

Eaton Data Center Power System using BladeUPS 12kW to 60kW (N+1) UPS

**GUIDE SPECIFICATIONS FOR
12kW-60kW (N+1) UPS & Power Distribution System 400VAC**

PART 1 GENERAL UPS

1.0 SUMMARY UPS

1.01 This specification describes the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power Supply (UPS) hereafter referred to as the UPS. All UPS systems shall be capable of being deployed in an N+1 redundant, scalable architecture. This UPS can be initially deployed as a single stand-alone (SA) UPS or installed with other like systems in a standard 19" four post IT enclosure for parallel capacity (PC) power applications from 12 to 60 kW, or installed with other like systems in a standard 19" four post IT enclosure for parallel redundant (PR) power applications from 12 to 60 kW (N+1). Any system deployment shall comprise of hot swappable / user replaceable 12 kVA/12 kW electronics modules. Each replaceable 12 kVA/12 kW electronics module contains individual UPS system logic controls, a power factor corrected input power converter/rectifier, PWM inverter, continuous duty bypass static switch module and battery charging circuit. Each 12 kW system shall also comprise of hot swappable / user replaceable battery modules, individual user replaceable LCD interface display, intelligent automated maintenance bypass contactor, battery breaker, individual system input breaker, and output distribution breaker. Each 12 kW module shall contain two battery strings in parallel enhancing system reliability. The system shall be designed that all modules in parallel will all equally support the individual output distribution breakers and receptacle used to connect to independent output distribution modules (Rack Power Module).

- A. The UPS shall consist of the following pieces, as required by the project;
- B. UPS module(s) with internal battery and internal automated maintenance bypass
- C. Extended battery runtime modules
- D. Paralleling power bus system located in a typical IT enclosure
- E. Rack mountable power distribution modules
- F. Rack mounted three (3) breaker maintenance bypass, 6U high
- G. Battery connection box for customer supplied external batteries, (400V systems ONLY)
- H. Paralleling bus bar system and wireway designed for mounting in existing IT rack
- I. Ceiling mounted power distribution busway with user replaceable receptacle options
- J. Floor standing IT rack matching power distribution rack (PDR)
- K. Other features as described in this specification.

- (1) UPS modules, extended battery modules, rack mounted power distribution modules and power distribution units, shall be capable of installation in any EIA-310-D, or EIA-310-E four post 19 inch IT enclosure, with minimum depth of 765mm (30 inches).
- (2) The paralleling power bus option can be ordered pre-installed in one EIA-310-D four post 19 inch, 600mm (24 inch) wide, 42U high equipment enclosure with a depth of 1070mm or 42 inches. The 6U electrical connection wireway can be specified to be installed in the bottom or top of the IT enclosure

- L. In addition, this specification describes the following:
 - (1) Automated UPS maintenance bypass system and its operation with the rack mounted power distribution unit, hereafter referred to as the RPM or Rack Power Module.
 - (2) Parallel bus bar kit for installation in a standard EIA-310-D (E) enclosure.
 - (3) Rack level power management and distribution products.
 - (4) Software and connectivity solutions for integrating power system information into building or facility monitoring requirements.
- M. 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 loads.
- N. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the System.

2.0 STANDARDS

- A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States.
- B. CSA C22.2 No 107.1(Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.
- C. IEC 62040-1-1 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.
- D. IEC 62040-1-2 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.
- E. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
- F. CISPR 22: FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices.
- G. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees
 - (1) IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
 - (2) NFPA 70E®: Standard for Electrical Safety in the Workplace®
 - (3) NEMA - National Electrical Manufacturers Association
 - (4) OSHA - Occupational Safety and Health Administration

- (5) MIL-HDBK-217E (Military Handbook) – Reliability prediction of electronics equipment
- (6) IEEE 519-1992 Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.
- (7) ISO 9001
- (8) ISO 14001

3.0 UPS MODES OF OPERATION

- A. Standard: Power strategy set for High Efficiency: Utilizing commercial AC power, the critical load shall be continuously supplied regulated and protected AC power. The system shall power the load while regulating both voltage and frequency in compliance with the UPS output specifications (Section 2.2C). The system shall derive power from the commercial AC source if the input source is within the specifications for the UPS input. Upon loss of AC power or an event where the input AC source is not is tolerance the UPS shall supply DC power to the Inverter which will supply an output voltage in compliance with the output voltage specifications. System efficiency will be 98% or better for loads exceeding 70%, 97% or greater, over the range of 40% to 70% load. System efficiency will be 95% or better from 20 to 40% load. The UPS shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption. When High Efficiency is utilized, the UPS must perform per the IEC 61000-4-4 level 2 fast transient and IEC 61000-4-5 level 3 surge specifications. During standard operation the AC source shall provide power for the loads in conjunction with charging the battery.
- B. Normal: Power strategy set for Normal: Utilizing commercial AC power, the critical load shall be continuously supplied regulated and protected AC power. The system shall power the load while regulating both voltage and frequency in compliance with the UPS output specifications (Section 2.2C). The system shall operate in double conversion mode of operation unless forced or commanded to battery mode, bypass mode, high efficiency mode or system off. The system shall derive power from the commercial AC source and shall supply DC power to the Inverter in conjunction with charging the battery. All systems shall be capable of changing between normal and high efficiency modes from the front panel of the UPS system. All parallel connected systems shall change modes together, needing only one of the parallel connected modules to be programmed. There shall be no time restraints for normal mode operation.
- C. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied AC power by the system, which shall obtain power from the batteries without any operator intervention. Continuous operation of the critical load shall never be jeopardized during the failure or restoration of the commercial AC source.
- D. Charger: Upon restoration of the commercial AC or back-up generation source, the charger shall recharge the batteries and simultaneously supply power to the input power converter (rectifier) which provides power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.

- E. Static Bypass: Each UPS power module shall incorporate a continuous duty static bypass to provide transfer of critical load from the inverter output to the bypass source. This transfer, along with its retransfer, shall have no effect on the operation of the critical load. In the event of an emergency or severe overload on the UPS output, this transfer shall be an automatic function.
- F. Maintenance Bypass: Each UPS module shall be equipped with an intelligent automated internal make-before-break maintenance bypass to isolate the UPS during routine maintenance and service of the UPS electronics or battery modules. The maintenance bypass shall be powered by a separate power supply, not part of the removable electronics module.

4.0 SUBMITTALS

4.01 Proposal Submittals:

- A. Bid requirement bill of materials.
- B. Product catalog sheets or equipment brochures.
- C. Product guide specifications.
- D. System single-line operation diagram.
- E. Installation information, including weights and dimensions.
- F. Information about terminal locations for power and control connections.
- G. Drawings and details for requested optional accessories.

4.02 Delivery Submittals:

- A. Installation and user manual including:
 - (1) Instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
 - (2) Instructions for operating the system
- B. Equipment drawings
 - (1) Interconnection Drawings
 - (2) Battery Wiring Diagram
 - (3) UPS One-Line Drawings
 - (4) Equipment Outline Drawings
 - (5) Accessory Wiring Diagrams

5.0 PRODUCT

5.01 DESIGN REQUIREMENTS

- A. The UPS shall be sized for _____ kW / _____ kVA load (12/12, 24/24, 36/36, 48/48, 60/60 please select one)
- B. The UPS system (shall/shall not) have N+1 redundancy.
- C. The UPS battery shall be sized for _____ minutes runtime at a Power Factor of _____ for a _____ kW load.

5.02 SYSTEM CHARACTERISTICS

A. System Capacity: The system shall be rated for full kW output in the following configurations

- (1) 12 kW/kVA – using one (1) 12kW UPS system
- (2) 12 kW/kVA (N+1) – using two (2) 12kW UPS systems
- (3) 24 kW/kVA - using two (2) 12kW UPS systems
- (4) 24 kW/kVA (N+1) – using three (3) 12kW UPS systems
- (5) 36 kW/kVA - using three (3) 12kW UPS systems
- (6) 36 kW/kVA (N+1) – using four (4) 12kW UPS systems
- (7) 48 kW/kVA - using four (4) 12kW UPS systems
- (8) 48 kW/kVA (N+1) – using five (5) 12kW UPS systems
- (9) 60kW/kVA - using five (5) 12kW UPS systems
- (10) 60 kW/kVA (N+1) – using six (6) 12kW UPS systems

B. When power strategy is set for Normal, all systems will support up to 12 kVA/12 kW of connected load. All N+1 configurations will include fully isolated and redundant logic controls, electronics modules, battery systems, battery breakers, static switch assemblies, and automatic maintenance bypass.

(1) Input Specifications:

- a. AC Input nominal voltage: 400Y/230V, 3 Phase, 4 wire plus ground 50 or 60 Hz.
- b. AC Input Voltage Window (range before re-transfer from battery):
 - i. System loading less than 93% or 11kW per 12 kW module: 168 to 289vac, line to neutral, (-27/+27%), without using stored energy mode.
 - ii. System loading greater than 93% or 11 kW per module: 184 to 289vac, line to neutral, (-20/+27%) without using stored energy mode.
 - iii. “Transfer to battery” window is typically 3 to 5% more that re-transfer from battery to compensate for hysteresis.
- c. Maximum Frequency Range: (automatically set upon start-up)
 - i. 60 Hz operation: 55-65 Hz before switching to battery operation
 - ii. 50 Hz operation: 45 to 55 Hz before switching to battery operation
- d. Input Power Factor:
 - i. While operating in High Efficiency: > .97 with fully loaded active PFC IT loads (load dependent)
 - ii. While operating in Normal: > .99 operating at full load from IGBT based input power converter (load independent)
- e. Input Current Distortion (*with no additional passive filter*)
 - i. While operating in HE: < 10% typical with fully loaded active power factor corrected (PFC) IT loads (load dependant)
 - ii. While operating in Normal: < 5% operating at full load from UPS input power converter, with PFC or Non-PFC loads.

- f. Current inrush: No transformer magnetizing inrush in standard UPS
 - i. From start or retransfer from battery: Shall not exceed connected load inrush
 - ii. For parallel systems: Staggered transfer from battery: Upon retransfer from battery each UPS module shall delay transfer to the incoming source for a minimum of 500ms (1/2 second) from the retransfer of the prior UPS module on the same parallel bus.

(2) Output Specifications:

- a. AC Output: 400Y/230V, 3 Phase, 4 wire plus ground, 50 or 60 Hz.
- b. AC Output Voltage Distortion: Max. 3% @ 100% Linear Load.
- c. AC Output Voltage Window:
 - i. 207 vac to 253 vac L to L (+/- 10%)
- d. Voltage Transient Response:
 - i. HE operation: Dependant upon input mains source, however typically maintains voltage within output specification window with +/- 1% maximum deviation for 0-100% or 100% to 0 load step
 - ii. Normal operation: +/- 6% RMS maximum for 0-100% or 100% to 0 load step in conjunction with typical output voltage window
 - iii. Reserve energy mode: +/- 6% RMS maximum for 0-100% or 100% to 0 load step in conjunction with typical output voltage window
- e. Voltage Transient Recovery to normal output voltage regulation window within <50 milliseconds
- f. Static transfer duration
 - i. With mode set to high efficiency: typical 2-3 ms
 - ii. With mode set to normal: 0 ms
- g. Output Voltage Harmonic Distortion: Stored energy or inverter operation
 - i. <3% THD maximum and 1% single harmonic for a 100% linear load
 - ii. <5% THD maximum for non-linear load as described in IEC 62040-3
- h. Phase Angle Displacement:
 - i. 120 degrees +/- .1 degree for balanced load
 - ii. 120 degrees +/- .1 degrees for 50% imbalanced load
 - iii. 120 degrees +/- .3 degrees for 100% imbalanced load
- i. Overload Rating
 - i. Normal Operation
 - a. 125% for one minute

- b. 110% for ten minutes
- c. 105% continuous
- ii. Static Bypass Operation
 - a. 125% continuous
 - b. 1000% for 500 milliseconds
- iii. Maintenance Bypass Operation
 - a. > 150% continuous
 - b. High current short duration dependent on input breaker trip curve
- j. System AC-AC Efficiency: Power Strategy set to High Efficiency >98% at 100% load, with nominal input voltage and frequency.
- k. System AC-AC Efficiency: Power Strategy set to Normal >91.5% at 100% load, with nominal input voltage and frequency.
- l. Output Power Factor Rating: 0.9 lead to 0.7 lag
 - i. The UPS output shall not require derating for purely resistive or power factor corrected loads (PF of 1). The output kW and kVA ratings of the UPS shall be equal. For loads exhibiting a power factor of .9 leading to .7 lagging no derating of the UPS shall be required.

(3) Environmental

- a. Storage Ambient Temperature: -40°F to 158°F (-40°C to 70°C)
- b. Operating Ambient Temperature: +32°F to 104°F (0°C to 40°C). (25°C is ideal for most battery types)
- c. Relative Humidity: 5 to 95% Non-condensing
- d. Altitude: Maximum installation with no derating of the UPS output shall be 3300 feet (1000m) above sea level.

C. INPUT POWER CONVERTER

- (1) The input power converter for each 12kW system is housed within the removable electronics module. This electronics module shall also contain the system control logic, continuous duty static switch and continuous duty inverter. The input power converter shall constantly receive power from the mains input to the system, to provide the necessary UPS power for precise regulation of the DC link voltage to the inverter and battery charger, therefore maintaining regulated output power.
- (2) Input Current Total Harmonic Distortion: The input current i_{THD} shall be actively controlled by the input power converter while operating from the converter in normal operational mode. The input i_{THD} shall be less than 5% at full system load.
- (3) Magnetization Inrush Current: If provided with an optional isolation transformer or PDU/System Bypass, system inrush shall be limited to 10 times the nominal input current of the transformer.

(4) Input Current Limit:

- a. The input converter shall control and limit the input current draw from utility to 130% of the UPS output. With mains deviation of up to +27%/ -20% of the nominal input voltage the UPS shall be able to support 100% load, charge batteries at >5% of the UPS output rating, and provide voltage regulation per the output voltage specification in 2.2.C.
- b. When installed in a parallel configuration the UPS systems shall adjust charge levels to ensure batteries are properly charged, without compromising the parallel bus bar capacity rating, or upstream breaker ratings.

(5) Redundancy: When installing systems in a parallel redundant (PR) configuration, the system shall include redundant input converters, each with semiconductor fusing, and logic controlled contactors to remove a failed module from the power bus.

(6) Battery management system: The UPS shall contain a battery management system with the following features:

- a. **Battery Recharge:** The battery management system shall provide a three-step charging process. These periods shall be recognized as constant current, constant voltage and rest. After recharging batteries to full capacity, UPS shall isolate the charging circuit from the battery to increase expected battery life. Continual float charging of the battery shall not be allowed, therefore reducing the possibility of positive grid corrosion.
- b. **Battery Runtime Monitoring:** The battery management system shall monitor battery and provide status to end user of battery run time via front panel, serial and optional network communications, or both. Run time calculations to be based on load demand and analysis of battery health.
- c. **Battery Health Monitoring:** UPS shall continuously monitor battery health and the UPS will provide warnings visually, audibly and/or via serial and optional network communications when battery capability falls below 80% of original capacity. Battery testing may also be user initiated via the front panel or serial communications.
- d. Parallel connected systems shall independently monitor their battery voltage during discharge. Each system shall communicate with other systems on the parallel bus, sending information about current battery conditions (voltage).
- e. The battery charging circuit shall remain active when in any normal mode of operation or while in static bypass mode.

(7) Back-feed Protection: Each UPS shall provide a UL1778 approved back-feed protection scheme.

D. OUTPUT INVERTER

- (1) The UPS output inverter shall be used to regulate the output voltage to operate in conjunction with the connected IT load equipment. The output inverter shall use IGBT driven power converters, operating at high frequency to limit the effects of step loads and reduce the operating audible noise from the system. In both double conversion 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 continued operation of the critical load.
- (2) Overload Capability: The output inverter shall be capable of supporting 300% overload for a short period, in attempt to clear any short-circuit on the output. The UPS inverter shall remain operational for one (1) minute if a steady-state overload condition of up to 125% is seen on the output of the system. If the overload persists past the outlined time limitation, the critical load will be automatically switched to the static bypass output of the UPS. In the event the static switch exceeds its overload capability, the UPS shall activate the automated maintenance bypass to continue to support the overload until activation of an overcurrent protection device, or the overload condition is removed from the system.
- (3) Inverter Output Isolation: The inverter output shall be provided with a semi conductor fuse and output mechanical contactor to provide overcurrent protection and physical isolation of the inverter from the critical bus. This feature allows a failed inverter to remove itself from the critical bus while not affecting the operation of other parallel systems (PR) supporting the loads. Battery Protection: Each UPS shall be capable of controlling battery discharge depth, with the additional feature of removing all DC power draw from the battery in case of an extended input power outage. This will ensure that the batteries will not be deeply discharged which could cause damage to the battery.
- (4) Redundancy: When installing systems in a parallel redundant (PR) configuration, the UPS shall be configured with redundant output inverters, each independently controlled from fully isolated logic control systems. The inverters shall be able to share output even if intra-module communication is lost between individual UPS modules. All UPS inverters shall utilize high speed semiconductor fusing, and logic controlled contactors to remove a failed inverter from the critical bus without affecting the output of the other modules on the bus.

E. STATIC BYPASS

- (1) Each UPS system shall include a hot swappable static bypass switch. Static bypass operation will be based upon the system configuration, stand-alone single module (SA), parallel capacity system (PC), or parallel redundant system (PR). When deployed as a SA or PC UPS system, overloads exceeding the rating of the inverter, load fault, or internal failures shall automatically transfer the critical load to the commercial AC power by using the automated maintenance bypass. If a PR system is in overload the system will automatically determine if all available systems are capable of handling the overload, and if so the system will remain in normal operation. If the overload or load fault exceeds the capability of all connected systems each modules internal static bypass switch shall automatically transfer the critical load to the commercial AC power. If an internal failure occurs on a PR

system, the system affected by the fault will automatically remove itself from the critical output bus, ensuring the critical load is protected by the remaining systems operating in normal operation, with no transfer to static bypass initiated. If a mode change to static bypass was the result of an overload or load fault, the system shall automatically return to normal operation once the condition is has cleared. No-break transfer between operating modes shall be capable of being initiated manually from the front display of any parallel connected system. Each UPS shall constantly monitor the bypass input source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.

- (2) The design of the static switch power path shall consist of Silicon Controlled Rectifiers (SCR) with a minimum continuous duty rating of 125% of the UPS output rating.
- (3) 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.
- (4) Manual Transfers: Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface. All parallel connected systems shall transfer to static bypass simultaneously upon request from one system display.
- (5) 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.
- (6) Redundancy: The static bypass switch shall be incorporated into each UPS Module, so PR systems will include redundancy in the Static switch function.
- (7) Modular Design: The static switch assembly shall be incorporated in the electronics module therefore reducing mean time to repair (MTTR).

F. System Protection:

- (1) Back-feed protection: As a requirement of UL1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. Back-feed protection shall be a function of a mechanical contactor in series with the bypass SCR(s). The back-feed contactor shall open immediately upon sensing a condition where AC is being supplied from the output back to the input of the system. However, during cases where the AC input is present and the UPS is doing the battery test, the back-feed contactor will remain closed. Shorted SCRs in the static bypass assembly will cause the back-feed protection to activate.
- (2) Parallel connected system protection: Parallel connected systems shall include a redundant communication method for detecting if a single UPS module has initiated a transfer to bypass, which will cause all systems to transfer to static bypass mode. This communication method is used in event the primary communication between parallel connected modules fails.

G. MAINTENANCE BYPASS

- (1) Each 12kW UPS system shall include an automated internal maintenance bypass, which will allow hot-swappable replacement of logic control, input converter (rectifier), output converter (inverter), battery modules and static bypass switch. Parallel connected UPS modules shall be capable of full removal and replacement if necessary. Maintenance bypass operation will be based upon the system configuration, stand-alone single module (SA), parallel capacity system (PC), or parallel redundant system (PR). When deployed as a SA or PC UPS system, conditions requiring maintenance bypass operation shall force all connected systems to the maintenance bypass mode. This shall be an automated process, with activation coming from either a command from the front panel, or when a display panel RJ45 connector is unplugged from the electronics module. Overloads exceeding the rating of the static switch shall automatically transfer the critical load through the maintenance bypass to the commercial AC power, if programmed to do so from the front panel. PR systems can be commanded to maintenance bypass through the front panel, however automated transfer to maintenance bypass by unplugging one display will be inhibited as long as it does not force other connected systems into an overload condition. If a front display is unplugged in a PR configuration, the UPS module will take itself off-line allowing all other connected systems to support the critical load in normal operation. Overloads of the static bypass on PR systems will automatically transfer the critical load to the commercial AC power. If an internal failure occurs on a PR system, the system affected by the fault will automatically remove itself from the critical output bus, ensuring the critical load is protected by the remaining systems operating in normal operation, with no transfer to static or maintenance bypass initiated. Each UPS shall constantly monitor the maintenance bypass input source voltage, and inhibit potentially unsuccessful transfers to maintenance bypass from taking place.

H. OUTPUT POWER DISTRIBUTION

- (1) Each 12kW UPS module shall provide power to an output connector on the rear of the UPS chassis. This connector shall be protected by a properly sized breaker (3 pole 25A), limiting the output of each UPS module to its rating. This output connector shall be wired internally so that anytime it is attached to the parallel bus system; the connector shall be supported by all UPS modules on the parallel bus. The connector shall be capable of supporting loads connected to it even in event the electronics and battery modules are removed. This connector shall also be designed so that the internal UPS electronics module will support the loads on the output connector in event of a parallel bus failure. The output connector shall be monitored by the UPS controls per the information in section 2.8.c.d.

I. DISPLAY AND CONTROLS

- (1) System control and information network interconnections
 - a. Any UPS installed as a parallel system shall connect to a digital monitoring network so information about system voltage, current and power measurements can be accessed from any system display. This network shall not be needed to ensure proper system synchronization or load balancing control for each module on the output power bus. This network will allow accumulated or single system information to be displayed on any system display. The network will also allow for full system operating mode changes to be controlled from any display. Each

UPS shall also be capable of individual module control through its own independent display.

- b. Each UPS module installed in parallel shall include a digital monitoring network card, using industry standard control area network (CAN) architecture. This control architecture allows systems to operate in electrically noisy environments with extremely high reliability. This network allows accumulation of information between systems and mode control selection for all connected systems. The digital networking card will require a tool to install securely in each UPS module.
 - c. Cabling for the UPS monitoring network shall consist of interconnecting cable (ANSI/TIA/EIA-568-A, Category 5e) segments secured at each UPS with an interlocked 8P8C modular plug (RJ45). All information network interconnections shall be made on independent control area network (CAN) cards, which are inserted in an independently controlled and powered communication slot on each UPS module. Each of these interconnection cables shall serve as the physical layer for the UPS information network. This network cable shall be included by the manufacturer with every control area network card purchased. And shall not require tools to install.
 - d. A secondary independent control network shall be connected to each UPS module to allow system mode control changes in case of failure on the digital monitoring network. This network will ensure that if any UPS in a parallel connected system in the same mode of operation as other UPS systems on the parallel bus. However, bypass mode will be disabled if the digital control network is lost. This redundant network is used to ensure that even in event of the primary digital network failure that no unsafe conditions exist for personnel working on the upstream electrical system.
 - e. The secondary control network consists of a non-shielded twisted pair cable that shall daisy chain between paralleled UPS modules. The twisted pair cables shall come assembled with a two pin female connector, used to plug into a male connector header located on the back chassis of each UPS module. These male pins shall be recessed into the chassis to prevent damage during shipping or use. Each UPS module shall have two connection points that shall not be located on the network communication card and shall be isolated from the card. UPS modules in the bottom-most and top-most positions shall only need one cable connection. Any UPS modules located in-between two other modules will have two connected cables, one to the module below and one to the module above the said module. This twisted pair cable shall be included by the manufacturer with every control area network card purchased, and will not require tools to install.
 - f. The length of all the interconnecting cable segments for each network shall be approximately 45 centimeters.
- (2) UPS performance with loss of control wiring interconnections
- a. With the complete loss of digital network communications all UPS modules shall have the capability to support the critical load up to their rated load, with no reduction in system operational capability.

- b. With the complete loss of the digital and analog network communications, all UPS modules shall have the capability to support the critical load up to their rated load; however capability to switch modes to static bypass will be inhibited.
 - c. With the complete loss of one or both of the UPS communication networks, each UPS module shall have the capability to detect an internal failure and remove itself from the paralleled UPS bus.
 - d. Control in this method eliminates the need for system wide synchronization control signals, therefore eliminating any possibility of a synchronization control failure causing the entire system to go off line or remove power from the critical load.
 - e. It shall not be possible for a failure in the controls of one UPS power module to propagate a failure into other UPS power modules.
- (3) Front Panel Display: The UPS shall include a front panel display consisting of a graphical LCD display with backlight, four status LED's, and a four-key keypad. The LCD shall display a mimic screen of power flow through the UPS system when programmed for this function. The keypad keys shall be menu driven per the function being performed.
- a. Graphical LCD display: Includes basic language (English and local selectable languages), display of unit function and operating parameters. It shall be used to signify the operating state of the UPS, for indicating alarms, for changing operations control parameters and set points. The graphical display shall have a real time clock which will stamp events with event type and time information, reviewable in the logged data menus.
 - i. Local language packages available:
 - a. English, Spanish, German (Standard)
 - b. English, Finnish, Swedish, Norwegian
 - c. English, Hungarian, Romanian
 - d. English, Greek, Turkish
 - e. English, Chinese
 - f. English, Korean
 - g. English, Czech , Polish
 - h. English, Italian, Bulgarian
 - i. English, Russian
 - j. English, French
 - k. English, Portuguese
 - ii. Four status LED's, which indicate:
 - a. Alarms, with a red LED
 - b. On Battery, with a yellow LED
 - c. On Bypass, with a yellow LED
 - d. Power On, with a green LED

- iii. Four-Key Multifunction Keypad: UPS shall have keypad to allow user to:
 - a. Adjust UPS parameters
 - b. View UPS metered data
 - c. View all parallel UPS systems metered data
 - d. View alarm and inverter logs
 - e. Change UPS operational modes of the individual module
 - f. Change operational modes of all parallel connected systems
 - g. Turn individual UPS systems on and off
 - h. Turn all parallel connected systems on or off
- iv. Metered Data: The following metered data, shall be available on the alphanumeric display:
 - a. Input:
 - i. Voltage Line to Neutral
 - ii. Voltage Line to Line
 - iii. Frequency
 - b. Battery:
 - i. Voltage
 - ii. Current
 - iii. Runtime
 - c. Output:
 - i. Voltage Line to Neutral
 - ii. Voltage Line to Line
 - iii. Current
 - iv. Frequency
 - v. Power kW
 - vi. Power kVA
 - vii. Power factor (pf)
 - d. Parallel System:
 - i. kW [by unit]
 - ii. kW [Parallel total]
 - e. Load Receptacle:
 - i. Voltage Line to Line
 - ii. Frequency
 - iii. Power kW
 - iv. Power kVA
 - v. Current
- v. Event log: The display unit shall allow the user to display a time and date stamped log of the 100 most recent status and alarm events. Each event will be time stamped with Year, Month, Day, Hour, Minute, Second of occurring event.

- vi. The system shall be capable of displaying the following system status information:
 - a. System Normal
 - b. High Efficiency Power: %
 - c. Battery Resting
 - d. Battery Floating
 - e. UPS in Parallel mode
 - f. Parallel Unit Number
 - g. Units on Parallel Bus
 - h. Units on Load

- vii. The system control functions shall have the following capability
 - a. Go to Normal Mode
 - b. Go to Bypass Mode
 - c. Turn UPS On/Off
 - d. Turn system UPS On/Off
 - e. Start Battery Test
 - f. Start Display Test

- viii. The following system information shall be available from the front display
 - a. UPS Type
 - b. UPS Part Number
 - c. UPS Serial Number
 - d. UPS Firmware Revision
 - e. UPS Display Firmware Revision
 - f. UPS CAN Bridge Firmware Revision

- ix. Alarms and system information: 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:
 - a. On Battery
 - b. Battery Low
 - c. On Bypass
 - d. Bypass Unavailable
 - e. Battery Breaker Open
 - f. Battery Connection
 - g. Overload
 - h. Over-temperature
 - i. Site Wiring Fault
 - j. The UPS does not provide the expected backup time
 - k. Power is not available at the UPS output receptacle
 - l. The UPS does not start
 - m. The UPS does not turn off
 - n. The UPS operates normally, but some or all of the protected equipment is not on
 - o. Battery test failed
 - p. Battery test pending
 - q. Battery test did not run
 - r. Battery test aborted

- s. The UPS does not transfer to Bypass mode
 - t. Check Parallel Board
 - u. Abnormal output voltage at startup
 - v. Selective Trip
 - w. Redundancy Loss Due to Overload
 - x. Configuration Error and the UPS does not start.
- x. System Configuration: The following shall be configurable from the display unit:
- a. Set Date and Time
 - b. Display Contrast
 - c. Change Language
 - d. Relay Configuration
 - e. Signal Inputs
 - f. Serial Port Configuration
 - g. Parallel Operation Settings
 - h. Modem Configuration
 - i. Battery Setup
 - j. Power Strategy (normal or high efficiency)
 - k. Start Screen
 - l. User Password
 - m. Audible Alarms
 - n. Unsynchronized Transfer to Bypass
 - o. Transfer to Bypass When Overload
 - p. Automatic Start Delay
 - q. Control Commands from X-Slot 1
 - r. Control Commands from X-Slot2
 - s. X-Slot Signal Input Activation Delay
 - t. Site Wiring Fault Notice
 - u. Input Range
 - v. Reset Custom Event Settings
 - w. REPO Configuration
- xi. Communication Interface Board: A communication interface board shall provide the following communication ports which can be used simultaneously:
- a. Communication Card Slots:
 - i. Each UPS shall provide (2) communication slots in the back of the system allowing for additional connectivity options, including SNMP/Web, AS/400 relays, Modbus, etc
 - b. Serial communications (via RS-232) with manufacturer-supplied power management software package RS232 Serial Port #1

- c. REPO Input, N/O and N/C connections for connection to isolated contact on room EPO switch:
 - i. Each module in a PC or PR configuration shall require a separate EPO connection, ensuring failure of one EPO connection does not cause entire system shutdown.
- d. Two programmable signal inputs shall be programmable for the following system control:
 - i. ABM Resting (Charger disable)
 - ii. Remote ON/OFF
 - iii. Remote Go To Normal
 - iv. Force UPS to Static Bypass (External Bypass Interface)
 - v. External Battery Breaker Status (Disconnect notice)
- e. Summary alarm relay output

J. BATTERY

- (1) The UPS battery shall be of modular construction made up of user replaceable, hot swappable, battery modules with approved over-current protection. Each UPS module shall contain a minimum of two parallel battery strings therefore reducing the chance of a single battery failure causing complete loss of runtime. Each 12kW UPS in a parallel capacity (PC) or parallel redundant (PR) configuration shall have independent battery systems, with independent battery breakers therefore reducing any chance of a single point of failure in the DC bus.
- (2) The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type. The battery case shall be made of flame retardant material rated as UL94-V0.
- (3) The UPS shall incorporate a battery management system to automatically monitor the health of the battery system. This UPS shall notify the user via the front panel and serial/network communications in the event that a failed or weak battery is found.
- (4) Each 12kW UPS module shall have an independent 70A DC breaker for isolation of all internal and external battery modules to the DC bus. The UPS module shall notify the user if the DC breaker is in the off position.

PART 2 ACCESSORIES

2.0 PARALLELING BUS SYSTEM

- A. A parallel bus bar system shall be available in a standard EIA-310-D four post 19" IT enclosure measuring 42 inches (1050mm) deep, 80 inches (2030mm) tall (42U) and 24 inches (600mm) wide. The parallel bus shall be rated for a maximum of 60kW N+1 of output power, allowing up to six (6) UPS modules to be connected to it in one enclosure. The enclosure shall include full length side panels, castors and split rear door. Cable entry into the enclosure shall be capable from top, bottom or sides without effecting front or rear door operation. The parallel bus shall include a 6U high power wiring area with multiple conduit landing areas appropriate for installation in raised or non-raised floor applications. The wireway area shall be available in either a top of cabinet, or bottom of cabinet configuration. The bus bar system is different between a top and bottom wireway configurations, so they are not user capable of conversion from top to bottom or visa versa modification. The parallel bus shall include both input and output bussing systems with fully rated power connections located in the wiring area. The parallel bus system shall include UL approved touch safe connectors, for easy installation and/or removal (hot swap) of individual UPS modules while power is still applied to the critical output bus. UPS system installation procedures shall be capable of being completed by the user or other designated personnel.

(1) Input Specifications:

- a. Maximum continuous input current, with 6 x 12kW UPS modules installed shall be 120A @ 400Vac
- b. Maximum input OCP protection shall be 160A
- c. Input lugs shall be compression type.
 - i. Input mains and neutral lugs shall accept wire sizes from 13.3mm² to 177mm²
 - ii. Protective Earth (ground) lugs shall accept wire sizes from 2mm² to 52mm²

(2) Output Specifications:

- a. Maximum continuous output current, with 6 x 12kW UPS modules installed, shall be 87A @ 400Vac, (60kVA)
- b. Maximum output OCP protection shall be sized per local electrical code requirements.
- c. Output lugs shall be compression type.
 - i. Input mains and neutral lugs shall accept wire sizes from 13.3mm² to 177mm²
 - ii. Protective Earth (ground) lugs shall accept wire sizes from 2mm² to 52mm²

- B. A paralleling bus bar with wireway kit shall be available to allow the user to connect up to six (6) 12 kW UPS modules, for a total capacity of 60 kW with N+1 redundancy. In addition a parallel bus bar assembly allowing connection of only four (4) modules shall

be available, for a 48 kW capacity maximum. The bus bar allowing connection of six UPS systems shall require an EIA-310-D or E standard 19 inch four post cabinet with minimum dimensions of 600mm (24 inches) wide, by 1000mm (40 inches) deep, with internal open space of 42U (rack units or 1867mm (73.5 inches)). The bus bar system allowing connection of only four (4) UPS systems shall require an EIA-310-D or E standard 19 inch four post cabinet with minimum dimensions of 600mm (24 inches) wide, by 1000mm (40 inches) deep, with internal open space of 30U (rack units or 1334mm (53 inches,)). External wiring connection box for either bus system shall be 6U, 267mm (10.5 inches) high and shall run from the back to the front of the enclosure. The wireway shall have adjustments to fit racks with front to rear mounting rail placements of 762mm (30 inches) +/- 38mm (1.5 inches). Power wire ways shall be designed as universal fit, for top or bottom cabinet mounting, however the bus bar systems shall be two different designs and must be ordered for either top or bottom wireway mounting

2.01 POWER DISTRIBUTION SYSTEM

- A. The UPS module output connector on the rear of the UPS chassis shall be designed to interface to a rack mounted power distributions system (RPM). Each rack mounted power distribution system (when installed on paralleled UPS modules), shall be protected by all systems on the AC output bus. This power distribution system shall be modular and scalable in relationship to the upstream UPS system modules.

2.02 RACK POWER MODULE (RPM)

- A. For power distribution from the UPS modules to enclosure mounted power distribution units or directly to the loads, a 3U Rack Power Module (RPM) shall be available. Each RPM shall be capable of distributing power to single-phase loads, line to neutral connected. Each RPM shall be capable of being plugged into the back of each UPS module, allowing power distribution growth at the same time as UPS power capacity growth. The cord connecting the RPM to the UPS module shall be rated for above floor wire routing only. Each RPM shall come with a standard four post rail mounting kit to ensure easy slide in installation into the rack or enclosure. RPMs shall be capable of mounting into the same enclose that houses the UPS modules, server equipment or EBMs, except enclosures configured with a 60kW N+1 UPS system will consume all 42U of available rack space. An optional wall mounting kit to mount the RPM vertically on the wall shall be available. Each cord shall be capable of being routed through the IT enclosures using tool-less mounting hardware, or bolt on hardware. The cords shall also be capable for routing above the enclosure using optional wire routing trays. The RPM shall always have 12 breaker pole positions in any selectable configuration. The breaker poles shall be grouped in two groups of six poles to match available output receptacle plates. There shall always be two receptacle plates of the same or different types of receptacles available on the rear panel of the RPM. Output connections to the RPM shall be made though IEC type receptacles. Input and output current monitoring shall be provided by individual eight segment multi colored LED displays for each breaker pole as well as the three input phases. Percentage of capacity of all input and output currents shall be displayed at the same time on the front of the RPM. Each RPM shall be configurable with the following available features:

- a. Physical attributes
 - i. 3U, 130 mm, (5.25 in), height
 - ii. 507 mm, (20 in) depth, add 160mm (6.4 in for hardwire units)
 - iii. 440 mm, (17.4 in) width

CSI SECTION 16611 STATIC UNINTERRUPTIBLE SYSTEM/POWER DISTRIBUTION

- iv. 14 to 23 kg, (32 to 50) lbs based on configuration options
- b. Input type
 - i. Connection direct to UPS module connector (typical for BladeUPS)
 - ii. Hardwire (100A maximum), (3P + N + G)
- c. Input cord lengths (not applicable to hardwire units)
 - i. 1.8 meters, (six (6) feet)
 - ii. 3.05 meters, (ten (10) feet)
 - iii. 4.57 meters, (15 feet)
 - iv. 6.1 meters, (20 feet)
- d. Output receptacle types / number per receptacle plate / Number per breaker
 - i. IEC320-C13 / 12 / 2
 - ii. IEC320-C19 / 6 / 1
- e. Monitoring
 - i. True RMS monitoring of all input and output current
 - ii. Percent (%) load on all breakers (standard)
 - iii. Percent (%) load on input connector (standard)
 - iv. LED indicator for power available to the system
 - v. LED indicator for overload alarm
 - vi. Audible alarm indicator for overload
 - vii. Optional individual branch circuit monitoring with network connection using hot swappable energy management card with following:
 - a. Web-enabled monitoring of power quality data
 - b. Data and event logging with time stamp
 - c. Power quality data via Modbus TCP
 - d. Power quality data via WEB/SNMP interface with standard browser
 - e. Customized email messaging for events notification
 - f. Real-time power monitoring
 - g. Standard SNMP MIB support
 - h. Support of environmental monitor probe
- f. Cable Restraining
 - i. Each RPM distribution module shall come standard with a cable restraining system capable of holding connected equipment plugs from accidentally pulling out of the systems output receptacles.

2.03 ENCLOSURE MOUNTED POWER DISTRIBUTION UNITS (ePDU):

- A. Distributing power within the IT enclosure shall be accomplished by enclosure (rack) mount power distribution units (ePDU). The ePDU units shall come in many sizes and input plug and output receptacle configurations for supporting the wide variety of IT load equipment power connections. Two (zero) 0U vertical ePDUs shall be capable of being installed in the back of the accompanying enclosure to consume no U space reserved for the IT equipment. One 1U and two 2U configurations shall be capable of installation in the U space on a rack meeting the EIA-310-D 19" specification. One U (1U) ePDUs shall also have available optional brackets for mounting the device in the zero U (0U) space. In this configuration up to three like or unlike 1U ePDU's can be mounted on each side of a 42U high enclosure (total 6 in 0U space rear of enclosure. Additional optional enclosure mounting brackets shall be available to mount more than six (6) of the 1U ePDUs in the rear of the cabinet, or more than two (2) of the 0U vertical ePDUs without effecting mounting space for the IT equipment.
- a. Input Connection – All ePDU units used with the RPM power distribution system shall be connected via IEC320 connectors. Input plugs shall be offered for single phase connections.
 - b. Output Connections - The outputs of the ePDU shall be distributed to receptacles capable of supplying power to cord connected equipment.
 - c. Power options- The ePDUs shall be capable of delivering the following power to the rack based on input connection used:
 - i. IEC320-C14 2.3 kW
 - ii. IEC320-C19 3.68 kW
 - d. Metering, Monitoring and management options
 - i. Phase metering and local display of input current or branch circuit breakers shall be an option on the ePDUs, and is based on the model selected.
 - ii. Remote monitoring via built in SNMP or serial communications of the phase metering shall be an option based on the ePDU model selected.
 - iii. Individual outlet switching control shall be an option based on the ePDU model selected. Outlet switching can be done either via WEB/SNMP interface or via serial communication.
 - e. Agency
 - i. All ePDUs shall be listed to the 60950 agency specification though one of the following organizations:
 - a. UL or ETL North American Products
 - b. CE International Products

2.04 EXTENDED RUNTIME BATTERY

- A. Extended runtime for the UPS shall be available as an option. These extended battery runtime modules (EBM) will come in a standard rack mount design, with capability to go into any EIA-310-D, or EIA-310-E four post 19" IT enclosure, with minimum depth of 762mm (30 inches). Each EBM shall be 3U (132 mm /5.20 in) in height, 660 mm (26 in) depth, and 437 mm (17.2 in) width. Each EBM shall come with a standard four post rail mounting kit to ensure easy slide in installation into the rack or enclosure. EBMs shall be capable of mounting into the same enclosure that houses the UPS modules, server equipment or RPMs, except enclosures configured with a 60kW N+1 UPS system will consume all 42U of available rack space. Each EBM will include a cord assembly that allows plug in capability to the rear of the UPS system or other like EBMs. Each EBM shall include a matching input connector that allows easy tool-less "daisy chaining" of additional EBM modules by plugging them together. The DC output of each EBM shall be protected by an over-current protection device (breaker) with capability of being reset without tools. The cord length of the EBM will be 914mm (36 inch) to allow easy installation above or below any UPS, or when connecting to parallel UPS systems. When connecting to parallel UPS systems the EBMs will be designed to go into standard racks to the left of the UPS cabinet. This configuration will allow use of the standard cable length, however in cases where additional cable length is needed; an optional 914mm (36 inch) jumper cable shall be available. A maximum of two (2) jumper cables should only be used to limit voltage drop when on battery operation. Up to four (4) Extended Battery Modules shall be capable to be added to the standard UPS system for increased battery runtime greater than 30 minutes.

- B. A connection box for adding user sourced batteries shall be available. This external battery connector box shall allow connection of larger battery types to the UPS system. The battery connector box shall mount in the 6U space behind each UPS module by attaching to the standard left (from the back) rear EIA-310 rack rail. This box will include an input cord to connect to the UPS DC input connector. Each UPS in a parallel configuration will require a separate battery connection box and separate 240Vdc energy source.

2.05 RACK MOUNTED MAINTENACE BYPASS MODULE

- A. A rack mounted maintenance bypass module (MBM) shall be available to allow bypassing of the UPS system in case of maintenance needs on the UPS paralleling bus bar system or full UPS tower. This cabinet will include three breakers to allow make before break transfer of the connected load to a second source without disruption to the load.

(1) General Requirements

a. Standards:

- i. The maintenance bypass module shall be designed, tested, and manufactured in accordance with the latest applicable standards of UL 1778 4th edition; CSA C22.2, No. 107.3, and IEC 62040.
- ii. The cabinet shall be constructed and installed in accordance with all applicable current sections of NEMA, ANSI, IEEE, IEC and NFPA® codes

- b. Storage, handling, and maintenance:
 - i. Equipment shall be handled and stored in accordance with the manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment
- c. Qualifications
 - i. The manufacturer shall have produced similar electrical equipment for a period of 10 years
- d. Manufacturers:
 - i. The maintenance bypass module shall be from Eaton Corporation
- e. Ratings as indicated on the cabinet:
 - i. kVA rating: 60 kVA for matching to 60 kVA UPS system
 - ii. Nominal current: 120A
 - iii. Input: 400vac Three-phase, 4 wire, plus PE (ground)
 - iv. Frequency: 50 or 60 Hz
 - v. Fault Current: 35 kAIC at 400V
- f. Cabinet construction
 - i. The module shall be made from enclosure-grade steel
 - ii. The module shall have matching front cover plates similar in design to the UPS system and identical in design to the extended battery modules (EBM), except for name logo. The front covers shall be removable and can remain off in normal operation of the UPS with MBM system
 - iii. The cabinet shall be capable of top, bottom and side cable entry and exit
 - iv. The cabinet shall include removable top and bottom conduit landing plates
 - v. The cabinet shall be capable of mounting in any standard four post EIA 310 enclosure measuring a minimum of 915mm (36 inches) in depth
- g. Bypass construction
 - i. Bypass shall be constructed of three molded case circuit breakers (MCCB)
 - a. UPS Input Breaker, UIB, (150A)
 - b. Maintenance Bypass Breaker, MBB, (150A)
 - c. UPS Output Breaker, UOB, (150A)

- ii. Bypass shall include a mechanical interlock device to force the user to close the maintenance bypass breaker before turning off the UPS output breaker, or close the UPS output breaker before turning off the maintenance bypass breaker
- h. Input cable connections
 - i. Input lugs shall be compression type.
 - ii. Input mains and neutral lugs shall accept wire sizes from 13.3mm² to 177mm²
 - iii. Protective Earth (ground) lugs shall accept wire sizes from 2mm² to 52mm²
- i. Output cable connections
 - i. Output lugs shall be compression type.
 - ii. Output mains and neutral lugs shall accept wire sizes from 13.3mm² to 177mm²
 - iii. Protective Earth (ground) lugs shall accept wire sizes from 2mm² to 52mm²
- j. MBM to UPS connectivity
 - i. The customer shall be responsible for all power cabling between the UPS system and maintenance bypass module (MBM).
 - ii. The manufacturer shall include communication cables between the UPS tower and maintenance bypass module.
 - iii. The UPS to MBM control wiring will include the following functionality:
 - a. Indicator lamp in the MBM to illuminate any time the UPS electronic modules are in a bypass mode of operation.
 - b. Push button device on MBM that will force the connected UPS systems to internal bypass, therefore illuminating the UPS on bypass indicator on the maintenance bypass module.
 - c. UPS lock into bypass when bypass switch on MBM is closed.
 - d. UPS acknowledgement that maintenance bypass is active.
 - iv. The MBM shall include a simple power flow diagram on the front of the panel, with corresponding power available lamps at the UPS input, UPS output and maintenance bypass output positions
 - v. All indicator lamps shall be long life LED type, with removable/replaceable fuses from the front of the cabinet
 - vi. The MBM shall include a contact that will force any connected UPS systems into a bypass mode any time the maintenance bypass breaker (MBB) is closed. This contact will also hold the UPS from returning to normal operation until the MBB is opened.

- vii. The UPS system shall indicate and annunciate that the maintenance bypass system is engaged, therefore locking out the UPS from transferring back to normal operation
- viii. The MBM shall have connection for a remote EPO connection. The EPO shall require a momentary contact closure to shunt trip the maintenance bypass breaker.
- ix. The MBM shall include a single N/O and N/C auxiliary contact on all three power breakers. These contacts shall be rated to handle up to 5A @ 250 vac
- x. All auxiliary contacts and EPO connections shall be terminated at a terminal block in the power wiring area of the module
- k. Physical attributes
 - i. 6U, 261 mm, (10.5 in), height
 - ii. 754 mm, (29.6 inches) depth
 - iii. 441 mm, (17.3 in) width
 - iv. 34.5kg (76 lbs) weight

2.06 INFORMATION TECHNOLOGY (IT) ENCLOSURE

- A. IT enclosures shall be available for housing of customer supplied IT equipment. Enclosures shall meet the requirements of the 60950 agency specifications.

(1) General Requirements

- a. The Enclosure shall be designed to provide a secure, managed environment for computer and networking equipment.
- b. The Enclosure shall conform to EIA-310 Standard for Cabinets, Racks, Panel and Associated Equipment and accommodate industry standard 19 inch rack mount equipment.
- c. The Enclosure shall be designed with four (4) adjustable vertical posts to allow installation of typical rack mount equipment.
- d. The enclosure posts shall have adjustable top and bottom rails allowing front to back post relocation, as well as side to side post movement.
- e. The standard enclosure shall be available with a vertical equipment mounting space of 42U (1U=1.75" or 44.45mm).
- f. U space markings shall be on the front and rear of each rail to allow easy identification of rack U used when installing equipment.
- g. Varying U heights, frame designs, door configurations and other cosmetic changes shall be available as options.
- h. The enclosure shall have "Z" type rails front and rear to give additional strength in the vertical rail and for added equipment mounting surfaces.

- i. The enclosure shall not require any horizontal bracing in the zero U mounting areas to meet the maximum weight ratings of the cabinet, and to comply to IBC zone 4 seismic requirements. Areas in the zero U space and the U space outside the IT equipment mounting space shall be available for cable management and power distribution options.

(2) Physical Requirements

- a. Standard enclosure width shall be 600 mm (23.5") for 19" enclosures for typical 24" floor tile width matching.
- b. Standard enclosure depth shall be 1050mm (42 inches), for optimal 1220mm (48 inch) cold isle, 915mm (36 inch) hot isle installations on typical raised floor tiles.
- c. The enclosure of a 42U design shall have a maximum external height of 2030mm (80") to allow passage through standard 2060mm (81inch) or taller doorway without tipping.
- d. The enclosure shall support a dynamic load (rolling on castors) of 909kG (2000 lbs.) total weight.
- e. The enclosure shall support a static weight of 1451kG (3200 lbs).
- f. Enclosure shall also be designed and manufactured to be used to house the UPS modules, rack power modules, enclosure power distribution units and extended runtime battery modules to provide a uniform and consistent appearance in a datacenter environment.

(3) Equipment Access and Mounting

- a. The enclosure shall provide 42U 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 enclosure shall be designed with quick release hinges allowing for easy detachment without the use of tools. Each enclosure shall come standard with key locking front and rear doors.
- d. Optional side air flow panels shall be available which will allow baying enclosures together while blocking side to side air flow between adjacent enclosures. These panels shall include areas in the back of the rack allowing cables to pass between enclosures. Use of these panels will eliminate the need for side panels while maintaining proper front to rear air flow for high density computing requirements.

(4) Seismic Floor Anchor Brackets.

- a. An optional floor anchor bracket system shall be available to solidly connect each enclosure to the floor to help meet IBC Zone 4 seismic requirements.
- b. Optional seismic rated floor stands shall be available to support enclosures populated with IT or UPS equipment. Floor Stands shall be available in custom heights to maintain a flush mount installation with the raised floor, and shall be designed in accordance to the equipment weight and contact points.

(5) Cable management brackets and wire-ways

- a. Optional tool-free or tools required cable management brackets shall be available for routing power and communication cables internal to the enclosure.
- b. An optional top mounted cable tray shall be available for routing cables at the top of the enclosure down the row of IT enclosures. Trays shall be available for both front and rear cable routing.

(6) Additional enclosure options

- a. The following is a list of other enclosure options:
 - i. Tool-free blacking panels
 - ii. Rear door air flow assist fans
 - iii. Enclosure bottom blowers
 - iv. Universal mounting plates
 - v. Tool-free and tool required shelves
 - vi. Heavy duty support rails
 - vii. Enclosure baying kits

2.07 DISTRIBUTION BUS SYSTEM

- A. A busway system, including all necessary fittings, hangers, and accessories shall be available to be installed as a power distribution system from the UPS system

(1) General Requirements:

- a. Shall be manufactured in a facility certified to ISO 9001
- b. Standards:
 - i. The low voltage busway and all components shall be designed, tested, and manufactured in accordance with the latest applicable standards of ANSI/UL 857 and CSA C22.2 No. 27
 - ii. The busway shall be constructed and installed in accordance with all applicable current sections of NEMA, ANSI, IEEE, and NFPA® codes
- c. Storage, handling, and maintenance:
 - i. The NEMA Publication BU1.1 shall be a reference guide for proper installation, operation, and maintenance of the busway products
 - ii. Equipment shall be handled and stored in accordance with the manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment
- d. Qualifications
 - i. All components shall be of the same manufacturer as the busway
 - ii. The manufacturer shall have produced similar electrical equipment for a period of 10 years

- iii. The busway and related accessories shall be suit able for and certified to meet all applicable seismic requirements of the International Building Code (IBC), Uniform Building Code (UBC), and the California Building Code for Zone 4 applications
- e. Manufacturers:
 - i. All busway products shall be Cutler-Hammer Pow-R-Flex brand as manufactured by Eaton Corporation
- f. Ratings as indicated on the contract drawings:
 - i. Three-phase, three-wire, 50% integral ground
 - ii. Three-phase, three-wire, 50% internal ground
 - iii. Three-phase, three-wire, 50% isolated ground
 - iv. Three-phase, four-wire, 100% neutral, 50% integral ground
 - v. Three-phase, four-wire, 100% neutral, 50% internal ground
 - vi. Three-phase, four-wire, 100% neutral, 50% isolated ground
 - vii. An oversized neutral shall be available, rated 150% or greater for select ampere ratings
 - viii. The busway shall be capable of 240V, 480V, or 600V ratings
 - ix. Busway short circuit ratings shall be 22,000 rms symmetrical for 150A Al and 225A Cu ratings, 35,000 rms symmetrical for 225–300A Al and 400A Cu ratings, 42,000 rms symmetrical for 400A Al and 500–600A Cu ratings
- g. Busway housing construction:
 - i. The busway shall be totally enclosed without the use of accessory covers and UL listed for indoor applications
 - ii. The busway housing shall be made from electrical-grade extruded aluminum alloy 6063
 - iii. Housings shall be finished with an ANSI 61 or black, baked-epoxy powder paint, applied by an electrostatic process
 - iv. For plug-in type busway, each plug-in opening shall be accessible without removing any covers. The plug-in outlet shall utilize a spring shutter design with a positive screw-holding feature and shall require a tool for removal before use

- h. Busway conductors
 - i. Bus bars shall be fabricated from high-strength 55% conductivity aluminum alloy 6101 or 98% conductivity copper alloy 110 and shall be silver plated
 - ii. All conductors shall be firmly supported within the housing with high-strength molded polycarbonate supports rated Class B 130°C
- i. Plug-in openings:
 - i. Busway shall include a minimum of nine (9) plug-in openings on one side of the busway for each 10-foot (3m) length
 - ii. All plug-in openings shall be usable simultaneously
 - iii. Positive mechanical guides for plug-in units shall be provided at each plug-in opening to facilitate plug-in unit alignment and prevent improper installation
- j. Joints:
 - i. Each busway section shall be furnished complete with a factory-installed bridge joint
 - ii. Each bridge joint shall be compression type, single bolt, non-rotating design, which shall be removable without disturbing adjacent sections of busway
 - iii. High-pressure spring-type joint connections shall not be allowed
 - iv. All bridge joints shall be furnished with torque indicating, double-headed bolts and shall utilize a captive nut retainer on the opposite side of the bolt
 - v. The bridge joint design shall ensure proper installation without the use of a torque wrench and provide visual indication that the joint is properly torqued
 - vi. Each bridge joint shall allow for a minimum of 0.50-inch adjustment in section length at each joint connection
- k. Plug-in units:
 - i. Plug-in units shall be of fusible switch or circuit breaker type with provisions for factory installation of circuit breaker and wiring devices
 - ii. Fusible plug-in units shall have a quick-make, quick-break disconnect switch and positive pressure fuse clips
 - iii. Circuit breaker plug-in units shall have an interrupting rating as indicated on the contract drawings and shall meet the requirements of UL 489
 - iv. Where indicated on the contract drawings, provide plug-in units with a surge protective device (SPD). SPD units shall have thermally protected metal oxide varistors (MOVs)

CSI SECTION 16611 STATIC UNINTERRUPTIBLE SYSTEM/POWER DISTRIBUTION

- v. Receptacle plug-in units shall have an interrupting rating as indicated on the contract drawings and shall meet the requirements of UL 489. Receptacles shall be UL listed per the ratings indicated on the contract drawings
- 1. Busway supports:
 - i. Busway hanger spacing shall not exceed 10 feet (3m) in length. Manufacturer's standard supports shall be used when applicable

2.08 SOFTWARE AND CONNECTIVITY

- A. The UPS manufacturer shall be capable of providing three separate levels of system management for the data center. The following is a list of levels and their functionality:
- (1) Basic single UPS system operation, management and graceful load shutdown software to be included with every UPS shipped and/or is available from the manufacturers public web portal with the most recent release
- a. The included UPS software shall have automatic model detection of the manufacturer's current models of UPS systems as well as automatic detection for some competitive UPS models.
 - b. The software shall provide sequential shutdown to further help network administrators determine what sequence to shut down servers during an extended power outage.
 - c. The shutdown software shall be capable of being used completely unknown to the user at the display, for use on point of service or other public environments where not relevant to involve the user
 - d. The software shall automatically detect time used on battery and calculate the cost savings of the UPS by not subjecting the user to downtime.
 - e. Software Compatibility, the supplied with each UPS sold shall support graceful shutdown and remote monitoring for the following systems:
 - i. Microsoft: Windows 2000 (Server, Advanced Server, Professional) Windows XP Home Windows XP Professional, Windows 2003 Server (Web, Small Business), Windows 2003 Server (Standard, Enterprise), Windows 2003 Server R2 (Standard, Enterprise), Windows Vista (Ultimate, Home Premium, Business), Windows XP on 64-bit architecture, Windows Server 2008, Windows 7, Microsoft Hyper-V, Microsoft Hyper-V Server
 - ii. HP-UX v. 10.20, 11.0, 11i (11.11), 11i v1.6 (11.22), 11i v2 (11.23)
 - iii. BM AIX: v. 4.3.2 for RISC, v. 4.3.3 for RISC and PowerPC 3, v. 5.1, 5.2, 5.3 for PowerPC 3, v. 5.3 for PowerPC 5
 - iv. Mac OS v. 10.2.x 10.3.x, 10.4.x, 10.5x
 - v. Red Hat 7.2, 8.0 9.0, Red Hat Enterprise Linux 3 and 4 (ES and AS), Red Hat Enterprise Linux 4 (ES, AS, and Desktop), Red Hat Enterprise Linux AS v. 2.1 and v. 3 2, Fedora Core 5
 - vi. SCO Unix OpenServer v. 5.0.6, 5.0.7
 - vii. SGI Irix (MIPS) v. 6.5.2.x
 - viii. Sun Solaris v. 7, 8, 9, 10 for SPARC, v. 7, 8, 9, 10 for Intel
 - ix. SuSE Linux v. 7.2, 8.0, 8.2, 9.0, 9.3, 10.0, SuSE Enterprise Linux Server 8 and 9
 - x. Fedora Linux – Core 5, 6
 - xi. Ubuntu Linux v. 6.10
 - xii. Novell NetWare v. 5.0, 5.1, 6.0, 6.5 (must upgrade to latest SP)
 - xiii. VMWare ESX v. 3.5 (Linux Kernel 2.4), ESXi v. 3.5, 4.0 / vSphere Management Assistant VMA 4.0, VMware®'s vCenter™ server
 - xiv. Cisco Unified Communications Manager 4.3
 - f. Optional data center, Windows®-based client/server software package (Power Xpert) that provides real-time monitoring of critical power conditions for the entire enterprise down to a single channel or parameter of the UPS. It is

specifically designed to support multiple UPS systems in the data center including:

- i. Real-time, enterprise-wide monitoring analyzes critical power conditions and identifies problems
 - ii. Drill-down monitoring of individual meter or status for the UPS isolates the issue and speeds diagnosis
 - iii. Monitoring via client (local or remote), server or the Web (computer or PDA) provides easy “anywhere/anytime” access
 - iv. Scalable architecture (single/multi server) allows network managers the flexibility to monitor power conditions from within each LAN or monitor multiple LANs from a centralized, master client
 - v. Alarm notification through alphanumeric paging and/or SMTP email speeds corrective action
 - vi. Customizable alarms tailor notification to user needs
 - vii. Powerful data collection, graphing and report writing toolset provide trend analysis and diagnosis of chronic power problems.
- g. Optional enterprise wide, Windows®-based client/server software package (Power Xpert Foreseer) that provides monitoring and management of the power through the entire power train including UPS and a variety of foundation equipment. This software shall have capability of data monitoring of any manufactures equipment which is equipped with data output capability. The software is highly customizable to fit the application. The advanced features of Foreseer include:
- i. Unique graphical user interface and unparalleled performance analysis tools deliver the information needed to identify dangerous trends; execute corrective action; and, prevent failures.
 - ii. Easily configurable for unique environments, regardless of the complexity, size, or number of distributed sites.
 - iii. Monitoring of power over networks, modems, T1, or virtually any Ethernet or serial connection.
 - iv. Advanced alarm management capabilities, including a stoplight color scheme and Alpha-numeric OutCall Paging™, ensure that the right personnel are automatically notified of alarms and potential problems.
 - v. Easy to set-up graphical views to accurately depict site. Authorized users, enterprise-wide, can personalize software views based on individual preference. The editor function includes extensive drawing capability and allows import of CAD files, logos, photographs and scanned images.
 - vi. A variety of easy-to-use reports. Standard reports are included with each system and a Custom Report Generator produces management reports and other specific information whenever needed. Some of the available reports include: Load Analysis, Capacity Planning, Equipment Run Times and Alarm Reports.
 - vii. Installation, service and support by Eaton Corporation, Worldwide Services Group. A range of installation packages are available to meet specific needs including complete, turn-key project management and on-site training.
 - viii. Supported facilities equipment includes
 - a. Generators
 - b. Power metering systems
 - c. Uninterruptible power systems (UPSs)
 - d. Static switches

- e. Security systems including WEB enabled cameras
- f. Computer room air conditioners
- g. Chillers
- h. Leak detection systems
- i. Fuel monitoring systems
- j. Fire detection and suppression systems
- k. Building automation systems (BMS)
- l. Building management systems
- m. Power distribution units (PDU)
- n. Enclosure (rack) based power distribution units (ePDU)
- o. Switch gear and automatic transfer switches (ATS)
- p. DC power systems
- q. Battery monitoring sensors
- r. Power monitoring systems

(2) UPS monitoring and management

- a. Network management: An Ethernet WEB/SNMP and ModBus TCP network communication adaptor shall be available to allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP and/or ModBus network environments. SNMP information shall be available in the standard management information base (MIB) data, which can be used by network management software programs. SNMP information shall be provided in DOS and UNIX "tar" formats. The WEB/SNMP interface adaptor shall be a hot swappable card capable of being inserted into any open UPS communication slot.
 - i. Parallel connected UPS modules shall be able to be monitored from one WEB/SNMP card in any of the paralleled UPS communication slots. In this configuration all modules are monitored and managed as one UPS system. Individual UPS monitoring shall be capable by utilizing one communication card for all UPS modules paralleled on the parallel bus bar system.
- b. A single network management card shall have the capability of interfacing and delivering WEB/SNMP and ModBus TCP information concurrently
- c. Unattended shutdown shall be a function of the UPS reporting operating data to a network management device, so that IT systems can gracefully shut down. When utility AC is lost and the UPS is operating on battery, information sent about battery runtime is used to determine if and when the IT systems should start their automatic shutdown.
- d. Each UPS system shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during operation on battery.
- e. Isolated potential free contacts shall be available with an optional relay interface board. This relay interface board shall come in two different models, one for low voltage/low current applications and the other for voltages up to 250Vac and currents up to 5A. Either relay interface board shall change relay states for UPS changes from the following list:
 - i. Normal Operation
 - ii. Battery Operation
 - iii. Bypass Operation
 - iv. Common Fault
 - v. Low Battery
 - vi. UPS Off.

PART 3 EXECUTION

3.0 STANDARD EQUIPMENT WARRANTY

3.01 Standard equipment warranty shall be eighteen (18) months from the date of purchase

3.02 FACTORY ASSISTED UPS STARTUP

A. If an optional 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. Visually inspect all equipment for signs of shipping damage and/or foreign materials
- b. Observe type of ventilation, room cleanliness, use of proper signs and any safety related items that may be noteworthy

(2) MECHANICAL INSPECTION

- a. Check internal power connections in UPS module for tightness while observing proper safety precautions
- b. Check all control wiring terminations and plugs in UPS module for tightness and/or proper setting
- c. Check to see that all factory connections, power modules, subassembly pans and legs are secure
- d. Inspect the auxiliary connections and devices connected to UPS system

(3) ELECTRICAL PRECHECK

- a. Check system for ground faults at all power inputs and outputs
- b. Check DC bus for short circuits and proper polarity
- c. Checks input and bypass power terminations for proper voltages and phase rotation inside all modules
- d. Check and adjust, if necessary, all power supply voltages
- e. Verify CTO and Serial numbers programmed into system match the equipment labels

(4) INITIAL UNIT ENERGIZATION

- a. Verify all system annunciations are in "go" condition
- b. Energize unit(s) and verify proper DC walkup and AC phase on
- c. Check DC link holding voltage, AC output voltages and output waveforms
- d. Check final DC link voltage and inverter AC output. Adjust if required
- e. Check for proper synchronization with bypass source
- f. Check voltage differences between inverter outputs and bypass source
- g. Power up all additional accessories (EBM/RPM)

(5) BATTERY SET-UP

- a. Determine common or separate battery set-up process and settings
- b. Check for proper cell interconnections with respect to polarity throughout battery

- c. Check battery configuration matches required unit configuration (voltage, polarity, number of cells per string)

(6) BRANCH CIRCUIT MONITORING SET-UP (if optionally purchased on RPM)

- a. Ensure installation configuration matches application
- b. Perform branch circuit breaker scheduling
- c. Check voltage and current calibrations

(7) OPERATIONAL INSPECTION

- a. Check proper system operation in Normal Mode, Bypass Mode, and Battery Mode
- b. Check system transitions between operating modes
- c. Check multi-module operations
- d. Verify system calibrations and adjust as necessary

(8) FUNCTIONAL TEST

- a. Switch on utility power at UPS connection point
- b. Energize UPS and verify no alarms are present (or have been corrected and cleared)
- c. Test Battery mode
- d. Simulate the loss of bypass when on battery testing
- e. Emergency transfer testing
- f. Configure UPS. 5.3.1. Select appropriate display language
- g. Set Date and Time
- h. Set number of EBMs
- i. Building Alarms testing
- j. Local and Remote Emergency Power Off testing

(9) INSTALL OPTIONAL CONNECTIVITY AND MONITORING

- a. Upon customer enrollment and request (www.powerquality.eaton.com/enotify, select “Install eNotify”, and complete an “eNotify Request Form”), install and program connectivity parts and test monitoring connection. Customer must enroll and authorize Eaton to provide monitoring (connectivity parts may require separate purchase); customer may self install eNotify or purchase a separate installation if not completed at startup

(10) INSPECTION COMPLETION

- a. Ensure dead fronts and door panels are reinstalled
- b. System will be left in normal mode when environmental controls are operational
- c. Conduct on-site customer system operation training
- d. Final EEPs, calibration EEPs, meters report, service log, and configuration reports will be downloaded and stored
- e. Startup data forms and reports are available as required
- f. Clean up tools and debris around the system
 - i. Register the warranty if applicable

- (11) If an optional PDU with bypass is ordered and an optional factory assisted start-up is requested, factory trained service personnel shall perform the all functions from section 4.2 that are relevant to this device.

3.03 IN THE FIELD ASSEMBLY AND SET UP SERVICE

- A. The following is an outline of general procedures, if applicable, that are normally performed by Field Service Personnel prior to a standard start-up for modular UPS models. Start-up service may be purchased separately and is not included in Assembly and Set-Up Service. All checks and processes may not be applicable to all equipment models
- B. Customer is responsible for inside delivery of all equipment and arranging a licensed electrician to provide all necessary input power and any hardwired output connections and locating all equipment in the site area where the equipment is to be started. Suitable equipment racks may be supplied either by manufacturer or customer and be compatible with the customer ordered system, accessories and cables for the intended application and site location; this service does not apply any power nor validate settings

(1) UNPACK

- a. Unpack UPS and accessories
- b. Removal of all packing materials to customer disposal location

(2) VISUAL INSPECTION

- a. Verify that all equipment and accessories listed in User Guide are included
- b. Visually inspect all equipment and accessories for signs of damage and/or foreign materials
- c. Observe type of ventilation, room cleanliness, use of proper signs and any safety-related items that may be noteworthy

(3) INSTALL UPS IN SUITABLE EQUIPMENT RACK

- a. Secure suitable customer supplied rack to floor, upon request (excludes seismic anchors)
- b. Install UPS mounting rails in customer rack
- c. Install UPS on mounting rails in rack
- d. Remove and reinstall UPS electronics module in UPS chassis
- e. Install battery modules in UPS chassis
- f. Install UPS front panel
- g. Install ConnectUPS or PowerXpert connectivity cards and accessories for eNotify (if optionally purchased)
- h. Install CAN Bridge Cards, CAN Bridge Card Wiring, and Redundant Signal Wiring (parallel systems only)
- i. Connect UPS input and output power connectors (no power is applied)

(4) INSTALL EATON ACCESSORIES (if applicable) IN SUITABLE EQUIPMENT RACK (EBM, RPM; excludes RPP/PDU and products with separately available startup service)

- a. Install Eaton Accessories mounting rails in customer rack

- b. Install Eaton Accessories on mounting rails in rack
- c. Connect EBM to UPS (if applicable)

(5) ON-SITE OPERATIONAL TRAINING:

- a. Prior to leaving the site, the Customer Support Engineer will familiarize customer personnel in the operation of the UPS. The familiarization takes 1 hour to 8 hours at Eaton's discretion, and depends on site personnel, equipment type and equipment availability. Basic operational training includes:
 - i. Key pad operation
 - ii. LED indicator explanation
 - iii. Start-up and shutdown procedures
 - iv. System maintenance bypass operation information
 - v. Component familiarization
 - vi. Alarm and notice familiarization.

3.04 MANUFACTURER FIELD SERVICE

- A. The UPS manufacturer shall have a worldwide service organization, 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
- B. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours

3.05 MAINTENANCE CONTRACTS

- A. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by Eaton authorized trained service personnel
- B. Contracts shall be available for both Monday through Friday, normal business hours next day response, and seven days a week, any hour with up to two (2) hour response time

3.06 TRAINING

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

End of Section 16611