

Uninterruptible Power System for Industrial Use

Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.

The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."

CONTEC

Comissão de Normalização
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SC - 06

Electricity

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 09/2013) of PETROBRAS N-2760 REV. A 11/2012. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard sets forth the minimum requirements which shall be complied supply of Uninterruptible Power Systems (UPS) for PETROBRAS facilities, according to national, international and foreign standards.

1.2 This Standard applies to UPS for industrial use with power exceeding 3 kVA.

1.3 This Standard applies to procedures started as of its date of issuance.

1.4 This Standard contains only Technical Requirements.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-329](#) - Bateria de Acumuladores (Storage Battery);

PETROBRAS [N-332](#) - Retificadores para Uso Industrial (Rectifiers for Industrial Use);

PETROBRAS [N-1219](#) - Colors (Cores);

ABNT [NBR 5410](#) - Instalações Elétricas de Baixa Tensão (Low Voltage Electrical Installations).

ABNT [NBR IEC 60439-1](#) - Conjuntos de Manobra e Controle de Baixa Tensão - Parte 2: Requisitos Particulares para Linhas Elétricas Pré-Fabricadas (Sistemas de Barramentos Blindados) (Low-voltage Switchgear and Controlgear Assemblies - Part 2: Particular requirements for Pre-Fabricated Electrical Lines [Shielded Busbar Systems]);

ABNT [NBR IEC 60529](#) - Graus de Proteção para Invólucros de Equipamentos Elétricos (código IP) (Degrees of Protection Provided by Enclosures (IP Code));

ISO [7779](#) - Acoustics - Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment;

ASTM [G21](#) - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi;

IEC [60068-2-6](#) - Environmental Testing - Part 2-6: Tests - Test FC: Vibration (Sinusoidal);

IEC [60068-2-27](#) - Environmental Testing - Part 2-27: Tests - Test Ea and Guidance: Shoc;

IEC [60146-2](#) - Semiconductor Converters - Part 2: Self-Commutated Semiconductor Converters Including Direct d.c. Converters;

IEC [61000-2-2](#) - Electromagnetic Compatibility (EMC) Part 2-2: Environment - Compatibility Levels for Low-Frequency Conducted Disturbances and Signaling in Public Low Voltage Power Supply Systems;

IEC [61086-1](#) - Coatings for Loaded Printed wire Boards (Conformal Coatings) - Part 1: Definitions, Classification and General Requirements;

IEC [61378-1](#) - Converter Transformers - Part 1: Transformers for Industrial Applications;

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;

IEC [CISPR 16-1-2](#) - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-2: Radio Disturbance and Immunity Measuring Apparatus - Ancillary Equipment - Conducted Disturbances;

IEC [CISPR 16-1-3](#) - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-3: Radio Disturbance and Immunity Measuring Apparatus - Ancillary Equipment - Disturbance Power;

IEC [CISPR 16-1-4](#) - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-4: Radio Disturbance and Immunity Measuring Apparatus - Antennas and Test Sites For Radiated Disturbance Measurements;

IEC [CISPR 16-1-5](#) - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-5: Radio Disturbance and Immunity Measuring Apparatus - Specifications and Validation Procedures for Calts and Refs from 30 Mhz to 1 000 Mhz;

IEEE [STD 485](#) - Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications;

IEEE [STD 1115a](#) - Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications.

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

AC (Alternating Current) Safe Busbar

busbar fed by UPS output with controlled voltage and frequency which remains energized even with deterioration of the main AC source

3.2

electrostatic shielding

used to reduce interference between primary and secondary windings (capacitive coupling), thereby providing proper galvanic insulation. It is especially indicated where there is necessity for low leakage currents between windings, such as in those situations where electric noise is present on the mains or equipment. This shielding is comprised of a conductive layer between primary and secondary windings, which shall be connected to the grounding of the circuit and/or mains

3.3

overload capacity

output current capacity of the UPS exceeding to the permanent direct current at a given time, with the output voltage within the nominal range, in normal or stored energy mode

3.4

100 % unbalanced load

load in which 2 phases shall operate with linear load and rated current between phases or phase-neutral (if any), and third phase with no load

3.5

linear load

load with sinusoidal waveform and peak factor equal to square root of 2, or load which current is defined by ratio: $I = V/Z$, where I is the current in load, V is the feeding voltage, and Z is the load impedance (constant as a function of time and voltage)

3.6

non-linear load

load with sinusoidal waveform and peak factor different from square root of 2, or load in which Z impedance is not a constant as a function of time or voltage

3.7

transfer switch

mechanical switch used to connect / isolate the UPS from the load, or energize / de-energize the alternative source circuit

3.8

static switch

electronic device consisting of one or more switches used to transfer the power from the inverter to the alternative source

3.9

alternative source

the second power source which feeds the UPS via an alternative circuit or by-pass

3.10

Main Source

Source of energy that is normally available on a continuous basis and is usually supplied by an electric utility company, but is sometimes generated by the facility itself

3.11

IMO

it is abbreviature of International Maritime Organization, which is the United Nations specialized agency responsible for improving maritime safety and preventing pollution from ships

3.12

Man Machine Interface (MMI)

equipment responsible for receiving and treatment data from the UPS

3.13

DC (Direct Current) Link

Direct Current bus between the rectifier and the inverter input

3.14**Operation Mode of Stored Energy or Battery In Operation**

Operation mode of UPS when fed under the conditions below:

- primary source disconnected or out of tolerance limits;
- DC energy storage system is discharging
- load is within its given range;
- output voltage is within its withstand range.

3.15**Operation Mode by Alternative Circuit**

Operation status of UPS when it only supplies the load through alternative circuit

3.16**Normal Operating Mode**

Stable operating mode which the UPS reaches when fed under the conditions below

- main power supply connected and within tolerance limits;
- storage battery is charged or recharging within the power recovery time;
- the operation is continuous or may be continuous;
- the phase synchronism is active, if any;
- the load is within the established range;
- the output voltage is within the established range;
- the alternative circuit, when used, is available and within the specified tolerance.

3.17**Modu Code**

English acronym for “code for the construction and equipment of mobile offshore drilling units”. It refers to a set of requirements intended to ensure minimum operational safety standards compatible with the characteristics of drilling platforms

3.18**alternative circuit**

circuit through which the alternative source power feeds the static switch or safe busbar of UPS through transfer switch

3.19**TAC**

Field Acceptance Test

3.20**TAF**

Factory Acceptance Test

3.21**tropicalization**

an industrial treatment process against degradation of electronic and mechanical components, such as: fungus growth or oxidation due to high air relative humidity levels, which is aimed at ensuring proper functional performance of the components when subject to the peculiar environmental characteristics of regions having a tropical climate

3.22**UPS**

It is abbreviation of Uninterruptible Power System. This system is constituted of a combination of converters, switches and devices of energy storage (accumulators battery, for example), with the purpose to keep the continuity of feeding for the load in the case of imperfection of the main supply

3.23**THD**

It is abbreviation of Total Harmonic Distortion

3.24**rms**

It is abbreviation of Root Meter Square

3.25**RFI**

It is abbreviation of Radio Frequency Interference

4 Specific Conditions

4.1 Whenever there are discrepancies between the Data Sheet of Annex B and this Standard, the information contained in the Standard shall prevail.

4.2 The UPS shall be designed to be a stationary, fixed, and integrated equipment to be installed in an area that may only be accessed by qualified personnel.

4.3 The UPS shall be designed to be permanently connected.

4.4 The normal operation of the UPS shall be characterized by feeding load by inverter, synchronized with mains and with batteries on float charge. In the occurrence of abnormal conditions in the mains, the batteries shall assume the load. The load shall only be transferred to the by-pass via static switch if the batteries are discharged or an inverter failure occurs.

5 General Conditions

5.1 The UPS design shall have been sold for similar applications and with at least 3 years of successful operation. This history shall be witnessed by users. Prototypes or non-proven equipment will not be accepted.

5.2 The specific characteristics of the UPS are those indicated on the Data Sheet of Annex B, which, together with this Standard, is an integral part of the Material Requisition (RM).

5.3 The supplier shall fill all blank items on the Data Sheet of Annex B (technical data, list of standards used in the design, manufacturing, and testing as well as the list of tests) and return it to PETROBRAS duly authenticated.

5.4 The specific characteristics of each UPS are indicated on its respective Data Sheets, which are numbered according to each design. The blank form of these Data Sheets is standardized by Annex B of this Standard.

5.5 The UPS shall be designed, manufactured and tested in accordance with the provisions of this Standard and the recommendations of the publications mentioned in Section 2 of this Standard.

5.6 Any discrepancy or alternative presented by the bidder in relation to the conditions originally specified by PETROBRAS shall be clearly indicated in its bid in an item entitled "deviations from and alternatives to specifications".

5.7 When "deviations or alternatives" occur, the bid shall include matching references to the numbers of the corresponding paragraphs of this Standard, Data Sheet or RM.

5.8 If "deviations or alternatives" are not mentioned, the manufacturer's supply will be considered to be fully in accordance with the specifications.

5.9 Any conflicts that may occur between the requirements of this Standard and those set forth in the specifications, codes or reference standards, purchase orders or other design documents shall be reported to PETROBRAS. In such cases, no action shall be taken before one seeming for writing from PETROBRAS is emitted.

5.10 When the UPS is installed on offshore production units, it shall follow the recommendations of the classification societies. In the case of a floating type offshore unit, the inclination requirements specified in IMO and in the Modu Code shall also be observed.

5.11 The UPS shall be designed to provide a minimum mean time between failures (MTBF) of at least 180 000 hours and a maximum mean time to repair (MTTR), considering personnel qualified for repair beside the equipment with spares, at most 4 hours.

5.12 The manufacturer shall be responsible for supplying the UPS set with all components as specified in this Standard.

5.13 The UPS shall operate within, or in more severe, grid conditions established below, in normal operating mode, as per standard IEC [62040-3](#):

- a) input voltage variation: $\pm 10\%$ of rated voltage;
- b) input frequency variation: $\pm 5\%$ of rated frequency;
- c) ratio between negative and positive input sequence: $\leq 5\%$;
- d) total voltage harmonic distortion rate: $\text{THD} \leq 8\%$;
- e) individual harmonics, as defined in standard IEC [62040-3](#).

5.14 The UPS system specification shall be done alongside standard PETROBRAS [N-329](#), Storage Battery, since the storage battery sizing and recharge time are essential for sizing of UPS rectifier.

6 Environmental Conditions

6.1 The equipment shall operate in a sheltered location and in a non-hazardous area.

6.2 Printed circuits in electronic modules of equipment shall be treated for protection against aggressive and salted environments (tropicalization) and corrosive gases (for example, gases containing sulfur or chlorine). Treatments shall consist of application of Class 2 reinforced protective



in accordance with IEC [61086-1](#), and fungiproof, in accordance to ASTM [G21](#). The manufacturer shall inform in its proposal the processes used for this protection, subjected to PETROBRAS' approval.

6.3 The ambient temperature range is 0 °C to 40 °C. In this temperature range, the UPS shall operate with rated power. Above this range, the UPS shall remain operating, allowing a reduction in the output power

6.4 The relative air humidity is 95 %, with no condensation, at 25 °C.

6.5 The maximum altitude is 1 000 m, unless otherwise indicated on the Data Sheet of Annex B.

7 Constructive Characteristics

7.1 General Characteristics

7.1.1 The UPS specified by this Standard shall be VFI-S type, as per IEC [62040-3](#).

7.1.2 The UPS and its parts and components shall be manufactured in accordance with the recommendations of the standards mentioned in Chapter 2.

7.1.3 In an IT insulated system (see grounding system, according to ABNT [NBR 5410](#)), if the load distribution center is defined in the scope of supply, as per Chapter 11, it shall contain an insulation monitoring system capable of identifying the branch of the load with low isolation with more than two simultaneous faults.

7.1.4 The by-pass system shall be mounted in a separate compartment adjacent to the UPS cabinet.

7.1.5 The components and systems of the UPS shall be designed for continuous operation under rated output power conditions, considering allowable overload cycles of the UPS as well, without reduction of system capability.

7.1.6 The design of power and control circuits shall be developed so as to prevent a failure in a particular component or printed circuit board from propagating in cascading fashion or causing another failure in the other components or printed circuit boards.

7.1.7 The UPS shall be immune to the accumulation of electrostatic charges, voltage transients, voltage sags and electric noises caused by short circuit in the electrical system, switching of capacitor banks, startup of electric motors, and by lightning discharges, in accordance with the essential electromagnetic compatibility and immunity requirements specified in IEC [62040-2](#).

7.1.8 Insulators of bars, supports and joining parts shall be made of non-hygroscopic and nonflammable material.

7.1.9 Where indicated on the Data Sheet, the UPS shall be provided with heating resistors fed at 120 Vac, one for each vertical section or compartment. These resistors are fed by a source external to the UPS. They shall be protected by a thermomagnetic circuit breaker and automatically controlled by means of a thermostat with a maximum scale range of 60 °C.

7.1.10 The internal circuits of the UPS, excluding the circuits of heating resistors, shall be fed by redundant sources with feed from both, the safe DC busbar of the UPS and of the by-pass circuit.

7.1.11 Autotransformers shall not be used for adapting the UPS input or output voltage or by-pass voltage.

7.1.12 The efficiency of the rectifier/inverter assembly of the UPS, including isolation transformers, under any operating conditions, shall not be lower than the values specified in EC [62040-3](#).

7.1.13 The UPS shall include self-monitoring of hardware and software, continuously monitored, and any irregularity immediately detected shall cause a local signal and set off a remote alarm as specified in items 12.7 and 12.13.

7.1.14 The audible noise shall be ≤ 75 dBA, in accordance with IEC [62040-3](#).

7.1.15 In normal operating mode, the UPS shall remain in operation without the battery bank.

7.1.16 The parameterization of internal adjustments of the UPS shall allow modifications to be made by the user, with specific instructions being included in the installation, operation or maintenance manual.

7.1.17 The circuit fed by the alternative source shall contain a transformer as specified in Section 16.

7.2 Power Semiconductors

Provision shall be made for a redundant forced ventilation system to keep power semiconductors within their allowable operating temperature limits. The fans of the system of forced ventilation shall be monitored on its functioning. The fan shall be able to be replaced with no need to de-energize the UPS, no loss of UPS functionalities and no risk for the equipment, facilities or people. In the eventuality of non-availability of one of them alarms shall be acted in accordance with 12.7.

7.3 Enclosure

7.3.1 The degree of protection of the UPS shall be that indicated on the Data Sheet in accordance with ABNT [NBR IEC 60529](#).

7.3.2 The UPS shall be resistant to corrosion caused by the characteristic atmosphere of the installation site, as indicated on the Data Sheet of Annex B.

7.3.3 The treatment and paint system of metallic plates of the UPS shall present a high performance level for the environmental conditions indicated in this Standard and on the Data Sheet. The manufacturer shall present, together with its proposal, the treatment and paint system to be adopted.

7.3.4 The final finish color should be as specified on the Data Sheet. When the color is not specified, the light gray color corresponding to code 0065 of PETROBRAS [N-1219](#) shall be used.

7.3.5 The UPS shall be mounted on a self-supporting panel. (see Chapter 9 of this Standard).

7.3.6 The metal parts comprising the UPS that are not expected to be of the current-carrying type shall present electrical continuity and be connected to the ground busbar of the UPS. The doors shall have electrical continuity with the metallic structure of the UPS through flexible copper braid.

7.3.7 The ground busbar shall be located on the bottom inside part of the UPS, covering its entire extension and shall have a compression connector suitable for connecting a bare copper stranded ground wire with the nominal cross-section indicated on the Data Sheet of Annex B.

7.4 Identification

7.4.1 Internal components and terminal blocks shall be identified. The wiring shall be identified according to the respective wiring diagrams.

7.4.2 The UPS identification plate shall be attached to the outside of the UPS and shall be made of series AISI 300 stainless steel. This plate shall contain at least the following data:

- a) manufacturer's name or brand name;
- b) supply voltage, number of phases, and rated frequency;
- c) rated power supply current;
- d) rated power in kVA and rated power factor;
- e) rated output voltage;
- f) rated output current;
- g) momentary current (overload) sustained for 60 seconds;
- h) serial number;
- i) model.

7.4.3 The panel shall be provided with a supplementary identification plate made of series AISI 300 stainless steel containing at least the following data:

- a) Petróleo Brasileiro S.A. - PETROBRAS;
- b) name of PETROBRAS department;
- c) project name;
- d) UPS-CA identification;
- e) RM number;
- f) Purchase and Service Order number (PCS);
- g) the contract number, in case the acquisition is made under a Turn Key, Lump Sum, and other similar types of contracts.

7.5 Printed Circuit Boards

7.5.1 The components of the printed circuit boards shall have industrial quality level.

Boards, circuits and their components shall be protected so as to prevent fungus growth or the occurrence of damages due to local humidity, salinity, chlorine and sulfur.

7.6 Wiring and Connections

7.6.1 The insulation of internal power and control cables shall have a flame-retardant chemical composition.

7.6.2 All points of wiring for external connection (input and output circuits) shall be functionally identified within the UPS, on each terminal block or power connection, including power, grounding, control and alarm cables.

7.6.3 Insulation and leakage distances shall be sized in accordance with ABNT [NBR IEC 60439-1](#), considering rated voltage V, overvoltage category III, pollution degree 3, material group 3A and non-homogeneous field.

7.7 Local Digital Control Panel

7.7.1 The UPS shall have a local digital control panel on its front part to allow man/machine interface. This panel shall contain at least the following devices for operation and monitoring:

- a) "on" key;
- b) "off" key;
- c) parameter selection key;
- d) parameter and adjustment programming keys;
- e) key to increment functions or control values;
- f) key to decrement functions or control values;
- g) led indicating equipment is energized;
- h) digital alphanumeric display to indicate the variables described according to Chapter 12;
- i) UPS synoptic to indicate the status of system operation according to Chapter 12.

7.7.2 During the normal operation period, the display shall allow at least indication of the current, voltage, and frequency values. The values shall be input, output and internal actual values, as defined in block diagram of the UPS and in 12.6.

7.7.3 The data of the local control digital panel shall be stored in non-volatile memory so as to allow recovery of parameterization, alarms, and register of events even after the UPS has fully de-energized.

7.8 UPS Communication

7.8.1 Physical Layer

Interfaces shall be made available for connection between the UPS and MMI, according to Data Sheet of Annex B.

7.8.2 Link Layer

The UPS shall communicate with the MMI using MODBUS protocol, unless otherwise specified on the Data Sheet.

7.9 Configuration

7.9.1 The UPSs shall allow configuration and access to all parameters via man-machine interface, comprised of the elements specified in 7.7 and 12.9.

7.9.2 Any needed software for the configuration shall be provided to PETROBRAS with the UPS, at no expense. The configuration software shall be compatible with the Windows^{®1)} operating system.

7.9.3 The configuration of the UPS via the serial port shall be implemented with the UPS in operation, without interrupting the AC safe busbar feed.

7.9.4 Configuration adjustments shall be implemented in the UPS in non-volatile memory.

7.9.5 Accesses for changing the configuration and for cleaning recorded data using any means shall be protected by a configurable password available to PETROBRAS. Provision shall be made for a password not to be required for reading UPS data.

7.11 Redundant Parallel Architecture

7.11.1 If requested in Data Sheet of Annex B, the UPS to be supplied shall have redundant parallel architecture and present the performance requirements shown below:

7.11.1.1 The load shall be automatically and equally distributed among the UPS units.

7.11.1.2 If any failure occurs in one of the redundant UPS units, the load shall be automatically distributed among the other ones.

7.11.1.3 There shall be no single point of failure of the synchronism system affecting the other UPSs. It is not allowed a central module of load division control and synchronism external to redundant UPSs.

7.11.1.4 The technology shall be capable of operating with at least 5 UPS units in parallel with active load division. To add an UPS in parallel, it is not allowed to add hardware in the other UPSs, unless the interconnection by means of communication between the UPSs.

7.11.1.5 The redundant system with more than one UPS in parallel shall perform an active sharing of load and supply current equal to voltage.

7.11.1.6 The configuration of static switch shall comply with options defined in IEC 62040-3 and established as per Data Sheet between UPS with common or shared static switch.

NOTE The parallel connection of transformers from varied by-passes is a problem due to small impedance differences in each secondary winding. It is recommended to contact the manufacturer if the shared static switch topology is required. In the configuration of shared static switch, composed transfer switches shall not be used, since they add an unnecessary complexity.

7.11.1.7 The total number of redundant parallel UPSs and the load division is equal to "N + R" and shall be defined as per Data Sheet, where N is the number of individual UPS units required to withstand the load and R is the number of redundant UPS units.

¹⁾ Windows[®] é o nome comercial de um produto da Microsoft Corporation. Esta informação é dada para facilitar aos usuários desta Norma e não constitui um endosso por parte da PETROBRAS ao produto citado. Podem ser utilizados produtos equivalentes, desde que conduzam aos mesmos resultados.

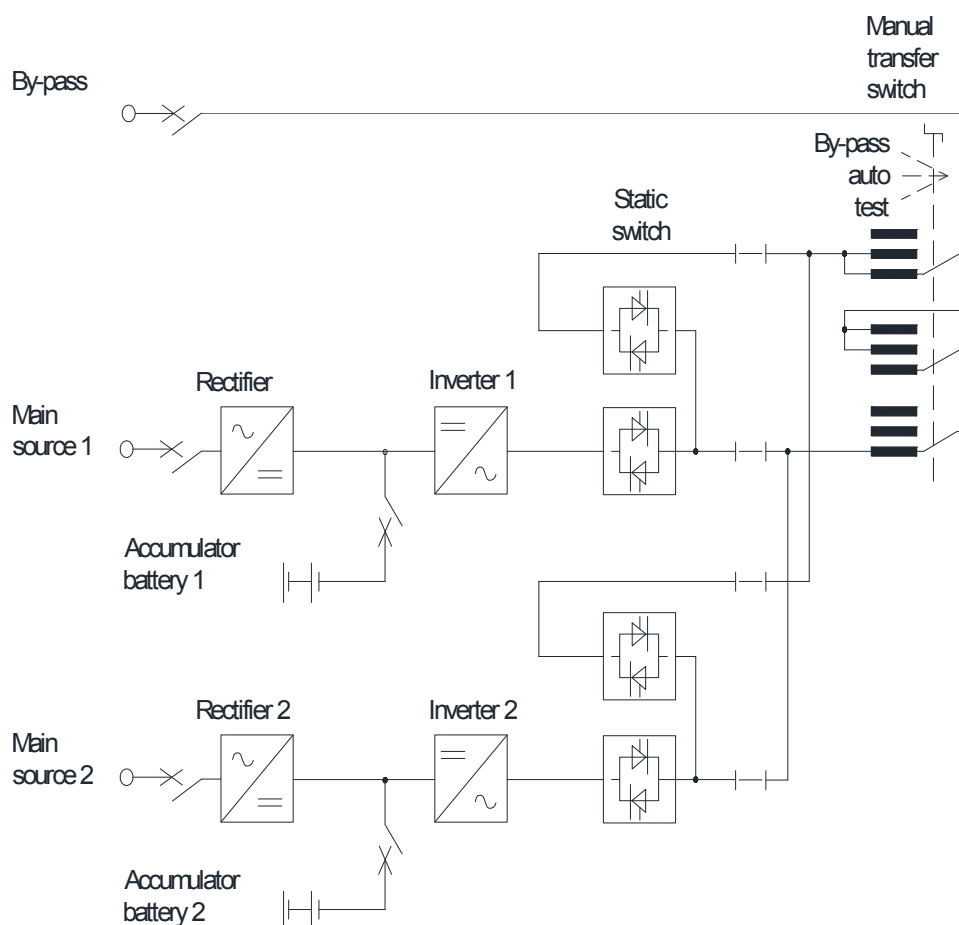


Figure 1 - Typical Configuration of Redundant Parallel UPS N = 1 and R = 1

- NOTE 1 A typical configuration, in which 2 units in redundant parallel configuration shall withstand 100% of load each, is N = 1 and R = 1.
- NOTE 2 Another example of configuration, in which many redundant units add the required to withstand the load, for instance, 4 UPS in parallel and one redundant unit, is N = 4 and R = 1. In this case, there are 5 UPS in parallel relying on the redundant unit. In this configuration, each of the 5 units is sized to withstand 25 % of the load.
- NOTE 3 Figure 1 represents a typical configuration of scope of supply of redundant parallel UPS N = 1 and R = 1, and does not establish a supply standard. The application in a design shall be thoroughly studied so as to adapt the configuration of the equipment being purchased to local standards and installation site needs.

8 Input Supply Characteristics

8.1 The UPS shall meet the grid requirements, as per 5.13, unless otherwise indicated in the Data Sheet of Annex B.

8.2 Unless otherwise indicated in Data Sheet of Annex B, the input supply shall be four-wire three-phase.

8.3 The negative-to-positive sequence ratio shall not exceed 5 %.

8.4 The short-circuit level in the UPS feed panel shall be as indicated on the Data Sheet of Annex B.

9 Characteristics of Fed Load

9.1 The fed load by the UPS has non-linear characteristics with a minimum peak factor of 3, typically comprised of switch mode power supplies, with power factor usually between 0,6 and 1.

9.2 The UPS shall be sized to continuously supply the load of 100 % of the nominal apparent power.

10 Output Characteristics

10.1 The output voltage shall be as specified on the Data Sheet of Annex B.

10.2 The frequency shall be 60 Hz $\pm$ 3 Hz synchronized with the alternative source or $\pm$ 0,05 Hz by an internal crystal oscillator.

10.3 The inverter shall limit the total harmonic distortion of output voltage for less than 3 % of the total RMS with 100 % of linear load, or less than 5 % RMS with 100 % of non-linear load. The individual harmonic distortion shall not exceed 3 %. In the by-pass mode, the harmonic distortion shall be equal to or less than the input supply voltage distortion.

10.4 The UPS shall have output voltage characteristics under conditions involving change in mode of operation (normal/stored energy/by-pass) and under conditions involving application of load increase or decrease, and shall comply with 10.4.1 and 10.4.2.

10.4.1 Static voltage regulation shall be better than $\pm$ 1 % of the efficient nominal voltage under any normal operating conditions.

10.4.2 Unless otherwise specified in the Data Sheet, the output voltage dynamic performance curves of the UPS shall remain, according to IEC 62040-3, within the limits CCC equal to 111 for change of operation mode, degree of linear load and degree of non-linear load.

10.5 The UPS shall withstand temporary overloads of 150 % of the rated current for a period of 1 minute, and of 125 % of the rated current for a period of 10 minutes. This overload condition shall be tested considering the UPS supplying rated power and with the internal temperature stabilized in both the normal and stored energy modes of operation.

10.6 The UPS, when three-phase type is specified, shall provide a phase angle between voltages of $120^\circ \pm 1^\circ$ for balanced loads and $120^\circ \pm 3^\circ$ for 100 % unbalanced loads, in the normal and stored energy mode of operation.

10.7 The UPS, when three-phase type is specified, shall withstand 100 % of load unbalancing in continuous duty, keeping an unbalance of the output voltage at $\pm$ 5 %, at the most in the normal and stored energy operation mode.

11 Load Distribution Panel

If established in Data Sheet of Annex B, the UPS manufacturer shall be responsible for supplying the load distribution panel. The description, drawing and requirements are defined in a separated specification to be supplied by PETROBRAS.

12 Protection, Metering, Control and Signaling

12.1 The protection in the UPS inputs shall operate for short circuit, overvoltage and overcurrent conditions.

12.2 The UPS shall inhibit the rectifier by high DC voltage or by short circuit at the rectifier output.

12.3 The UPS shall disconnect the battery bank when operated by final battery discharge voltage adjustment. If the batteries reach the discharge limit recommended by the manufacturer, the static switch shall transfer to the alternative source provided the synchronism conditions are fulfilled. Otherwise the power delivered to the load shall be interrupted.

12.4 The UPS shall inhibit the inverter by continuous voltage outside limits, by overload and by inverter failure. The inverter shall limit the current to the overload values and if the specified time is exceeded, it shall transfer to the alternative source, when synchronized, and within the specified voltage limits.

12.5 The UPS shall inhibit transfer by loss of synchronism with the alternative source, with the frequency being transferred to reference of internal oscillator.

12.6 The UPS shall contain an alphanumeric digital display to indicate voltage, frequency, current, historical register of faults, display of local alarms, adjustment parameter values:

- a) main source input - voltage;
- b) alternative source input - voltage, frequency;
- c) direct current branch - rectifier output voltage and current, battery current, battery open circuit voltage;
- d) inverter output - voltage, current and frequency.

12.7 The diagnosed failures shall be available in accessible memory through digital communication described in item 7.8, and shall be contained in the summary of alarms:

- a) main source undervoltage;
- b) main source overvoltage;
- c) abnormal rectifier;
- d) DC undervoltage;
- e) DC overvoltage;
- f) rectifier overload;
- g) alternative source undervoltage;
- h) alternative source overvoltage;
- i) synchronism under abnormal conditions;
- j) out of synchronism;
- k) abnormal / blocked static switch;
- l) abnormal inverter;
- m) inverter overload;
- n) inverter output undervoltage;
- o) inverter output overvoltage;
- p) self-monitoring failure detection;
- q) battery disconnected;
- r) battery discharging;
- s) static switch transferred to alternative source;
- t) manual transfer to alternative source;
- u) earth leakage in DC link (optional Data Sheet);
- v) earth leakage in safe busbar of consumers (optional Data Sheet);

- w) UPS ventilation failure;
- x) inhibition reload for gas detection in the batteries room (optional Data Sheet)

12.8 The UPS shall store in non-volatile memory historical register of the last 50 events at least. The man-machine interface shall allow the reading of failures and events described in Chapter 12.

12.9 The UPS shall have a synoptic panel to show system operations, indicating at least the following:

- a) presence of voltage in main source and within normal parameters;
- b) rectifier in operation;
- c) direct current busbar energized and within normal parameters;
- d) battery on float charge;
- e) battery discharging;
- f) inverter in operation;
- g) presence of voltage in alternative source and within normal parameters;
- h) normal static switch;
- i) load fed by inverter;
- j) load fed by main source;
- k) load fed by alternative source.

12.10 The UPS shall have a circuit breaker for the main source input and one for the alternative source input.

12.11 The UPS shall have manual static switch control on the front part of the UPS cabinet to allow selection of the alternative source or inverter output. If the UPS is synchronized with the alternative source, it shall promote transfer without interrupting the power delivered to the loads.

12.12 The UPS shall have a transfer switch with single command “make before break” type or composite with simple switches to allow removal of the UPS for maintenance, as defined in Data Sheet of Annex B. If the UPS is synchronized with the alternative source, the operation of this switch shall not cause interruption of power delivered to the loads. When indicated in Data Sheet of Annex B, the single command switch shall have an intermediate test position between normal and alternative positions, so as to feed the safe AC busbar and static switch input by alternative source. When a composite transfer switch is defined in Data Sheet of Annex B, it shall be made of simple switches, as per Figure.

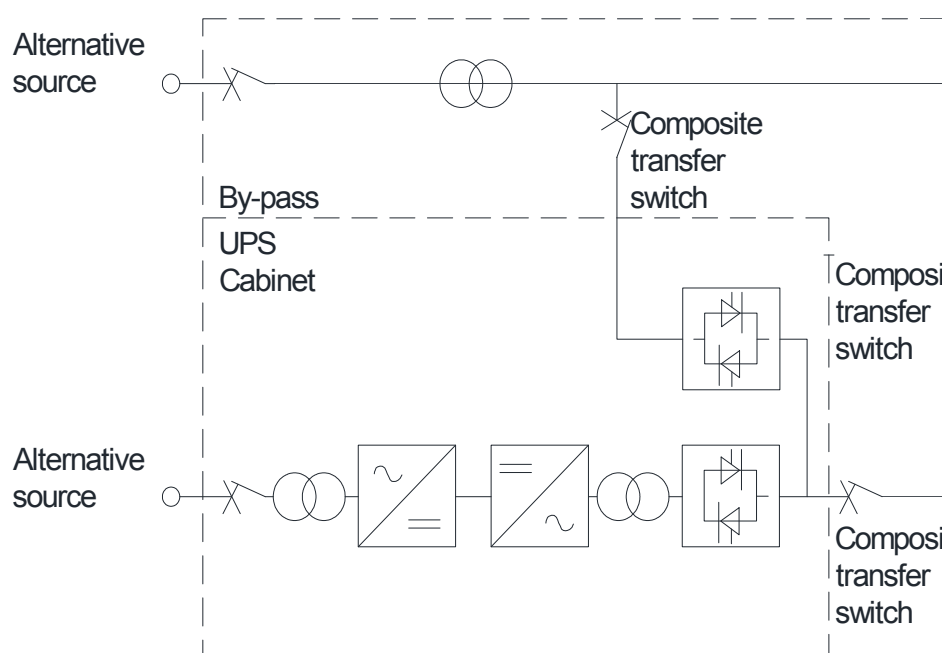


Figure 2 - Composite Transfer Switch

12.13 The UPS shall have at least remote alarms of battery feeding the load, load fed by the alternative source and summary of failures. These alarms shall be made available through voltage-free SPDT dry contacts with capacity of 0,5 A, 250 Vac / 125 Vdc, with inductive load ($L/R = 0,04$ s).

12.14 If the UPS manufacturer is responsible for supplying the load distribution panel, as established in Chapter 11, it shall also be responsible for coordinating the protection of the entire system.

13 Static Switch

13.1 The static switch of the UPS shall implement the immediate transfer of load from the inverter to the alternative source without interruption in case of overload, voltage outside limits, protection of battery or by manual operation command. The synchronism transfer shall take place in a time of 4 ms or shorter by inverter failure or overload. Out of synchronism, the transfer time shall be at least 1 cycle (16,66 ms).

13.2 The static switch of the UPS shall implement transfer up to 4 ms from the alternative source to the inverter, for recovery to within normal conditions or by manual operation, without interruption in power delivered to the loads, in those situations in which the voltage of the alternative source and of the UPS are normal and synchronized.

13.3 The static switch shall be sized to continuously withstand an overload current of 125 % of the rated current of the UPS. It shall also withstand an overload of 200 % of the rated current of the UPS for 30 s and withstand for 100 ms a current value of 1 000% of rated current.

14 Rectifier

The technical requirements for performance are established according to PETROBRAS N-332.