

Schneider Electric
APC InfraStruXure for Small Data Centers, 20kW Base Building Block
10kW-20kW UPS/Distribution

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 26 53] [16471]

STATIC UNINTERRUPTIBLE POWER SUPPLY POWER DISTRIBUTION UNIT

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) with embedded power distribution unit (PDU) 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 the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS. The UPS shall utilize an N+1 redundant, scalable array architecture. The UPS shall be ENERGY STAR qualified. The system power train shall be comprised of swappable 10kW/10kVA power modules, which shall operate in parallel, and be configured for N+1 redundant operation at rated load. Each 10kVA/10kW power module contains a full rated input rectifier / boost converter (hereafter referred to as Input Converter), full rated output inverter, and 10% battery charging circuit. The system shall also comprise of a user-replaceable continuous duty bypass static switch module, swappable battery modules, redundant control modules, redundant logic power supplies, and LCD interface display. System static switch shall be capable of being fed from the same input as the rectifier or a separate input. All of the above system components are housed in two standard, 24 inch wide, 36 inch deep, 42U high equipment racks.
- C. In addition, this specification describes the performance, functionality, and design of the UPS Maintenance Bypass Cabinet and power distribution section of the UPS. In addition this specification also includes multi-conductor overhead

distribution, rack level power management products, the Battery System, and connectivity solutions including complete InfraStruXure™ system management solutions.

- D. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution section to provide quality uninterrupted power and distribution for mission critical, electronic equipment load. The entire system shall bear the UL60950 listing as a complete product solution.
- E. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the System.

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. **Underwriters Laboratories, Inc. (UL):**
 - 1. UL 1778 Uninterruptible Power Supply Equipment
 - 2. UL60950 Information Technology Equipment
- C. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
 - 1. IEEE 519-1992 Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.
- D. **International Organization for Standardization (ISO):**
 - 1. ISO 9001
 - 2. ISO 14001
- E. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees:
 - 1. NFPA- National Fire Protection Associations
 - 2. NEMA - National Electrical Manufacturers Association
 - 3. OSHA - Occupational Safety and Health Administration

1.3 SUBMITTALS

- A. Product data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
 - 1. 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.

1.4 DESIGN REQUIREMENTS

- A. The UPS shall be sized for _____ kVA and _____ kW load.
- A. The UPS battery shall be sized for _____ at a Power Factor of _____ for _____ minutes.

1.5 SYSTEM CHARACTERISTICS

- A. System Capacity: The system shall be rated for full kW output in the following frame sizes:
 1. 20 kVA/kW - Can be configured with up to (3), 10kW power modules for N+1.

- B. Input:
 1. AC Input Nominal Voltage: 208 V, 3 Phase, 4 wire, 50/60 Hz.
 2. AC Input Voltage Window: +/- 15% of nominal (while providing nominal charging to the battery system).
 3. Short Circuit Withstand Rating: 30,000 Symmetrical Amperes
 4. Maximum Frequency Range: 40-70Hz
 5. Input Power Factor:
 - a. > .96 at 50% load
 - b. > .99 at 100% load

6. Input Current Distortion *with no additional filters*:
 - a. < 6% at 100% load
 - b. < 6% at 50% load
7. Soft-Start: Shall be linear from 0-100% input current and shall not exhibit inrush. This shall take place over a 15 second time period

C. UPS Output:

1. AC Output Nominal Voltage: 208V, 3 Phase, 4 wire, 60 Hz.
2. AC Output Voltage Distortion: Max. 3% @ 100% Linear Load.
3. AC Output Voltage Regulation: +/- 1% For 100 % Linear or Nonlinear Load
4. Voltage Transient Response: +/- 5% maximum for 100% load step
5. Voltage Transient Recovery within <60 milliseconds
6. Output Voltage Harmonic Distortion:
 - a. <2% THD maximum and 1% single harmonic for a 100% linear load
 - b. <5% THD maximum for a 100% non-linear load
7. Phase Angle Displacement:
 - a. 120 degrees +/- 1 degree for balanced load
 - b. 120 degrees +/- 1 degrees for 50% imbalanced load
 - c. 120 degrees +/- 3 degrees for 100% imbalanced load
8. Overload Rating:
 - a. Normal Operation:
 - 1) 150% for 30 seconds
 - 2) <105% continuous
 - b. Bypass Operation:
 - 1) 100% continuous
 - 2) 1000% for 500 milliseconds
9. System AC-AC Efficiency: >94% from 50% to 100% load in double-conversion mode. ENERGY STAR qualified.
10. Output Power Factor Rating: The UPS output shall not require derating for purely resistive loads (PF of 1). The output kW and kVA ratings of the UPS shall be equal. For loads exhibiting a power factor of 0.9 leading to 0.8 lagging no derating of the UPS shall be required.

1.6 SUBMITTALS

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 - 1. As bid system bill of materials
 - 2. Product catalog sheets or equipment brochures
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 - 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.

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 - 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.

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. **Basis of Design:** Product specified is "APC Symmetra PX 20 kW" as manufactured by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 UPS 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 the AC input source, 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 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 to electrically isolate the UPS during routine maintenance and service of the UPS. The maintenance bypass shall completely isolate both the UPS input and output connections.

2.3 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

2.4 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.

2.5 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:** -15 to 40 °C (5 to 104 °F)
 - 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:** 25% to 85% non-condensing
 - d. **Altitude:** Maximum installation with no derating of the UPS output shall be 10,000ft (3000m) above sea level.

2.6 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

2.7 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.

2.8 INPUT POWER CONVERTER

- A. The input power converters of the system are housed within the parallel connected, 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 THD_i shall be held to 6% or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.
- C. Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100% of the nominal input over a default 15 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. ($di/dt = \text{constant}$)
- D. Magnetization Inrush Current: The UPS shall exhibit 0% inrush current.
- E. Input Current Limit:
 - 1. The input converter shall control and limit the input current draw from utility to 150% of the 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 of up to +/15% of the nominal input voltage.
 - 2. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 126% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

- B. Redundancy: The UPS shall be configured with redundant input converters, each with semiconductor fusing, and logic controlled contactors to remove a failed module from the input bus.
- C. Charging:
 1. The battery charging shall keep the DC bus float voltage of +/- 220v, +/- 1%
 2. The battery charging circuit shall contain a temperature compensation circuit, which will regulate the battery charging to optimize battery life.
 3. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.
- D. Back-feed Protection: The above-mentioned logic controlled contactor also provides the back-feed protection required by UL1778.

2.9 OUTPUT INVERTER

- A. The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT 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 recreated output voltage sine wave delivered by the output inverters.
- B. Overload Capability: The output power converters shall be capable of 300% for short-circuit clearing. 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 will 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 removed 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 configured with redundant output inverters, each with semiconductor fusing, and logic controlled contactors to remove a failed component from the critical bus.

2.10 STATIC BYPASS

- A. As part of the UPS, a system static bypass switch 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 can not 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. 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 bus output 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 rated and 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 500 milliseconds.
- F. Modularity: The static bypass switch shall be of a modular design.
- G. System Protection:

As a requirement of UL1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed 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 back-feeding 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.

2.11 DISPLAY AND CONTROLS

- A. Control Logic: The UPS shall be controlled by two fully redundant, swappable control modules. 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 the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

C. Metered Data: The following metered 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
7. Internal Battery temperature

D. Event log: The display unit shall allow the user to display a time and date stamped log of the 64 most recent status and alarm events.

E. Alarms: The display unit shall allow the user to display a log of all 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 Temp 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 is installed and failed
29. Redundant Intelligence Module is installed and failed
30. Redundancy has been lost
31. Redundancy is below alarm threshold
32. Runtime is below alarm threshold
33. Load is above alarm threshold
34. Load is no longer above alarm Threshold
35. Minimum Runtime restored
36. Bypass is 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. Q001 open/closed
44. Q002 open/closed
45. Q003 open/closed
46. High DC Warning
47. High DC Shutdown
48. Low Battery Shutdown
49. Low Battery Warning

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

1. Silence audible Alarm
2. Set the alphanumeric display language
3. Display or set the date and time
4. Enable or disable the automatic restart feature
5. Transfer critical load to and from static bypass
6. Test battery condition on demand
7. Set intervals for automatic battery tests
8. Adjust set points for different alarms
9. Program the parameters for remote shutdown.

G. Potential Free (Dry) Contacts

1. The following potential free contacts shall be available on an optional relay interface board:
 - a. Normal Operation

- b. Battery Operation
- c. Bypass Operation
- d. Common Fault
- e. Low Battery
- f. UPS Off

H. Communication Interface Board: A communication interface board shall provide the following communication ports which can be used simultaneously:

1. RS232 Serial Port #1
2. RJ-45 Interface port for a Remote Display

2.12 BATTERY

- A. The UPS battery shall be of modular construction made up of swappable, fused, battery modules. 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 that a failed or weak battery module is found.

2.13 BATTERY DISCONNECT BREAKER

- A. Each UPS system shall have a 250 VDC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped shunt trip mechanisms and 1A/1B auxiliary contacts. The circuit breakers are to be located within the UPS cabinet or as part of a line-up-and-match type battery cabinet.

2.14 MAINTENANCE BYPASS

- A. The UPS cabinet shall include an integrated three-switch maintenance bypass. The maintenance bypass shall provide power to the critical load from the bypass source, during times where maintenance or service of the UPS is required. The PDU/System bypass shall provide a mechanical means of complete isolation of the UPS from the critical output distribution.

2.15 OUTPUT DISTRIBUTION PANEL

- A. Each UPS cabinet shall include one 39 pole, 3-phase distribution panel. The distribution panel shall provide a means to install breakers and branch circuit conductors to power the connected critical load. Overhead distribution conductors like discussed in Section 3.7 may be connected to the distribution panel at the factory to provide a complete tested distribution system. Various breaker options may be factory installed and fully tested before shipment to site.

PART 3 - ACCESSORIES

3.1 MODULAR BATTERY SOLUTIONS

- A. Modular battery cabinets shall be available for increased reserve battery runtime. For ease of maintenance the modular battery cabinets, shall house draw-out battery cartridges. These cartridges shall conform to OSHA lifting requirements for one person to replace battery cartridges without lifting tools or additional mechanisms. Battery cartridges shall interlock in place within the battery cabinet to ensure proper contact. When withdrawing a battery cartridge, a catch shall stop the battery cartridge from inadvertently being withdrawn in an unsafe manner. The Extended Run Battery solution shall be housed in a standard, 24 inch wide, 36 inch deep, 42U high equipment racks. Up to (3) modular battery cabinets may be added for increased battery runtime.

3.2 OVERHEAD DISTRIBUTION

- A. Flexible Distribution Conductors - For purposes of overhead distribution wiring of datacenter branch circuits from the output distribution panel, flexible conductors of either an SJO type, or TC type shall be available as a distribution means. Flexible conductors shall be equipped with NEMA or IEC style cord caps and shall be agency approved under UL60950 as part of the InfraStruxure™ system.

3.3 FLOOR ANCHORING BRACKETS

- A. Floor Anchor brackets shall be available to solidly connect the UPS cabinet to the floor to minimize unintended moving of the equipment.

3.4 SOFTWARE AND CONNECTIVITY

- A. **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.

- B. **Unattended Shutdown:** The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems.
- C. **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.

3.5 SOFTWARE COMPATIBILITY

- A. 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 for:
 - 1. Windows
 - 2. Hyper-V
 - 3. VMware
 - 4. Linux
 - 5. Unix
 - 6. Mac OS X

The full and updated supported OS compatibility chart can be found here:
<http://www.apc.com/whitepaper/?um=200>

3.6 **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.

- A. **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.
- B. **Monitored Values:** Data Center Expert shall be capable of monitoring alarms, general status parameters, voltage and current of the PDU.
- C. **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.
- D. **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.

PART 4 - EXECUTION

4.1 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

4.2 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.

4.3 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.

4.4 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.

4.5 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