Schneider Electric

Gutor PXC

Industrial one and three Phase Uninterruptible Power Supply

Guide Specifications

10 - 80 kVA UPS

THIS GUIDE SPECIFICATION IS WRITTEN IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) MASTERFORMAT. THIS SECTION MUST BE CAREFULLY REVIEWED AND EDITED BY THE ARCHITECT OR THE ENGINEER TO MEET THE REQUIREMENTS OF THE PROJECT. COORDINATE THIS SECTION WITH OTHER SPECIFICATION SECTIONS IN THE PROJECT MANUAL AND WITH THE DRAWINGS.
WHERE REFERENCE IS MADE THROUGHOUT THIS SECTION TO "PROVIDE", "INSTALL", "SUBMIT", ETC., IT SHALL MEAN THAT THE CONTRACTOR, SUBCONTRACTOR, OR CONTRACTOR OF LOWER TIER SHALL "PROVIDE", "INSTALL", SUBMIT", ETC., UNLESS OTHERWISE INDICATED.
THIS SECTION IS WRITTEN TO INCLUDE THE 2004 MASTERFORMAT AND THE 1995 MASTERFORMAT VERSIONS. WHERE APPLICABLE, THESE ITEMS ARE BRACKETED AND, IN EACH CASE, UNLESS OTHERWISE INDICATED, THE FIRST CHOICE APPLIES TO THE 2004 MASTERFORMAT AND THE SECOND CHOICE APPLIES TO THE 1995 MASTERFORMAT.

SECTION [26 33 63] [16611]

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

A. **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for a solid state uninterruptible power supply (UPS) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

B. **Section includes:** The work specified in this Section includes, but shall not be limited to, a three-phase, on-line, double conversion, solid state UPS. The UPS shall operate in conjunction with the existing building electrical system to provide high quality power conditioning, back-up power protection, and distribution for electronic equipment loads. The system shall consist of a solid state IGBT rectifier/inverter, power factor corrected rectifier, a 100 percent rated for continuous duty static switch, battery plant, graphical status/control panel, and synchronizing circuitry as described herein.

1.2 [Parallel] SYSTEM DESCRIPTION

A. **General characteristics**

1. Double Conversion – Transformerless Design
2. Integrated Parallel capability
   a. Up to 1+1 UPS units for redundancy
3. Front access only required for service
4. Top or bottom cable entry
5. High efficiency (94% at low load levels from 25% to 75%)
6. Battery charging in bypass operation (only when mains is available)

B. **Design requirements:**

INSERT APPLICABLE VALUES IN PARAGRAPHS BELOW.

1. The UPS shall be sized for [___] kVA load.
2. [The parallel system shall be comprised of [___] UPSs for N+[___] system-level redundancy.]
3. [The parallel system shall be sized for [___] kVA load.]
4. The UPS battery system shall be sized for [___] kVA at power factor 0.8 for [___] minutes.

C. **System characteristics**:

1. **Input**: The system input shall be configurable for either single or dual utility derived from a three phase wyes source. The system should facilitate both top and bottom cable entry.
   a. **Input voltage:** [___] volts AC
      1) three-phase, 4-wire (L1, L2, L3 + PE) or 5-wire (L1, L2, L3, N + PE)
   b. **Frequency:** 50/60 Hertz
   c. **Input power factor correction:**
      1) 0.96 – 0.98 full range
   d. **Total Harmonic Distortion (THDI):**
      1) < 5% @ 100% load
   e. **Generator ramp-in**: 10% nominal power/sec.
   f. **Rated conditional short-circuit current Icc**: 65 kA
   g. **Rated peak withstand current Ipk**: N/A
   h. **Protection**: Built-in backfeed contactor.
   i. **Inrush Current:** Less than nominal input current for less than one cycle. Shall not exceed 1000% of nominal rating (only with input transformer).

2. **Bypass:**
   a. **Bypass voltage:** [___] volts AC
      1) one-phase, 3-wire (L, N + PE) or (L1, L2 + PE)
      2) three-phase, 4-wire (L1, L2, L3 + PE)
   b. **Frequency:** 50 or 60 Hz

3. **UPS output:**
   a. **Output voltage:** [___] volts AC, ±1 percent steady state variation phase to neutral / phase-to-phase voltage volts AC
      1) one-phase, 3-wire (L, N + PE)
      2) three- phase, 5-wire (L1, L2, L3, N + PE).
   b. **Frequency:** 50/60 hertz, ±0.01 percent (free running)
   c. **Output voltage range**
      1) **Symmetric load (0-100%):**
         a) ± 1% static
   d. **Output Voltage Transient Response:** The output voltage returns to within ±1% of the steady state value within 60ms.
   e. **Output power factor:** 0.8 rated
   f. **Ouput Voltage Transient Characteristics:**
      1) 100% load step change ±5%
   g. **Total Harmonic Distortion (THDU):**
      1) < 2% at 100% linear load
      2) < 5% at 100% non-linear load
   h. **Slew rate (Hz/sec):** Programmable
      1) one-phase 0.25, 0.5, 1, 2, 4
      2) three-phase 0.25, 0.5, 1, 2, 4 ,6
   i. **Load power factor**: 0.5 leading to 0.5 lagging without de-rating (PF 0.8 rated)
   j. **Overload rating:**
      1) Normal operation:
         a) 150% for 1 minute at 40 °C
         b) 125% for 10 minutes at 40 °C
      2) **Battery operation**:
         a) 150% for 1 minute at 40 °C
         b) 125% for 10 minutes at 40 °C
      3) **Bypass operation**:
         a) 1000% for 100 ms
         b) 150% for 1 minute
         c) 125% for 10 minutes
   k. **System AC-AC efficiency**:
      1) Up to 95% in normal operation

4. **Battery**: The battery system should consist of [____] [modular battery cabinets/classic battery cabinets/battery breaker box]
   a. **Battery voltage:** 400 volts DC nominal

b. **Charging power is 20% of output power** (reduced charging power by using a output transformer)
c. **Battery test**: Manual or automatic (selectable)
d. **Deep discharge protection**
e. **Recharge according to battery temperature**
f. **Cold start without additional equipment**
g. **Battery type:** Valve regulated sealed lead acid (VRLA), vented lead acid (VLA) and NiCd. Separate battery cabinet or rack
h. **Maximum DC current:** Maximum DC current at cutoff voltage shall be [____] amperes.

1.3 SUBMITTALS

A. **Product data:** Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
1. Catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product inspecting and testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of the product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.

B. **Shop drawings:** Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data, including, but not limited to, complete electrical characteristics and connection requirements. Provide detailed equipment outlines with cabinet dimensions and spacing requirements; location of conduit entry/exit paths; location of floor/seismic mounting; available battery types/sizes; cabinet weights; heat rejection and air flow requirements; single line diagram; and control and external wiring.

C. **Wiring diagrams:** Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer installed wiring and field installed wiring, and between components provided by the manufacturer and those provided by others.

D. **Contract closeout submittals:**
1. **Project record documents:** Submit a complete set of installation drawings showing all the information specified elsewhere in this Section.
2. **Operation and maintenance data:** Submit operation and maintenance data to include in operation and maintenance manuals specified in [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], including, but not limited to, safe and correct operation of UPS functions.

1.4 QUALITY ASSURANCE

A. **Qualifications:**
1. **Manufacturer qualifications:** Manufacturer shall be a firm engaged in the manufacture of solid state UPS of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.
a. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.

B. **Regulatory requirements:** Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
1. The UPS shall meet the requirements of the following standards:
a. **Safety**:
1) IEC 62040-1: 2008-06, 1st edition Uninterruptible Power Systems (UPS) - Part 1: General and safety requirements for UPS
2) EN 62040-1: 2013-01, 1st edition amendment 1
b. **EMC/EMI/RFI**:

1) IEC 62040-2: 2005-10, 2nd edition Uninterruptible Power Systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements

c. **Performance**:
   1) IEC 62040-3: 2011-03, 2nd edition Uninterruptible Power Systems (UPS) - Part 3: Method of specifying the performance and test requirements
d. **Markings**: CE
e. **Transportation**: ISTA 2B
f. **Seismic**: IBC 2012 (sds=1.00g)

C. **Source Responsibility:** Materials and parts comprising the UPS shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. Active electronic devices shall be solid state and shall not exceed the manufacturer's recommended tolerances for temperature or current to ensure maximum reliability.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. The customer shall store materials in their original, undamaged packages and containers, inside a well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by modes of ground transportation and air transportation where specified.

D. Prior to shipping, products shall be inspected at the factory for damage.

E. Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.

F. Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a period of eight hours to recharge the batteries.

1.6 PROJECT CONDITIONS

1. The UPS shall operate under the following environmental conditions:
   a. **Temperature:**
      1) **Operating ambient temperature:** -10 °C to 40 °C.
      2) **Storage ambient temperature without batteries:** -30 °C to 80 °C.
   b. **Relative humidity (operating and storage):** 0 percent to 95 percent non-condensing.
   c. **Elevation:**
      1) **Operating**:
         a) 1000 m: 1.000
         b) 1500 m: 0.975
         c) 2000 m: 0.950
         d) 2500 m: 0.925
         e) 3000 m: 0.900
      2) **Non-operating**: 0-15000 m
   d. **Audible noise:**
      1) 65 dBA at 100% load and 1 m (39 in) from surface
      2) 55 dBA at 70% load and 1 m from surface

1.7 WARRANTY

A. **Factory Warranty:** The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for period indicated below. This warranty shall extend the one year period of limitations contained in the General Conditions. The warranty shall be countersigned by the Installer and the manufacturer.

1. **UPS cabinets:** The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of 12 months from date of installation or acceptance by the Owner or 18 months from date of shipment from the manufacturer, whichever occurs first.
2. **Battery cabinets:** The battery manufacturer's warranty shall be passed through to the final Owner and shall have a minimum period of one year.

B. **Additional owner rights:** The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 MAINTENANCE

A. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available from the manufacturer.

B. The manufacturer shall, upon request, provide spare parts kits for the UPS system in a timely manner as well as provide access to qualified factory trained first party service personnel to provide preventative maintenance and service on the UPS when required.

C. UPS subassemblies, as well as the battery, shall be accessible from the front. UPS design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the UPS shall be equipped with a self test function to verify correct system operation. The electronic UPS control and monitoring assembly shall therefore be fully microprocessor based, thus doing away with potentiometer settings. This shall allow:

1. Auto compensation of component drift.
2. Self adjustment of replaced subassemblies.
3. Extensive acquisition of information vital for computer aided diagnostics (local or remote).
4. Socket connection to interface with computer aided diagnostics system.

D. The UPS shall be repairable by replacing standard subassemblies requiring no adjustments. Communication via a modem with a remote maintenance system shall be possible.

E. The manufacturer shall offer additional preventative maintenance and service contracts covering both the UPS and the battery bank. Accredited professional service engineers employed exclusively in the field of critical power systems service shall perform maintenance and service. The manufacturer shall also offer extended warranty contracts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Basis of design:** Product specified is Gutor PXC by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance.

2.2 MODES OF OPERATION

A. UPS shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.
1. **Normal:** The UPS system shall continuously supply power to the critical load.
2. **Battery:** Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any interruption, shall obtain its power from the battery.
3. **Recharge:** Upon restoration of the utility AC power source (prior to complete battery discharge), the PFC rectifier shall power the inverter and simultaneously recharge the battery.
4. **Static bypass:** The static bypass switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.

5. **Maintenance bypass:** In maintenance bypass the load is supplied with unconditioned power from the bypass input included in the UPS.
6. **Parallel operation**: The system shall have the option to install up to 1+1 for redundancy.
    a. The parallel UPSs shall be of the same design, kVA-size, voltage, and frequency.
    b. **Output control**: A load sharing circuit shall be incorporated into the parallel control circuits to ensure that under no-load conditions, no circulating current exists between the UPSs. This feature also allows each UPS to share equal amounts of the total critical load bus. The output voltage, output frequency, output phase angle, and output impedance of each UPS shall operate in uniformity to ensure correct load sharing.
    c. **Parallel system control**: The UPS shall have no single dedicated control system designed to control of the parallel system.
    d. **Communication**: Communication between the UPSs shall be connected so that the removal of any single cable shall not jeopardize the integrity of the parallel communication system. Load sharing communications shall be galvanically isolated for purposes of fault tolerances between UPSs. A UPS's influence over load sharing shall be inhibited in any mode where the UPS inverter is not supporting its output. Transfer to and from bypass can be initiated from any online UPS.
    e. **Battery runtime**: Each UPS shall have its own battery solution

2.3 COMPONENT DESCRIPTION

A. **PFC rectifier and battery charger:** Incoming AC power shall be converted to a regulated DC output voltage by an IGBT (insulated gate bipolar transistor) power factor correction (PFC) rectifier. The PFC rectifier shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
    1. **Input Power Factor Correction (PFC):** The PFC rectifier shall be power factor corrected so as to maintain an input power factor of 0.98 @ loads > 50% to unity to ensure generator compatibility and avoid reflected harmonics from disturbing loads sharing the utility power. The battery charger output shall be filtered with a ripple current not exceeding 1% rms over the allowable continuous input voltage range.
    2. **Input harmonic current suppression:** The PFC rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content, limiting THD on the UPS input to below 5 percent @ 100% load.
    3. **Battery charger current limiting:** The UPS shall be equipped with a system designed to limit the battery recharge current.
        a. 20% charger 0% - 100% load
    4. **Wide battery voltage window:** 335-540V.

B. **Inverter:** The UPS output shall be derived from a variable frequency Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics while operating over the battery voltage range. Inverter shall be individually fused with fast-acting fuses. UPS display shall indicate inoperable fuses.
    1. **Transient Response**
        a. The inverter transient voltage shall not exceed the following parameters:
            1) ±5% for a 10% to 100% step load application and removal with 10% initial load or 100% initial load.
            2) ±5% for transfer of rated load from the bypass source to the UPS inverter output during automatic forward transfer of the static bypass transfer switch.
            3) 0% for loss of or return of main AC input.
    2. **Transient Recovery**
        a. The output voltage returns to within ±1% of the steady state value within 60ms.
    3. **Fault Clearing**
        a. The inverter shall electronically be turned off to protect against excessive overload conditions which exceed the parameters defined.
        b. UPS systems shall sense an overload condition and automatically transfer to the bypass input source which shall be used to provide the necessary fault clearing current required.
    4. **Inverter DC Protection**
        a. The inverter shall be protected by the following features that shall be independently adjustable for maximum system flexibility.
            1) DC Over-voltage Trip.
            2) DC Under-voltage Shutdown.

3) DC Under-voltage Disconnect annunciated by an internal visual alarm and relay contact closure.

5. **Output Protection**
   a. The inverter shall be electronically turned off to protect against overloads and abnormal load conditions which exceed the units rating.
   b. UPS systems shall sense an overload condition and automatically transfer to the bypass input source which shall be used to provide the necessary current required.
6. **Over-current Protection**
   a. The inverter shall be protected from excessive overloads, including reverse currents, by fast acting fuses to prevent damage to power semiconductors. All fuses shall be provided with a blown fuse indicator with alarm indication on the control panel.

C. **Static bypass - 100 percent rated, continuous duty:** The static bypass transfer switch shall be solid state, rated for 100 percent continuous duty without mechanical contactor device in parallel for higher reliability and consistent response time and shall operate under the following conditions:
1. **Uninterrupted transfer:** The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
   a. Inverter overload exceeds unit's rating.
   b. Battery protection period expired and bypass current is available.
   c. Inoperable inverter.
2. **Automatic uninterrupted forward transfer:** The static bypass transfer switch shall automatically forward transfer power, without interruption, after the UPS inverter is turned on after an instantaneous overload induced reverse transfer has occurred and the load current returns the UPS's nominal rating or less.
3. **Manual transfer:** A manual static transfer shall be initiated from the UPS control panel by turning the UPS inverter off.
4. **Overload Ratings:** Each static bypass transfer switch shall have the following overload characteristics:
   a. 1,000% of UPS output rating for 100 milliseconds.
   b. 150% of UPS output rating for one (1) minute.
   c. 100% of UPS ouput rating indefinitely.
   d. Each switch shall be suitable for all load conditions permitted by the upstream protective devices such that no damage is sustained during operation.

2.4 SYSTEM CONTROLS AND INDICATORS

A. **Microprocessor controlled logic:**
1. The full UPS operation shall be provided through the use of microprocessor controlled logic. Operation and parameters shall be firmware controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include, but shall not be limited to, a self test and diagnostic circuitry. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS. UPS shall be microprocessor controlled.
2. The UPS shall include, but shall not be limited to, a standard easy to use control and indicator panel. Included shall be a backlit, liquid crystal displays (LCD) with a keypad driven menu and light-emitting diodes (LEDs). The UPS panel shall include UPS on and UPS off pushbuttons that shall permit the Owner to command the UPS on or off.

B. **Front Panel:**
1. **Human-machine interface:** The front panel includes a comprehensive and flexible human-machine interface. It is divided into three sections:
   a. Control and display consists of a liquid-crystal display screen, indication LEDs for operating modes, and pushbuttons to navigate through the display menus and control the UPS. The user can access measurement data and system information via display menus, including the event and alarm logs.
   b. Mimic diagram with multi-color LED indicates the current operational status of the system and its components. It clearly indicates the power path currently supplying the load and the availability of the other supplies.
   c. System alarms and external signals can be flexibly assigned to LEDs for visualization.
2. **Access:** The display shall provide access to:

a. Auto start
b. Auto boost charge
c. Set date/time
d. Charge mode
e. Bypass operation
f. Battery capacity test
g. Battery monitor test (optional)
h. Display settings
i. Menu language

3. **System parameters monitored:** The visual display shall include, but shall not be limited to, the following system parameters based on true RMS metering:
   a. **Measurements:**
      1) AC rectifier line power input voltage, current, and frequency.
      2) AC bypass line power input voltage, current and frequency (optional).
      3) AC output voltage, current and frequency
      4) Load in kVA, kW and percentage of nominal rating
      5) Battery voltage and current.
      6) Battery capacity percentage and expected runtime
      7) Total system status in parallel/redundant operation.
      8) Three temperature measurements (with optional sensors).
      9) Runtime and switchover statistics
      10) Maximum and minimum voltages and currents
   b. **Status indications and events:**
      1) Rectifier input supply available.
      2) Alternative/bypass supply available.
      3) Battery supply available.
      4) Rectifier on.
      5) Rectifier failure.
      6) Battery on high rate charge (if specified).
      7) Battery on initial charge.
      8) Battery on float charge.
      9) Battery operation.
      10) Inverter on.
      11) Inverter failure.
      12) Inverter/bypass synchronised.
      13) Load on inverter.
      14) Load on static bypass.
      15) Load on manual bypass.
      16) Inverter output within tolerance.
      17) Status of input-, battery- and output MCCBs or switches.
      18) Common alarm
   c. **Time-stamped historical events:** This function shall time stamp and store important status changes and anomalies.

C. **Buttons:**
   1. UPS off
   2. UPS on

D. **Audible alarm reset:** The UPS shall provide an audible alarm that can be stopped using the user interface.

E. **Emergency Power Off (EPO):** The UPS shall be equipped with provisions for remote emergency power off and dry contact input that shall be used to command UPS and battery system shutdown remotely.

F. **RS232 port:** shall be provided for field diagnostics.

G. **Dry contacts**: The UPS shall be provided standard with a programmable input/output relay board. This board shall have three dry contacts for inputs and three relays for output.
   1. Input Contacts: Programmable as:
      a. Custom Input 1

b. Custom Input 2
c. Emergency Shutdown

2. Output Relays: Programmable as:
   a. Common Alarm
   b. Programmable
   c. Programmable
3. The contacts shall be normally open and shall change state to indicate the operating status. The contacts shall be rated at 8.0 amperes (250 volts AC/30 volts DC).

2.5 MECHANICAL DESIGN AND VENTILATION

A. **Cabinet:** The UPS shall be housed in a freestanding cabinet with dead front construction. The mechanical structure of the UPS shall be sufficiently strong and rigid to withstand handling and installation operations. The sheet metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, bi-chromating, or an equivalent.

B. **Cable access:** The standard UPS available shall accommodate top or bottom cable entry in standard cabinet.

C. **Cabinet weights and dimensions:** The width of the UPS shall be [_____] mm and shall have a maximum weight of [_____] kg.

INSERT WIDTH AND WEIGHT IN PARAGRAPH ABOVE. INSERT BTUs PER HOUR IN PARAGRAPH BELOW.

D. **Ventilation and Heat Rejection:** The UPS shall be designed for forced air cooling. Air inlets shall be provided from the front of the UPS cabinet. Air flow shall be from the front to the back. Minimum distance from back wall shall not be less than 100 mm.

2.6 BATTERY

A. **General:** The UPS shall use vented lead acid or valve-regulated sealed lead acid or NiCd heavy duty industrial battery, designed for auxiliary power service in an UPS application. The primary battery shall be furnished with impact-resistant plastic cases and housed in a matching cabinet(s) next to the UPS.

B. **Protection against Deep Discharge and Self-Discharge:** The UPS shall be equipped with a device designed to protect the battery against deep discharge, depending on discharge conditions, with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge at less than the rated output.

C. **Battery self-tests:**
   1. **Battery test**: This feature performs tests on the batteries with weak or defective battery detection. The battery self-test can be setup to run automatically in different time intervals between weekly and up to a year.
   2. **Runtime calibration**: This feature is used for re-calibrating the estimated remaining runtime value.

2.7 OPTIONAL ACCESSORIES

A. **Battery Cabinets:** Matching battery cabinets shall be furnished in adjacent versions.

B. **External control and communications devices:** The UPS shall contain two smart slots for the following optional control and communications devices:
   1. **Battery/Ambient temperature monitoring:** Up to three temperature sensor (PT100) can be connected to the external connection board for monitoring or battery temperature compensation purposes.
   2. **Network Management Card (AP9635):** The UPS NMC display has possibility to connect to SNMP, Web, Data Center Expert, Modbus, RMS over ethernet. But in the standard display NMC it is not possible to connect sensors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of conditions:** Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect/Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
   1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

A. Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

3.3 FIELD QUALITY CONTROL

A. **General:** See [Section 01 45 23 - INSPECTING AND TESTING SERVICES] [Section 01410 - INSPECTING AND TESTING SERVICES].

B. **Field service engineer qualifications:** The manufacturer shall employ a 7 x 24 nationwide (international where applicable) field service organization with rapid access to all regions of the nation. The responding service professionals shall be factory-trained engineers with an accredited and proven competence to service three-phase UPS.

C. **Spare parts:** Field Engineers shall have immediate access to recommended spare parts with additional parts storage located in regional depots. Additional spare parts shall be accessible on a 7 x 24 basis from the national depot and shall be expedited on a next available flight basis or via direct courier (whichever mode is quickest).

3.4 DEMONSTRATION

A. Provide the services of a factory-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Owner's personnel.
   1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
   2. Train the Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
   3. Review data in operation and maintenance manuals with the Owner's personnel.
   4. Schedule training with the Owner, through the Architect/Engineer, with at least seven day's advanced notice.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the Installer that shall ensure that the solid state UPS shall be without damage at time of Substantial Completion.

END OF SECTION