

SECTION 16610
STATIC UNINTERRUPTIBLE POWER SUPPLY
2 Module Parallel Redundant System
200 - 500 kVA

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes a three-phase continuous duty, on-line, solid state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back up and distribution for critical electrical loads. The UPS shall consist of two UPS modules connected together through a single parallel cabinet, one or more battery strings, and other features as described in this specification.

1.02 UPS MODULE DESCRIPTION

- A. UPS Module Components: The UPS module shall consist of the following main components:
 - 1. Rectifier/Charger
 - 2. Static Inverter
 - 3. Bypass
 - 4. Output Isolation Transformer
 - 5. Control Panel
 - 6. Monitor Panel
 - 7. Communication Panel
- B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
 - 1. Normal: The critical load shall be continuously supplied by the Inverter. The Rectifier/Charger shall derive power from the commercial AC source and shall supply DC power to the Inverter while simultaneously float-charging the battery.
 - 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.

3. Recharge: Upon restoration of the AC source, the Rectifier/Charger shall recharge the batteries and simultaneously shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually, without operation of the static switch.

1.03 REFERENCES

- A. UL 1778 - (Underwriters Laboratories) Standard for Uninterruptible Power Supply Equipment. Listed Equipment (US and Canada).
- B. CSA C22.2 NO.107.1 - (Canadian Standards Association) Commercial and Industrial Power Supplies. Listed Equipment (US and Canada).
- C. NEMA PE-1 - (National Electrical Manufacturers Association) Uninterruptible power systems standard.
- D. IEC 801-2 - (International Electrotechnical Commission) Electromagnetic Compatibility For Industrial-Process Measurement and Control Equipment.
- E. EN 50091-3 - (European Standard) Methods of specifying performance and test requirements of uninterruptible power systems.
- F. IEEE 587 (ANSI C62.41), Category A & B - (International Electrical and Electronic Engineers) Recommended practice on surge voltages in low voltage power circuits.
- G. FCC Rules and Regulations 47, Part 15, Class A - (Federal Communications Commission) Certified compliance.
- H. EN 50091-1 - (European Standard) Uninterruptible power systems, General and safety requirements for UPS used in restricted access locations.
- I. IEC 62040-2 (EN 50091-2) - (International Electrotechnical Commission) Uninterruptible power systems, Electromagnetic compatibility requirements.
- J. EN 50082-1 - (European Standard) Uninterruptible power systems, Electromagnetic compatibility - generic emission standard; Generic standard class: Residential, commercial and light industrial.
- K. MIL-HDBK-217E - (Military Handbook) Reliability Prediction Of Electronics Equipment.

1.04 SUBMITTALS

- A. The UPS shall be supplied with sufficient documentation, including the following manuals:
 - 1. Operation Manual: One copy of the operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians to understand and operate the UPS equipment. The manual shall describe the UPS in full by including the following major items:
 - a) Operating Procedures
 - b) Performance and Technical Specifications
 - c) General Description
 - d) UPS Module Description
 - e) Communications Capability
 - f) Battery Description
 - g) Accessory Description
 - 2. Installation Manual: One copy of the installation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians to install the UPS equipment. One set of the following drawings and data sheets shall be supplied:
 - a) Receiving and Installation Instructions
 - b) UPS One-Line Drawings
 - c) Equipment Outline Drawings
 - d) Interconnection Drawings
 - e) Battery Wiring Diagram
 - f) Accessory Wiring Diagrams

1.05 QUALIFICATIONS

- A. The UPS manufacturer shall have a minimum of fifteen years experience in the design, manufacture and testing of solid-state UPS. A list of installed UPS of the same type as the manufacturer proposes to furnish for this application shall be supplied with the proposal.
- B. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and the field service organization.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

1. Operating Temperature: 0 degrees C to +40 degrees C (32 degrees F to 104 degrees F) without derating (excluding batteries).
 2. Storage Temperature: -20 degrees C to +70 degrees C (-4 degrees F to 158 degrees F). Prolonged storage above +40 degrees C (104 degrees F) will cause rapid battery self-discharge.
 3. Relative Humidity (operating and storage): 95% maximum non-condensing.
 4. Elevation: 5000 ft (1500 m) maximum at 40 degrees C without derating.
- B. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
- C. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, for Class A devices.
- D. Electrostatic Discharge (ESD): The UPS shall meet IEC 801-2. The UPS shall withstand up to 25 kV without damage and with no disturbance or adverse effect to the critical load.
- E. Efficiency: The typical UPS efficiency shall be 92% at full unity power factor load and nominal input voltage.
1. If present, an input auto-transformer may reduce the UPS efficiency an additional 1%.
 2. If present, an input isolation transformer may reduce the UPS efficiency an additional 3%.
- F. Input Surge Withstand Capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), Category A & B (6 kV).

1.07 RELIABILITY AND MAINTAINABILITY

A. Reliability

1. The calculated UPS module mean-time-between-failure which would result in an unsuccessful emergency transfer to internal bypass and subsequent load loss, shall be no less than 2,250,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C) and assume the availability of bypass input power to the UPS module.
2. The calculated mean-time-between-failure for the UPS module, which would result in a successful emergency transfer to internal bypass, shall be no less than 62,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C) and assume the availability of bypass input power to the UPS module.

3. The calculated mean-time-between-failure for any UPS module component, shall be no less than 43,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C).
 4. The UPS module shall feature redundant power supplies. Power to the control power supplies shall originate from the Rectifier/Charger input, Bypass input and UPS module output. In the event one of the power supplies shall fail, the UPS module shall continue to operate in Normal mode without load derating. A failed power supply condition shall be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm shall automatically clear when the failed power supply is replaced.
 5. The UPS module shall feature redundant cooling fans. In the event one of the fans shall fail, the UPS module shall continue to operate in Normal mode without load derating. A failed cooling fan condition shall be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm shall automatically clear when the failed fan is replaced.
 6. The UPS module shall utilize high-reliability wiring and connectors. The UPS module shall not feature ribbon cables.
 7. The inverter controls, rectifier/charger controls, bypass controls and monitoring/communication controls in the UPS module shall be contained, in their totality, on a maximum of four control printed circuit boards.
 8. All UPS module power cable connections to power transformers shall be secured with permanent cold weld crimps which require no maintenance or periodic retorquing. These cold weld crimps shall be Underwriters Laboratories recognized components.
- B. Maintainability: Calculated and demonstrated mean-time-to-repair (MTTR) shall not exceed 30 minutes, including time to diagnose the problem and replace the subassembly.

1.08 SAFETY

- A. The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778.
- B. The UPS shall be certified by the Canadian Standards Association in accordance with CSA C22.2 NO.107.1.
- C. The UPS shall carry the CE mark, indicating the equipment complies with European Community standards EN50091-1 (Safety) and IEC 62040-2 (EN50091-2) (Electromagnetic Compliance).

1.09 WARRANTY

- A. UPS Module: The UPS module warranty within the 50 United States shall be:
 - 1. No less than 90 days after acceptance for all costs including repair, labor, travel and living expenses for the manufacturer's service personnel.
 - 2. No less than 12 months after acceptance for all component costs.
- B. Battery: The UPS manufacturer shall warrant their battery cabinets on a prorated basis for ten years to deliver no less than 80% of its rated capacity, provided the prevailing ambient temperature of the battery area does not exceed 25 degrees C (77 degrees F). For external battery systems, the battery manufacturers' warranty shall apply.
- C. A service plan that includes the following shall be included as standard in addition to the above warranty within the 50 United States:
 - 1. One Year 7 x 24 Corrective Maintenance
 - 2. One 7 x 24 Annual Performance Check
 - 3. 7 x 24 Remote Monitoring Advance Response Service when UPS is ordered with a modem and remote notify.
 - 4. Monthly UPS Evaluation and performance Report when the UPS is ordered with a modem and remote notify.
 - 5. Web access to account information and site service activity
 - 6. One annual Power Protection Audit

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers: Powerware Corporation

2.02 UNINTERRUPTIBLE POWER SYSTEM STANDARD FEATURES

The UPS shall be available with the following characteristics:

- A. The UPS shall consist of the following components:
 - 1. Two identical UPS modules.
 - 2. One parallel cabinet.
 - 3. One common battery string for both UPS modules, or One separate battery string for each UPS module.
- B. UPS Configuration
 - 1. The outputs of the two parallel UPS modules shall be connected to the critical bus by the parallel cabinet.

2. The two UPS modules shall share a common bypass input source.
3. The rectifier input to the two UPS modules may be from the same source or from two different sources. If the two UPS module rectifier feeds are from two different sources and a common battery is utilized, one of the UPS modules shall feature an input isolation transformer.

C. UPS Module Configuration

1. The UPS shall feature two identical UPS modules.
2. Each UPS module shall feature a power processing unit comprised of a rectifier, DC link and inverter.
3. Each UPS module shall feature an internal emergency bypass circuit consisting of a static switch and a high speed bypass contactor.
4. Each UPS module shall use Digital Signal Processing to monitor and control its own operation.
5. A parallel capable single (reverse transfer) UPS module shall have the capability to be field upgradeable to serve as one of the two UPS modules in a parallel redundant configuration as described in this product specification.

D. Parallel Cabinet Configuration

1. The parallel cabinet shall provide either UPS module with the ability to be completely isolated from the critical bus for service, while the critical load remains energized and protected by the other UPS module.
2. The parallel cabinet shall feature a UPS module output breaker (MOB) to connect each UPS module to the critical bus. The MOB's shall provide output wiring protection.
3. The parallel cabinet shall not contain printed circuit boards.
4. An indicator light above each MOB shall be lit when it is "OK" to close the respective MOB, following any UPS module maintenance action. A lamp test button shall be provided to confirm the indicator bulbs and associated circuitry are in operational condition.
5. All serviceable components shall be located in the front of the parallel cabinet. Side or rear access to the parallel cabinet shall not be required for service or maintenance.
6. The parallel cabinet shall have multiple power wire routes to permit top, bottom, or side power or control wire entry.

E. Battery Configurations

1. Common Battery Configuration: The UPS shall be capable of operating with a common battery connected to the DC links of both UPS modules.

2. Separate Battery Configuration: The UPS shall be capable of operating with separate batteries connected to the DC links of each UPS module.
 - a) The integral Battery Management System shall provide up-to-date battery runtime information and battery health indication.
3. The UPS shall accommodate either valve-regulated (AGM) batteries or wet cell batteries.

F. Interconnections

1. The wiring between the UPS modules and parallel cabinet shall include power wiring and control wiring. The control wiring shall not be required for normal parallel operation. The control wiring shall only be used to facilitate closure of the MOBs during UPS module maintenance actions.
2. No inter-UPS module signals or control connections shall be required for balanced UPS module load sharing.
3. No inter-UPS module signals or control connections shall be required for UPS module selective tripping.
4. This wireless paralleling method shall not rely on information to be shared between the two UPS modules, thereby eliminating the need for inter-UPS module communications.
5. This wireless selective tripping method shall not rely on information to be shared between the two UPS modules, thereby eliminating the need for inter-UPS module communications.
6. The design of the maintenance control wiring shall provide galvanic isolation between the two UPS modules. All interconnections between the two UPS modules, through the parallel cabinet, shall monitor only contact closures. The control circuits between the two UPS modules shall not be interconnected. It shall not be possible for a failure in the controls of one UPS module to propagate a failure in the other UPS module.

G. UPS Performance During Normal Operation

1. The two UPS modules shall not have a master/slave relationship.
2. Wireless selective tripping and load sharing shall eliminate a controls single point of failure.
3. UPS modules shall share load equally to within +/- 2% when operating normally.
4. The UPS shall feature constraints which do not permit it to be continuously operated in a configuration where one UPS module is in bypass mode while the other UPS module is in

inverter mode and both UPS modules are connected to the critical bus.

5. It shall be possible to continuously load the UPS at 200% of the UPS module rating. UPS module redundancy shall be lost when the UPS is loaded beyond the UPS rating. Both UPS modules shall alarm when the UPS load exceeds 125% of the UPS level rating.

H. UPS Performance With A Faulty UPS module

1. In the event of a UPS module failure, the failed UPS module shall remove itself from the critical bus. The remaining UPS module shall immediately assume all of the critical load.
2. The UPS shall not interrupt the flow of conditioned power to the critical load, if one UPS module fails.
3. The UPS shall not interrupt the supply of power to the critical load, if a fuse in the bypass circuit blows.

I. UPS Performance During Maintenance Actions

1. With either of the MOB's open, both UPS modules shall act as independent UPS modules. In this configuration, UPS level constraints shall not restrict either UPS module from being transferred between normal and bypass mode.
2. If one UPS module fails, while the other UPS module is off or isolated from the critical bus, its internal bypass path shall close. The loss of voltage to the critical bus shall be less than 4 milliseconds in duration.
3. Provided the UPS output is synchronized with the bypass source, the UPS shall have the ability to operate in parallel with utility power without damage to either UPS module. This shall be considered an abnormal mode of operation, typically resulting from incorrectly operating external maintenance bypass switchgear.
4. Regardless of the operating mode, when the MOB indicator lamp is illuminated, it is "OK" to close the corresponding MOB. With either of the MOB's open, the MOB indicator lamp shall be illuminated during the following modes of operation:
 - a) Both UPS modules are in Normal mode (on inverter).
 - b) Both UPS modules are in Bypass mode (on bypass).
 - c) Either of the UPS modules is off.
 - d) With both UPS modules on bypass mode, it shall be permissible to close one or both of the MOB's in order to support the critical load with the UPS module bypass paths in parallel. Subsequently, it shall be possible to transfer both UPS modules to inverter through either one of the two UPS module's control panel.

J. UPS Performance During a Utility Outage

1. If one of the two UPS module loses all utility input power, its inverter shall remain on and connected to the critical bus. To prevent discharging the battery (common or separate), the inverter within the UPS module that loses its utility input shall phase back its output by .003 sec from the nominal frequency. With the bypass at nominal frequency, the UPS module with utility input shall fully support the critical load. In this manner the battery (or batteries) shall remain fully charged and available, while both UPS module inverters shall be available to support the critical load if utility input to the other UPS module is subsequently lost.
2. With the loss of bypass power to either UPS module, the UPS output frequency shall remain regulated at the frequency of the other UPS module's bypass. If both UPS modules lose bypass power and/or rectifier power, the UPS output frequency shall be regulated by the internal clock frequency set within each UPS module. The UPS modules shall remain in parallel and share load in this operating mode.

K. Load Sharing

1. The UPS shall share the critical load between the two UPS modules so equally that each UPS module's load is always within 2% of the other's.
2. The UPS shall be capable of providing balanced load sharing without any inter-UPS module connections.
3. Each UPS module shall need to monitor only its own input and output power in order to remain phase locked with the other UPS module. This wireless paralleling method shall not rely on information to be shared between the two UPS modules.

L. Selective Tripping

1. The UPS shall be able to selectively trip a failed UPS module off-line without any inter-UPS module connections.
2. Each UPS module shall look only at itself to determine if a UPS module failure has occurred. If a UPS module does occur, the faulty UPS module shall identify its own internal failure and subsequently remove itself from the critical bus by instantaneously shutting off the inverter and subsequently opening an output contactor internal to the UPS module. This wireless selective tripping method shall not rely on information to be shared between the two UPS modules.
3. The selective trip method each UPS module employs to identify an internal failure, shall require the UPS module to look for changes in UPS module output voltage and output current data relative to recent output current and voltage data.

4. Immediately after a failed UPS module removes itself from the critical bus, it shall continue to monitor the critical bus voltage. If the critical bus voltage stays within UPS specifications, it shall remain disconnected from the critical bus. If the faulty UPS module observes the critical bus voltage shift out of specification limits, it shall close its emergency bypass path.
5. If a UPS module does isolate itself from the critical bus, due to an identified internal failure, the UPS module shall try three times to restart. If the UPS module successfully restarts and its output is stable and remains within specification limits, it shall resynchronize with the critical bus and automatically reconnect itself to the critical bus. The reconnected UPS module shall resume load sharing with the other UPS module and UPS level redundancy shall once again be available.
6. The selective trip controls within each UPS module shall be independent of the inverter controls. The inverter controls within each UPS module shall also provide selective tripping capability for removing a faulty UPS module from the critical bus.
7. The selective trip controls within each UPS module shall be continuously monitored to assure they are functioning properly. Failure of a UPS module's selective trip controls shall not impair its ability to parallel its output and share the critical load with the other UPS module. A UPS module shall alarm if it determines its selective trip controls have failed.

M. UPS Fault Clearing Capability

1. With a fault on the critical bus which exceeds 160% of the current rating of each UPS module, both UPS modules shall transfer to their internal bypass after 5 cycles.
2. In the event of a fault on the critical bus, both UPS modules will transfer to bypass, thereby providing up to 200% of the UPS module level fault clearing current.
3. With two parallel bypass paths, the UPS shall provide fault clearing current rated at twice the single UPS module fault clearing current rating.

2.03 UPS MODULE STANDARD FEATURES

The UPS module shall consist of the following standard components:

- A. Rectifier/Charger: The Rectifier/Charger shall convert incoming AC power to regulated DC output for supplying the Inverter and for charging the battery. The Rectifier/Charger shall be of a six-pulse, phase-controlled, solid-state design. The modular design

of the UPS module shall permit easy removal of the Rectifier/Charger without removal of any other assembly.

- B. Inverter: The Inverter shall feature insulated gate bi-polar transistors (IGBTs) in a three-leg, pulse-width-modulation (PWM) design with a switching speed of 4500 HZ. The Inverter shall also have the following features:
1. The Inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 2. The modular design of the UPS module shall permit easy removal of each phase of the Inverter and DC electrolytic capacitors without removal of any other assembly.
 3. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to Bypass and from Bypass shall be possible with the Inverter logic, without using the emergency bypass control logic or the static switch. During manual transfers to Bypass mode, the Inverter must verify proper Bypass operation before transferring the critical load to the Bypass.
 4. The Inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
- C. Bypass: The Bypass shall serve as an alternate source of power for the critical load when performing maintenance on the UPS module or when a failure prevents operation in Normal mode. The Bypass shall consist of a naturally-commutated static switch, for high-speed transfers, and wrap-around switchgear. The modular design of the UPS module shall permit removal of the static switch without removal of any other assembly. The static switch shall only be necessary for controlling emergency make before break transfers. The Bypass shall feature the following transfer and operational characteristics:
1. Uninterrupted transfers to Bypass shall be automatically initiated for the following conditions:
 - a) Output overload period expired.
 - b) Critical bus voltage out of limits.
 - c) Over temperature period expired.
 - d) Total battery discharge.
 - e) UPS module failure.
 2. Uninterrupted automatic re-transfer shall take place whenever the Inverter is capable of assuming the critical load.
 3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:

- a) When transfer to Bypass is activated manually or remotely.
 - b) In the event of multiple transfer-re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the Bypass source.
 - c) UPS module failure.
4. All transfers and re-transfers shall be inhibited for the following conditions:
- a) Bypass voltage out of limits (+/-10% of nominal).
 - b) Bypass frequency out of limits (+/-0.5 Hz; adjustable, factory set).
 - c) Bypass out of synchronization.
 - d) Bypass phase rotation/installation error.
5. The Bypass shall be manually energized with a key switch on the control panel. No additional control logic shall be required.
6. The logic power required to perform an emergency transfer to bypass shall be derived separately from the logic power required to operate the inverter controls.
7. The control circuitry required to perform an emergency transfer to bypass shall operate independently from the inverter control circuitry.
8. The Rectifier/Charger input circuit breaker shall have no effect on Bypass operation
- D. Monitoring and Control Components: The following components shall provide monitor and control capability:
- 1. Micro-controller driven circuitry: Embedded 20 MHZ, 16 bit, single chip controller.
 - 2. Monitor Panel with status indicators
 - 3. Alarm and metering display
 - 4. Building alarm monitoring
 - 5. Input circuit breaker
 - 6. Inverter and bypass contactors
 - 7. RS-232 (EIA/TIA-232) and RS-485 communication ports
- E. Output Isolation Transformer: The UPS module shall contain an output isolation transformer featuring a single primary (an Inverter Delta winding) and a single secondary (a Wye winding to the UPS module output terminals). The Bypass path shall pass through the UPS module without transformation and without any phase shifting. This transformer shall provide isolation between

the primaries and secondary and shall qualify the UPS as a separately derived source when in Normal mode.

- F. Battery Management System: The UPS module shall contain a battery management system which has the following features:
1. The battery management system shall provide battery time available, or percent remaining, while operating in Normal mode and Battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Once commissioned, the battery time available information shall be accurate within +/- 3%.
 2. The battery management system shall automatically analyze the UPS battery during a user defined periodic test cycle (quarterly, monthly, etc.). During the test, the Rectifier/Charger shall not de-energize, but shall share load with the battery. For determining battery time remaining information, the battery shall be tested under the same load for each user defined periodic test. Should the battery be weak or defective, The battery management system shall detect and enunciate the battery failure condition without transferring the critical load to Bypass.
 3. The periodic test performed by the battery management system shall not remove more than 10% of the available battery run time from the battery. The periodic test, if performed on a monthly basis, shall not reduce overall battery life.
 4. If a utility outage occurs while a test is in progress, the test shall be discontinued and subsequently conducted at the next programmed interval. The occurrence of the periodic test shall be user programmable for day, date and time.
 5. The battery management system shall record and display the pass/fail status, battery voltage and health indicator value of the previous thirty (30) periodic tests.
 6. The battery management system shall provide battery health information in the form of a health indication value. When the health indication value approaches 0.80, it shall correspond with battery string end of life.
 7. The battery management system shall enunciate a user programmable battery time remaining warning when the UPS module is on battery power.
 8. The battery management system shall provide an imminent shutdown alarm to signal a low battery condition.
 9. The battery management system shall work with either wet cell batteries or valve-regulated batteries.
- G. Wiring Terminals: The neutral output compression terminal shall be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module shall contain mechanical compression terminals (adequately sized

to accommodate 90°C wiring) for securing user wiring to the following locations:

1. Rectifier/Charger input connections(3 phases)
2. Bypass input connections (3 phases or 3 phases and 1 neutral)
3. DC link connections for battery cabinets (positive and negative)
4. AC output connections (3 phases and 1 neutral)

2.04 UPS MODULE OPTIONS AND ACCESSORIES

The UPS module shall consist of the following options and accessories:

- A. (OPTION) Outcall Capability: The UPS module shall have outcalling capability with the following features:
 1. The UPS Module shall have the capability to initiate out calling for user selected alarms and notices. Out calling shall be accomplished through a Hayes compatible modem connected to a UPS module RS232 port. The outcalling feature shall allow the UPS module to interface with either a personal computer running terminal communications software or a pager.
 2. Over 190 programmable UPS module alarms and notices shall initiate UPS module out calling. Each of the six UPS module building alarms, which may monitor other facilities equipment, shall have the capability to initiate UPS module out calling to report facilities equipment failures.
 3. All available alarms and notices shall initiate out calling to two different user programmable phone numbers. When activated, each of the available alarms and notices shall have the capability to call either of the two different phone numbers, both phone numbers or neither phone number.
 4. When out calling to a pager or personal computer, The UPS module shall have the capability to leave the UPS module phone number (up to 20 characters maximum). The UPS module shall also leave a description of the event that triggered the outcall (up to 40 characters maximum) when interfacing with either a numeric pager or personal computer.
 5. The UPS module shall terminate out calling attempts, to either a pager or personal computer, once receiving an in-bound call from a personal computer. When the out call is successfully received through the UPS module modem, the UPS module shall automatically store a successful out call attempt in the event log.
 6. The UPS module shall sequentially initiate out going calls and receive incoming calls through the same modem and same

telephone line. After completing an out call, the UPS module will wait with the RS232 port configured for an incoming call through the modem.

7. Information available to a personal computer connected to the UPS module via modem shall include: Metering, Event Log, and Battery Test Log.
 8. The UPS module shall log each unsuccessful out call attempt in the event log. The number of redial attempts to the two different phone numbers shall be programmable up to a maximum of 255 attempts. The interval between redial attempts to the two different phone numbers shall be programmable in one-minute increments up to a maximum of 60 minutes.
 9. The UPS module shall provide continuous error detection and correction for misconfigured and disconnected modems.
 10. The UPS module shall be capable of initiating outcalling through either a customer supplied Hayes compatible external modem or an optional internal modem.
- B. (OPTION) Input Filter with Power Factor Correction: The input filter shall reduce the harmonic feedback current to less than 10% total harmonic distortion (THD) reflected onto the utility by the rectifier. Additionally, the filter shall improve the input power factor to approximately 0.95. The input filter shall be housed in the UPS module. The UPS module shall be programmable to automatically disconnect the input filter during the following conditions:
1. With loss of Rectifier/Charger input power.
 2. When the critical load is below a threshold, user programmable, from 0% to 25% of UPS module rated capacity.
- C. (Option) Internal Modem: An internal modem shall provide out of band connectivity via an RJ-11 telephone connector. The modem shall automatically set all data transmission speeds from 300 bps to 33,600 bps using industry standard (ITU-T) protocols. The modem shall be energized by the UPS module's critical bus.

2.05 UNINTERRUPTIBLE POWER SUPPLY OPTIONS AND ACCESSORIES

The uninterruptible power system shall consist of the following options and accessories:

- A. (Option) Battery Cabinets: The battery cabinets shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinets shall have the following features:

1. Battery Capacity Protection Time (at 25 degrees C):
_____ minutes.
2. The battery cabinets shall be the same depth and height as the UPS module. The battery cabinets shall be 43 inches in width.
3. The battery cabinets shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinets shall provide top and bottom cable entry.
4. Each battery cabinet shall feature 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
5. The battery cabinets shall be available in a remote configuration, where multiple battery cabinets stand apart from the UPS module and but shall be installed secured to each other. Control wiring between battery cabinet shall pass through the battery cabinets. All power wiring between the battery cabinets and UPS module shall be provided by others. All control wiring between the number one battery cabinet and the UPS module shall be provided by others.
6. The battery cabinets shall be available in a remote configuration, where multiple battery cabinets stand apart from the UPS module and shall be installed separate from each other. The power wiring and control wiring between multiple battery cabinets and the UPS module shall be provided by others.
7. The battery cabinets shall each feature a DC rated circuit breaker. The circuit breaker within an individual battery cabinet shall only provide protection to the battery string with that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.
8. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
9. The circuit breaker in each battery cabinet shall feature a 24 VDC shunt trip. The UPS shall shunt trip the battery breaker(s) for an emergency power off command or a battery disable command.

10. Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.
 11. Final Discharge Voltage:
 - a) Full Load: 1.66 V per cell (adjustable).
 - b) No Load: 1.75 V per cell (adjustable). The UPS module shall automatically select the final discharge voltage (either 1.66 or 1.75 Volts per cell) based on the rate and length of discharge.
 12. Nominal Float Voltage: 2.25 V per cell.
 13. Maximum Equalizing Voltage: 2.40 V per cell.
- B. (OPTION) Input Isolation Transformer: The UPS shall feature a transformer that provides an isolated input to the rectifier for applications which require a floating (not ground-referenced) DC link (for use with wet cell batteries, etc.). This transformer shall be in a matching 49"-wide cabinet.
- C. (OPTION) Output Power Distribution Module: The output power distribution module shall feature two panelboards housed in a matching 34" wide cabinet for output power distribution. Each panelboard shall be equipped with a main circuit breaker and shall accept up to 40 poles of Square D type QO breakers (total of 80 poles). The cabinet bottom shall allow space for up to 60 flexible distribution conduits. Output power distribution module shall be for use with 208 VAC output UPS configurations only.
- D. (OPTION) External Battery Disconnect: An enclosed DC circuit breaker shall provide a manual means of disconnecting a battery which is not located adjacent to the UPS module.
- E. (OPTION) Maintenance Bypass Panel: The Maintenance Bypass Panel (hereafter referred to as the MBP) shall provide electrical power to the critical load from the UPS module output or utility bypass and shall have the following features:
1. The MBP shall provide a make before break power transfer to the critical load between the UPS module output and utility bypass.
 2. The MBP shall provide disconnect devices enclosed within galvanized steel boxing with code gauge steel trim painted ANSI 61 gray. Integral bussing shall be factory installed, tin-plated aluminum for 100-400 amperes and tin-plated copper for 600-1200 ampere panels. The MBP shall be available in the following configurations:
 - a) Two Device - This configuration shall include both the UPS module wrap around (maintenance bypass) disconnect and UPS module output disconnect devices.
 - b) Three Device - This configuration shall include the UPS module wrap around (maintenance bypass)

disconnect, UPS module output disconnect and UPS module bypass input disconnect devices.

c) Four Device- This configuration shall include the UPS module wrap around (maintenance bypass) disconnect, UPS module output disconnect, UPS module bypass input disconnect and UPS module rectifier input disconnect devices.

3. The MBP disconnect devices shall be available as either molded case switches or molded case circuit breakers.
4. The MBP shall be available in ampacity ratings of 150, 250, 400, 600, 800, and 1200 amps.
5. The MBP shall be available in voltage ratings of 208, 400, 480 or 600 volts AC.
6. An interlock key shall be available which provides electrical isolation between the UPS module inverter output power and the utility bypass circuit while transferring power to the critical load.
7. A breaker auxiliary switch shall be available which provides includes 2NO and 2NC contacts suitable for remote signaling and indication of the circuit breakers main contact position.
8. A breaker shunt trip device shall be available which provides remote controllable tripping of circuit breakers with 24 VDC.
9. A NEMA 3R Enclosure shall be available which is suitable for outdoor use and protection.

F. (OPTION) Remote Emergency Power Off (REPO) Station: The REPO station shall be connected to a UPS module. The REPO shall feature a red push-button switch which, when depressed, opens the associated UPS module's breakers and contactors, and de-energizes that UPS module's critical load. A key shall be required to reset the push-button. The REPO station shall be approximately 4.5 inches in height and width, and may be flush or surface wall mounted. Maximum distance from the UPS module shall be 500 feet. Multiple REPO stations may be used with a single UPS module.

G. (OPTION) Remote Monitor Panel (RMP): The RMP shall contain seven backlit status indicators and a local horn that display the current operating mode of the UPS module. The RMP shall be approximately 8.5 inches high and 11.25 inches in width and shall provide flush or surface wall mounting capability. The maximum distance from the UPS module shall be 500 feet. The status indicators shall be:

1. UPS Module Normal
2. On Bypass
3. On Battery

4. Bypass Unavailable
 5. UPS Module Alarm
 6. Shutdown Imminent
 7. On Generator
- H. (OPTION) Supervisory Contact Module (SCM): The SCM shall contain seven Form "C" contacts and a local horn which enunciates the current operating mode of the UPS module. The SCM shall be approximately 8.5 inches high and 11.25 inches in width and shall provide flush or surface wall mounting capability. The maximum distance from the UPS module shall be 500 feet. Each UPS module shall be capable of driving up to two SCMs, RMPs or RIMs. The status indicators shall be:
1. UPS Module Normal
 2. On Bypass
 3. On Battery
 4. Bypass Unavailable
 5. UPS Module Alarm
 6. Shutdown Imminent
 7. On Generator
- I. (OPTION) Relay Interface Module (RIM): The RIM shall enunciate the current operating mode of the UPS module through a RS485 port with the capability to support the controlled shutdown of up to 8 critical loads. The RIM shall be approximately 8.5 inches high and 11.25 inches in width and shall provide flush or surface wall mounting capability. The maximum distance from the UPS module shall be 500 feet. Each UPS module shall be capable of driving up to two SCMs, RMPs or RIMs. The status indicators shall be:
1. UPS Module Normal
 2. Bypass Unavailable
 3. On Battery
 4. Shutdown Imminent
- J. (OPTION) SNMP Network Adapter: SNMP adapters shall provide a communications interface between the UPS module (via the RS-232 port) and SNMP-compatible network management systems. This capability shall allow the unit to be monitored remotely over an Ethernet or Token-Ring network.
- K. (OPTION) UPS Monitoring System: This dedicated PC based system shall continuously monitor critical power elements associated with the UPS, using the communications port on the UPS module. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition. The monitoring system shall be able to support a software interface with any UPS through Binary Computer Mode (BCM). The monitoring system shall

also be upgradable, at any time in the future, to incorporate multi-vendor power and environmental equipment.

1. The system shall use a real-time, true multi-tasking operating system capable of a minimum of 100 concurrent operating tasks.
2. The system shall be able to notify personnel of alarm conditions through a telephone paging system. A separate phone number shall be assigned to each point being monitored. At least ten separate numbers shall be called for each point monitored by the system.
3. The system shall provide the means to identify and resolve existing and potential failures. The alarm status for all measured variables shall be updated once per second or at a rate not less than the scan time of the UPS being monitored. The system shall be capable of providing rate-of-change alarms to proactively monitor the UPS variables. Each metered (analog) variable shall be measured against four alarm limits (critical high, cautionary high, critical low and cautionary low) configurable at the user-interface. An alarm summary screen shall display operator alarm responses, the time of the alarm, the alarm value and the current value. The system shall be able to prioritize multiple alarms.
4. The system shall be able to store and graph the most recent 1,400 data points for each variable being monitored.
5. System and power reports shall be provided. Power reports shall include a UPS Report, a Load Analysis report, and a Capacity Planning report. The system shall automatically update report information with the most current data for each point monitored.
6. The system's workstation shall consist of Intel's Pentium system controller, with a minimum 1 Gb hard drive, 16 Mb of random access memory, a 1.44 Mb 3.5" floppy drive, two serial ports, one parallel port, a network controller and a color monitor with VGA color resolution. The workstation shall include a 2400 Baud auto-dial modem to support the out call paging software for alarm notification.
7. The system software shall consist of a standard, commercialized application to ensure operating integrity and system support.
8. The system shall be expandable to allow for increased UPS monitoring capacity and functionality. The system shall be able to expand its monitoring capability beyond UPS monitoring to include local and or remote environmental equipment, safety/security systems, and other power equipment.

9. The system shall provide monitoring, data collection and performance analysis of all critical UPS elements. The points list shall be approved by the UPS manufacturer.
- L. (OPTION) Facilities Monitoring System: The system shall have a Client/Server architecture where the Server provides high speed data acquisition and control for real-time data acquisition. The Client shall provide a highly intuitive Graphical User Interface (GUI), data display, data analysis and alarm management. The MS-Windows 95 or NT-based Clients shall be able to connect to the multi-tasking Server(s) via any serial or Ethernet connection to retrieve information.
1. Up to sixteen remote Client users shall be able to access each Server simultaneously over a TCP/IP network or SLIP (high speed dial-up). Each remote user shall be capable of having different screens or views. All users shall be able to view alarm status and view real-time data, graph channel data, acknowledge alarms, run reports and perform any function permitted according to their password access.
 2. The Client shall be designed with an intuitive multi-level down to the operating detail of an hierarchy that shall offer a global view of the data center individual channel.
 3. The Client shall be capable of configuring and displaying customized floor equipment diagrams, equipment views with points monitored, and one-line diagrams. These graphical views shall be easily modified by each Client user and if desired, be completely unique and independent for each Client. The Client shall be able to import a variety of bit mapped graphics, including customer-provided CAD files, custom graphics provided by third party vendors, or any digitized image. The visual displays shall be highly graphical to accurately depict the layout of the site, critical support equipment, and even sensor-point detail of monitored points. It shall be possible to update and modify the displays to accommodate changes and growth. Any graphical view shall be easily configurable and modifiable at the Client without interrupting the acquisition, processing or archiving of data from the network.
 4. The Client password structure shall permit administrators to determine if a user will be allowed to acknowledge alarms, modify alarm properties, access reports, run reports, retrieve reports, schedule reports, change Server functionality, and the ability to modify drawings.
 5. An alarm summary screen shall display operator alarm responses, the time of the alarm, the alarm threshold, the current value, and any personalized message for that Client. Each active alarm shall be automatically prioritized based on a numeric value assigned by the user. Alarms shall be programmable by time of alarm (ascending or descending order), type of alarm, channel name, alarm priority or

Server location. Alarm filters shall be available to allow the user to select specific alarms or groups of alarms to display on the alarm summary screen.

6. The alarm response instructions shall automatically appear at the Client software when one or more channels is in alarm.
7. The Client shall be capable of notifying personnel through alpha and/or numeric paging. The paging capability shall provide for a specific priority phone list where the user can define at least ten separate numbers to be called for every channel monitored by the system. All alarm paging shall be automatic with user defined unanswered call times prior to automatic dialing of the next number on the call list. Automatic call escalation shall be provided such that paging continues until the alarm is acknowledged.
8. From a remote MS-Windows 95 PC, the system will be able display alarm values from one or multiple Servers with a highly intuitive user interface as well as all functions available in item 5 above.
9. The Client shall be able to display multiple graph windows simultaneously and shall only be limited to the number of windows currently supported by Microsoft Windows 95. The Client shall automatically scale each open window so tiled windows display all the information available regardless of the number of windows open.
10. The Client shall be able to display multiple graph types including 3D Bar, Area, Bar, Deep Bar, Group Bar, Line, Line with data markers, Stacked Bar, Stacked Line.
11. Each Client shall be able to graph data from any monitored point by simply pointing and right-clicking on a data value or group of values. Graphing shall be available at any time, from any where in the Client and shall be available via context sensitive "right mouse click" functions.
12. The Client shall be capable of copying graphs to any Windows 95 application via the clipboard. Copy/Paste from the clipboard with graph data shall use the Microsoft Metafiles format to allow modification in other applications. Copy/Paste from the clipboard shall also allow the user paste trace data values in addition to pasting the image.
13. The graph shall support a instant zoom in or zoom out feature to allow users to view an area of interest or zoom out to expand the area.
14. Each Client shall be able to open a network wide browser to select any point to graph against any other point with a single mouse click from any graph window. Client software shall support up to 20 different graphs in any graph window

simultaneously and from any Server without requiring the user to predefine any combination.

2.06 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A. UPS Continuous Ratings:

1. The UPS shall be rated at ____ kVA maximum for a load power factor range of 0.8 lagging to 0.9 leading (choose a kVA value from Appendix 1, Table One, column 3).
2. The UPS shall be rated at ____ kW (choose a kW value from Appendix 1, Table One, column 4).
3. The UPS shall be field upgradeable to ____kVA____kW (choose one set of kVA/kW values from Appendix 1, Table Two, column 3).

B. Rectifier/Charger Input:

1. Nominal Input Voltage: _____ VAC, 3-phase, 3-wire plus ground (choose a VAC value from Appendix 1, Table Three, column 3).
2. Operating Input Voltage Range: +10%, -15% of average nominal input voltage without battery discharge.
3. Operating Input Frequency Range is within 3 Hz of the nominal input frequency:
 - a) For a 50 Hz UPS module, the range is 47 to 53 Hz.
 - b) For a 60 Hz UPS module, the range is 57 to 63 Hz.
 - c) The frequency range is adjustable to nominal \pm 5 Hz, factory set.
4. Input Power Factor Range with optional input filter: 0.95 lag minimum (with optional input filter) at full load and nominal input voltage (with battery on float).
5. Normal Input Current Limit: The UPS module shall have the following programmable input current limit settings while operating in Normal mode:
 - a) Rectifier/Charger Input Current Limit: Shall be adjustable from 50% to 125% of full-load input current.
 - b) Battery Input Current Limit: Battery charge current limit shall be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.
6. On Generator Input Current Limit: The UPS module shall have the following programmable input current limit settings while operating in Normal mode on generator:

- a) Rectifier/Charger Input Current Limit: Shall be adjustable from 50% to 125% of full-load input current.
 - b) Battery Input Current Limit: Battery charge current limit shall be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.
- 7. Input Current Total Harmonic Distortion (THD) with optional input filter: 10% Maximum.
 - 8. Magnetizing Inrush Current: Typically 800% of the largest model's full load rectifier input current.
 - 9. Power Walk-in: Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.
- C. Bypass Input:
- 1. Synchronizing Bypass Voltage Range: +/-10% of average nominal input voltage.
 - 2. Synchronizing Bypass Frequency Range is centered on the nominal frequency (choose a value from Table Four of Appendix 1).
 - 3. Input Surge Withstand Capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), Category A & B (6 kV).
- D. Rectifier/Charger Output:
- 1. Nominal DC Voltage: Nominal DC voltage shall be _____ (choose a value from Appendix 1, Table Three, column 5).
 - 2. Steady State Voltage Regulation: +/- 0.5%
 - 3. Voltage Ripple: less than 0.5% (peak to peak)
 - 4. Capacity: The Rectifier/Charger shall support a fully-loaded Inverter and recharge the battery to 95% of its full capacity within 10 times the discharge time when input current limit is set at maximum.
 - 5. Low Line Operation: The Rectifier/Charger shall be capable of sharing the DC load with the Battery when the input voltage falls below the specified operating input voltage range, The On Battery indicator shall enunciate operation in this mode.
 - 6. Battery Equalize: Automatic and manual means must be provided for battery equalization
 - 7. DC Sensing: Redundant DC voltage sensing methods shall be incorporated for providing battery overvoltage protection.
- E. UPS Output in Normal Mode:

1. Nominal Output Voltage: _____ VAC, 3-phase, 3-wire plus ground or 4-wire plus ground (choose a VAC value from Appendix 1, Table Three, column 4).
2. Steady-State Voltage Regulation (on Inverter): Within +/-1% average from nominal output voltage.
3. Transient Voltage Response: Within +/-5% from nominal voltage for a 100% load step, full load re-transfers and full load drop on battery.
4. Transient Voltage Recovery: 25 ms to within +/-1% of steady state.
5. Linear Load Harmonic Distortion Capability: Output voltage THD of less than 3% into 100% linear load; 2% for a single harmonic.
6. Non-Linear Load Harmonic Distortion Capability: Output voltage THD of less than 5% for 100% non-linear load with a 3:1 crest factor.
7. Manual Output Voltage Adjustment: +/-5% from nominal.
8. Line synchronization Range: +/-0.5 Hz, adjustable to +/- 5 Hz.
9. Frequency Regulation: +/-0.005 Hz free running.
10. Frequency Slew Rate: 1 Hz/second maximum (adjustable).
11. Phase Angle Control:
 - a) Balanced Linear Loads: +/-1 degree from nominal 120 degrees.
 - b) Unbalanced Linear Loads: +/-3 degrees from average phase voltage for 100% load unbalance.
12. Phase Voltage Control:
 - a) Balanced Linear Loads: +/-1% from average phase voltage.
 - b) Unbalanced Linear Loads: +/-3% for 100% load unbalance.
13. Overload Current Capability (with nominal line and fully charged battery): The unit shall maintain voltage regulation for 125% for 10 minutes and 150% for 10 seconds.
14. Fault Clearing Current Capability: Up to 300% of phase-to-phase or phase-to-neutral rating for 2 cycles.
15. Static Transfer Time: Make-before-break transfer completed in less than 4 ms.
16. Common Mode Noise Attenuation: -65 dB up to 20 kHz, -40 dB up to 100 kHz.

F. UPS Output in Bypass Mode:

1. Nominal Output Voltage: _____ VAC, 3-phase, 3-wire plus ground or 4-wire plus ground (choose a VAC value from Appendix 1, Table Three, column 4).
2. Static Transfer Time: Make-before-break transfer completed in less than 4 ms.

2.07 MECHANICAL DESIGN

- A. Enclosures: The UPS module shall be housed in free-standing, double front enclosures (safety shields behind doors) equipped with leveling feet. The enclosures shall be designed for industrial or computer room applications in accordance with the environmental requirements. The UPS module enclosure shall provide fork lift access from the front, back and both sides. The enclosures shall line up and match up in style and color for an aesthetically pleasing appearance. Each of the enclosures shall be shipped separately with joining hardware to be bolted together at the time of installation.
- B. Ventilation: The UPS module shall be designed for forced air cooling. Air inlets shall be in the lower front. Air outlets shall be in the rear of the top. Twelve inches of clearance over the UPS air outlets shall be required for proper air circulation. Air filters for the UPS module shall be in commonly available sizes.
- C. No back or side clearance or access shall be required for any enclosure. The back & side enclosure covers shall be capable of being located directly adjacent to a wall.
- D. Cooling Fans: The modular design of the UPS module shall permit removal of each fan without removal of any other assembly. Fan replacement shall be accomplished by removing no more than one fastener per fan and shall not require the removal of another subassembly.
- E. Cable Entry: Standard cable entry for the UPS module shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS module for routing user input and output wiring. The wireway section shall be capable of being completely removed from the UPS module during installation to temporarily reduce the overall width of the UPS module by 9 inches.
- F. Front Access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). All components with exception of the power magnetics shall be located within the front 12 inches of the UPS module enclosure for easy maintenance access. Removal and replacement of any subassembly shall not require the removal of another subassembly. Side or rear access to the UPS module shall not be required for UPS module installation, service, repair or maintenance.

- G. Service Area Requirements: The UPS module, battery and options enclosures shall require no more than thirty inches (30") of front service access room, and shall not require side access for service or installation.
- H. Size: The UPS module shall not exceed a depth of 31.5 inches, a height of 73.5 inches and a width of _____. The UPS module shall not exceed an installation weight of _____. (choose values from Appendix 1, Table Five).

2.08 CONTROLS AND INDICATORS

- A. Micro-Controller Operated Circuitry: The UPS controls shall have the following design and operating characteristics:
 - 1. Fully automatic operation of each UPS module shall be provided through the use of micro-controllers. (Digital signal processing shall eliminate variances from component tolerance or drift, and provide consistent operational responses.)
 - 2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. All adjustments and calibrations shall be performed without the use of potentiometers. Printed circuit board replacement shall be possible without requiring calibration.
 - 3. Start-up and transfers shall be automatic functions.
 - 4. Multiple micro-controllers shall be used, so no single controller is in a mission critical application.
 - 5. All configuration, setup and calibration information shall be stored in non-volatile memory that does not require a control battery for data storage.
 - 6. Emergency transfers to Bypass due to UPS module failure, shall be independent of the control logic controlling the Rectifier/Charger, Inverter and Monitor panel. Emergency transfer circuitry shall contain all the necessary circuitry to perform an emergency transfer without any other functioning logic.
 - 7. Monitoring and communications logic shall be independent of the Rectifier/Charger and Inverter control logic. Circuitry and firmware required for monitoring and communications logic shall be functionally isolated from the Bypass, Rectifier/Charger and Inverter controls. Monitoring firmware shall be field upgradeable.
 - 8. The UPS module shall be programmable to optionally provide automatic restart capability following loss of utility and a complete battery discharge. When utility power returns, the UPS module shall automatically energize the output terminals and subsequently transfer to Normal mode.

- B. Monitor Panel Indicators: The UPS module shall be equipped with a monitor panel providing the following monitoring functions and indicators (each alarm and notice condition shall be accompanied with an audible alarm):
1. NORMAL: This symbol shall be lit when the UPS module is operating in Normal mode.
 2. BATTERY: This symbol shall be lit when the UPS module is operating in Battery mode. The Normal indicator also remains lit.
 3. BYPASS: This symbol shall be lit when the UPS module is operating in Bypass mode. The critical load is supported by the Bypass source. The Normal indicator shall not be lit when the UPS module is in Bypass mode.
 4. NOTICE: This symbol shall be lit when the UPS module needs attention. Some notices may be accompanied by an audible horn. Notices shall include:
 - a) Bypass not available
 - b) Battery undervoltage
 5. ALARM: This symbol shall be lit when a situation requires immediate attention. All alarms shall be accompanied by an audible alarm. Alarms shall include:
 - a) Over temperature
 - b) Output overload
 - c) Inverter failure
 - d) Rectifier/Charger failure
 - e) Shutdown imminent (Low battery in Emergency mode.)
 6. STANDBY: This symbol shall be lit when electricity is present in the rectifier and Inverter while the Normal indicator is not lit. During normal startup this indicator shall remain lit until the UPS module transfers to Normal mode, at which time the Normal indicator shall light. During normal shutdown the Standby indicator shall remain lit until all energy in the UPS module is dissipated and shutdown is complete.
- C. Monitor Panel Controls: The UPS module shall be equipped with a monitor panel providing the following control functions:
1. Menu and Cursor Controls: Selects, displays and scrolls data on the LCD.
 2. Load Off: Shuts down the UPS module, de-energizes the critical load and opens the UPS module's breakers and contactors.
 3. Horn Silence: Silences the current audible alarm(s). The Horn shall sound again if new alarms occur.

4. Screen Adjust: Controls the liquid crystal display contrast.
- D. Monitor Panel Liquid Crystal Display (LCD): The UPS module shall feature a liquid crystal display measuring 6" by 7.5" with 30 lines of information, 80 characters wide. The display shall feature an auto-blanking feature. Graphical user screens shall be provided on the Monitor panel LCD to display the UPS module's operating parameters. The monitor panel pushbuttons shall be used to access information in these screens. Information in the meter screen and alarm history screen shall be available to a remote terminal or printer through the RS-232 (EIA/TIA-232) communication port. The screens shall include:
1. Common Information: The following information shall be presented on the LCD panel at all times:
 - a) UPS Module Identification: A user programmable UPS module identification of up to 45 characters.
 - b) UPS module status.
 - c) Highest priority active alarm.
 - d) Highest priority active notice.
 - e) Real time clock, featuring time and date indications, which is programmable from the monitor panel.
 - f) Real-time battery time available (in the event a utility outage occurs) for the current critical load.
 2. UPS Module Meter Screen: Real-time digital metering of:
 - a) Rectifier/Charger inputs: voltage (per phase, RMS), current (per phase), frequency, kW, kVA, power factor.
 - b) UPS module outputs: voltage (per phase, RMS), current (per phase plus neutral), frequency, kW, kVA, power factor. Output voltage and current sensing shall independent of the Inverter controls.
 - c) Bypass inputs: voltage (per phase, RMS).
 - d) DC link voltage.
 - e) Battery charge and discharge current.
 3. Output Current Screen: Bar graph display of the percent output current of each phase.
 4. Event History Screen: Shall display up to 400 of the most recent events by date and time. Time shall be displayed in tenths of seconds (0.1 sec) and recorded in thousandths of seconds (0.001 sec). The screen shall define and display events as either alarms, notices, commands or status. A brief description shall be provided for each event recorded on this screen. When a system event occurs, a message shall be added to the Event History Log. The message shall optionally appear on the Monitor Panel of the UPS.

5. Active Events Screen: Shall automatically display a list of all active alarms and notices.
6. Statistics Screen: This screen shall display the following:
 - a) Time on battery: A record shall display the duration and frequency of utility outages in the life of the batteries and in the current month.
 - b) Building alarms: A record shall display the frequency of each building alarm enunciation in the life of the UPS module and in the current month.
 - c) Operational History: A record shall display the total amount of time the UPS module has been in the each of the following modes of operation: Normal, Bypass and Battery. A record shall display the total amount of time the UPS module has been on generator.
 - d) Availability: The observed availability of the Normal mode shall be displayed. In addition, the availability of the Bypass supply as a backup source shall be displayed.
 - e) Startup Date: The date the UPS module was initially energized shall be displayed.
7. UPS Module Mimic Screen: A graphic display of the UPS module operational mode and power flow through the UPS module to the critical load shall be displayed in real-time. The operational status of the Inverter, Rectifier/Charger, Bypass and Battery is also indicated. Circuit breaker and contactor states shall be indicated.
8. Setup Screen: Shall permit setting time and date for the UPS module clock with controls on the Monitor Panel. Shall permit configuration of the RS232 and RS485 communications ports, with controls on the Monitor Panel, for the following modes of operation:
 - a) Terminal Mode: UPS module events shall be logged immediately as they occur.
 - b) Calibration Mode: Shall be used by service personnel for UPS module diagnostics.
 - c) UPS Module Configuration Mode: Shall allow setup and configuration of user level functions like battery test and building alarms. Shall allow the six building alarms to be customized with a description of up to 30 characters for display locally on the monitor panel screens and remotely. Shall allow the six building alarms to be programmed to initiate UPS module commands upon contact closure.
 - d) Computer Mode: Shall allow the user to interface with the UPS module in Binary Computer Mode.

- e) Remote Monitor Mode: The RS485 port shall be configured to interface with a Remote Monitor Panel, Supervisory Contact Module or Relay Interface Module.
- E. Control Panel: The UPS module shall be equipped with a control panel providing UPS module control functions. (A key shall be required to turn on the UPS module.) The following controls shall be provided on the control panel:
- 1. The Key switch shall initiate the energize sequence to place the UPS module in either Normal mode or Bypass mode, as defined by the Mode switch position.
 - 2. The Mode switch shall control the manual transfer of the UPS module to and from Bypass mode.
 - 3. The Battery switch shall enable or disable closure of an external battery breaker.
 - 4. A circuit breaker shall enable operation of the rectifier.
 - 5. A Load Off Reset switch shall reset the UPS module, following a Load Off command.
- F. Communication Panel: The UPS module shall be equipped with a communication panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:
- 1. Alarm and Notice Contacts: Dry contacts for summary alarms and notices shall be provided for external use.
 - a) Alarm: Indicates the UPS module is experiencing an Alarm condition.
 - b) Notices: Indicates the UPS module is experiencing a Notice condition.
 - 2. RS-232 (EIA/TIA-232) and RS-485 Communication Interface: Circuitry shall be provided for one RS-232 (EIA/TIA-232) and one RS-485 communication port. These ports may be used with simple terminals to gain remote access to all unit operation information.
 - 3. Remote Monitor Panel Connection: Circuitry shall be provided for connection of up to two accessory remote monitor panels, relay interface modules or supervisory contact module.
 - 4. Building Alarms: Six inputs shall be provided for monitoring the status of external dry contacts. One input shall be dedicated to monitoring an external battery disconnect, and one shall be dedicated to monitoring an auxiliary generator and initiating reduced input current limit. The remaining four inputs shall be user selected (smoke, temperature, water, etc.) Building alarms shall be set up through the UPS module configuration mode function of the RS-232 (EIA/TIA-232) port. The building alarms shall also provide the following capabilities:

- a) Building alarms shall allow the user to customize the building alarm message (up to 30 characters max.) which appears locally on the Monitor Panel or remotely through the communication ports.
- b) Building alarms shall be programmable to initiate a transfer of the UPS module from Normal Mode to Bypass Mode upon contact closure.
- c) Building alarms shall be programmable to initiate a transfer of the UPS module from Bypass Mode to Normal Mode upon contact closure.

2.09 UPS MODULE PROTECTION

- A. Rectifier/Charger protection shall be provided by thermal-magnetic or RMS current sensing molded-case circuit breakers and transient suppression circuitry.
- B. The static switch shall feature a thermal switch which will open the backfeed contactor in the event the static switch temperature exceeds normal operating parameters
- C. Battery protection shall be provided by individual fusing or thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery. The UPS module shall feature positive and negative DC fusing to the external batteries.
- D. Output protection shall be provided by electronic current limit circuitry, DC fusing of each pole of each inverter leg.
- E. UPS module output protection shall be provided through 3 phase AC fusing of the inverter output on the secondary side of the UPS module output isolation transformer.
- F. UPS module output protection shall be provided through 3 phase AC fusing for connecting the inverter AC output filter capacitors to the inverter output.
- G. Input wiring to the Rectifier/Charger input and Bypass input shall be monitored for proper sequencing. If wiring is installed out of sequence, the UPS module shall detect and enunciate this condition (on the Monitor Panel) when power is supplied to the inputs. The UPS module shall not allow operation in Normal mode until the wiring error is corrected.
- H. Inverter circuitry shall be provided controls which automatically inhibits the Inverter IGBT switching currents should they exceed normal operating parameters.
- I. The UPS module shall remain in Normal mode during a failure condition where the Bypass backfeed protection fails. Manual transfers between Normal mode and Bypass mode shall be possible with this failure condition

- J. The UPS module shall remain in Normal mode during a failure condition where one or more SCRs in the static switch shorts. Manual transfers between Normal mode and Bypass mode shall be possible with this failure condition

PART 3 - EXECUTION

3.01 (OPTION) INSTALLATION AND FIELD QUALITY CONTROL

- A. Installation shall be performed in accordance with manufacturer's instructions.
- B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
 - 1. Visual Inspection:
 - a) Visually inspect all equipment for signs of damage or foreign materials.
 - b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
 - 2. Mechanical Inspection:
 - a) Check all the power connections for tightness.
 - b) Check all the control wiring terminations and plugs for tightness or proper seating.
 - 3. Electrical Precheck:
 - a) Check the DC bus for a possible short circuit.
 - b) Check input and Bypass power for proper voltages and phase rotation.
 - c) Check all lamp test functions.
 - 4. Initial UPS Startup:
 - a) Verify that all the alarms are in a "go" condition.
 - b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - c) Check the DC link holding voltage, AC output voltages, and output wave forms.
 - d) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - e) Check for the proper synchronization.
 - f) Check for the voltage difference between the Inverter output and the Bypass source.
 - 5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.03 MANUFACTURER'S FIELD SERVICE

- A. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours 80% of the time. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.
- B. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.
- C. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest engineering levels as they are developed.
- D. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These products shall be proposed as a field-installable, optional kit.

PART 4 - Appendices

4.01 Appendix 1: Tables

Table One: UPS Continuous Ratings

<u>UPS Product</u>	<u>Model</u>	<u>KVA</u>	<u>kW</u>
200	200	200	160
225	225	225	180
250	200	200	160
250	250	250	200
300	225	225	180
300	300	300	240
400	300	300	240
400	400	400	320
500	400	400	320
500	500	500	400

Table Two: UPS Upgrades

<u>UPS Prod.</u>	<u>From Model</u>	<u>To kVA/kW</u>
200	200	No Upgrade
225	225	No Upgrade
250	200	250/200
300	225	300/240
400	300	400/320
500	400	500/400

Table Three: Nominal Voltage Configurations

<u>UPS Prod.</u>	<u>Models</u>	<u>UPS Module Volts In</u>	<u>UPS Module Volts Out</u>	<u>Battery DC Volt</u>
200	200	400	400	420
225	225	208	208	480
225	225	480	208	480
225	225	480	480	480

250	200, 250	400	400	420
300	225, 300	480	480	480
300	225, 300	600	600	480
400	300, 400	400	400	420
500	400, 500	480	480	480

Table Four: Synchronizing Bypass Frequency Range

<u>UPS Prod.</u>	<u>Range</u>
225, 300, 500	60 +/-5 Hz
200, 250, 400	50 +/-3 Hz
200, 250, 400	60 +/-5 Hz

Table Five: UPS Size Limits

<u>UPS Prod.</u>	<u>Model</u>	<u>Volts In</u>	<u>Volts Out</u>	<u>Width (In.)</u>	<u>Weight(lb.)</u>
200	200	400	400	65	3812
225	225	208	208	65	6363
225	225	480	480	65	3863
225	225	480	208	65	3863
250	200, 250	400	400	65	4177
300	225, 300	208	208	163	12,377
300	225, 300	480	208	114	8277
300	225, 300	480	480	65	4177
300	225, 300	600	600	65	4177
400	400	400	400	74	6100
500	400	208	208	172	14,100
500	400	480	208	123	10,100
500	400, 500	480	480	74	6100
500	400, 500	600	600	123	10,100
Parallel Cabinet	All	All	All	34	2475

END OF SECTION