Schneider Electric

Galaxy VS with Internal Batteries

Data Center Grade 3-Phase Uninterruptible Power Supply

3 × 380/400/415 V UPS - Guide Specifications

10 kW to 100 kW UPS with Internal Batteries

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. Related Documents

A. Drawings and general provisions of the Contract, including General Conditions, [Division 01 GENERAL REQUIREMENTS] [Division 1 GENERAL REQUIREMENTS], and other applicable specification sections in the Project Manual apply to the work specified in this Section.

1.2. 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**: This specification describes a three-phase, on-line, continuous operation, solid state uninterruptible power supply (UPS). The UPS shall operate as an active power control system, working in conjunction with the building electrical system to provide power conditioning and on-line power protection for the critical loads.

1.3. References

A. **General**: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
   1. ANSI/IEEE C62.41, "Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits" (copyrighted by IEEE, ANSI approved)
C. **International Organization for Standardization (ISO):**
   1. ISO 9001, "Quality Management Systems - Requirements"
   2. ISO 14001, "Environmental Management Systems - Requirements With Guidance for Use"
D. **International Electrical Commission (IEC):**
   1. IEC 62040-1: 2008 (First Edition) + Am 1: 2013 "General and safety requirements for UPS"

2. IEC 62040-2: 2006 Category C2, “Electromagnetic compatibility (EMC) requirements”
3. IEC 62040-3, “Uninterruptible Power Systems - Method of Specifying the Performance and Test Requirements”.

1.4. **Submittals**

A. **Proposal Submittals:**
1. System bill of materials (level one).
2. Product technical specifications or equipment brochures.
3. Product specifications.
4. System operation diagram.
5. Installation manual.
6. Drawings for requested optional accessories.

B. **Delivery Submittals:**
1. Installation manual, which includes unpacking and installation of all systems.
2. Operation manual, which includes start-up and operating instructions.

1.5. **Quality Assurance**

A. **Qualifications**
1. **Manufacturer Experience**: The manufacturer shall have a minimum of 20 years experience in the design, manufacture, and testing of UPS systems.
2. **ISO 9001 Certification**: The manufacturer shall be ISO 9001 & 14001 certified. Certification assures that the vendor’s quality control & environmental measures have been certified by an accredited registrar and meet internationally recognized standards.
3. **Installer Qualifications**: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing solid state UPS similar in type and scope to that required for this Project.

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. **Safety**:
   a. IEC 62040-1: 2008-06, 1st edition Uninterruptible Power Systems (UPS) - Part 1: General and safety requirements for UPS.
   b. EN 62040-1: 2013-01, 1st edition amendment 1.
2. **EMC/EMI/RFI**: IEC 62040-2: 2005-10, 2nd edition Uninterruptible Power Systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements.
3. **Performance**: IEC 62040-3: 2011-03, 2nd edition Uninterruptible Power Systems (UPS) - Part 3: Method of specifying the performance and test requirements.

C. **Factory Testing**
Prior to shipment the manufacturer shall complete a documented test procedure to test functions of the UPS and batteries (via a discharge test), when supplied by the UPS manufacturer, and warrant compliance with this Section.

D. **Pre-installation Conference**
Conduct pre-installation conference in accordance with [Section 01 31 19 PROJECT MEETINGS] [Section 01200 PROJECT MEETINGS]. Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect/Engineer.

E. **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. Semiconductor devices shall be sealed. Relays shall be provided with dust covers. The manufacturer shall conduct inspections on incoming parts, modular assemblies,

and final products.

1.6. **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. 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 six months without powering up the equipment for a period of eight hours to recharge the batteries.

1.7. **Project Conditions**

Do not install the solid state UPS until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

A. **Environmental Requirements**
    a. Storage ambient temperature: -15 °C to 40 °C.
    b. Operating ambient temperature: 0 °C to 40 °C.
2. Operating relative humidity: 0 to 95%, non-condensing.
3. Storage altitude: 0 to 15000 m above sea level.
4. Elevation derating according to IEC 62040-3:
    a. Up to 1000 m: 1.000
    b. Up to 1500 m: 0.975
    c. Up to 2000 m: 0.950
    d. Up to 2500 m: 0.925
    e. Up to 3000 m: 0.900

1.8. **Warranty**

A. **General:** See [Section 01 77 00 - CLOSEOUT PROCEDURES] [Section 01770 - CLOSEOUT PROCEDURES].
B. **Special 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 special warranty shall extend the one-year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the Installer and the manufacturer.
    1. **UPS:** 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:** The battery manufacturer's warranty shall be passed through to the final Owner and shall have a minimum period of one year.
C. **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.

Part 2 PRODUCT

2.1. **Manufacturer**

A. **Schneider Electric**: Galaxy VS. No substitutes will be considered.

OR

B. **Schneider Electric**: Galaxy VS or approved equal. However, if a brand other than Schneider is proposed, the decision of the Engineer shall be final and a "differentiation report" must be submitted. This report shall address each paragraph of the specification individually and list any difference from what is specified. If there are no differences, a report stating so shall be provided. If, after installation, omitted differences are found, the Contractor shall correct differences to the satisfaction of the Owner and Engineer or unsatisfactory equipment shall be removed and equipment acceptable to the Owner and Engineer shall be installed at no additional cost to the project. Also, make modifications to the facilities infrastructure as needed to accommodate the substitute, at no additional cost to the project. Examples of modifications include, but are not limited to the following:

1. Structural reinforcement to accommodate heavier equipment.
2. Increased sizes of circuit breakers, raceways and wiring.
3. Larger back-up generators (including upgraded accessories and wiring) to avoid instability caused by most double conversion UPS systems.
4. Larger HVAC equipment (including duct work and wiring) to accommodate increased heat dissipation of less efficient UPS systems.

2.2. **System Description**

A. **General**

1. The UPS shall be housed in a freestanding cabinet with casters and contain smart modular batteries. Maintenance shall be possible from the front.
2. The UPS shall be in a self-contained cabinet and shall be available in the following models:
   a. 10 kW, 15 kW, and 20 kW UPS for up to 2 internal 7 Ah smart modular battery strings.
   b. 10 kW, 15 kW, 20 kW, 30 kW, 40 kW, and 50 kW UPS for up to 4 internal 9 Ah smart modular battery strings. Modular battery cabinets shall be available for increased runtime.
   c. 20 kW, 30 kW, 40 kW, and 50 kW UPS with N+1 redundant power module for up to 5 internal 9 Ah smart modular battery strings. Modular battery cabinets shall be available for increased runtime.
   d. 60 kW, 80 kW, and 100 kW UPS for up to 5 internal 9 Ah smart modular battery strings. Modular battery cabinets shall be available for increased runtime.
3. Output power factor: 1.0.
4. Backfeed contactor included.
5. The UPS shall support installation with either 3-wire (L1, L2, L3, PE) WYE or 4-wire (L1, L2, L3, N, PE) WYE.
6. The UPS shall contain a static bypass switch and a display. The UPS shall be of the double conversion on-line topology with power factor corrected inputs.
   a. The UPS shall be sized for _____ kVA/kW load at a power factor of ____ for _____ minutes of runtime and with N+1 redundant power module.
7. The UPS shall be using a modular design in which power functions, static bypass, and system control are embedded in modules for optimal MTTR.
8. The UPS shall have a short circuit rating of 65 kA RMS.
9. The UPS shall be tested against EMC (electromagnetic compatibility) category C2.

B. **System Input**

1. Nominal input voltage rating: 400 V 3-phase (adjustable for 380 V or 415 V 3-phase).
2. Input voltage window:
   a. 380 V: 331 V to 437 V
   b. 400 V: 340 V to 460 V

c. 415 V: 353 V to 477 V
3. Earthing principle: [TN-S] [TN-C] [TT] or [IT].
4. Input frequency range: 40-70 Hz
5. Input power factor:
   a. 0.99 for load greater than 50%
   b. 0.95 for load greater than 25%
   c. NOTE: For a UPS with N+1 redundant power module, the input power factor is 0.99 at 100% load.
6. Total harmonic distortion:
   a. 10 kW, 15 kW, and 20 kW UPS for up to 2 modular battery strings: < 3% at full linear load (symmetrical).
   b. 10 kW, 15 kW, 20 kW, 30 kW, 40 kW, and 50 kW UPS for up to 4 modular battery strings: < 3% at full linear load (symmetrical).
   c. 20 kW, 30 kW, 40 kW, and 50 kW UPS with N+1 redundant power module for up to 5 modular battery strings: < 6% at full linear load (symmetrical).
   d. 60 kW, 80 kW, and 100 kW UPS for up to 5 modular battery strings: < 3% at full linear load (symmetrical).

C. **System Output**
1. Nominal output voltage rating: 400 V 3-phase (adjustable for 380 V or 415 V 3-phase).
2. Output voltage tolerance: +/- 1% for symmetrical loads.
3. Dynamic load response:
   a. +/- 5% after 2 ms
   b. +/- 1% after 50 ms
4. Output frequency: 50 or 60 Hz.
5. Output voltage harmonic distortion:
   a. For UPSs for up to 2 internal 7 Ah smart modular battery strings:
      1) <1% at 100% linear load
      2) <3% at 100% non-linear load
   b. For UPSs for up to 4 internal 9 Ah smart modular battery strings:
      1) <1% at 100% linear load
      2) ≤ 20 kW: <3% for non-linear load
      3) >20 kW: <5% for non-linear load
   c. For UPSs for up to 5 internal 9 Ah smart modular battery strings:
      1) <1% at 100% linear load
      2) <3% at 100% non-linear load
6. Overload capability:
   a. 150% for 1 minute (normal operation)
   b. 125% for 10 minutes (normal operation)
   c. 125% for 1 minute (battery operation)
   d. 110% continuous (bypass)
   e. 1000% for 100 ms (bypass)
7. Output power factor: 1.0
8. Audible noise:
   a. UPSs for up to 2 modular battery strings:
      1) 10-20 kW UPS:
         a) 49 dBA at 70% load
         b) 55 dBA at 100% load
   b. UPSs for up to 4 modular battery strings:
      1) 10-20 kW UPS:
         a) 49 dBA at 70% load
         b) 55 dBA at 100% load
      2) 30-50 kW UPS:
         a) 54 dBA at 70% load
         b) 61 dBA at 100% load
   c. UPSs for up to 5 modular battery strings:
      1) 20-60 kW UPS:
         a) 49 dBA at 70% load
         b) 55 dBA at 100% load
      2) 80-100 kW UPS:
         a) 57 dBA at 70% load
         b) 65 dBA at 100% load

2.3. Operation Modes

A. **Normal**: In normal operation, the UPS supports the load with conditioned power.
B. **Battery**: If the utility/mains supply fails, the UPS transfers to battery operation and supports the load with conditioned power from the batteries.
C. **Requested Static Bypass**: The UPS can be transferred to requested static bypass following a command from the display. During static bypass operation, the load is supplied from the bypass source. If a fault is detected, the UPS will transfer to normal operation or forced static bypass operation. If there is an interruption to the utility/mains power supply during requested static bypass operation, the system will transfer to battery operation.
D. **Forced Static Bypass**: The UPS is in forced static bypass following a command from the UPS system or because the user has pressed the inverter OFF button on the UPS. During forced static bypass operation, the load is supplied directly by the bypass source.
E. **Internal Maintenance Bypass**: When the internal maintenance breaker (IMB) is closed, the UPS transfers to internal maintenance bypass operation. The load is supplied with unconditioned power from the bypass source. Service can be performed only on power modules, the static bypass switch module, and on the controller box during internal maintenance bypass operation. The internal maintenance breaker IMB can only be used in single systems with no external maintenance bypass breaker.
F. **External Maintenance Bypass**: When the maintenance bypass breaker (MBB) is closed in the external maintenance bypass panel/cabinet, the UPS transfers to external maintenance bypass operation. The load is supplied with unconditioned power from the bypass source. Service can be performed on the entire UPS during external maintenance bypass.
G. **Static Bypass Standby**: The UPS enters static bypass standby if the UPS is prevented from entering forced static bypass and the other UPS units of the parallel system can support the load. In static bypass standby, the output of the specific UPS is off. The UPS automatically changes to the preferred operation mode when possible. Note: If the other UPS units cannot support the load, the parallel system enters forced static bypass. The UPS in static bypass standby will then transfer to forced static bypass.
H. **ECO Mode**: ECO mode allows the UPS to be configured to use requested static bypass, with the load supplied through the bypass, as the preferred operation mode under predefined circumstances. If a fault is detected (bypass voltage out of tolerance, output voltage out of tolerance, etc.), the UPS will immediately transfer to normal operation or forced static bypass. The main advantage of ECO mode is a reduction in the consumption of electrical power. In case of interruption to the utility/mains supply, the UPS transfers to inverter operation for a continuous supply of the load. The batteries are charged when the UPS is in ECO mode.
I. **ECOnversion Mode**: ECOnversion allows the UPS system to supply the active part of the load through the static bypass. The inverter is kept running in parallel with the bypass source and supplies the reactive part of the load. The input power factor of the UPS is, regardless of the load power factor, maintained close to unity as the reactive part of the load is significantly reduced in the UPS input current. In case of an interruption to the utility/mains supply, the inverter immediately maintains the output voltage so that breaks or drops during the transfer from ECOnversion mode are practically eliminated. The batteries are charged when the UPS is in ECOnversion mode.

2.4. Components

A. **Rectifier**
   1. The UPS shall include an active power factor corrected rectifier.
   2. The input current limiter shall be designed to:
      a. Fast battery recharging:
         1) 80% of the UPS output rating at 0-40% load.
         2) 20%[1] of the UPS output rating at 100% load.

[1] 15% at 380 V for 50 kW and 100 kW

b. Provide regulation with input deviation of up/down to +/-15% of the nominal input voltage.

3. The battery charging shall keep the float voltage of 545 VDC for 40 battery blocks.
4. The battery charging voltage shall be compensated against temperature variations (battery temperature compensation) to always maintain optimal battery float charging. Temperature compensation rate shall be 3.3 mV/degree/cell for ambient temperatures > 25 °C and 0mV/°C for ambient temperatures < 25 °C.
5. Input power factor shall be 0.98 lagging at 100% load without the use of passive filters. Rectifier shall employ electronic waveform control technology to maintain the current sinusoidal.
6. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control shall not be acceptable.

B. **Inverter**

1. The inverter shall consist of fast switching IGBTs.
2. The inverter shall be a 3-level hybrid inverter.
3. Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable.
4. The inverter modules shall be rated for an output power factor at 1.0.
5. Nominal output voltage shall be 400 V 3-phase (adjustable for 380 V or 415 V 3-phase).

C. **Static Bypass Switch**

1. The static bypass switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Partly rated SCRs with a wraparound contactor shall not be acceptable.
2. The static bypass switch shall be of modular design with connectors at the rear.
3. The static bypass switch shall automatically transfer the load to bypass supply without interruption after the logic senses one of the following conditions:
   a. Inverter overload beyond rating.
   b. Battery runtime expired and bypass available.
   c. Inverter inoperable.
   d. Control system inoperable.
4. The static bypass switch shall automatically retransfer from bypass to the inverter.
5. The inverter shall be active (on).
6. The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.

D. **Battery**

1. **General**:
   a. The UPS shall contain:
      1) Up to 2 internal 7 Ah smart modular battery strings for 10 kW, 15 kW, and 20 kW UPSs.
      2) Up to 4 internal 9 Ah smart modular battery strings for 10 kW, 15 kW, 20 kW, 30 kW, 40 kW, and 50 kW UPSs.
      3) Up to 5 internal 9 Ah smart modular battery strings for 20 kW, 30 kW, 40 kW, 50 kW, 60 kW, 80 kW, and 100 kW UPSs.
   b. End of discharge voltage at full load: 384 VDC for 40 battery blocks.
   c. Battery charge current limit: The selection shall be made from the display. The battery charge current limit should be software and hardware current limit.
   d. The battery charging circuit shall remain active when the PFC operates normally.
   e. The standard/long-life batteries shall be embedded in modules that contain battery blocks, a monitoring board, fuse and temperature sensors.
   f. The battery modules shall be user swappable using a simple, front-access disconnecting device integrated in the UPS cabinet.
   g. The battery solution shall be scalable and redundant.
2. **Battery Monitoring**:
   a. Battery monitoring shall be provided at system level.
   b. The UPS shall incorporate a battery capacity test that will determine the available runtimes.

2.5. **Mechanical**

A. The UPS shall be housed in a freestanding cabinet with casters.
B. Dust filter shall be available.
C. The cable entry shall be from the rear of the UPS.
D. The cabling section shall be large enough to accept copper cables.
E. The UPS shall have the following dimensions:
    1. 10-20 kW UPS for up to 2 internal 7 Ah smart modular battery strings: 1485x333x847 mm and shall meet an ingress level of minimum IP20.
    2. 10-50 kW UPS for up to 4 internal 9 Ah smart modular battery strings: 1485x521x847 mm and shall meet an ingress level of minimum IP20.
    3. 20-100 kW UPS for up to 5 internal 9 Ah smart modular battery strings: 1970x550x847 mm and shall meet an ingress level of minimum IP20.
F. The UPS shall have a seismic kit option.

2.6. **Display, Controls, and Alarms**

A. A color touch screen display shall be located on the front of the UPS.
B. The following metered data shall be available on the display:
    1. Year, month, day, hour, minute, second of occurring events.
    2. Input voltage.
    3. Input current.
    4. Input frequency.
    5. Output voltage.
    6. Output current.
    7. Output frequency.
    8. Battery voltage.
    9. Battery current.
    10. Battery temperature.
C. The display shall allow the user to display active alarms.
D. The following controls or programming functions shall be accomplished by use of the display unit.
    1. Silence audible alarm.
    2. Set the alphanumeric display language.
    3. Display and set the date and time.
    4. Enable or disable the automatic restart feature.
    5. Transfer load to and from static bypass.
    6. Test battery condition on demand.
E. LEDs for indication of operation mode.
F. Push button user controls:
    1. Inverter ON.
    2. Inverter OFF.
G. For purposes of remote communications with the UPS, a network management card shall be integrated.

2.7. **Accessibility**

A. **Software and Connectivity**
    1. The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in MIB formats. The SNMP interface adaptor shall be connected to the UPS via the RJ45 serial port on the standard communication interface board.
    2. The UPS shall offer a Modbus interface.
    3. The UPS shall be equipped with eight dry contacts (four inputs, four outputs) for user-assignable alarms or remote monitoring.

B. **Remote UPS Monitoring**
    Three methods of remote UPS monitoring shall be available:
    1. Smartphone application: With remote monitoring and live system status and remote alarms.
    2. Web monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.

3. Simple Network Management Protocol (SNMP): Remote UPS monitoring shall be possible through a standard MIB II compliant platform.

C. **Software Compatibility**

The UPS manufacturer shall have available software to support shutdown and or remote monitoring.

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

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. Manufacturer Assisted Start-up

A manufacturer assisted UPS start-up shall be available, manufacturer trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. **Visual Inspection:**
   1. Inspect equipment for signs of damage.
   2. Verify installation per manufacturer's instructions.
   3. Inspect cabinets for foreign objects.
   4. Inspect batteries.

B. **Mechanical Inspection:**
   1. Check internal power wiring connections on all UPSs and external battery cabinets.
   2. Check tightness on terminal screws, nuts, and/or spade lugs on all UPSs and external battery cabinets.
   3. Check that all smart battery modules in the UPS and the modular battery cabinets are fastened to the shelves.

C. **Electrical Inspection:**
   1. Verify correct input and bypass voltage.
   2. Verify correct phase rotation of all input and bypass connections.
   3. Verify correct UPS control wiring and terminations.
   4. Verify voltage of batteries.
   5. Verify neutral and ground conductors are properly landed.

D. **Site Testing:**
   1. Ensure correct system start-up.
   2. Verify correct firmware control functions.
   3. Verify correct firmware bypass operation.
   4. Verify correct internal maintenance breaker operation.
   5. Verify system set points.
   6. Verify correct inverter operation and regulation circuits.
   7. Simulate input power failure.
   8. Verify correct charger operation
   9. Document, sign, and date all test results.

E. **On-Site Operational Training**: During the manufacturer assisted start-up, operational training for site personnel shall include LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.4. Manufacturer Field Service

A. **Worldwide Service**: The UPS manufacturer shall have a worldwide service organization available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

3.5. **Demonstration**

Provide the services of a manufacturer-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Owner's personnel.

A. Test and adjust controls and safety. Replace damaged or inoperable controls and equipment.
B. Train the Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
C. Review data in operation manual with the Owner's personnel.

3.6. **Maintenance**

A. **Maintenance Contracts**: A complete offering of preventative and full-service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by Schneider Electric-trained service personnel.
B. The manufacturer shall, upon request, provide spare parts kits for the UPS in a timely manner as well as provide access to qualified and trained service personnel to provide preventative maintenance and service on the UPS when required.
C. The UPS shall be repairable by replacing standard subassemblies requiring no adjustments.
D. UPS subassemblies 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 self-test function shall identify the subassembly requiring repair in the event of an alarm condition. 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.

3.7. **Training**

UPS service training workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

END OF SECTION