

APC by Schneider Electric

MGE GALAXY 5000

Uninterruptible Power Supply

Guide Specifications

20 kVA to 120 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 (1+1): 1.88×10^6 MTBF in hours/Non availability: 5.32×10^{-6}
 - b. 3 UPS units (2+1): 1.25×10^6 MTBF in hours/Non availability: 7.98×10^{-6}
 - c. 4 UPS units (3+1): 9.39×10^6 MTBF in hours/Non availability: 1.07×10^{-6}

The total load supplied by the UPS system shall be equal to _____kVA, at a power factor pf = 0.8.

- B. **Brief description:**

1. The UPS system shall be made up of ...[2 / 3 / 4 / 5 / 6]... identical parallel-connected single-UPS units (same power rating), operating in double-conversion mode (also called on-line mode); it shall be a VFI-type UPS (as per standard IEC 62040-2).
2. Each UPS unit shall have a unit rating of ...[20 / 30 / 40 / 60 / 80 / 100 / 120]... and shall comprise the following components, described below in this specification:
 - a. PFC rectifier
 - b. Battery charger
 - c. Inverter
 - d. Battery
 - e. User and communications interface
 - f. Battery management system
 - g. Any and all other devices required for safe operation and maintenance, including circuit breakers, switches, etc.

(for a system with 2 UPSs in an active redundancy configuration)

- a. Static bypass (via a static switch) for each UPS unit
- b. Manual maintenance bypass for each UPS unit

(for all other cases)

- a. User and communications interface
 - b. Battery management system
 - c. Any and all other devices required for safe operation and maintenance, including circuit breakers, switches, etc.
- C. 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. Each single-UPS unit shall operate in double-conversion mode (also called on-line mode); it shall be a VFI-type UPS (as per standard IEC 62040-2), made up of the following components, described in detail in this specification.
- 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.
- 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. The UPS system shall ensure equal sharing of the total load between the various parallel-connected units.
- E. **Parallel operation and 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 a UPS unit shall result in load transfer to the bypass AC source via the various static bypass switches.
 2. **With redundancy:**
 - a. The units shall operate in parallel with redundancy, 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 (short-circuits, heavy inrush currents, etc.) the load shall be automatically transferred, instantaneously and without interruption, to the bypass AC source, on the condition that bypass power is available and within tolerances.
 2. To that end, synchronisation of each inverter in phase and frequency with the bypass source shall be automatic. Transfer of the load back to the UPS-unit outputs shall be automatic or manual. During transfer, the load shall not suffer an outage or disturbance in the supply of

- power.
 - 3. To ensure transfer in complete safety, the system shall simultaneously control the static switches.
 - 4. 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. For maintenance purposes, all electronic components shall be accessible from the front of the UPS.
 - 2. In addition, a built-in manually-operated mechanical bypass system shall be:
 - a. Installed in each UPS unit; **(for a system with 2 UPS units with active redundancy)**
 - b. Installed separately in an external bypass enclosure or cubicle **(other cases)**.
 - 3. For personnel safety during servicing or testing, this system shall be designed to isolate the UPS units while continuing to supply power to the load from the bypass AC source. Transfer to the manual bypass mode and back shall be possible without interruption to the load.
 - 4. 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 of each UPS unit, the system shall include a circuit breaker to isolate the battery from the corresponding rectifier/charger and 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 UPS 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:** The UPS shall be based on sixpack IGBT technology with built-in thermal monitoring and a high 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.
 - 2. It shall be made up of ...[2 / 3 / 4 / 5 / 6]... UPS units, each with an identical rating of ...[20 / 30 / 40 / 60 / 80 / 100 / 120]... 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 backup time of each battery in the event of a normal AC source outage shall be ...[5 / 10 / 15 / 30 / 60...]... minutes.
 - 2. The service life of each battery shall be equal to at least ...[5 / 10]... years.
 - 3. Batteries shall be selected and sized accordingly.
- D. **Reliability and MTBF:** The active redundancy type architecture shall allow the installation to reach an MTBF of ...[$1.88 \times 10^6 / 1.25 \times 10^6 / 9.39 \times 10^5$ hours] corresponding to an unavailability of [$5.32 \times 10^{-6} / 7.98 \times 10^{-6} / 1.07 \times 10^{-5}$].
- E. **Types of loads accepted:**
- 1. If all the connected loads are non-linear (100% non-linear loads), each UPS unit shall accept high crest factors (3:1) without derating of output.
 - 2. For both linear and non-linear loads, the voltage total harmonic distortion at UPS output:
 - a. THDU downstream ph/ph and ph/N $\leq 1.5\%$ for linear loads;
 - b. THDU downstream ph/ph and ph/N $\leq 3.5\%$ for non-linear loads.

- F. **Limitation of harmonics upstream of the UPS system:**
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 (formerly IEC 1000 3-4).
 2. In particular, the UPS shall respect the following characteristics at the normal AC input:
 - a. Total harmonic current distortion (THDI) upstream of the rectifier not exceeding:
 - 1) - 3% at full rated load for an RCD (computer) load, at P_n;
 - 2) - 5% from 30% to 100% of the full rated load;
 - b. Input power factor (pf) greater than or equal to 0.99.
 3. These performance levels, due to the "clean" input rectifier drawing sinusoidal current, limit upstream distortion and avoid oversizing of upstream equipment (cables, circuit breakers, etc.), without requiring additional filters.
- G. **Efficiency:** Overall efficiency of each UPS unit shall be greater than or equal to: 91% @ full load.
- H. **Noise level:** The noise level, measured as per standard ISO 3746, shall for each unit be less than: 66 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: 340 - 470 V at full rated load, 250 - 470 V at 70% load (or 340 - 470 V with backfeed option)
 2. Number of phases: 3 ph + earth. The neutral is not necessary.
 3. Frequency: 50 or 60 Hz \pm 8%.
- B. **Bypass AC source** (static-bypass input, if separate from rectifier input):
1. The bypass AC source shall continue to supply the load, without interruption, if its characteristics remain within voltage tolerances (323 to 470 volts).
 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:** The rectifier and charger module shall be supplied via the normal AC input. It must be capable of operating without a neutral.
 2. **Inrush current:** A device shall be provided to limit inrush currents. When AC power fails and during genset start, the rectifier shall limit the power drawn to 70% of its rating for ten seconds. The remaining 30% shall be supplied by the battery.
 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] [15 minutes in less than 13 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 x C₁₀ 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:** Each UPS unit shall be equipped with its own battery of the:
1. **(batteries in the UPS cabinet)**
 - a. sealed lead-acid type, with a service life of ...[5 / 10]... years, factory mounted and wired in the UPS cabinet. Battery mounting in the UPS cabinet is intended to facilitate installation and reduce the overall footprint.
 - b. Consequently, backup times of:
 - 1) [5] minutes for the [40 / 60 / 80] kVA ratings
 - 2) [10] minutes for the [40 / 60] kVA ratings

3) [15] minutes for the [40] kVA ratings
shall be ensured by batteries installed in the UPS cabinet

2. **(batteries in a separate cabinet)**

- a. ...[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 of ...[5 / 10]... years.
 - b. The battery shall be installed in a cabinet identical in appearance to that of the UPS.
 - c. The battery shall be sized to ensure continuity in the supply to the inverter for at least [5 / 10 / 15 / 30] minutes for a power rating of [40 / 60 / 80 / 100 / 120] kVA.
3. Each battery shall be sized to ensure continuity in the supply of power to the corresponding inverter for at least ...[5 / 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.
4. Sizing calculations shall assume an ambient temperature between 0° C and 40° C.
5. The UPS system shall include devices to ensure:
- a. effective battery protection;
 - b. battery management.

C. **Inverter:** Each inverter shall be sized to supply a load rated ...[20 / 30 / 40 / 60 / 80 / 100 / 120]... kVA at a power factor (pf) of 0.8, taking into account the characteristics presented below.

1. **Output voltage**

- a. **Rated voltage:** ...[380 / 400 / 415]... volts rms, adjustable via the user interface (see section 10), within tolerances of +/- 3%.
- 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 $\pm 1\%$ 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.

2. **Output frequency**

- a. **Rated frequency:** - 50 or 60 Hz.
- b. **Variations:** - ± 0.5 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 $\pm 0.5\%$ to $\pm 8\%$ with respect to the rated frequency).
- b. **Synchronisation with an external source:** It shall be possible to synchronise with all types of external source. For example, if the bypass source is a generator set, the synchronisation tolerances shall be approximately $\pm 8\%$ (adjustable) with respect to the rated frequency.
- 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 $\pm 0,1\%$. When bypass power returns to within tolerances, the inverter shall automatically resynchronise.
- d. **Variation in frequency per unit time:** During the switch to free-running mode and the switch back to synchronised mode, 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. 10 minutes at a load representing 125% of the rated load;
- b. 1 minutes at a load representing 150% of the rated load;
- c. 1 second at a load representing 210% of the rated load.
- d. If necessary, the UPS shall operate as a generator (current limiting) with a peak capacity of 270% 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. Each UPS unit shall be equipped with a static bypass comprising a static switch. The static bypasses shall be controlled simultaneously by a built-in system. 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 synchronised.
- b. Transfer shall take place automatically in the event of a major overload or an internal inverter fault.
- c. Manually initiated transfer shall also be possible.
- d. If the bypass power is outside the specified tolerances or is not synchronised with the inverter, automatic transfer of the load from the inverter to bypass power shall take place after a calibrated interruption adjustable from 13 to 1000 ms.

2. **Static-switch protection:** Each static switch 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 shall make it possible to use the short-circuit power of the bypass source to trip the downstream protection devices of common inverter output.
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 UPS-system current).
3. If the bypass source is outside the specified tolerances, the UPS-system 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.
4. Parallel connection of a number of UPS units significantly improves discrimination.

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** (Concerns only UPSs with the battery installed in a separate cabinet):

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.

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. **Safety:**

1. The equipment shall meet the requirements of degree of protection index IP21, in compliance with standard IEC 60529.
2. 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.
3. 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 +40° C.
 - b. Recommended temperature range: +20° C to + 25° C;
 - c. Maximum relative humidity: 95%;
 - d. Maximum altitude: 1000 meters.
2. **Storage**
 - a. **The UPS, not including the battery, shall be designed for storage under the following conditions:** ambient temperature range: -20° C to +45° C.

2.7 BATTERY MANAGEMENT

- A. **Battery meter:** A battery-meter function shall estimate the available backup time of the UPS system as a function of the battery charge and the percent load. It shall be possible to set the battery meter so that it can take into account the exact battery configuration installed with the UPS.
- B. **Digital battery monitoring**
1. The 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 the 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, on each UPS unit, comprising:
1. a graphic display (at least quarter VGA and high resolution are preferable);
 2. controls;
 3. status indications with mimic panel.
 4. The information and controls shall be centralised by a system (electronic board) built into one of the UPS units.

- B. **Graphic display:** The graphic display shall facilitate operation by offering the functions listed below.
1. **Operating language:** It shall be possible to display in the _____ language all the operating information supplied on the screens.
 2. **Step by step operating help:** The graphic display shall assist the user by providing step by step help in the user's language.
 3. **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).
 4. **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
 5. **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.
 6. **Display of operating graphs:** It shall be possible to graphically display the measurements mentioned above on the screen over significant periods.
 7. **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 2 000 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 unit shall have as standard equipment:
1. **A programmable card for input/output information.** This card shall provide a total of eight dry contacts: six for incoming information and two for outgoing information.
 2. At least three communication ports for later addition, without interrupting operation, of communication cards implementing different protocols, e.g. SNMP, JBus/ModBus, RS232, USB, XML.
- B. **Communications options:** The UPS system 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. A USB communication card.
 5. 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:** The UPS 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:** The rectifier and charger shall automatically shut down if the DC voltage reaches the maximum value specified by the battery manufacturer or if the temperature exceeds the limits specified above.
- C. **Inverter:** Inverters shall self-protect against overloads and short-circuits, irrespective of the operating mode (AC power or battery power).
- 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:**
 - a. Battery monitoring shall be carried out by an automatic device. Self-test intervals shall be set to one month by default, but shall be adjustable.
 - b. This self-test system shall, where necessary, initiate indications via LEDs on the front panel or a message to a remote monitoring system.
 - 5. **Possibility of backfeed protection:** If backfeed protection is necessary, it must be possible to install two independent systems on the normal and bypass AC inputs.
 - 6. **Possibility of battery circuit-breaker management:** Each UPS shall be capable of receiving and managing two battery circuit breakers. Battery availability is improved by dividing it into two sections. If one section is disconnected for servicing or any other reason, the second shall remain available and provide approximately half of the backup time. In such a case, the UPS shall regulate the charge accordingly.

3.2 MAINTAINABILITY

- A. **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 61000-3-4: Limits for harmonic current emissions (equipment input current > 16 A/ph).
 - h. IEC 61000-4: EMC - Electrical fast transient/burst immunity.
 - i. EN 55011 and EN 55022: Limits and methods of measurement of radio interference characteristics of industrial, scientific and medical (ISM) radio-frequency equipment - Level A conducted and radiated emissions.
 - j. IEC 439: Low-voltage switchgear and controlgear assemblies.
 - k. IEC 60529: Degrees of protection provided by enclosures (IP Code).
 - l. ISO 3746: Sound power levels.
 - m. 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 SERVICES

- A. **Maintenance:** The supplier shall propose contracts covering four levels of maintenance.
- 1. **Level one:** simple checks and settings, procedures accessible without any dismounting 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 disman-

ting of equipment and replacement of equipment, in compliance with applicable standards on environmental protection.

3.5 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	
Identical parallel-connected units		Units rated		kVA each	
Including redundant units				units	
and a manual maintenance bypass rated				kVA	
Manufacturer					
Range of products					
Operating mode (IEC 62040-3)	double conversion VFI	Yes		No	
Continuous operation at 40 °C		Yes		No	

Rectifier

3-phase input voltage	at Pn	342-470 V	Yes		No	
	at 0.90 Pn	250-470 V	Yes		No	
With auto-transformer option	at Pn	337-460 V or 352-480 V depending on connection	Yes		No	
Sinusoidal current drawn (PFC)		not requiring auxiliary cabinet	Yes		No	
	Sinusoidal input current	THDI upstream $\leq 3\%$	Yes		No	
	Input power factor	PF > 0.99	Yes		No	
	THDI, PF performance	constant from 30 to 100% of Pn	Yes		No	
Frequency		45-65 Hz	Yes		No	
Phase sequence		Wrong phase sequence is signaled by contact	Yes		No	
No inrush or start-up current			Yes		No	
Rapid battery charger		Backup time 10 minutes in $t \leq 11$ hours, 4 hours 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	
Service life		Years	Yes		No	
Backup time		Minutes	Yes		No	
Integrated battery in UPS cabinet		Up to 80 kVA	Yes		No	

Battery management and protection

Automatic entry of battery parameters		Yes		No	
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	
Battery meter		Yes		No	
Block by block monitoring		Yes		No	

Inverter

Three-phase output voltage with neutral			Volts	Yes		No	
Compensation	Adjustable line drop	0 to $\pm 5\%$		Yes		No	
Steady-state conditions		$\pm 1.5\%$		Yes		No	
Voltage transients		$\pm 3\%$ (load from 0 to 100 or 100 to 0 %)		Yes		No	
Output voltage distortion at Pn		THDU ph-N < 2% for linear loads		Yes		No	
		THDU ph-N < 3% for non-linear loads					
Output frequency with neutral			Hz	Yes		No	
Variation in output frequency		± 0.5 Hz		Yes		No	
Frequency synchronisation with an external source		Adjustable up to $\pm 8\%$ of rated frequency		Yes		No	
Overload capacity		150% In for 1 minutes		Yes		No	
		210% In for 1 second		Yes		No	
Current limiting		270% In for 150 milliseconds		Yes		No	
Crest factor		Up to 3:1		Yes		No	

Bypass function

Automatic bypass	With static switch	Yes		No	
Fuseless technology	No fuses in series with static switch	Yes		No	
Short-circuit withstand of static bypass	45 In at 20 kVA / 19 In at 120 kVA – 20 ms	Yes		No	
Static switch is protected against switching and lightning voltage surges		Yes		No	
Maintenance bypass		Yes		No	

Efficiency

Normal mode	> 92% at Pn, > 90 % at Pn/2		Yes		No	
ECO Mode	> 97% at Pn		Yes		No	

User interface

Graphic display in 15 languages		selection of operating language	Yes		No	
	Customisation menu	with password	Yes		No	
	Display	measurements, status, events, graphs	Yes		No	
	Event log	time-stamping	Yes		No	
Controls		Separated ON/OFF buttons	Yes		No	
		EPO terminal block	Yes		No	
Redundant interface with separated mimic panel		Not included on display	Yes		No	
Status indications		Audio alarm, LEDs	Yes		No	

Communication

Programmable relay card			Yes		No	
EPO terminal block			Yes		No	
3 slots for communication cards			Yes		No	
Options	Ethernet SNMP card		Yes		No	
	RS485 JBus/ModBus card		Yes		No	
	RS232 U-Talk card		Yes		No	
	USB 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

Cabinet height	1900 mm maximum	Yes		No	
UPS cabinet weight (without batteries)	520 kg maximum	Yes		No	
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

Safe maintenance	Built-in input, -output and bypass switches	Yes		No	
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	