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) and optional 40kVA InfraStruxure Power Distribution Unit with maintenance bypass 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, static 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/kVA power modules, which shall operate in parallel, and shall be configured for N+1 redundant operation at rated load. Each 10 kVA/10 kW power module shall contain a full rated input rectifier/boost converter (hereafter referred to as input converter), full rated output inverter, and 10 percent battery charging circuit. The system shall also be comprised of a swappable continuous duty bypass static switch module, swappable battery modules, redundant control modules, redundant logic power supplies, and LCD interface display. All of the above system components shall be housed in two standard, 24 inch (610 mm) wide, 36 inch (914 mm) deep, 42U high equipment racks.

1. In addition, this Section describes the performance, functionality, and design of the UPS maintenance bypass cabinet and power distribution unit, hereafter referred to as the PDU/system bypass. In addition this Section also includes, but shall not be limited to, multi-conductor overhead distribution, rack level power management products, the battery system, and connectivity solutions, including, but not limited to, complete system management solutions.

2. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power and distribution for mission critical, electronic equipment load. The entire system shall bear the UL 60950 listing as a complete product solution.

3. All programming and miscellaneous components for a fully operational system as described in this Section 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. **Electronic Industries Association (EIA):**
   1. EIA 310, "Racks, Panels, and Associated Equipment" (copyrighted by EIA, ANSI approved).

C. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

D. **International Organization for Standardization (ISO):**
   1. ISO 9001, "Quality Management Systems - Requirements."
   2. ISO 14001, "Environmental Management Systems - Requirements With Guidance for Use."

E. **Underwriters Laboratories, Inc. (UL):**
   1. UL 891, "Standard for Dead-Front Switchboards" (copyrighted by UL, ANSI approved).
   3. UL 60950, "Standard for Information Technology Equipment."

1.3 **SYSTEM DESCRIPTION**

A. **Design Requirements:**
   1. The UPS shall be sized for [____] kVA and [____] kW load.

   INSERT APPLICABLE VALUES IN SUBPARAGRAPHS ABOVE AND BELOW.

   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. 40 kVA/kW, can be configured with up to five 10 kW power modules for N+1.
   2. **Input:**
      a. **AC Input Nominal Voltage:** 208 volts three-phase, 4 wires, 60 hertz.
      b. **AC Input Voltage Window:** ±15 percent of nominal (while providing nominal charging to the battery system).
      c. **Short Circuit Withstand Rating:** 30,000 symmetrical amperes.
      d. **Maximum Frequency Range:** 40 hertz to 70 hertz.
      e. **Input Power Factor:**
         1) Greater than 0.96 at 50 percent load.
         2) Greater than 0.99 at 100 percent load.
      f. **Input Current Distortion With No Additional Filters:**
         1) Less than 6 percent at 100 percent load.
         2) Less than 6 percent at 50 percent load.
      g. **Soft Start:** Shall be linear from 0 percent to 100 percent input current and shall not exhibit inrush. This shall take place over a 15 second time period.
   3. **UPS Output:**
      a. **AC Output Nominal Output:** 208 volts, three-phase, 4 wires, 60 hertz.
      b. **AC Output Voltage Distortion:** Maximum 3 percent at 100 percent linear load.
      c. **AC Output Voltage Regulation:** ±1 percent for 100 percent linear or non-linear load.
      d. **Voltage Transient Response:** ±5 percent maximum for 100 percent load step.
      e. **Voltage Transient Recovery:** Within less than 60 milliseconds.
      f. **Output Voltage Harmonic Distortion:**
         1) Less than 2 percent THD maximum and 1 percent single harmonic for a 100 percent linear load.
2) Less than 5 percent THD maximum for a 100 percent non-linear load.

g. **Overload Rating:**
1) **Normal Operation:**
   a) 150 percent for 30 seconds.
   b) Up to 105 percent.

2) **Bypass Operation:**
   a) 100 percent continuous.
   b) 1000 percent for 500 milliseconds.

h. **System AC-AC Efficiency:** Greater than 94% from 50% to 100% load in double-conversion mode. ENERGY STAR qualified.

i. **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 output 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.

### 1.4 SUBMITTALS

A. **General:** See [Section 01 33 00 - SUBMITTAL PROCEDURES] [Section 01300 - SUBMITTALS].

B. **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.

C. **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.

D. **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.

E. **Operation and Maintenance Data:** Submit operation and maintenance data to include in operation and maintenance manuals specified in [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], including, but not limited to, safe and correct operation of UPS functions.
   1. 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.
   3. Submit project record equipment drawings.

### 1.5 QUALITY ASSURANCE

A. **Qualifications:**
   1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of static UPSs 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 static UPSs 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
      b. UL 891
      c. UL 60950
   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. ANSI/IEEE 519
      e. ISO 9001
      f. ISO 14001
      g. ENERGY STAR

C. **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.

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 static UPS PDU’s 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**: -40 °F (-40 °C) to 158 °F (70 °C).
      b. **Operating Ambient Temperature**: 32 °F (0 °C) to 104 °F (40 °C) (77 °F [25 °C] shall be ideal for most battery types).
      c. **Relative Humidity**: 0 percent to 95 percent non-condensing.
      d. **Altitude**: Maximum installation with no derating of the UPS output shall be 10,000 feet (3048 m) above sea level.

1.8 **WARRANTY**
A. **General:** See [Section 01 77 00 - CLOSEOUT PROCEDURES] [Section 01770 - CLOSEOUT PROCEDURES].

B. **Special Warranty:** The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for period indicated below. This special warranty shall extend the one year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the Installer and the manufacturer.
   1. 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.

1.9 **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 InfraStruXure for Medium Data Centers, 40 kW Base Building Block; 10 kW - 40 kW UPS” 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 enclosure to electrically isolate the UPS during routine maintenance and
service of the UPS. The maintenance bypass enclosure shall completely isolate both the UPS input and output connections.

2.3 INPUT POWER CONVERTER

A. General: The input power converters of the system shall be 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 THDI shall be held to 6 percent 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 percent to 100 percent 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 = constant).

D. Magnetization Inrush Current: The UPS shall exhibit 0 inrush current as a standard product. If provided with an optional isolation transformer or PDU/system bypass, system inrush shall be limited to six 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 150 percent of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100 percent load, charge batteries at 10 percent of the UPS output rating, and provide voltage regulation with mains deviation of up to ±15 percent 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 percent of UPS capacity, input current shall not exceed 126 percent of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

F. 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.

G. Charging:
   1. The battery charging shall keep the DC bus float voltage of ±220 volts, ±1 percent.
   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.

H. Back-Feed Protection: The above mentioned logic-controlled contactor shall also provide the back-feed protection required by UL 1778.

2.4 OUTPUT INVERTER

A. General: 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 percent for short circuit clearing. Steady state overload conditions, of up to 150 percent 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 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 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. **Design:** The design of the static switch power path shall consist of silicon-controlled rectifiers (SCR) with a continuous duty rating of 125 percent 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 rated and capable of handling overloads equal to or less than 125 percent 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 percent of system capacity for periods of up to 500 milliseconds.

F. **Modular:** The static bypass switch shall be of a modular design.

G. **System Protection:** As a requirement of UL 1778, 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.

2.6 **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.
   7. Internal battery temperature.

D. **Event Log:** The display unit shall allow the Owner 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 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. 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. Bad battery module.
   26. Bad power module.
   27. Intelligence module is installed and failed.
   28. Redundant intelligence module is installed and failed.
   29. Redundancy has been lost.
   30. Redundancy is below alarm threshold.
   31. Runtime is below alarm threshold.
   32. Load is above alarm threshold.
   33. Load is no longer above alarm threshold.
   34. Minimum runtime restored.
   35. Bypass is not in range (either frequency or voltage).
   36. UPS in bypass due to internal fault.
37. UPS in bypass due to overload.
38. System in forced bypass.
39. Fault, bypass relay malfunction.
40. Q001 open/closed.
41. Q002 open/closed.
42. Q003 open/closed.
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. 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:** The following potential free contacts shall be available on an optional relay interface board:

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

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

1. RS-232 serial port #1.
2. RJ-45 interface port for a remote display.

### 2.7 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 Owner in the event that a failed or weak battery module is found.

D. As a standard product offering, the UPS shall be capable of delivering 4.5 minutes of back-up (at 40 kW) with battery cartridges located internal to the UPS. This option shall not cause any increase to the UPS footprint.

### 2.8 ACCESSORIES

A. **Battery Disconnect Breaker:** Each UPS system shall have a 250 volt DC 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 shall be located within the UPS cabinet or as part of a line-up-and-match type battery cabinet.

B. **PDU/System Bypass:**
   1. The PDU/system bypass cabinet 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. The PDU/system bypass shall be constructed in a standard 24 inch (610 mm) wide 36 inch (914 mm) deep, 42U High, IT rack style cabinet.
   2. As a minimum, the PDU/system bypass shall contain the following features and accessories:
      a. Appropriately rated circuit breakers to fully isolate the UPS during times where maintenance is required. As a part of this design there shall be a UPS input circuit breaker designated as Q1, a UPS output circuit breaker designated as Q2, and a wrap-around maintenance bypass circuit breaker designated as Q3. For PDU/system bypass panels equipped with an input transformer, there shall also be a molded case switch to isolate the transformer primary windings from the mains input to the system. Minimum 1A/1B auxiliary contacts for the purpose of relaying status information of each circuit breaker/switch actuator to the UPS and PDU/system bypass shall be provided, along with a means of locking out the circuit breakers to inhibit operation of the bypass transfer pair. The PDU/system bypass shall be available for a 208 volt, 480 volt, or 600 volt input.
      b. Also included in the PDU/system bypass shall be two 42 pole distribution panelboards connected to the output bus of the PDU/system bypass to serve as critical load distribution.
      c. For purposes of providing local annunciation of status and alarm messages, the PDU/system bypass shall have an alphanumeric display with pushbutton switches, allowing retrieval of active alarms, system level programming, and event history of the PDU/system bypass. For purposes of simplicity and ease of use, the PDU/system bypass display shall be identical in nature to that of the Symmetra PX 40 kW UPS.
      d. The PDU/system bypass shall also have a full length hinged front door, with locking mechanism; to allow access to the two 42 pole panelboard circuit breakers and three breaker type maintenance bypass circuit breakers. There shall also be a hinged rear door to allow access to the main input circuit breaker.
      e. The PDU/system bypass shall bear a full mimic diagram inside the hinged front door. Also associated with the mimic panel shall be indicating lights, capable of depicting proper operation of maintenance bypass circuit breaker and UPS output circuit breaker.
   3. The following minimum options shall also be available for the PDU/system bypass:
      a. For ease of load bank testing the system, a pin-and-sleeve cam lock type load bank test port shall be available to allow use of a portable load bank to be connected to the system, without having to remove deadfronts or gain access to live bus work or circuit breakers. A load bank shall be available with a properly configured connector on flexible cord to facilitate ease of use.
      b. Each pole of each circuit breaker shall be monitored, and report the load current drawn on each circuit breaker pole to a common infrastructure management system. Values metered by branch circuit monitoring shall be available through a web-based browsing system and shall be incorporated into the same monitoring system as the other components within this Section.

C. **Modular Battery Solutions:** For purposes of providing extended UPS back-up power, modular battery cabinets shall be available. For ease of maintenance the modular battery cabinet 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 modular battery solution shall be housed in a standard, 24 inch (610 mm) wide, 36 inch (914 mm) deep, 42U high equipment racks. Up to four modular battery cabinets may be added for increased battery runtime.

D. **Rack Mount Power Distribution Units:** For purposes of distributing power within an IT cabinet, rack mount power distribution units shall be available for installation within the IT cabinet. The rack
mount power distribution units shall be capable of being installed in the back of the accompanying cabinet to consume zero U-space in the front of the rack, and shall not require tools for installation within the rack.

1. **Input Connection:** For ease of installation, the rack mount PDU shall be connected via a twist lock connector, and shall be capable of being fed from agency-approved flexible cored distribution wiring as described elsewhere in this Section. The input shall be capable of being served by 208Y120 volts from an L21-20 Type NEMA connector.
   a. A hard-wired version of the product shall also be available as an option and shall be capable of being fed from a three-pole 20 ampere circuit breaker.

2. **Output Connections:** The output of the rack mount PDU shall be fed from 208Y120 volts, and shall be distributed to receptacles capable of supplying power to cord-connected equipment. Assuming rack mount PDU is fed from a circuit breaker with an 80 percent continuous rating, a single rack mount PDU shall be capable of distributing up to 5.7 kW in a single rack.

3. **Options:**
   a. **Phase Metering:** The current of each input phase of the rack mount PDU shall be monitored, displayed locally on an illuminated seven segment display, and reported through a built-in web/SNMP interface.
   b. **Outlet Management:** The outlets of the rack mount PDU shall have managed switched capability as an option. The current of each input phase of the rack mount PDU shall be monitored, displayed locally on an illuminated seven segment display, and reported through a built-in web/SNMP interface. The web/SNMP interface shall also be used to manage and control the outlet receptacles.

E. **Overhead Distribution:**
   1. **Flexible Distribution Conductors:** For purposes of overhead distribution wiring of data center branch circuits, 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 UL 60950 as part of the system.
   2. **Cable Ladder:** For purposes of routing data and power cables between rows in a data center aisle layout, cable ladders shall be available to span the gap between rows. Cable ladders shall be agency-approved under UL 60950 as part of the system. The use of overhead cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in data centers not utilizing raised floor. Optional covers shall be available for ladders as a means of adhering to local codes requiring such.
   3. **Cable Trough:** For purposes of routing data and power cable along the length of a row of IT cabinets in a data center environment, cable troughs shall be available as a means of separating and housing data and power cable. Optional covers shall be available for troughs as a means of adhering to local codes requiring such. The use of overhead cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in data centers not utilizing raised floor.

F. **Remote Power Panel (RPP):** For purposes of wiring convenience, remote power panels (RPP) shall be available to take a single feed from the PDU/system bypass output, and distribute power to the critical load. A total of two 42 pole panelboards shall be housed in the RPP to distribute a combination of single-phase and three-phase load equipment.
   1. **Branch Circuit Monitoring:** Branch circuit monitoring shall be available as outlined elsewhere in this Section.
   2. **System Manager:** RPP shall be fully compatible with system manager, management system as outlined elsewhere in this Section.
G. **Information Technology (IT) Cabinet:** IT cabinets shall be available for housing of Owner-supplied IT equipment. Cabinets shall be listed under the same UL 60950 agency approval as other products outlined within this Section.

1. **General Requirements:**
   a. The cabinet shall be designed to provide a secure, managed environment for computer and networking equipment.
   b. The cabinet shall conform to EIA 310 and accommodate industry standard 19 inch (483 mm) rack mount equipment.
   c. The cabinet shall be designed with four vertical posts to allow rack mount equipment installation utilizing four vertical mounting rails.
   d. The cabinet shall be available with a vertical equipment mounting space of 25U, 42U, or 47U. (1U=1.75 inch [44.45 mm])
   e. A four-post open frame configuration shall be available with 42U vertical equipment mounting space.

2. **Physical Requirements:**
   a. External width dimensions shall be 23.5 inches (597 mm) for 19 inch (483 mm) rack cabinets, and 29.4 inches (747 mm) for 23 inch (584 mm) rack cabinet.
   b. External depth dimensions shall be 35.4 inches (900 mm) or 42.2 inches (1070 mm).
   c. Rack cabinets of a 42U design shall have a maximum external height of 81.5 inches (2070 mm) to allow passage through a standard 7 foot (2134 mm) doorway without tipping.
   d. Rack cabinet shall support a dynamic load (rolling on castors) of 2000 lbs (909 kg) total weight.
   e. Rack cabinet shall also be designed and manufactured to be matching in both color and construction to the UPS, PDU/system bypass and modular battery cabinet to provide a uniform and consistent appearance in a data center environment.

3. **Equipment Access and Mounting:**
   a. The cabinet shall provide 25U, 42U, or 47U of equipment vertical mounting space.
   b. The vertical mounting rails shall be adjustable to allow different mounting depths.
   c. Front and rear doors of the cabinet shall be designed with quick release hinges allowing for easy detachment without the use of tools.

H. **Floor Anchor Brackets:** Floor anchor brackets shall be available to solidly connect UPS, PDU/system bypass, and battery cabinet to minimize unintended moving of the equipment.

I. **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.

J. **Remote System Monitoring:** The following three 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. **RS-232 Monitoring:** Remote UPS monitoring shall be possible via either RS-232 or contact closure signals from the UPS.
3. **Simple Network Management Protocol (SNMP):** Remote UPS monitoring shall be possible through a standard MIB II compliant platform.

1.1 **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 for:

   A. Windows
B. Hyper-V  
C. VMware  
D. Linux  
E. Unix  
F. Mac OS X  
The full and updated supported OS compatibility chart can be found here:  
http://www.apc.com/whitepaper/?um=200  

K. **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.  

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

B. **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.

B. **UPS Training Workshop:** A UPS training workshop shall be available from the UPS manufacturer. The training workshop shall include, but shall not be limited to, a combination of lecture and practical instruction with hands-on laboratory sessions. The training workshop shall include, but shall not be limited to, instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls, adjustments, preventative maintenance, and troubleshooting.
3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the Installer, which shall ensure that the static UPSs shall be without damage at time of Substantial Completion.

END OF SECTION