

APC by Schneider Electric
MGE GALAXY 9000
Uninterruptible Power Supply
Guide Specifications
800/900 kVA to 4800/5400 kVA
Parallel UPS, three-phase

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SECTION [26 33 63] [16611]

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 UPS DEFINITIONS

- A. **Purpose:** The purpose of this specification is to define the design, manufacture and testing characteristics required in view of supplying, putting into operation and maintaining an Uninterruptible Power Supply system (referred to as a UPS in the rest of this document). The UPS system shall be designed to supply dependable electric power to:
1. **The Single-UPS unit with static bypass shall be designed to supply dependable electric power to:** 475.000 MTBF in hours/Non availability: 2.1×10^{-5} .
 2. **Active redundancy N+1:**
 - a. 2 UPS units: 3.11×10^6 MTBF in hours/Non availability: 3.22×10^{-6}
 - b. 3 UPS units: 2.42×10^6 MTBF in hours/Non availability: 4.14×10^{-6}
 - c. 4 UPS units: 1.97×10^6 MTBF in hours/Non availability: 5.07×10^{-6}
 - d. 5 UPS units: 1.67×10^6 MTBF in hours/Non availability: 6×10^{-6}
 - e. 6 UPS units: 1.44×10^6 MTBF in hours/Non availability: 6.95×10^{-6}
- B. **Brief description:** The UPS system shall be made up of ...[2 / 3 / 4 / 5 / 6]...identical parallel-connected UPS units with the same power rating, operating in double-conversion mode (also called on-line mode) in accordance with the VFI category described in standard IEC 62040-2. Each UPS unit shall have a unit rating of ...[800 / 900]... kVA, made up of the following components, described in this specification:
1. Rectifier
 2. Battery charger
 3. Inverter
 4. Battery
 5. Battery management system
 6. In addition, the UPS shall be equipped with:
(for parallel connection of two single UPS units, with redundancy)
 - a. Static bypass (via a static switch) on each unit;
 - b. Manual maintenance bypass on each unit;
 - c. User and communications interface on each unit.**(for parallel connection with an external maintenance-bypass cabinet, up to four units)**
 - a. Static bypass (via a static switch) on each unit;
 - b. Common, external, maintenance bypass for all units, installed in a cabinet;

- c. User and communications interface on each unit.
 - (for parallel connection with a centralized-bypass cabinet, up to six units)**
 - a. A centralized bypass shall be made up of the following components:
 - 1) static bypass (via a static switch);
 - 2) manual maintenance bypass.
 - 7. The centralized bypass shall be sized to support the entire load.
 - a. A user and communications interface for the entire UPS system.
 - C. The UPS system shall also comprise any and all other devices required for safe operation and maintenance, including circuit breakers, switches, etc.
 - D. The UPS shall ensure continuity of electric power to the load within the specified tolerances, without interruption upon failure or deterioration of the normal AC source (utility power) for a maximum protection time determined by the capacity of the backup batteries installed.
- 1.2 WARRANTY**
- A. The rectifier/charger and inverter subassemblies shall be guaranteed (parts and labour on site) for one year following the start-up date.
 - B. The sealed lead-acid battery shall be covered by the same warranty as the UPS.

PART 2 - PRODUCTS

2.1 OPERATING PRINCIPLES

- A. The double-conversion UPS (also called on-line) shall operate as defined below:
- B. **Normal operation** (normal AC source available): The rectifier supplies the inverter with DC current while the charger simultaneously float charges the battery. The load is continuously supplied with dependable electrical power by the inverter.
(for parallel connection with a centralized bypass cabinet, up to six units)
 A current-loop system shall ensure automatic distribution of the total load between the various parallel-connected units.
- C. **Operation on battery power** (normal AC source not available or outside tolerances):
 Upon failure or excessive deterioration of the normal AC source, the inverter shall continue to supply the load from battery power without interruption or disturbance, within the limits imposed by the specified battery backup time.
- D. **Battery recharge** (normal AC source restored): When the normal AC source is restored, the rectifier shall again power the inverter, without interruption or disturbance to the load, while the charger automatically recharges the battery.
- E. **Parallel operation with redundancy**
 - 1. **(without redundancy):** The system shall not be redundant. The ...[2 / 3 / 4 / 5 / 6]... UPS units must operate in parallel to supply the load. Shutdown of one unit shall result in transfer to
 - a. ...[the various static bypasses, connected to the same bypass AC source]
 - b. ...[the centralized bypass]
 - 2. **(with redundancy):**
 - a. The units shall operate in parallel and redundantly, with the load shared equally between the units.
 - b. Redundancy shall be of the "n+1" (or n+2) type, i.e. "1" (or 2) units shall be redundant in the total of n units. If a major fault occurs on a unit, it shall automatically disconnect.
 - c. If the remaining unit(s) are sufficient to supply the load, it/they shall remain in operation.
 - d. If the total available power is insufficient, the load shall be automatically transferred, without interruption, to the bypass AC source, if it is within tolerances.

F. **Transfer to bypass AC source:**

1. In the event of an overload exceeding system capabilities or UPS shutdown, the static bypass switch shall instantaneously transfer the load to the bypass AC source without interruption, on the condition that bypass power is available and within tolerances.
2. **(for parallel connection with an external maintenance-bypass cabinet, up to four units)**
During transfer, the system shall simultaneously switch the static switches.
3. **(for parallel connection with a centralized-bypass cabinet, up to six units)**
Transfer shall be carried out by the common static bypass in the centralized-bypass cabinet, with simultaneous orders to the UPS units.
4. Transfer of the load back to the UPS-unit output, synchronised with the bypass AC source, shall be automatic or manual. During transfer, the load shall not suffer an outage or disturbance in the supply of power.
5. On request, the UPS system may automatically transfer the load with a micro-interruption if a major fault occurs on the UPS system and if synchronisation with the bypass source has not been established.

G. **UPS maintenance:**

1. All electronic components shall be accessible from the front of the UPS.
(for a two-UPS system with active redundancy)
 - a. Built into each UPS unit
 - (with external maintenance-bypass cabinet)**
 - a. Installed separately in the external maintenance bypass cabinet
 - (with centralized-bypass cabinet)**
 - a. Installed separately in the centralized bypass.
2. This system shall be designed to isolate the UPS while continuing to supply power to the load from the bypass AC source. The UPS shall also include a device making it possible to isolate the rectifiers and the chargers from the normal AC source.

- H. **Battery maintenance:** For safe maintenance on the battery, the system shall include a circuit breaker to isolate the battery of each parallel-connected UPS unit from the rectifier, the corresponding charger and the inverter. When the battery is isolated from the system, the UPS shall continue to supply the load without interruption or disturbance, except in the event of a normal AC source outage.

- I. **Cold start (normal AC source absent):** The battery of each unit shall be capable of ensuring UPS start-up even if normal AC power is not available and continuing operation within the specified back-up time (start on battery power shall be possible on the condition that the system was already started with AC power present).

2.2 SIZING AND GENERAL CHARACTERISTICS

- A. **Technology:** Each unit in the UPS system shall be based on IGBT technology with built-in thermal monitoring and a free-frequency chopping mode to dynamically optimise efficiency and power quality.

B. **Rating:**

1. The UPS system shall be sized to continuously supply a load of ____ kVA, at a power factor (pf) of [0.8 / 0.9].
2. It shall be made up of ...[2 / 3 / 4 / 5 / 6]... UPS units, each with an identical rating of ...[800 / 900]... kVA.
3. The total installed power rating shall thus be _____ kVA. ...[Consequently, 1 (or 2) unit(s) may be redundant.]

C. **Battery backup time:**

1. The battery backup time in the event of a normal AC source outage shall be _____ minutes, for a load power factor of 0.8.
2. Battery service life shall be equal to at least ...[10 / 12]...years. It shall be selected and sized correspondingly, for a load power factor of 0.8.

D. **Types of loads accepted:**

1. The UPS shall accept high crest factors without derating to ensure correct operation with computer loads.
2. The total harmonic voltage distortion at UPS output (THDU downstream) shall respect the following limits:
 - a. THDU downstream $\text{ph/ph} \leq 4\%$ and $\text{ph/N} \leq 3\%$ for linear loads.

E. **Limitation of harmonics upstream of the UPS:**

1. The UPS system shall not draw a level of harmonic currents that could disturb the upstream AC system, i.e. it shall comply with the stipulations of guide IEC 61000-3-4.
2. To that end, it shall be possible to equip each rectifier/charger input with a filter of the type ...[compensated LC / non-compensated LC / with contactor / double-bridge / phase shifting]...capable of limiting the total harmonic distortion of the current (THDI) upstream to $< 7\%$.
3. If necessary, it shall be possible to use an electronic active filtering system to obtain, at the normal AC input, the following levels, constant from 50% to 100% load:
 - a. Total harmonic current distortion (THDI) upstream of the rectifier/charger not exceeding 4%;
 - b. Input power factor (pf) greater than 0.95.

F. **Efficiency:** Overall efficiency shall be greater than or equal to:

1. 93% at full rated load (I_n).
2. 94% at half rated load ($I_n/2$).

G. **Noise level:** The noise level, measured as per standard ISO 3746, shall be less than: 75 dBA.

2.3 AC SOURCES

A. **Normal AC source** (rectifier input): The normal AC source supplying the UPS shall, under normal operating conditions, have the following characteristics:

1. Rated voltage: 380, 400 or 415 volts rms at full rated load P_n ;
2. Number of phases: 3;
3. Frequency: _____ Hz $\pm 10\%$.

B. **Bypass AC source** (static-bypass input, if separate from rectifier input):

1. The bypass power supplying the UPS in the event of an inverter shutdown (maintenance, failure) or an overload (short-circuit, heavy inrush currents, etc.) shall have the following characteristics:
 - a. Voltage: _____ / _____ volts, $\pm 10\%$;
 - b. Number of phases: 3 + N + earth; (a non-distributed neutral is possible);
 - c. Frequency: _____ Hz $\pm 5\%$ (adjustable up to ± 2 Hz).
2. Outside these tolerances, it shall be possible to supply the load, but in downgraded mode.

2.4 ELECTRICAL CHARACTERISTICS

A. **Rectifier and charger**

1. **Supply:** Each rectifier and charger module shall be supplied via the normal AC input and shall have the characteristics presented below.
2. **Inrush current:** A device shall be provided to limit inrush currents. When AC power fails and during genset start, the rectifier shall gradually limit the power it draws over a 10-second walk-in ramp.
3. **Operating mode:** The standard charger shall be sized to recharge the battery rapidly: a battery with a backup time of...[5 / 10 minutes in less than 11 hours] (following a discharge to $P_n/2$ to recover 90% of backup time).
4. **Battery-current limiting:** For long battery life, an electronic device shall automatically limit the charging current to the maximum value specified by the battery supplier ($0.1 \times C_{10}$ for a sealed lead-acid battery).
5. **Voltage regulation:** Rectifier/charger regulation shall take into account the ambient temperature of the battery and shall ensure DC output voltage fluctuations of less than 1% irrespective of load and AC input voltage variations (within the specified limits).

B. **Batteries:**

1. Each UPS unit shall be equipped with its own battery of the ...[sealed lead-acid type, factory mounted and wired in a cabinet identical to that of the UPS,] ... [sealed lead-acid type, mounted on shelves,]...[vented lead-acid type, mounted on a rack,]... with a service life equal to at least ...[10 / 12]... years .
2. Each battery shall be sized to ensure continuity in the supply of power to the corresponding inverter for at least ...[8 / 10 / 15 / 30 ...]... minutes, in the event of a normal AC source failure, with the inverter operating at full rated load, i.e. _____ kVA at a power factor (pf) of 0.8.
3. Sizing calculations shall assume an ambient temperature between 0° C and 35° C.
4. The UPS shall include devices to ensure:
 - a. Effective battery protection;
 - b. Battery management.

C. **Inverter:** Each inverter shall be sized to supply a rated load of ...[800 / 900]... kVA at [0.8 / 0.9] pf and shall satisfy the specifications listed below.

1. **Output voltage**

- a. **Rated voltage:** ...[380 / 400 / 415]... volts rms, adjustable via the user interface, within tolerances of +/- 0.5%.
- b. **Number of phases:** 3 phases + neutral + earth.
- c. **Steady-state conditions:** The variation in the rated voltage shall be limited to $\pm 2\%$ for a balanced load between 0 and 100% of the rated power, irrespective of normal AC input and DC voltage levels, within the specified limits.
- d. **Voltage variations for load step changes:** Output voltage transients shall not exceed $\pm 0.5\%$ of rated voltage for 0 to 100% or 100 to 0% step loads. In all cases, the voltage shall return to within steady-state tolerances in less than 100 milliseconds.
- e. **Unbalanced load conditions:** For a load unbalance between phases, the output voltage variation shall be less than 1.5%.

2. **Output frequency**

- a. **Rated frequency:** - 50 or 60 Hz.

3. **Synchronisation with bypass power**

- a. **When bypass power is within tolerances:** To enable transfer to bypass power, the inverter output voltage shall be synchronised with the bypass source voltage whenever possible. To that end, during normal operation, a synchronisation system shall automatically limit the phase deviation between the voltages to 3 degrees, if the bypass source frequency is sufficiently stable (within adjustable tolerances of $\pm 0.5\%$ Hz with respect to the rated frequency).
- b. **Synchronisation with an external source:** It shall be possible to synchronise with all types of external source.
- c. **Autonomous operation following loss of synchronisation with bypass power:** When the bypass source frequency deviates beyond these limits, the inverter shall switch over to free-running mode with internal synchronisation, regulating its own frequency to within ± 0.02 Hz. When bypass power returns to within tolerances, the inverter shall automatically resynchronise.
- d. **Variation in frequency per unit time:** To avoid transmitting to the inverter any excessive frequency variations on the bypass AC source when it is within tolerances, inverter frequency variations per unit time (dF/dt) shall be limited to 1 Hz/s or 2 Hz/s (user defined).

4. **Overload capacity:** The UPS shall be capable of supplying for at least:

- a. 1 minutes a load representing 150% of the rated load.
- b. If necessary, the UPS shall operate as a generator (current limiting) with a peak capacity of 212% for 150 milliseconds, to allow highly disturbed transient operating states (high overloads, very high crest factors, etc.) without transferring the load to the bypass.

D. **Static bypass**

1. **Load transfer to the static bypass:**

- a. Instantaneous transfer of the load from the inverters to bypass power and back shall take place without a break or disturbance in the supply of power to the load, on the condition

that the bypass source voltage and frequency are within the specified tolerances and that the inverters are synchronized. Transfer shall take place automatically in the event of a major overload or an internal UPS-system fault. Manually initiated transfer shall also be possible.

- b. If the bypass power is outside the specified tolerances or is not synchronized with the inverters, automatic transfer of the load from the inverters to bypass power shall be inhibited or shall take place after a calibrated interruption of 500 to 800 milliseconds.
 - c. Manual initiation of this transfer as well as transfer back to the inverters shall also be possible.
2. **Static-switch protection:** The static switch:
- a. **With centralized-bypass cabinet:** common centralized-bypass
 - b. **Other cases:** in each UPS unit
- shall be equipped with an RC filter for protection against switching overvoltages and lightning strikes.
- E. **Discrimination and short-circuit capacity**
1. If the bypass power is within the specified tolerances, the presence of the static switch:
 - a. **With centralized-bypass cabinet:** common centralized-bypass
 - b. **Other cases:** in each UPS unit, supplied by the same bypass AC source shall make it possible to use the short-circuit power of the bypass source to trip the downstream protection devices of the inverter.
 2. To ensure tripping in a selective manner, the available power shall be sufficient to trip protection devices with high ratings (circuit breaker rated $I_n/2$ or UR fuses rated $I_n/4$, where I_n is the rated inverter current).
 3. If the bypass source is outside the specified tolerances, the inverter on its own shall, for the same discrimination requirements, be capable of tripping circuit breakers rated $I_n/2$ or UR fuses rated $I_n/4$, irrespective of the type of short-circuit.
- F. **System earthing arrangement:** The UPS shall be compatible with the following system earthing arrangements:
1. **Upstream source:** ...[TT/ IT / TNS / TNC]...
 2. **Downstream installation:** ...[TT/ IT / TNS / TNC]...
 3. If the upstream and downstream earthing arrangements are different, galvanic isolation shall be provided on the static-bypass line.

2.5 MECHANICAL CHARACTERISTICS

- A. **Mechanical structure:** The UPS and batteries shall be installed in cabinet(s) with a degree of protection IP20 (standard IEC 60529). Access to the subassemblies making up the system shall be exclusively through the front.
- B. **Scalable design:**
1. The UPS shall be designed to allow the installed power to be easily increased on site by connection of additional UPS units, either to meet new load requirements or to enhance system availability by introducing redundancy.
 2. This transformation shall be possible directly on site, without returning the equipment to the factory and without causing excessive system downtime.
- C. **Dimensions:** The UPS shall require as little floor space as possible. To gain space, it shall be possible to install the UPS with the back to the wall or back-to-back with another UPS.
- D. **Connection:**
1. To facilitate connections, all terminal blocks must be easily accessible from the front when the UPS is installed with the back to the wall. Entry of upstream and downstream power cables, as well as any auxiliary cables, shall be possible through the bottom for a false floor.
 2. The UPS shall be equipped with an earth-circuit connector, in compliance with the listed standards.
 3. The cables shall comply with the listed standards and be mounted in compliance with the stipulations. The neutral conductor shall be oversized for any third-order harmonic currents and their multiples (the size of the neutral shall be 1.5 times that of each phase).

- E. **Ventilation:**
 - 1. The UPS units shall be provided with forced-air cooling.
 - 2. To facilitate positioning of UPS units (back to the wall), ventilation shall take place through the top with an air intake on the front.
- F. **Safety:**
 - 1. For the safety of maintenance personnel, the cabinet shall be provided with a manually operated mechanical bypass designed to isolate the rectifier, charger, inverter and static switch while continuing to supply the load from the bypass AC source.
 - 2. It shall be possible to send to the UPS an external EPO order resulting in opening of the battery circuit breaker and the upstream circuit breaker.

2.6 ENVIRONMENT CONDITIONS

- A. **UPS** (not including battery)
 - 1. **Operation:** The UPS, not including the battery, shall be capable of operating under the following environmental conditions without loss of performance:
 - a. Ambient temperature range: 0° C to +35° C.
 - b. Recommended temperature range: +20° C to + 25° C.
 - c. Maximum temperatures: 40 °C for 8 hours
 - d. Maximum relative humidity: 95%.
 - e. Maximum altitude without power derating: 1000 meters.
 - 2. **Storage**
 - a. **The UPS, not including the battery, shall be designed for storage under the following conditions:** ambient temperature range: -10° C to +45° C.

2.7 BATTERY MANAGEMENT

As the life of the batteries is very sensitive to operating conditions, the battery shall be managed in an optimum manner.
In addition to the indicated devices, the battery-management system shall include the features listed below.

- A. **Measurement of actual backup time:** The battery function shall be combined with a system that continuously monitors the actual backup time available (AC source present) or remaining (AC source absent), according to the actual load on the UPS, the battery temperature and the age of the battery.
- B. **Digital battery monitoring**
 - 1. Each UPS shall be equipped with a system for battery digital management.
 - 2. Based on a number of parameters (percent load, temperature, battery type and age), the system shall control the battery charge voltage and continuously calculate:
 - a. The true available backup time.
 - b. The remaining service life.
- C. **Block by block monitoring**
 - 1. To further optimise battery availability and service life, it shall be possible to equip each UPS with an optional system to continuously monitor all battery strings and display a block by block failure prediction.
 - 2. The system shall include the functions listed below.
 - a. Continuous measurement of the voltage of each block.
 - b. Continuous measurement of the internal resistance.
 - c. Identification of faulty blocks (trend curves).
 - d. Possibility of replacing individual blocks.
 - e. Remoting of all information via Ethernet, dry contacts or JBus.

2.8 DISPLAY

- A. **User interface:** UPS operation shall be facilitated by a user interface comprising:

1. A colour graphic display (touch screen);
2. Controls;
3. Status indications with mimic panel.

B. **Graphic display:** The graphic display shall facilitate operation by offering the functions listed below.

1. **Animated colour mimic diagram:** The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (e.g. bypass). It can be used to supervise either a single UPS unit or a configuration with up to 6 UPS units connected in parallel and a centralized-bypass cabinet.
2. **Display of measurements:** It shall be possible to display the following measurements:
 - a. Inverter output phase-to-phase voltages
 - b. Inverter output currents
 - c. Inverter output frequency
 - d. Voltage across battery terminals
 - e. Battery charge or discharge current
 - f. Rectifier/charger input phase-to-phase voltages
 - g. Rectifier/charger input currents
 - h. Crest factor
 - i. Active and apparent power
 - j. Power factor of the load
 - k. Battery temperature
3. **Display of status conditions and events:** It shall be possible to display the following indications:
 - a. Load on battery power
 - b. Load on UPS
 - c. Load on automatic bypass
 - d. General alarm
 - e. Battery fault
 - f. Remaining battery backup time
 - g. Low battery warning
 - h. Bypass AC source outside tolerances
 - i. Battery temperature
 - j. Additional information shall be provided in view of accelerating servicing of the system.
4. **Display of operating graphs:** It shall be possible to display curves and bargraphs over significant periods for the measurements mentioned above.
5. **Display of statistics:** number of overloads, number of transfers to battery power, cumulative time on battery power, maximum power, demand power.
6. **Log of time-stamped events:** This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of all important status changes, faults and malfunctions, complete with an analysis and display of troubleshooting procedures. It shall be possible to time stamp and store at least 3 000 events.

C. **Controls:** The UPS shall comprise the following controls:

1. **Two ON and OFF buttons:** Located on the front panel of the UPS, they shall control UPS-unit ON/OFF status. It shall be possible to turn OFF the UPS externally via an isolated dry contact.
2. **EPO terminal block:** The UPS shall be equipped with an emergency power off terminal block for complete system shutdown following reception of an external control signal. The EPO command shall result in:
 - a. Shutdown of UPS units;
 - b. Opening of the static switch on the bypass line and of the battery circuit breaker;
 - c. Opening of an isolated dry contact on the programmable card.
3. **Alarm reset button:** This button shall turn off audio alarms (buzzer). If a new alarm is detected after clearing the first, the buzzer sounds again.

D. **Status indications with mimic panel:** Indication of status conditions shall be distinct of the graphic display.

1. Three LEDs on the control panel indicate the following status conditions:

- a. Load protected;
 - b. Minor fault;
 - c. Major fault.
2. The mimic panel shall represent the UPS and indicate the status of the load supply using five two-colour (red and green) LEDs:
 - a. Load supplied (LED at UPS output on mimic panel),
 - b. Inverter on (inverter LED on mimic panel),
 - c. Operation on battery power (LED between battery and inverter on mimic panel),
 - d. Bypass activated (bypass LED on mimic panel),
 - e. PFC rectifier on (rectifier LED on mimic panel).
3. A buzzer shall warn the user of faults, malfunctions or operation on battery power.

2.9 ACCESSORIES

- A. **StruxureWare Data Center Expert:** A centralized infrastructure management platform hereafter referred to as Data Center Expert shall be available for purposes of complete system monitoring and management of all components outlined in this specification used as a single solution for small IT or part of the StruxureWare software stack providing data to systems such as Data Center Operation.
1. **Monitoring** - Data Center Expert shall be capable of monitoring a PDU through a network of Cat 5 cable and a switch supplied by the user. This switch shall relay information to Data Center Expert, which in turn shall allow access to this information via the user's public network via a single IP address.
 2. **Monitored Values:** Data Center Expert shall be capable of monitoring alarms, general status parameters, voltage and current of the PDU.
 3. **Thresholds:** For individualized customer needs, Data Center Expert shall allow for user configurable thresholds for alarm notification. With this feature, Data Center Expert can notify clients of reaching thresholds for PDU capacity, or branch circuit breaker capacity. Other custom programmable alarm points for non- APC products shall also be available via dry contact input signal.
 4. **Public Network Monitoring:** Data Center Expert shall also be capable of monitoring other APC devices that are connected to the client's public network.

2.10 COMMUNICATION

- A. **Standard communication:** It shall be possible to remote the following controls, indications and measurements. To that end, each UPS shall have as standard equipment:
1. A dry contact card
- B. **Communications options:** Each UPS shall be designed to enable the extension of communications, without system shutdown, to the following types of cards:
1. An SNMP communication card for connection to an Ethernet network, for connection to a computer-network management system.
 2. An RS485 serial-link communication card capable of implementing the JBus/ModBus protocol for connection to a building management system (BMS).
 3. An RS232 serial-link communication card for communication with a modem and a remote-maintenance system.
 4. An USB communication card.
 4. A XML-Web communication card for direct UPS connection to an intranet network, without connection to a server, capable of supplying information via a standard web browser.
- The UPS shall be detectable by supervision software for large UPS systems.
Shutdown and administration software shall be available in addition to the communication cards.

PART 3 – EXECUTION

3.1 PROTECTION

- A. **UPS:** Each UPS unit shall include protection against AC-source overvoltages (as per standard IEC 60146), excessive external or internal temperature rise and vibrations and impacts during

transport.

B. Rectifier and charger:

1. Each rectifier/charger shall be equipped to receive an external order to automatically shut down under the following circumstances:
 - a. Emergency off; in this case, the shutdown will be accompanied by opening of the battery circuit breaker;
 - b. Battery room ventilation fault.
2. The rectifier and the charger shall automatically shut down if the DC voltage reaches the maximum value specified by the battery manufacturer.

C. Inverter:

1. The load shall be protected against any overvoltages that could result from voltage regulation failure at the output of the inverters.
2. The inverter (and the corresponding rectifier/charger) shall automatically shut down if the DC voltage reaches the minimum value specified by the battery manufacturer.
3. Each inverter shall be equipped with an automatic shutdown system to protect its power circuits against overloads exceeding UPS-system overload capacity when bypass power is not available. In particular, a short-circuit on the load shall initiate a static shutdown of each inverter, without blowing a fuse.

D. Batteries:

1. **Protection against deep discharge and self-discharge:** The UPS shall comprise a device designed to protect the battery against deep discharges, taking into account the characteristics of the discharge cycles, with isolation of the battery by a circuit breaker.
2. **Independent regulation and monitoring systems:**
 - a. A regulation system shall regulate the battery voltage and the charge current.
 - b. A second system, independent of the regulation, shall monitor the battery voltage and the charge current. Consequently, if the regulation system fails, the monitoring system steps in to shut down the charger and avoid overcharging.
3. **Regulation of the battery voltage depending on the ambient temperature:**
 - a. A temperature sensor adapts the charge voltage to the ambient temperature.
 - b. This regulation system takes into account the chemical reaction and prolongs the battery service life.
 - c. The permissible temperature range is set in the personalisation parameters.
 - d. An alarm shall be issued for temperatures outside the permissible range.
4. **Self-test:** The battery shall include a self-test system initiated in two manners:
 - a. As necessary by a manual command;
 - b. Automatically at user-defined intervals.This self-test system shall update the battery parameters and detect any abnormal deterioration to facilitate preventive maintenance.

3.2 MAINTAINABILITY

- A. For optimum safety during servicing, a maintenance bypass shall be available to completely isolate the UPS.
- B. **Local and remote diagnostics and monitoring - E. Services:** The UPS shall be equipped with a self-test system to check operation of the system as a whole each time it is started. To that end, the supply control/monitoring electronics shall offer:
1. Auto-compensation of component drift.
 2. Acquisition of information vital for computer-aided diagnostics or monitoring (local or remote).
 3. Overall readiness for remote supervision services provided by the manufacturer.

3.3 STANDARD AND TESTS

A. Standards

1. All equipment shall be designed and built in accordance with accepted engineering practice and applicable international standards, in particular the standards listed below.

- a. IEC 6014A-4: UPS - Performance.
 - b. IEC 62040-1 and EN 62040-1: UPS - Safety.
 - c. IEC 62040-2 and EN 62040-2: UPS - Electromagnetic compatibility - [level C3 / C2 class A is optional].
 - d. IEC 62040-3 and EN 62040-3: UPS - Performance.
 - e. IEC 60950 / EN 60950: Safety of IT equipment, including electrical business equipment.
 - f. IEC 61000-2-2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems.
 - g. IEC 61000-4: EMC - Electrical fast transient/burst immunity.
 - h. IEC 439: Low-voltage switchgear and controlgear assemblies.
 - i. IEC 60529: Degrees of protection provided by enclosures (IP Code).
 - j. ISO 3746: Sound power levels.
 - k. CE marking.
2. What is more, the equipment must comply with environmental-protection standards, with production taking place on premises certified ISO 14001. The UPS design procedure shall be covered by an ISO 9001 quality system as well as a dependability study to ensure maximum reliability.
- B. **Certification of conformity:** The manufacturer shall provide, on request, a complete qualification file demonstrating compliance with the above standards. What is more, the indicated levels of performance shall be confirmed by certification from independent laboratories (e.g. TÜV or Veritas).

3.4 TEST PROCEDURES AND QUALITY SYSTEM

- A. **Test procedures:**
1. The UPS manufacturer shall provide proof of a stringent Quality Assurance programme.
 2. In particular, the main equipment manufacturing stages shall be sanctioned by appropriate tests such as:
 - a. Incoming components inspection, discrete subassembly testing;
 - b. Complete functional checks on the final product.
 3. Equipment shall undergo on-load burn-in before leaving the factory.
 4. Final inspection and adjustments shall be documented in a report drawn up by the supplier's Quality Inspection department.
 5. ISO 9001 or 9002 certification of the production site is compulsory.
- B. **Quality system.** The UPS design procedure shall be covered by an ISO 9001 quality system as well as a dependability study to ensure maximum reliability.

3.5 SERVICES

- A. **Maintenance:** The supplier shall propose contracts covering four levels of maintenance.
1. **Level one:** simple checks and settings, procedures accessible without any dismantling and involving no risk.
 2. **Level two:** preventive maintenance, checks not inhibiting continuous operation of the system and preparing operators for Manufacturer services.
 3. **Level three:** trouble-shooting. Repairs by standard exchange of subassemblies and functional power and control components. Preventive-maintenance operations, both systematic and when indicated by qualified diagnosis.
 4. **Level four:** major preventive and corrective maintenance operations or technical upgrades during start-up, operation or renovation of the UPS installation and recycling of equipment or components representing a risk. These operations require the use of devices and means that have been calibrated by certified organisations.
- B. **Technical competency:**
1. **Customer operators:** the supplier shall offer a level 2 training program.
 2. **Service personnel:** the supplier shall ensure that service personnel are qualified for level 4.
- C. **Functional components - organisation of supplier services:**

1. Sufficient geographical proximity of the supplier or an authorised agent shall ensure reasonable access times to the customer site in view of reducing the mean time to repair (MTTR). The supplier shall be in a position to offer a contract limiting the response time to four hours.
 2. The supplier's logistics system and the availability 24 hours a day of original replacement parts shall similarly contribute to reducing to the greatest extent possible the mean time to repair (MTTR).
- D. **System start-up:** The system and equipment shall be started up on site by the supplier or its authorised agent. The procedure shall include checks on the characteristics of the upstream and downstream protection devices and on the UPS installation parameters.
- E. **Replacement parts:** The supplier shall undertake to provide certified original replacement parts for at least ten years following the date of delivery.
- F. **Recycling and renovation/substitution:** At the end of the UPS service life, the supplier shall guarantee the continuity of service of the customer's installations if necessary, including dismantling of equipment and replacement of equipment, in compliance with applicable standards on environmental protection.

3.6 INSTALLATION SERVICES

A. Required services include:

1. Supply of the UPS and any accessory parts or elements.
2. Carriage-paid UPS transportation and delivery to the site.

B. Options:

1. UPS handling and installation on the site.
2. Connections between the battery and the UPS.
3. Connection of the normal AC source to the rectifier/charger.
4. Connection of the bypass AC source to the input transformer or bypass input.
5. Connection of the load circuits to the UPS output.

END OF SECTION

CHECK LIST FOR GUIDE SPECIFICATION

To meet the requirements of your project, use this checklist to identify the technical specifications available.

Type of UPS

Total rated power (kVA) at PF 0.8					kVA
Manufacturer					
Range of products					
Operating mode (IEC 62040-3)	double conversion VFI	Yes		No	
Parallel connection ≤ 4 integrated parallel units or 6 parallel units with SSC	kVA max.	Yes		No	

Rectifier

3-phase input voltage	at Pn	380 or 400 or 415 V $\pm 10\%$	Yes		No	
Frequency		50 or 60 Hz $\pm 10\%$	Yes		No	
Sinusoidal input current		THDI upstream $\leq 4\%$ with active filter	Yes		No	
Input power factor		PF > 0.95 with active filter	Yes		No	
No inrush or start-up current			Yes		No	
Rapid battery charger		Backup time 10 minutes in $t \leq 11$ hours, 45 minutes in $t \leq 24$ hours	Yes		No	
Voltage regulation		$\pm 1\%$	Yes		No	
Independent regulation/monitoring systems			Yes		No	

Battery

Type	Standard	Sealed lead acid in a cabinet	Yes		No	
	Other		Yes		No	
Service life		Years	Yes		No	
Backup time		Minutes	Yes		No	

Battery management and protection

Temperature correction		Yes		No	
Measurement of actual backup time, depending on: load, temperature, age		Yes		No	
Cold start on battery power		Yes		No	
Protection against deep discharge with circuit-breaker opening		Yes		No	
Charge-current limiting	0.05 C10 to 0.1 C10 (depending on battery)	Yes		No	
Self-tests		Yes		No	
Calculation of real backup time					
Block by block monitoring		Yes		No	
Management of 2 independent circuit breakers		Yes		No	

Inverter

Three-phase output voltage with neutral			Volts	Yes		No	
	Adjustable	$\pm 0.5\%$		Yes		No	
Steady-state conditions		$\pm 2\%$		Yes		No	
Voltage transients		$\pm 5\%$ (load from 0 to 100 or 100 to 0 %)		Yes		No	
Output voltage distortion at Pn		THDU < 3%		Yes		No	
Unbalanced load conditions		Voltage variations < 1.5 %		Yes		No	
Output frequency			Hz	Yes		No	
Variation in output frequency		± 0.5 Hz		Yes		No	
	Adjustable	± 0.25 Hz to 2 Hz		Yes		No	
Frequency synchronization with an external source		± 8 % of rated frequency		Yes		No	
Overload capacity		125% In for 10 minutes		Yes		No	
		150% In for 1 minute		Yes		No	
Current limiting		212% In for 150 milliseconds		Yes		No	
Crest factor		Up to 3:1		Yes		No	

Static bypass

Static bypass		Yes		No	
Fuseless technology	No fuses in series with static switch	Yes		No	
Short-circuit withstand of static bypass	depending on power	Yes		No	
Static switch is protected against switching and lightning voltage surges		Yes		No	
Built-in maintenance bypass		Yes		No	

Efficiency

Normal mode	> 94% at Pn	Yes		No	
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User interface

Graphic display		selection of operating language	Yes		No	
	Customisation menu	with password	Yes		No	
	Display	measurements, status, events, graphs	Yes		No	
	Event log	time-stamping 3000 events	Yes		No	
	Trend curves	power, voltage, currents and battery backup time values	Yes		No	
	Statistics	% time on batteries, number of batteries, average percent load	Yes		No	
Controls		Separated ON/OFF buttons	Yes		No	
		EPO terminal block	Yes		No	
Status indications		Audio alarm, LEDs	Yes		No	

Communication

Dry contacts end			Yes		No	
EPO terminal block			Yes		No	
Options	Ethernet SNMP card		Yes		No	
	RS485 JBus/ModBus card		Yes		No	
	RS232 U-Talk card		Yes		No	
	XML-Web card		Yes		No	
	Supervision software		Yes		No	
	Administration software	with shutdown management	Yes		No	

Certification

Certified standards and tests	See list in section 12.1	Yes		No	
Performance certification	TÜV	Yes		No	
Quality certification	ISO 9001 / 9002	Yes		No	
Eco-design and manufacturing	ISO 14001 site	Yes		No	

Installation

Installation against a wall	Yes		No	
Access to cable or bus bar connection through front	Yes		No	

Services

Technical competency of supplier	Level 4 NFX 060-010	Yes		No	
Diagnostics and monitoring	Remote	Yes		No	
Technical Support	International	Yes		No	

Operation/Maintainability

Access to power components through front		Yes		No	
Access to communication through front	hot-swap cards	Yes		No	
Access to batteries through front	hot-swap batteries	Yes		No	

Availability

Worldwide availability if original replacement parts	Yes		No	
Response time of Service teams	t<4h	4<t<8	8<t<24 h	t>24 h
Maintenance Programs	Preventive	Yes	No	
	Predictive	Yes	No	
Emergency services	Yes		No	
Renovation/substitution programs	Yes		No	