

APC by Schneider Electric

APC SYMMETRA PX 100 kW

10 kW - 100 kW

Uninterruptible Power Supply

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 53] [16611]

STATIC 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 static 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 continuous duty, three-phase, solid state, on-line double conversion static UPS.
 - 1. The UPS shall utilize a rack-mounted N+1 redundant, scalable array architecture. The UPS shall be ENERGY STAR qualified. The system power train shall be comprised of 10 kVA/10 kW power modules and shall be capable of being configured for N+X redundant operation at the rated system load. UPS shall facilitate the replacement of swappable power modules in less than ten minutes. Each 10 kVA/10 kW power module shall contain a fully rated input rectifier/boost converter hereafter referred to as the input converter, a fully rated output inverter, and battery charging circuit. The system shall also be comprised of a continuous duty bypass static switch module that can be swapped by trained personnel, battery modules that can be swapped by trained personnel, redundant control modules, redundant logic power supplies, and LCD interface/display. All of the above system components shall be housed in standard 600 mm wide by 1070 mm deep by 2000 mm high cabinets.
 - 2. In addition, this Section describes the performance, functionality, and design of the power distribution unit, hereafter referred to as the PDU, and the battery system.
 - 3. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.
 - 4. All programming and miscellaneous components for a fully operational system as described in this Section shall be available as part of the UPS.

1.2 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 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (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. **Underwriters Laboratories, Inc. (UL):**
1. UL 1778 second Edition, "Standard for Uninterruptible Power Supply Equipment" (copyrighted by UL, ANSI approved).
 2. UL 60950-1, "Standard for Information Technology Equipment."
- E. **International Electrotechnical Commission (IEC)**
1. IEC 61000-4-2, "Electromagnetic Compatibility - Testing and Measurement Techniques; Electrostatic Discharge Immunity Test."
 2. IEC 61000-4-3, "Electromagnetic Compatibility - Testing and Measurement Techniques; Radiated, Radio Frequency, Electromagnetic Field Immunity Test."
 3. IEC 61000-4-4, "Electromagnetic Compatibility - Testing and Measurement Techniques; Electrical Fast Transient/Burst Immunity Test."
 4. IEC 61000-4-5, "Electromagnetic Compatibility - Testing and Measurement Techniques; Surge Immunity Test."
 5. IEC 62040-2, "Uninterruptible Power Systems - Electromagnetic Compatibility (EMC) Requirements,"
 6. IEC 62040-3, "Uninterruptible Power Systems - Method of Specifying the Performance and Test Requirements."
- F. **CSA:**
1. C22.2 no. 107.1-M95, "General Use Power Supplies."
 2. 60950-1, "Information Technology Equipment - Safety - Part 1: General Requirements."
- G. **EMC:**
1. FCC part 15 Class A.

1.3 SYSTEM DESCRIPTION

A. **Design Requirements:**

INSERT APPLICABLE VALUES IN SUBPARAGRAPHS ABOVE AND BELOW.

1. The UPS shall be sized for [____] kVA and [____] kW load.
2. The UPS battery shall be sized for [____] kW at a power factor of [____] for [____] minutes.

B. **System Characteristics:**

1. **System Capacity:** The system shall be rated for full kW output in the following frame sizes:
 - a. 100 kVA/kW, can be configured with up to ten, 10 kW power modules for 100 kW or 90 kW N+1.
2. **Input:** The system input shall be configurable as either single or dual mains derived from a three phase wye source. Standard cable entry shall be through the top. Bottom cable entry shall also be facilitated. Depending on the specific configuration, the use of the optional side car may be required.
 - a. **AC Input Nominal Voltage:** 208 Y/120 V three-phase, 4-wires plus ground, 60 Hz.
 - b. **AC Input Voltage Window:**

- 1) $\pm 15\%$ for full performance (177 to 239 volts).
- c. **Short Circuit Withstand Rating:** 30,000 symmetrical amperes.
- d. **Maximum Frequency Range:** 40 to 70 hertz.
- e. **Input Power Factor:**
 - 1) Greater than 0.99 with load at 25%
 - 2) Greater than 0.95 with loads above 15%
 - 3) Greater than 0.90 with loads above 10%
- f. **Input Current Distortion With No Additional Filters:** Less than 5 percent at full load.
- 3. **UPS Output:**
 - a. **AC Output Nominal Output:** 208 Y/120 V, 4-wires plus ground, 60 Hz.
 - b. **AC Output Voltage Distortion:** Less than 2% at 100% linear load, less than 6.5% for non-linear load as defined by IEC/EN 62040-3
 - c. **AC Output Voltage Regulation:** $\pm 1\%$ for 100% linear or non-linear load.
 - d. **Voltage Transient Response:** $\pm 5\%$ maximum RMS change in a half cycle at load step 0% to 100% or 100% to 0%.
 - e. **Voltage Transient Recovery:** Within less than 50 milliseconds.
 - f. **Output Voltage Harmonic Distortion:** Less than 2% THD maximum and 1% single harmonic for a 100% linear load.
 - g. **Overload Capabilities:**
 - 1) **Normal Operation:**
 - a) 150% for 30 seconds before transfer to bypass.
 - 2) **Battery Operation:** 150% for 30 seconds.
 - 3) **Bypass Operation:**
 - a) 125% continuous at 208 V
 - b) 1000% for 100 milliseconds.
 - h. **UPS efficiency:**
 - 1) **ENERGY STAR qualified system efficiency in double conversion mode:**
 - a) 100% load: 94.7% efficient
 - b) 75% load: 94.9% efficient
 - c) 50% load: 94.8% efficient
 - d) 25% load: 93.2% efficient
 - i. **Output Power Factor Rating:** 0.5 leading to 0.5 lagging without any derating.

1.4 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. As bid system bill of materials.
 - 2. Product catalog sheets or equipment brochures.
 - 3. Product guide specifications.
- 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, the following:
 - 1. Installation information, including, but not limited to, weights and dimensions.
 - 2. Information about terminal locations for power and control connections.
 - 3. Drawings for requested optional accessories.
- 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.
 - 1. Submit system single-line operation diagram.
- D. **Operation and Maintenance Data:** Submit operation and maintenance data to include in operation and maintenance manuals including, but not limited to, safe and correct operation of UPS functions.

1. Submit an installation manual, which shall include, but shall not be limited to, instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
2. Submit an operation and maintenance manual, which shall include, but shall not be limited to, operating instructions.

1.5 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.
2. **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. Work shall also be designed in accordance with the following:
 - a. UL 1778 4th edition
 - b. UL 60950-1
2. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees:
 - a. National Fire Protection Association (NFPA).
 - b. National Electrical Manufacturers Association (NEMA).
 - c. Occupational Safety and Health Administration (OSHA).
 - d. Institute of Electrical and Electronics Engineers, Inc. (IEEE); ANSI/IEEE 519.
 - e. ISO 9001
 - f. ISO 14001
 - g. FCC
 - h. ENERGY STAR

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.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not install the 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.

1. **Environmental:**
 - a. **Storage Ambient Temperature:** 5 °F (-15 °C) to 104 °F (40 °C).
 - b. **Operating Ambient Temperature:** 32 to 104 °F (0 to 40 °C) (77 °F [25 °C] shall be ideal for most battery types).
 - c. **Relative Humidity:** 0% to 95% non-condensing.
 - d. **Altitude:** Maximum installation with no derating of the UPS output shall be 3280 feet (1000 m) above sea level. The UPS capacity shall be derated for altitude as follows:
 - 1) 4500 feet (1500 m), 95% load.
 - 2) 6000 feet (2000 m), 91% load.

- 3) 8000 feet (2500 m), 86% load.
- 4) 10000 feet (3000 m), 82% load.
- e. **Audible Noise (As Measured 3 Feet [914 mm] From Surface):**
 - 1) 60 dBA at 70% load.
 - 2) 67 dBA at 100% load.

1.8 WARRANTY

- A. **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.
- 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.

1.9 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. Contract work shall be performed by factory-trained service personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Product specified is "APC Symmetra PX 100 kW" as manufactured by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance.

2.2 MODES OF OPERATION

- A. **Normal:** The Input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
- B. **Battery:** Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.
- C. **Recharge:** Upon restoration of utility power to the UPS input, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.
- D. **Static Bypass:** The static bypass shall be used to provide controller transfer of critical load from the inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function.

- E. **Maintenance Bypass:** The system shall be equipped with an external make-before-break maintenance bypass cabinet (MBC) to electrically isolate the UPS during routine maintenance and service of the UPS. The MBC shall allow for the completely electrical isolation of the UPS.

2.3 INPUT CONVERTER

- A. **General:** The Input converters of the system shall be housed within the removable power modules, and shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and main inverter regulated output power.
- B. **Input Current Total Harmonic Distortion:** The input current THDI shall be held to less than 5% at full system load, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting both a linear or non-linear load. This shall be accomplished without the requirement for additional filters, magnetic devices, or other components.
- C. **Soft-Start Operation:** As a standard feature, the UPS shall contain a user-adjustable soft-start, capable of limiting the input current from 0% to 100% of the input over a default 10 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation.
- D. **Magnetization Inrush Current:** The UPS shall exhibit zero inrush current as a standard product. If provided with an optional isolation transformer, inrush should be limited to 11 times the nominal input current of the transformer.
- E. **Input Current Limit:**
 - 1. The Input converter shall control and limit the input current draw from utility to 130% of the rated UPS output. During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation +15/-5%.
- F. **Redundancy:** The UPS shall be capable of being configured with redundant Input converters, each with semiconductor fusing, and logic-controlled contactors to isolate a failed module from the input bus.
- G. **Backfeed Protection:** The above mentioned logic-controlled contactor shall also provide the backfeed protection required by UL 1778, CSA 22.2, and IEC/EN Standards.
- H. **Charging:**
 - 1. The battery charging shall keep the DC bus float voltage of nominal ± 218 volts, $\pm 1\%$.
 - 2. The battery charging circuit shall contain a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
 - 3. The battery charging circuit shall remain active when in static bypass and in normal operation.
 - 4. Maximum charging power: 10% of output power rating or a maximum charge current of 0.25 CA.

2.4 OUTPUT INVERTER

- A. **General:** The UPS output inverter shall constantly develop the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of semiconductor driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the output voltage sine wave of the inverters.

- B. **Overload Capability:** Steady-state overload conditions, of up to 150% of system capacity shall be sustained by the inverter for 30 seconds in normal and battery operation. Should overloads persist past the outlined time limitation, the critical load shall be switched to the automatic static bypass output of the UPS.
- C. **Output Contactor:** The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be isolated from the critical bus.
- D. **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.
- E. **Redundancy:** The UPS shall be capable of being configured with redundant output inverters, each with semiconductor fusing, and logic-controlled contactors to remove a failed component from the input, DC, and output critical bus.

2.5 STATIC BYPASS

- A. **General:** As part of the UPS, a system static bypass cabinet shall be provided. The system static bypass shall provide no break transfer of the critical load from the inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.
- B. **Design:** The design of the static switch power path shall consist of silicon-controlled rectifiers (SCR) with a continuous duty rating of 125% of the UPS output rating.
- C. **Automatic Transfers:** An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical output bus of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.
- D. **Manual Transfers:** Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.
- E. **Overloads:** The static bypass shall be capable of handling overloads equal to or less than 125% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the static bypass shall be capable of sustaining overloads of 1000% of system capacity for periods of up to 100 milliseconds.
- F. **Modular:** The static bypass switch shall be of a modular design.
- G. **System Protection:** As a requirement of UL 1778, backfeed protection in the static bypass circuit shall also be incorporated in the system design. To achieve backfeed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where backfeeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

2.6 DISPLAY AND CONTROLS

- A. **Control Logic:** The UPS shall be controlled by two fully redundant intelligence modules (IM) that can be swapped by trained personnel. These modules shall have separate, optically isolated, communication paths to the power and static switch modules. Logic power for the control modules shall be derived from redundant power supplies, each having a separate AC and DC input and output. The communication of the control modules shall be of controller area network (CAN Bus).
- B. **Display unit:** A microprocessor-controlled display unit shall be located on a hinged door in front of the system. The display shall consist of an alphanumeric display with backlight, four LEDs for quick status overview, and a keypad consisting of pushbutton switches.
- C. **Metered Data:** The following data shall be available on the alphanumeric display:
1. Year, month, day, hour, minute, second of occurring events.
 2. Source input voltage.
 3. Output AC voltage.
 4. Output AC current.
 5. Input frequency.
 6. Battery voltage.
- D. **Event Log:** The display unit shall allow trained personnel to display a time and date stamped log.
- E. **Alarms:** The display unit shall allow the Owner to display a log of active alarms. The following minimum set of alarm conditions shall be available:
1. Input frequency outside configured range.
 2. AC adequate for UPS but not for bypass.
 3. Low/no AC input, startup on battery.
 4. Intelligence module inserted.
 5. Intelligence module removed.
 6. Redundant intelligence module inserted.
 7. Redundant intelligence module removed.
 8. Number of batteries changed since last on.
 9. Number of power modules changed since last on.
 10. Number of batteries increased.
 11. Number of batteries decreased.
 12. Number of power modules increased.
 13. Number of power modules decreased.
 14. Number of external battery cabinets increased.
 15. Number of external battery cabinets decreased.
 16. Redundancy restored.
 17. Need battery replacement.
 18. The redundant intelligence module is in control.
 19. UPS fault.
 20. On battery.
 21. Shutdown or unable to transfer to battery due to overload.
 22. Load shutdown from bypass, input frequency, volts outside limits.
 23. Fault, internal temperature exceeded system normal limits.
 24. Input circuit breaker open.
 25. System level fan failed.
 26. Bad battery module.
 27. Bad power module.
 28. Intelligence module installed and failed.
 29. Redundant intelligence module installed and failed.
 30. Redundancy lost.
 31. Redundancy below alarm threshold.
 32. Runtime below alarm threshold.
 33. Load above alarm threshold.
 34. Load no longer above alarm threshold.

35. Minimum runtime restored.
36. Bypass not in range (either frequency or voltage).
37. Backfeed contactor stuck in OFF position.
38. Backfeed contactor stuck in ON position.
39. UPS in bypass due to internal fault.
40. UPS in bypass due to overload.
41. System in forced bypass.
42. Fault, bypass relay malfunction.
43. High DC warning.
44. High DC shutdown.
45. Low battery shutdown.
46. Low battery warning.

F. **Controls:** The following controls or programming functions shall be accomplished by the use of the display unit. Pushbutton membrane switches shall facilitate these operations:

1. Silence audible alarm.
2. Display or set the date and time.
3. Transfer critical load to and from static bypass.
4. Test battery condition on demand.
5. Set intervals for automatic battery tests.
6. Adjust set points for different alarms.
7. Program the parameters for remote shutdown.
8. Enable or disable the automatic restart feature (field service engineer only).

G. **Potential Free (Dry) Contacts:** The following potential free contacts shall be available on an optional relay interface board:

1. Normal operation.
2. Battery operation.
3. Bypass operation.
4. Common fault.
5. Low battery.
6. UPS off.

H. **Communication Interface Board:** A communication interface board shall provide the following communication port:

1. RS232 serial port: Enables local access to the UPS for management and monitoring, and provides UPS data and simple signaling support.

2.7 BATTERY

- A. The UPS batteries shall be of a modular construction and shall be protected by a fuse. Trained personnel shall be capable of swapping the battery modules without the requirement to transfer to bypass. Each battery module shall be monitored for voltage and temperature for use by the UPS battery diagnostic and temperature compensated charger circuitry.
- B. The battery jars housed within each removable battery module shall be of the valve regulated lead acid (VRLA) type.
- C. The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event a failed or weak battery module is found.

2.8 ACCESSORIES

A. **Power Distribution Unit:** As a minimum, the PDU shall contain the following features and accessories:

1. **Input voltage:** The PDU shall be available for a [208 V] [480 V] [600 V] input.

2. **Isolation transformer:** The [600:208 V][480:208 V][208:208 V] PDU shall contain an isolation transformer. A 208 V Modular PDU without transformer shall also be available for purchase.
 3. **Maintenance Bypass:** The system shall be equipped with an integrated, bus connected external make-before-break MBwD to electrically isolate the UPS during routine maintenance and service of the UPS. The MBwD shall allow for the completely electrical isolation of the UPS.
 - a. The Maintenance Bypass Panel shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS is required. The Maintenance Bypass Panel shall provide a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. As a minimum, the Maintenance Bypass Panel shall contain the following features and accessories:
 - 1) Circuit breakers of the appropriate size, withstand rating, and trip rating for the system.
 - 2) Minimum 1A/1B auxiliary contacts for the purpose of relaying status information of each circuit breaker/switch actuator to the UPS and static bypass.
 - a. The following minimum options shall also be available for the Maintenance Bypass Panel:
 - 1) Mimic label with light indications for power flow.
 2. **Distribution Board:** Also included in the PDU shall be one 72 pole distribution board connected to the output bus of the PDU to serve as critical load distribution. The distribution panel shall be intrinsically finger safe, and shall be suitable for the installation of single or three phase modular circuit breaker assemblies without the need for hand tools.
 3. **Cabinet with locking mechanism:** The PDU shall also have a full-length hinged front door, with locking mechanism, to allow access to the panel board circuits. There shall also be a hinged rear door to allow access to the back of the unit.
 4. **Testing and quality assurance:** The transformer and all circuit breakers shall be 100% factory tested to ensure the highest quality for the PDU. In addition the PDU shall be tested with 100% load and all panel circuit breakers shall be 100% tested. The PDU shall also be Hipot tested per UL 60950-1 guidelines.
 5. **IT Rack Form Factor:** All of the above system components are housed in an APC Netshelter™ SX Rack, 600 mm (W) x 1070 mm(D) x 2000 mm(H)
- B. **Power Distribution Modules:** For the purpose of providing power distribution to the protected load, a range of power distribution modules and accessories shall be available.
- C. **Battery Solutions:** For purposes of providing UPS back-up power, battery cabinets shall be available. For ease of maintenance the battery cabinets shall house draw-out battery cartridges. Battery cartridges shall interlock in place within the battery cabinet to ensure proper contact. This will ensure that the customer will not inadvertently withdraw the battery pack in an unsafe manner. The battery solution shall be housed in a standard 24 inch (610 mm) wide, 36 inch (914 mm) deep, 42 U high cabinet. Up to four battery cabinets may be added for increased battery runtime.
- D. **Seismic Anchor Brackets:** When the seismic anchoring bracket kits are installed, the unit shall have an SDS capacity of 1.41g and a Z/h capacity of 1.0 and shall be OSHPD pre-approved.
- E. **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-Schneider Electric products shall also be available via dry contact input signal.
4. **Public Network Monitoring:** Data Center Expert shall also be capable of monitoring other Schneider Electric devices that are connected to the client's public network.

2.9 Software and Connectivity:

1. **Network Adaptor:** The Network Management Card 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 DOS and UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via Ethernet Port.
 2. **Unattended Shutdown:**
 - a. The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems.
- B. **Remote UPS Monitoring:** The following methods of remote UPS monitoring shall be available:
1. **Web Monitoring:** Remote monitoring shall be available via a web browser such as Internet Explorer.
 2. **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 graceful shutdown and remote monitoring with PowerChute Network Shutdown (PCNS) for the following operating system families:
1. Microsoft Windows
 2. MAC OS X
 3. Hyper-V
 4. VMware
 5. Linux
 6. Unix

The full and updated supported OS compatibility chart can be found here:

<http://www.apc.com/whitepaper/?um=200>

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. **General:** Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.
- B. **Factory-Assisted Start-Up:** If a factory-assisted UPS start-up is requested, factory-trained service personnel shall perform the following inspections, test procedures, and on-site training:
1. **Visual Inspection:**
 - a. Inspect equipment for signs of damage.
 - b. Verify installation per manufacturer's instructions.
 - c. Inspect cabinets for foreign objects.
 - d. Inspect battery units.

- e. Inspect power modules.
- 2. **Mechanical Inspection:**
 - a. Check UPS and external maintenance bypass cabinet internal control wiring connections.
 - b. Check UPS and external maintenance bypass cabinet internal power wiring connections.
 - c. Check UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.
- 3. **Electrical Inspection:**
 - a. Verify correct input and bypass voltage.
 - b. Verify correct phase rotation of mains connections.
 - c. Verify correct UPS control wiring and terminations.
 - d. Verify voltage of battery modules.
 - e. Verify neutral and ground conductors are properly landed.
 - f. Inspect external maintenance bypass switch for proper terminations and phasing.
- 4. **Site Testing:**
 - a. Ensure proper system start-up.
 - b. Verify proper firmware control functions.
 - c. Verify proper firmware bypass operation.
 - d. Verify proper maintenance bypass switch operation.
 - e. Verify system set points.
 - f. Verify proper inverter operation and regulation circuits.
 - g. Simulate utility power failure.
 - h. Verify proper charger operation.
 - i. Document, sign, and date test results.
- 5. **On-Site Operational Training:** During the factory-assisted start-up, operational training for site personnel shall include, but shall not be limited to, key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.3 FIELD QUALITY CONTROL

- A. **Manufacturer Field Service:**
 - 1. **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.
 - 2. **Replacement Parts:** Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization shall be capable of shipping parts within four working hours or on the next available flight, so that the parts may be delivered to the Owner within 24 hours.

3.4 DEMONSTRATION

- A. **General:** 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