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. System description

A. The UPS shall consist of easy to repair rectifiers/inverters.

B. The UPS shall be provided with separate feeds for rectifier/inverter and the static bypass switch.

C. Modes of operation: The UPS shall operate as an on-line system in the following modes:

1. Normal mode: The UPS provides power to the connected load from mains. The UPS converts mains to conditioned power for the connected load while recharging the batteries (float or boost charge).

2. Battery mode: The UPS transfers to battery mode if the mains supply fails. The UPS provides power to the connected load from the connected batteries for a finite period. When the mains supply returns, the UPS transfers back to normal mode.

3. Frequency converter mode: In frequency converter mode, the UPS presents a stable output frequency (at 50 or 60 Hz) and the static bypass switch is not available.
4. Battery recharge: Upon restoration of the input source, the UPS shall simultaneously recharge the battery and regulate the power to the load.

5. Static bypass mode: The UPS supplies the load with power from the bypass source. If the conditions for normal or battery mode are not met, the load will be transferred from the inverter to the bypass source with no interruption in power to the load.

6. ECO mode: In ECO mode the UPS is configured to use static bypass mode as the preferred operation mode under predefined circumstances. The inverter is in standby in ECO mode and in case of interruption to the mains, the UPS transfers to battery mode and the load is supplied from the inverter.

7. Maintenance bypass mode: In maintenance bypass mode, the mains is sent via the (external) maintenance bypass breaker (MBB) to the load. Battery backup is not available in maintenance bypass mode.

8. Auto-restart mode: When auto-restart is enabled, the UPS automatically restarts the inverter and bypass when the mains returns. By default, auto-restart is enabled.

D. The UPS shall be provided with RS485, USB, and dry contact signaling and Web/SNMP integration. This system must provide a means for logging and alarming of all monitored points.

E. The UPS shall have nominal voltage of 3×400 V (adjustable for 3×380 V, 3×415 V), 50/60 Hz 4-wire configurations.

1.4. 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. International Organization for Standardization (ISO):  
   1. ISO 9001, "Quality Management Systems Requirements."

1.5. Standards

A. Safety:
   2. IEC 62040-1: 2013-01, 1st edition amendment 1


1.6. 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 guide
   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 operating instructions.
   3. Safety instructions
1.7. **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.

C. **Factory testing**
   Prior to shipment the manufacturer shall complete a documented test procedure to test functions of the UPS module 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.

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

1.9. **Project conditions**
   Do not install 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**
   1. Storage ambient temperature: -25 °C to 55 °C.
   2. Operating ambient temperature: 0 °C to 40 °C.
   3. Relative humidity: 0 to 95%, non-condensing.
   4. Storage altitude: 0 to 15000 m above sea level.
   5. Operating altitude with no derating: 0 to 1500 m above sea level.

1.10. **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. 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.

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.

1.11. **Maintenance**

A. 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.

B. A 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.

C. The UPS shall be repairable by replacing standard subassemblies requiring no adjustments.

D. The manufacturer shall offer additional preventative maintenance and service contracts covering both the UPS and the batteries. Accredited professional service representatives 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 PRODUCT

2.1. Manufacturer

A. Schneider Electric: Easy UPS 3M. No substitutes will be considered.

OR

B. Schneider Electric: Easy UPS 3M or approved equal. However, if a brand other than Schneider Electric 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. Static UPS

A. General

1. The UPS shall be housed in a freestanding cabinet with casters and shall contain the following breakers.
   a. Unit input breaker (UIB)
   b. Static switch input breaker (SSIB)
   c. Unit output breaker (UOB)
   d. Maintenance bypass breaker (MBB)
2. Installation access shall be from the backside of the system.
3. The UPS shall be in a self-contained cabinet and shall be available in the following models: 60 kVA, 80 kVA, 100 kVA, 120 kVA, 160 kVA, and 200 kVA
4. The UPS shall contain a bypass static switch; and a display. The UPS shall be of the double conversion on-line topology with power factor corrected inputs.
5. The UPS shall be sized for ______ kVA and ______ kW load.
6. The UPS battery shall be sized for ____ at a power factor of ____ for _____ minutes.
7. The UPS system shall have a runtime of ____ minutes.
8. The UPS shall have a short circuit withstand capability of 10 kA.
9. The UPS shall contain an EPO.

B. System input

1. Nominal Input voltage rating: 3×400 V (adjustable for 3×380 V or 3× 415 V).
2. Input voltage window: 342 V to 477 V at full load.
3. Earthing principle: [TN-S] [TN-C] [TT] or [IT].
4. Input frequency range: 40-70 Hz
5. Input power factor: > 0.99 for full linear loads
6. Total harmonic distortion: < 3% for full linear loads

C. System output

1. Nominal output voltage rating: 400 V 3-phase.
2. Output voltage regulation (static): +/- 1%
4. Output frequency: 50 or 60 Hz.
5. Output voltage harmonic distortion:
a. <3% at 100% linear load.
b. <5% at 100% non-linear load.

6. Overload capability at 30 °C:
a. 110% for 60 minutes.
b. 125% for 10 minutes.
c. 150% for 1 minute.

7. Output power factor: 1.0.

8. Efficiency in normal operation at 100% load:
a. 60 kVA: 94.8%
b. 80 kVA: 94.9%
c. 100 kVA: 94.8%
d. 120 kVA: 94.6%
e. 160 kVA: 94.5%
f. 200 kVA: 94.5%

9. Audible noise at full load and a 30 °C ambient temperature according to ISO 3746:
a. 60-100 kVA: 65 dBA
b. 120-200 kVA: 70 dBA

D. Components

1. Rectifier
   a. The UPS shall include an active power factor corrected, Insulated Gated Bipolar Transistor (IGBT) rectifier.
   b. The input current limiter shall be designed to:
      1) support 100% load at 342 V input voltage
      2) charge batteries at
         a) 20% of the UPS output rating for a 60 kVA UPS
         b) 30% of the UPS output rating for an 80 kVA UPS
         c) 24% of the UPS output rating for a 100 kVA UPS
         d) 20% of the UPS output rating for a 120 kVA UPS
         e) 22.5% of the UPS output rating for a 160 kVA UPS
         f) 24% of the UPS output rating for a 200 kVA UPS
      3) provide regulation with mains deviation between 150 V and 477 V.
   c. DC bus voltage shall be ± 370/400 VDC for the input voltages 380/400/415 V.
   d. The battery charging shall keep the float voltage of ± 215.5 VDC to ± 337.5 VDC for 32-50 blocks.
   e. The battery charging voltage shall be compensated against temperature variations (battery temperature compensation) to always maintain optimal battery float charging. Temperature compensation rate is adjustable and shall be 3mV/degree/cell for ambient temperatures > 28 °C and 0mV/°C for ambient temperatures < 28 °C.
   f. Input power factor shall be 0.99 lagging at 100% load with out the use of passive filters. Rectifier shall employ electronic waveform control technology to maintain the current sinusoidal.
   g. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control is not acceptable.

2. Batteries
   a. Standard battery technology shall be sealed lead acid.
   b. Support of:
      1) 32-34 battery blocks at 90% load
      2) 36-50 battery blocks at 100% load
   c. Battery voltage shall be battery temperature compensated as outlined in the rectifier section above.
   d. End of discharge voltage: ± 153.6 VDC to ± 240 VDC for 32-50 blocks.
   e. Battery charge current limit: The selection shall be made from the UPS Soft Tuner.
   f. The battery charging circuit shall remain active when the PFC operates normally.

3. Inverter
a. The inverter shall consist of fast switching IGBT.
b. The inverter shall be a 3-level inverter.
c. Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable.
d. The inverter modules shall be rated for an output power factor at 1.0.
e. Nominal output voltage shall be 3\times400\ V (adjustable for 3\times380\ V or 3\times415\ V).

4. Static bypass switch
   a. The static switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Part rated SCRs with a wrap around contactor are not acceptable.
   b. The static bypass switch shall automatically transfer the load to bypass input supply without interruption after the logic senses one of the following conditions:
      1) Inverter overload beyond rating.
      2) Battery runtime expired and bypass available.
      3) Inverter inoperable.
      4) Control system inoperable.
   c. The inverter shall be active (on).
   d. The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.

E. Mechanical
   1. Easy UPS 3M is housed in a freestanding cabinet with casters.
   2. The cable entry shall be from the back of the UPS.
   3. The Easy UPS 3M has the following dimensions and shall meet an ingress level of minimum IP20:
      a. 60-100 kVA: 915\times360\times850\ mm.
      b. 120-160 kVA: 1300\times500\times850\ mm.
      c. 200 kVA: 1300\times600\times850\ mm

F. Display, controls, and alarms
   1. A display shall be located on the front of the system. The display interface shall consist of a touchscreen display, and status LEDs.
   2. The following metered data, shall be available on the alphanumeric display:
      a. Year, month, day, hour, minute, second of occurring events
      b. Input voltage
      c. Input current
      d. Input frequency
      e. Output voltage
      f. Output current
      g. Output frequency
      h. Battery voltage
      i. Battery current
      j. Battery temperature
   3. The display shall allow the user to display active alarms.
   4. The following controls or programming functions shall be accomplished by use of the display unit. Push button membrane switches shall facilitate these operations.
      a. Silence audible Alarm
      b. Set the display language
      c. Display and set the date and time
      d. Transfer load to and from static bypass
      e. Test battery condition on demand
   5. The following shall make up the UPS front panel LEDs:
      a. Alarm
         1) Steady red: Critical alarm
         2) Flashing red: Warning alarm
         3) Off: No alarm condition
      b. Bypass
         1) Steady yellow: The load is supplied by the bypass source
         2) Flashing yellow: There is an alarm condition on the bypass source
         3) Off: The load is not supplied by the bypass source
c. Battery
   1) Steady yellow: The load is supplied by the battery source
   2) Flashing yellow: The battery source is unavailable
   3) Off: The load is not supplied by the battery source
d. Inverter
   1) Steady green: Inverter on
   2) Off: Inverter off

6. For purposes of remote communications with the UPS an optional network card shall be available.

G. Accessories
   1. Software and connectivity
      a. 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.
      b. Unattended Shutdown.
   2. Remote UPS monitoring
      Three methods of remote UPS monitoring shall be available:
      a. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.
      c. Modbus protocol through RS485 port.
   3. Software compatibility
      The UPS manufacturer shall have available software to support shutdown and or remote monitoring for the following systems:
      a. Microsoft Windows 7 and Microsoft Windows 10
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 all UPS, external battery cabinets internal power wiring connections.
   2. Check all UPS, external battery cabinets terminal screws, nuts, and/or spade lugs for tightness.

C. **Electrical Inspection**
   1. Verify correct input and bypass voltage.
   2. Verify correct phase rotation of all mains 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 proper system start-up.
   2. Verify proper firmware control functions.
   3. Verify proper firmware bypass operation.
   4. Verify proper maintenance bypass switch operation.
   5. Verify system set points.
   6. Verify proper inverter operation and regulation circuits.
   7. Simulate input power failure.
   8. Verify proper 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 key pad operation, 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 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.

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