R” shall be 33% of “N” round up for “N” $>$ 6;
  - b) **GENERIC DC** UPS shall have “hot swap” and “hot standby” 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 ESA.
- 4.2.3 **GENERIC DC** UPSs and their auxiliaries shall be constructed in compliance with the requirements of the CLASSIFICATION SOCIETY.
- 4.2.4 **GENERIC DC** 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 62040-5-3, and IEEE std 519.
- 4.2.5 **GENERIC DC** UPS shall be provided with stabilizing filter at DC outgoing, allowing the disconnection of the battery bank, with the DC system not suffering any alteration.
- 4.2.6 Voltage transient suppressors shall be provided at the rectifiers/chargers, AC input and DC output.
- 4.2.7 **GENERIC DC** UPS shall be constant voltage type with current limitation.
- 4.2.8 **GENERIC DC** UPS rectifier shall be galvanically isolated from the AC supply.
- 4.2.9 **GENERIC DC** UPS electrical components shall be type tested according to IEC standards. These components shall be selected to exclude combustible materials and to minimize heat generation.
- 4.2.10 All internal circuits of **GENERIC DC** UPS, **except for** auxiliary circuits (heating resistor, socket, lighting, etc.), shall have at least two redundant hot standby sources. Each source shall have power from the AC input supply and power from the battery bank branch circuit.
- 4.2.11 **GENERIC DC** UPS system configuration shall be as UPS AND DC SYSTEMS ONE-LINE DIAGRAM.
- 4.2.12 **GENERIC DC** UPS category according with IEC 62040-2 shall be defined during DETAILED DESIGN.
- 4.2.13 All assembly accessories and components shall be immune against electromagnetic and radio frequency interference (EMI/RFI).
- 4.2.14 The DC system shall not be grounded.



## 5 CONSTRUCTIONAL REQUIREMENTS

### 5.1 GENERAL REQUIREMENTS

- 5.1.1 Battery chargers shall be assembled on cabinets built with steel sheets, with only front access, through a latched door.
- 5.1.2 For redundant systems, each **GENERIC DC** UPS shall be furnished complete and assembled in separate enclosures.
- 5.1.3 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 **GENERIC DC** 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 The enclosure shall be constructed from folded and welded mild sheet not less than 14 USG thick. MANUFACTURER can propose other different thickness standards for PETROBRAS evaluating.
- 5.1.6 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.
- 5.1.7 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.
- 5.1.8 Protection devices that cause the **GENERIC DC** UPS to trip shall not be mounted on the door.
- 5.1.9 Power main circuit switches and moulded case circuit-breakers (MCCBs) shall have padlocking facilities.
- 5.1.10 Circuit-breakers shall comply with IEC 60947-2.
- 5.1.11 Transformers and reactors used for input and output isolation shall be air-cooled type.
- 5.1.12 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.
- 5.1.13 Outgoing capacitors shall be protected of internal overpressure.
- 5.1.14 Bus bars shall be of electrolytic copper, dimensioned to rated current in steady state condition. Insulators duly dimensioned, for the specified voltage class shall support bars.
- 5.1.15 **GENERIC DC** UPS shall be provided with switch(es) considering the following operation modes:
- a) Floating: battery bank has a constant voltage, permanently applied to its terminal which is sufficient to maintain it in a state close to full charge and is intended to supply a circuit whose normal power supply may fail.
  - b) Equalization: voltage applied to the battery bank is higher than float voltage to correct inequalities among battery cells (voltage or specific gravity) that may develop in service.

- c) Boost Charge: high current for a limited period to quickly charge the battery bank after a heavy discharge.
- d) Manual: control of an operation by human intervention.
- e) Automatic: control of an operation without human intervention, in response to the occurrence of predetermined conditions.

5.1.16 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, maintenance, and test operation.

5.1.17 **GENERIC DC** UPS shall have simple construction and easy maintenance.

## 5.2 ELECTRONIC EQUIPMENT

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

5.2.2 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.

5.2.1 All external connections of the printed circuit boards shall be made through polarized non interchangeable terminal blocks.

5.2.2 Gold plated terminal blocks shall be selected for the signal paths.

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

5.2.4 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.

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

5.2.6 The electronic components of the automatic regulation device shall be assembled on a single chassis, with an easily removable protecting casing.

5.2.7 Electrical connections shall be “plug-in” type.

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

5.2.9 **GENERIC DC** UPS electronic components shall be perfectly insulated from any contact with ground, 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.

5.3.2 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.

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

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

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5.3.5	Doors and hinged parts shall be bonded to <b>GENERIC DC</b> UPS structure by means of flexible copper connections having a minimum cross-sectional area of 6mm <sup>2</sup> and arranged so that they cannot be trapped as the door is opened or closed.		
5.3.6	Grounding cables shall be according with to requirements of I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.		
5.3.7	Connections from the main grounding bar to components shall consist of green/yellow sheathed stranded copper conductors. Termination lugs shall be compression type.		
<b>5.4</b>	<b>WIRING AND TERMINALS</b>		
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 <sup>2</sup> 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.		
5.4.5	All wiring drawings shall clearly identify the appropriate reference numbers.		
5.4.6	All wiring shall be terminated with pin-crimped terminations.		
5.4.7	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.		
5.4.8	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.		
5.4.9	Voltage levels shall be clearly identified by labels.		
5.4.10	No more than one wire shall be inserted into any one terminal. Looping between terminals, when required, shall be carried out using proper bridges.		
5.4.11	Terminal blocks associated with external sources of supply shall be fully shrouded and fitted with a danger warning label.		
5.4.12	Terminals associated with external current monitoring signals shall be provided with easily removable shorting plugs.		
5.4.13	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.		
5.4.14	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.		

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

**5.5 CABLE TERMINATION**

5.5.1 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 GENERIC DC UPS.

5.5.2 The use of any type of sealing mass for cable entrance is forbidden.

5.5.3 Undrilled removable non-magnetic gland plates shall be provided on cable termination compartments.

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

5.5.5 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 rectifier shall be minimum of 6 pulses type, with constant voltage and current limiting control circuits and soft start philosophy.

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

6.1.3 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.

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<p>6.1.4 After batteries undergo a period of deep discharge and bank battery terminal voltage drops to minimum voltage, boost charging shall be automatically initiated and continue until the batteries are fully recharged if in auto mode.</p> <p>6.1.5 The duration of the boost charging shall be controlled by feedback of the battery current and voltage indicating that adequate battery charge has been achieved.</p> <p>6.1.6 The rectifier unit shall revert automatically to float charging upon completion of the boost charging or equalization charging if in auto mode.</p> <p>6.1.7 The circuits shall have means to avoid accidental contact to energized parts.</p> <p>6.1.8 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 internal protection devices of the rectifier.</p> <p>6.1.9 The rectifier unit shall restart automatically upon restoration of the mains power supply following a power interruption.</p> <p><b>6.2 BATTERY</b></p> <p>6.2.1 Regarding batteries specification, see I-ET-3010.00-5140-714-P4X-001 – SPECIFICATION FOR ELECTRICAL BATTERIES FOR OFFSHORE UNITS, except to batteries for engine starting and cranking applications.</p> <p><b>6.3 TRANSFORMER</b></p> <p>6.3.1 The rectifier shall be isolated from the input power supply by a transformer with electrostatic shield. The transformer shall be sized for the harmonic content according to IEC 61378-1.</p> <p>6.3.2 Transformer construction shall be of the dry-type, double wound, with a grounded shield between windings, configured to suit the uninterruptible power supply system.</p> <p>6.3.3 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.</p> <p>6.3.4 Transformer shall be design according to IEC 60076 (Power Transformers) and shall have insulation class F with temperature rise class B.</p> <p>6.3.5 Unless otherwise stated in PROJECT DOCUMENTATION, the isolation input transformer shall have rated primary as I-ET-3010.00-5140-700-P4X-003 - ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.</p> <p><b>6.4 DIODES</b></p> <p>6.4.1 Block diodes shall be furnished according with UPS AND DC SYSTEMS ONE-LINE DIAGRAM.</p> <p>6.4.2 Drop diodes units shall not be accepted.</p>			

## 7 PROTECTION

- 7.1 **GENERIC DC** 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 **GENERIC DC** UPS.
- 7.4 The incoming circuit-breaker shall be a MCCB, utilization category AC-23.
- 7.5 Fast action fuses compatible with the A<sup>2</sup>s characteristic of the power semiconductors shall be added to the system if the circuit-breaker cannot provide this protection.
- 7.6 Fuses shall comply with IEC 60269 and shall be fitted in fully insulated carriers and bases.
- 7.7 MANUFACTURER shall carry out the dimensioning of **GENERIC DC** UPS circuit-breakers and device considering the load rated power and the maximum in-rush of the system.
- 7.8 Current transformer shall comply with the requirements of [4]I-ET-3010.00-5140-700-P4X-007 – SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE EQUIPMENT.
- 7.9 The secondary winding of current transformer shall be grounded and short-circuited through a removable link, with provision for attaching test links.
- 7.10 Current transformer shall be rated to withstand the thermal and magnetic stresses resulting from fault current.
- 7.11 The rectifier shall be protected against over voltages.
- 7.12 Other 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.
- 7.13 Batteries shall be protected according with UPS AND DC SYSTEMS ONE-LINE DIAGRAM and batteries MANUFACTURER limits.

## 8 MONITORING AND SUPERVISION

### 8.1 GENERAL

- 8.1.1 **GENERIC DC** 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) “PRE-SETS AND ADJUSTING PARAMETERS VALUE”.

8.1.3 HMI shall 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) Battery in boost charging;
- d) Battery in floating;
- e) Battery equalizing;
- f) Discharged battery;
- g) Common AC UPS alarm (necessarily LED signalling light);
- h) Controls, annunciations, and indications described in this specification.

8.1.4 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 “GENERIC D.C. UPS SYSTEM”.

8.1.5 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).

8.1.6 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.

8.1.7 At a minimum, the historical record of the last 100 events, faults and alarms shall be stored in non-volatile memory.

8.1.8 At least 3 events at a time shall be easily visible on HMI screen.

8.1.9 All configuration adjustments shall be implemented in **GENERIC DC** UPS system in non-volatile memory.

8.1.10 The data from 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.

8.1.11 **GENERIC DC** UPS system shall be able to be configured for operation without interrupting the loads supply.

8.1.12 Failure of HMI display or indicating equipment on **GENERIC DC** UPS shall not compromise the operation of **GENERIC DC** UPS.

## 8.2 MEASURING INSTRUMENTS

8.2.1 **GENERIC DC** UPS shall be provided with the following local analogue or digital instrumentation:

- a) AC input voltage with changeover switch (RS-ST-TR);
- b) DC output voltage;

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

## 8.3 SIGNALS, ALARMS, TRIPS, AND INTERLOCKS

8.3.1 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 **GENERIC DC** 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 “GENERIC D.C. UPS SYSTEM”.

Table 1 – Trip functions

Trouble Description	Rectifier Trip
AC INPUT VOLTAGE FAILURE	X <sup>1,2</sup>
RECTIFIER FAILURE	X
DC OUTPUT OVERVOLTAGE	X

- Notes:
- 1 In case of the AC input voltage falls below allowable limits.
  - 2 When the AC input voltage resumes and remains within allowable limits; the rectifier shall start automatically, and no reset is required.
  - 3 Trip functions shall be reset manually, locally, or remotely, except for the AC input failure.

8.3.3 It shall be provided auxiliary interposing relays for each **GENERIC DC** 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 “GENERIC D.C. UPS SYSTEM”.

8.3.4 The wet signals from A&C shall have interposing relays with enough quantity to convert discrete 24 V<sub>DC</sub> signal in discrete voltage-free signal and rectifier shall execute the following actions:


- a) Inhibition of batteries recharging when the ventilation of the battery compartment is turned off;
- b) Inhibition of batteries boost recharging when the detection of H<sub>2</sub> occurs.

8.3.5 **GENERIC DC** UPS unit shall be provided with audible alarm. 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 “GENERIC D.C. UPS SYSTEM”.

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

8.3.7 Alarms related to failure in main supply shall be time delayed with the maximum value allowed by **GENERIC DC** UPS control board, to avoid alarm during load transference and during temporary power failures.



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			INTERNAL

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

## 9 COMMUNICATION REQUIREMENTS

9.1 **GENERIC DC** UPS system shall communicate with Electrical System Automation by Ethernet based protocol, defined by MANUFACTURER, according with I-DE-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE DIAGRAM.

9.2 For **GENERIC DC** 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, the ethernet based protocol defined by MANUFACTURER and requirements according to I-ET-3010.00-5140-797-P4X-001 - ELECTRICAL SYSTEM AUTOMATION ARCHITECTURE.

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

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

9.5 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.

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

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

9.8 **GENERIC DC** 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.

## 10 NAMEPLATES AND LABELS

10.1 **GENERIC DC** UPSs’ first nameplate shall be in accordance with IEC 62040-1 and made with AISI-316L stainless steel.

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

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

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Note: In alternative to paragraph f), the number of the contract, in the cases of acquisition built-in in contract of the lump sum type ("Turnkey ", "Lump Sum", etc.).			
<p>10.3 <b>GENERIC DC</b> UPS shall have their compartments signalled with literal and graphical labels of instructions, cares, warnings, and alert of dangers according to the requirements for identification plates listed in I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.</p> <p>10.4 Internally to <b>GENERIC DC</b> 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.</p> <p>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.</p> <p>10.6 Circuit-breakers labels shall include rated current and trip current set.</p> <p>10.7 All labels and plates shall be secured with non-corrodible screws. Adhesive or self-tapping screws are unacceptable.</p> <p>10.8 All components incorporated within the unit shall be indelibly marked with the component circuit reference. Handwritten stickers or dynotape labels are unacceptable.</p>			
<h2>11 PAINTING</h2> <p>11.1 <b>GENERIC DC</b> UPS 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.</p>			
<h2>12 QUALITY ASSURANCE</h2> <p>12.1 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.</p> <p>12.2 <b>GENERIC DC</b> UPS MANUFACTURER shall furnish the accredited certificate (TYPE APPROVAL) issued by a CLASSIFICATION SOCIETY.</p> <p>12.3 An obsolescence management plan in accordance with an industry recognized system (e.g., IEC 62402) shall be provided for all <b>GENERIC DC</b> UPS assembly components.</p>			
<h2>13 DOCUMENTATION</h2> <p>13.1 All documentation shall be in accordance with I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.</p> <p>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.</p> <p>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</p>			

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 <sup>(note 1)</sup>
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
9	Materials list <sup>(note 2)</sup>
10	General arrangement <sup>(note 3)</sup>
11	Layout <sup>(note 4)</sup>
12	Equipment and accessories performance curves
13	Electric one line diagram
14	Block diagram <sup>(note 5)</sup>
15	Equipment datasheet <sup>(note 6)</sup>
16	Enclosure ventilation requirements
17	UPS calculation memory <sup>(note 7)</sup>
18	Thermal dissipation <sup>(note 8)</sup>
18	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 architecture
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 <sup>(note 9)</sup>
31	Recommended spare parts list considering the entire life cycle of the equipment <sup>(note 9)</sup>
32	Quality plan
33	Inspection and test plans including all tests listed in item 16
34	ISO 9001 certificate of conformity
35	Factory acceptance test procedure
36	CLASSIFICATION SOCIETY certificates
37	Type approval certificates by the CLASSIFICATION SOCIETY
38	Maritime Authority certificates
39	Type test reports <sup>(note 10)</sup>

- Note 1: **GENERIC DC** UPS MANUFACTURER shall present a supply list of similar equipment with a minimum operation of 3 years.
- Note 2: Catalogs of **GENERIC DC** 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 **GENERIC DC** 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 **GENERIC DC** 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 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: **GENERIC DC** UPS MANUFACTURER shall submit a copy of the Type Tests.

### 13.5 Documents to be sent for Approval shall be, at least:

Table 3 – Approval 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
5	Scope of supply
6	Sub-suppliers list
7	Materials list <sup>(note 1)</sup>
8	Fabrication progress report
9	General arrangement <sup>(note 2)</sup>
10	Layout <sup>(note 3)</sup>
11	List of interfaces and connections
12	Dimensional drawings <sup>(note 4)</sup>
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 <sup>(note 5)</sup>
19	Equipment data sheet <sup>(note 6)</sup>
20	UPS calculation memory <sup>(note 7)</sup>
21	Center of gravity and weight
22	Cause and effect matrix
23	Detail drawing of load Main <b>GENERIC DC</b> UPS Distribution Panel <sup>(note 8)</sup>

Item	Description
24	Functional diagram <sup>(note 9)</sup>
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
36	Recommended spare parts list for installation, commissioning and start-up <sup>(note 10)</sup>
37	Recommended spare parts list considering the entire life cycle of the equipment <sup>(note 10)</sup>
38	Quality plan
39	Inspection and test plans including all detailed tests listed in this document.
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 (for offshore units)
48	Training program
49	Preservation, installation and operation manuals in Portuguese <sup>(note 11)</sup>
50	Maintenance manual in Portuguese <sup>(note 11)</sup>
51	Protection Selectivity and Coordination Analysis

Note 1: List of all **GENERIC DC 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 **GENERIC DC 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 **GENERIC DC 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 **GENERIC DC 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 Main **GENERIC DC UPS** Distribution Panels together with **GENERIC DC 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.

### 13.6 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
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 Main GENERIC DC UPS 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

Item	Description
38	Data sheets, calculations and adjustments
39	Quality plan
40	Inspection and test plans including all detailed tests listed in this document.
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 (for offshore units)
47	Type approval certificates by the CLASSIFICATION SOCIETY (for offshore units)
48	Maritime Authority certificates (for offshore units)
49	Training program
50	Preservation, installation and operation manuals in Portuguese
51	Maintenance manual in Portuguese
52	Protection Selectivity and Coordination Analysis

13.7 **GENERIC DC UPS** assembling, operation and maintenance manual shall be sent for approval before factory acceptance test.

13.8 **GENERIC DC 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.

13.9 **GENERIC DC 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.

## 14 SPARE PARTS AND UNUSUAL TOOLS

- 14.1 MANUFACTURER shall recommend the CLASSIFICATION SOCIETY required spares, if any.
- 14.2 MANUFACTURER shall provide the necessary spare parts for the commissioning and pre operation periods.
- 14.3 MANUFACTURER shall supply the accessories, tools recommended by its own experience or by the component MANUFACTURER and recommendations for operation and maintenance and list of recommended spare parts.
- 14.4 MANUFACTURER shall include in the scope of supply all spares required for start-up, commissioning, and pre-operation periods.
- 14.5 MANUFACTURER shall further include in his quotation a proposed list of spares for two (2) years operation with separate prices for each item.
- 14.6 Components requiring periodic replacement shall be listed in the spare parts list with recommended replacement frequency.
- 14.7 MANUFACTURER shall supply all unusual tools required for installation, commissioning, operation, and maintenance of the equipment.

## 15 TRAINING

- 15.1 VENDOR shall furnish training.
- 15.2 This course shall be complete in GENERIC DC 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. 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 It shall be provided by GENERIC DC UPSs MANUFACTURER trip test in circuit-breakers with current injection considering at least 3 points of the thermal curve and the instantaneous curve.
- 16.3 All alarms and status signals that will be sent to the Electrical Workstation and the CSS shall be verified during both FAT and SAT Tests.



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

16.5 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-001 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-001 AND UPS DESIGN	1-2
4	MARKING, IDENTIFICATION, DATA ON NAMEPLATE AND SAFETY WARNINGS CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
5	MATERIAL LIST INVENTORY CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
6	CHECKING OF INTERCHANGEABLE DEVICES	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
7	PAINTING (COLOUR, 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
11	BATTERY CHARGE INHIBITION BY EXTERNAL SIGNAL (BATTERY ROOM VENTILATION FAILURE)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
12	BATTERY DEEP CHARGE INHIBITION BY EXTERNAL SIGNAL (BATTERY ROOM WITH H2 DETECTION)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
13	BURN-IN TEST (MINIMUM 48h 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	CABLE AND INTERCONNECTION CHECK	ACCORDING WITH IEC 62040-5-3	1
17	GROUNDING CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
18	SOFTWARE TESTS (INCLUDING SUPERVISORY AND REMOTE TESTS)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
19	SOFTWARE LICENSES INVENTORY CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
20	BACK UP SOFTWARE INSTALLATION VERIFYING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
21	OPERATION AND SUPERVISION SCREENS RUNNING AND FULLY OPERATIONAL	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
22	COLOR CODE CHECK WITH ALL ELECTRICAL EQUIPMENT ANIMATED	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
23	SCREENS NAVIGATION CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
24	VERIFICATION OF DATA, TIME, COMPANY IDENTIFICATION, UNIT , ETC. AT SCREENS	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
25	USER ACCESS AND CHANGE PROFILE CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
26	GENERAL TURN OFF, TURN ON AND RESET CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
27	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-001 AND UPS DESIGN	1-2
28	GENERAL SYSTEM FUNCTIONS INCLUDING HARDWARE REDUNDANCY AND DIAGNOSTIC CHECK;	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
29	CONTROL DEVICE(S)	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
30	PROTECTIVE DEVICE(S)	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
31	AUXILIARY DEVICE(S)	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
32	SUPERVISORY, MONITORING, SIGNALLING DEVICE(S)	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
33	AUTO TRANSFER TO STORED ENERGY MODE AND BACK TO NORMAL	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1-2
34	NO LOAD	ACCORDING WITH IEC 62040-5-3 WITH NO LOAD	1
35	FULL LOAD	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
36	AC INPUT FAILURE	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
37	AC INPUT RETURN	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
38	STEADY-STATE INPUT VOLTAGE TOLERANCE	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
39	INPUT FREQUENCY TOLERANCE	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
40	INPUT INRUSH CURRENT	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
41	HARMONIC DISTORTION OF INPUT CURRENT	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1



**TECHNICAL SPECIFICATION**

No. **I-ET-3010.00-5140-773-P4X-002**

REV. **B**

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**SPECIFICATION FOR GENERIC DC UPS FOR OFFSHORE UNITS**

**ESUP**  
**INTERNAL**

ITEM	MINIMUM TEST LIST	METHOD CRITERIA	SCHEDULE
42	POWER FACTOR	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
43	EFFICIENCY	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
44	PHASE ROTATION TEST	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
45	NORMAL MODE – NO LOAD	ACCORDING WITH IEC 62040-5-3 WITH NO LOAD	1
46	NORMAL MODE – FULL LOAD	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
47	STORED ENERGY MODE – NO LOAD	ACCORDING WITH IEC 62040-5-3 WITH NO LOAD	1
48	STORED ENERGY MODE – FULL LOAD	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
49	OUTPUT OVERVOLTAGE TEST	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
50	PERIODIC OUTPUT VOLTAGE VARIATION TEST (MODULATION)	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
51	OVERLOAD – NORMAL MODE	ACCORDING WITH IEC 62040-5-3, OVERLOAD PROFILE SHALL BE IN ACCORDANCE WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
52	OVERLOAD – STORED ENERGY MODE	ACCORDING WITH ITEM IEC 62040-5-3, OVERLOAD PROFILE SHALL BE IN ACCORDANCE WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
53	FAULT CLEARING CAPABILITY – NORMAL MODE	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
54	FAULT CLEARING CAPABILITY – STORED ENERGY MODE	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
55	DYNAMIC PERFORMANCE – NORMAL TO STORED ENERGY MODE	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
56	DYNAMIC PERFORMANCE – STORED ENERGY TO NORMAL MODE	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
57	DYNAMIC PERFORMANCE – STEP LOAD – NORMAL MODE	ACCORDING WITH IEC 62040-5-3 I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
58	DYNAMIC PERFORMANCE – STEP LOAD – STORED ENERGY MODE	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
59	OUTPUT CHARACTERISTICS – CONSTANT POWER LOAD	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
60	STORED ENERGY TIME	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
61	RESTORED ENERGY TIME	ACCORDING WITH IEC 62040-5-3, I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
62	BATTERY RIPPLE CURRENT	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1
63	RESTART TEST	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	1-2
64	REPETITIVE SHOCK DURING TRANSPORTATION	ACCORDING WITH IEC 62040-5-3.	3
65	FREE-FALL DURING TRANSPORTATION	ACCORDING WITH IEC 62040-5-3.	3
66	STORAGE IN DRY HEAT, DAMP HEAT AND COLD ENVIRONMENTS	ACCORDING WITH IEC 62040-5-3.	3
67	OPERATION IN DRY HEAT, DAMP HEAT AND COLD ENVIRONMENTS	ACCORDING WITH IEC 62040-5-3.	3
68	ACOUSTIC NOISE	ACCORDING WITH IEC 62040-5-3 WITH 100% OF FULL LOAD	3
69	EMC TESTS	ACCORDING WITH IEC SERIES 61000 STANDARDS.	3
70	COMMUNICATION TESTS (INTERNAL AND EXTERNAL)	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
71	CARDS AND CONTROL BOARDS ARRANGEMENT CHANGEOVER	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
72	INTERLOCKS AND TROUBLESHOOTING CHECKING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
73	ALL FUNCTIONAL TESTS	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
74	ALARMS AND EVENT RECORD CHECK	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1-2
75	TEMPERATURE RISE	ACCORDING WITH IEC 60146-1-1	3
76	MEASUREMENT OF THE INHERENT VOLTAGE REGULATION	ACCORDING WITH IEC 60146-1-1	1
77	RADIO FREQUENCY GENERATED INTERFERENCE AND CONDUCTED NOISE	ACCORDING WITH IEC 60146-1-1	1
78	CHECK OF FLOATING VOLTAGE, CHARGE VOLTAGE AND CURRENT LIMITING	ACCORDING WITH I-ET-3010.00-5140-773-P4X-001 AND UPS DESIGN	1
79	MEASUREMENT OF WINDING RESISTANCE	ACCORDING WITH IEC 60076-1	3
80	MEASUREMENT OF VOLTAGE RATIO AND CHECK OF PHASE DISPLACEMENT	ACCORDING WITH IEC 60076-1	3
81	MEASUREMENT OF SHORT-CIRCUIT IMPEDANCE AND LOAD LOSS	ACCORDING WITH IEC 60076-1 AND IEC 60076-11	3
82	MEASUREMENT OF NO-LOAD LOSS AND CURRENT	ACCORDING WITH IEC 60076-1	3
83	SEPARATE SOURCE AC WITHSTAND VOLTAGE TEST	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	3
84	INDUCED AC WITHSTAND VOLTAGE TEST	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	3
85	LIGHTNING IMPULSE TEST (LI)	ACCORDING WITH IEC 60076-3 AND IEC 60076-11	3

ITEM	MINIMUM TEST LIST	METHOD CRITERIA	SCHEDULE
86	TEMPERATURE RISE TEST <sup>(1)</sup>	ACCORDING WITH IEC 60076-2 AND IEC 60076-11	3
87	DETERMINATION OF SOUND LEVEL	ACCORDING WITH IEC 60076-10 AND IEC 60076-11	3
88	SHORT-CIRCUIT WITHSTAND TEST	ACCORDING WITH IEC 60076-5 AND IEC 60076-11	3
89	MEASUREMENT OF HARMONIC CONTENTS OF THE NO-LOAD CURRENT	ACCORDING WITH IEC 60076-1	3
90	MEASUREMENT OF INSULATION RESISTANCE OF WINDINGS TO EARTH AND/OR OF DISSIPATION	ACCORDING WITH IEC 60076-1	3
91	FACTOR (TAN δ) OF INSULATION SYSTEM CAPACITANCES AND RESISTANCE TEST (USING THE MICRO OHMMETER INSTRUMENT)	ACCORDING WITH IEC 60076-1	3

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 62040-5-3

## 17 ANNEX I - DATASHEETS FORMS

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

17.2 The Data sheets are models and do not refer to any equipment. The MANUFACTURER shall fill in a Data sheet for each equipment.

17.3 For equipment without Data sheet model, MANUFACTURER shall fill in Data sheets according to its own standard and submit to PETROBRAS approval.

## 18 ANNEX II - ABBREVIATIONS AND ACRONYMS

AC	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
IR	Intelligent Relay
LED	Light Emitting Diode
MCCB	Moulded-Case Circuit-Breaker
MCT	Multi-Cable Transit
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NEMA	National Electrical MANUFACTURERS Association
PCC	Point of common coupling
PF	Power Factor

**TECHNICAL SPECIFICATION**No. **I-ET-3010.00-5140-773-P4X-002**REV. **B**

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**SPECIFICATION FOR GENERIC DC UPS FOR OFFSHORE UNITS**

ESUP

INTERNAL

RFI	Radio Frequency Interference
RIL	Reliability Integrity Level
RM	Material Requisition
RMS	Root Mean Square
SCADA	Supervisory Control and Data Acquisition
SAT	Site Acceptance Test
THD	Total Harmonic Distortion
UAM	Unit Alarm Malfunction
UAS	Unit Alarm Shutdown
UPS	Uninterruptible Power Supply
VRLA	Valve Regulated Lead-Acid