SECTION 16610

STATIC UNINTERRUPTIBLE POWER SUPPLY

Parallel Redundant/Capacity System

## 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 of conditioned power for critical electrical loads.

B. The UPS shall consist of from one to eight Uninterruptible Power Modules (UPM) connected together through a single System Bypass Module (SBM), one or more battery strings, and other features as described in this specification.

C. The individual UPMs described in this specification shall be available with an output capacity from 200 – 500 kVA.

### 1.02 REFERENCES

A. UL 1778 - (Underwriters Laboratories) Standard for Uninterruptible Power Supply Equipment. Listed Equipment (US).

B. CSA C22.2 NO.107.1 - (Canadian Standards Association) Commercial and Industrial Power Supplies. Listed Equipment (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 - (Institute of 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.

## 1.03 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) UPM 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

## 1.04 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 made available upon request.

B. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and the field service organization.

## 1.05 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) for the UPMs and SBM. Prolonged storage of batteries 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 SBM under normal operation shall not exceed 65 dbA. Noise generated by the UPM under normal operation shall not exceed _____dbA. Acoustical readings shall be measured one meter from any operator surface, at 25 degrees C (77 degrees F) and full load (choose a dbA value from Appendix 1, Table Four, column 6).

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 UPM efficiency shall be 92% at full unity power factor load and nominal input voltage.

1. If present, an input auto-transformer may reduce the UPM efficiency an additional 1%.

2. If present, an input isolation transformer may reduce the UPM 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).

## 1.06 RELIABILITY AND MAINTAINABILITY

A. Reliability

1. The calculated UPM 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 UPM.

2. The calculated mean-time-between-failure for the UPM, which would result in the UPS successfully Removing itself from the critical bus, 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).

3. The calculated mean-time-between-failure for any UPM 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 UPM shall feature redundant power supplies. Power to the control power supplies shall originate from the Rectifier/Charger input and UPM output. In the event one of the power supplies shall fail, the UPM 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 UPM shall feature redundant cooling fans. In the event one of the fans shall fail, the UPM 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 UPM shall utilize high-reliability wiring and connectors. The UPM shall not feature ribbon cables.

7. The inverter controls, rectifier/charger controls, monitoring/communication controls and Power Net controls in the UPM shall be contained, in their totality, on a maximum of four control printed circuit boards.

8. All UPM 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.

1.07 SAFETY

A. The UPS shall be ETL (Electrical Testing Laboratories) listed by Intertek Testing Services in accordance with Underwriters Laboratories standard UL 1778.

B. The UPS shall be ETL (Electrical Testing Laboratories) listed by Intertek Testing Services in accordance with the Canadian Standards Association standard 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).

1.08 WARRANTY

A. Uninterruptible Power Module: The UPS 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 all other 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 SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A. UPM & SBM Configuration:

1. The UPS shall feature SBM _____, Model _____ (choose the SBM type and Model from Appendix 1, Table One, columns 1 & 2).

2. The UPS shall feature UPM _____, Model _____ (choose the UPM type and Model from Appendix 1, Table Two, columns 1 & 2).

3. The UPS shall feature a quantity of _____ UPMs (choose the UPM quantity from Appendix 1, Table Two, columns 5 & 6).

B. UPM Continuous Ratings:

1. Each UPM 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 Two, column 3).

2. Each UPM shall be rated at ____ kW (choose a kW value from column 4 of Table Two in Appendix 1).

3. Each UPM shall be field upgradeable to ____kVA____kW (choose one set of kVA/kW values from Appendix 1, Table Three, column 3).

C. UPM Rectifier/Charger Input:

1. Nominal Input Voltage: _____ VAC, 3-phase, 3-wire plus ground (choose a VAC value from Appendix 1, Table Four, 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 UPM, the range is 47 to 53 Hz.

b) For a 60 Hz UPM, the range is 57 to 63 Hz.

c) The frequency range is adjustable to nominal + 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: Each UPM 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 UPM's full load input current regardless of the actual load on the UPM.

6. On Generator Input Current Limit: Each UPM 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 UPM's full load input current regardless of the actual load on the UPM.

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.

D. UPS 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 Appendix 1, Table Four).

3. Input Surge Withstand Capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), Category A & B (6 kV).

E. UPM Rectifier/Charger Output:

1. Nominal DC Voltage: Nominal DC voltage shall be _____ (choose a value from Appendix 1, Table Four, 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.

F. 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 of in Appendix 1, Table Four, 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 +/- 1 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.

G. 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 Four, column 4).

2. Static Transfer Time: Make-before-break transfer completed in less than 4 ms.

## 2.03 UNINTERRUPTIBLE POWER SYSTEM STANDARD FEATURES

The Uninterruptible Power Supply shall feature the following standard components and capabilities:

A. The UPS shall consist of the following components:

1. One to eight Uninterruptible Power Modules (UPMs).

2. One System Bypass Module (SBM).

3. One common battery string for each UPM or one separate battery string for each UPM.

B. UPS Configuration

1. The SBM shall source from either the UPM bus within the SBM or the SBM bypass input to support the loads on the critical bus. During Normal operation the SBM sources from the UPM bus to support the loads on the critical bus.

2. The SBM shall automatically transfer the critical loads to the SBM bypass input source for emergency bypass power in the event of a UPM bus failure or for load fault clearing.

3. The SBM UPM input shall serve as the junction point for the UPM outputs and shall form the UPM bus.

4. The SBM bypass input shall serve as the junction point for an alternate energy source. The source for the SBM bypass input shall either be one of the UPM input sources or an alternate source.

5. The individual UPM inputs shall be from the same source or from different sources. If the UPM inputs are from more than one source and a common UPM battery is utilized, then each of the UPMs shall feature an input isolation transformer.

C. Uninterruptible Power Module Configuration

1. Open - The UPS shall feature identical UPMs.

2. A parallel capacity capable UPM in a reverse transfer configuration (one module system) shall have the capability to be upgraded after initial installation to serve as one of the UPMs in a parallel capacity configuration as described in this product specification.

3. A parallel capacity capable UPM in a parallel redundant configuration (two module system) shall have the capability to be upgraded after initial installation to serve as one of

the UPMs in a parallel capacity configuration as described in this product specification.

D. Battery Configurations

1. Common Battery Configuration: The UPS shall be capable of operating with a common battery connected to the DC links of all the UPMs. Inter-module communications shall not be required to support this battery configuration.

2. Separate Battery Configuration: The UPS shall be capable of operating with separate batteries connected to the DC links of each UPM. The integral Battery Management System shall provide up-to-date battery runtime information and battery health indication. Inter-module communications shall not be required to support this battery configuration.

3. The UPS shall accommodate either valve-regulated (AGM) batteries or wet cell batteries in any of the above configurations.

E. Power Wiring Interconnections

1. The UPS shall feature 3-phase power wiring (3 wires) to connect each UPM to the UPM bus within the SBM.

2. The power wiring used to connect each UPM to the SBM shall be run through external conduit per applicable local code requirements.

F. Monitoring Wiring Interconnections

1. The UPS shall feature 2 independent and fully redundant digital monitoring networks which connect the UPMs to the SBM. Each interconnecting cable (Belden 8761 or equivalent) shall consist only of a twisted shielded pair. Each of these interconnection cables shall serve as the physical layer for the UPS monitoring network.

2. Cabling for the UPS monitoring network shall consist of cable segments secured at each SBM or UPM with mechanical connectors. All module interconnections shall be fully redundant.

3. The 2 cables for the UPS monitoring network shall daisy chain between the UPMs and the SBM. This shall be done in such a manner that all but the outside modules shall have a total of 4 interconnecting cables landing at each module. Only 2 interconnecting cables shall be landed at the outer 2 modules. A specified module landing sequence for the interconnecting cables between the UPMs and SBM in the installation shall not be required.

4. The length of all the interconnecting cable segments in one network shall be no less than 100 meters. Other than this total network length, there shall be no restrictions as to the distance between modules on the network.

G. UPS Performance With Loss of Control Wiring Interconnections

1. With the complete loss of SBM interconnections for one of the two UPS monitoring networks, throughout the UPS, there shall be no reduction in system operational capability.

2. With the complete loss of SBM interconnections for all but one of the UPMs in the UPS, all UPMs shall have the capability to support the critical load up to their rated load and remain synchronized to the SBM bypass source provided the UPS load is greater than the total rating of the UPMs which have lost communication with the SBM. In this operational mode, a successful manual or emergency transfer of the critical load to bypass shall be possible.

3. With the complete loss of SBM interconnections for both of the UPS monitoring networks, throughout the UPS, all UPMs shall have the capability to support the critical load up to their rated load

4. With the complete loss of SBM interconnections for both of the UPS monitoring networks, each UPM shall have the capability to detect an internal UPM failure and remove itself from the UPS bus.

H. UPS Performance With Loss of Communications

1. With the complete operational loss for one of the two UPS monitoring networks, there shall be no reduction in system operational capability.

2. If all but one of the UPMs in the UPS lose communication capability to the SBM over both of the UPS monitoring networks, all UPMs shall have the capability to support the critical load up to their rated load and remain synchronized to the SBM bypass source provided the UPS load is greater than the total rating of the UPMs which have lost communication with the SBM. In this operational mode, a successful manual or emergency transfer of the critical load to bypass shall be possible.

3. With the complete operational loss of both of the UPS monitoring networks, all UPS shall have the capability to support the critical load up to their rated load.

4. With the complete operational loss of both of the UPS monitoring networks, each UPM shall have the capability to detect an internal UPM failure and remove itself from the UPS bus.

5. This wireless paralleling method shall not rely on information to be shared between the two UPMs, thereby eliminating the need for inter-UPM communications.

6. It shall not be possible for a failure in the controls of one UPM to propagate a failure in the other UPM.

I. UPS Start-Up Performance

1. With a single key twist on the SBM control panel, the UPS shall automatically transition from a fully denergized

condition to a Normal condition, provided each of the UPMs features an optional motor operated battery disconnect. This shall also require that power be available to the UPM inputs and SBM bypass input prior to initiating the keytwist.

2. If each of the UPMs do not feature an optional motor operated battery disconnect, the UPS shall automatically transition from a fully denergized condition to a Normal condition with only a key twist on the SBM control panel and manual closure of the battery disconnects. This shall also require that power be available to the UPM inputs and SBM bypass input prior to initiating the keytwist.

J. UPS Performance During Normal Operation

1. The UPMs shall not have a master/slave relationship.

2. The selective tripping and load sharing methods shall eliminate a controls single point of failure whereby the UPMs are unable to support the critical load

3. UPMs shall share kW load equally to within +/- 5% when operating normally.

K. UPS Overload Performance

1. If the total UPM online kVA rating is greater than the kVA rating of the SBM, then the SBM shall establish the UPS overload rating. The SBM overload rating shall be the same as the trip rating for the following SBM breakers: CBS, CBP & FBP. An alarm shall be enunciated when the critical load exceeds the SBM breakers' trip rating.

2. If the total UPM online kVA rating is less than the kVA rating of the SBM, then the UPMs shall establish the UPS overload rating in accordance with the following parameters:

a) Each UPM shall independently provide its own output overload protection.

b) Each UPM shall maintain output voltage regulation for 125% of the rated current for 10 minutes before the SBM transfers the critical load to the SBM bypass source.

c) Each UPM shall maintain output voltage regulation for 150% of the rated current for 10 seconds before the SBM transfers the critical load to the SBM bypass source.

L. UPS Performance With A Faulty Uninterruptible Power Module

1. In the event of a UPM failure, the failed UPM shall remove itself from the critical bus. The remaining UPMs 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 or more UPM fails.

M. UPS Transfers To and From Bypass

1. For manual transfers of the critical load from Normal mode to Bypass mode the UPS shall automatically adjust the UPS output voltage up to +/-7% to match the SBM bypass input voltage prior to connecting bypass source to the critical load. No manual UPM output voltage adjustments shall be required to perform this critical load transfer.

2. For manual and automatic transfers of the critical load from Bypass mode to Normal mode the UPS shall automatically adjust the UPS output voltage up to +/-7% to match the SBM bypass input voltage prior to connecting the UPM bus to the critical load. No manual UPM output voltage adjustments shall be required to perform this critical load transfer. This automatic UPM output voltage adjustment shall occur during the normal UPS start-up sequence.

N. UPS Performance During Maintenance Actions

1. Provided the UPS output is synchronized with the SBM bypass input source and the maintenance bypass input source, the UPMs shall have the ability to operate in parallel with utility power without damage to the UPMs or to the critical load. This shall be considered an abnormal mode of operation, typically resulting from incorrectly operating external maintenance bypass switchgear.

O. UPS Load Sharing Capability

1. The UPMs shall share the critical load such that each UPM's kW load is always within 5% of the other's.

2. The UPS shall be capable of 5% kW load sharing with one of the two UPS monitoring networks fully disabled.

3. In the event a UPM completely loses communication with the rest of the UPS, this UPM shall assume its rated output load or the complete UPS critical load, whichever is the smaller of the two. The output load on the other UPMs shall be reduced accordingly. This action shall only occur if at least one other UPM retains communication capability with the SBM on either of the UPS monitoring networks.

4. In the event two or more UPMs completely loses communication with each other and the rest of the UPS, these UPM shall assume their rated output loads or the complete UPS critical load, whichever is the smaller of the two. If these UPMs fully assume the UPS critical load, they shall share the kW component of the critical load to within 5% of each other. The output load on the other UPMs shall be reduced accordingly. This action shall only occur if at least one other UPM retains communication capability with the SBM on either of the UPS monitoring networks.

5. In the event all of the UPMs completely loses communication with the SBM and each other, these UPM shall assume the complete UPS critical load. In this operating mode, they shall share the kW component of the critical load to within 5% of each other. In this operating mode, each UPM shall need to monitor only its own input and output power in order to remain phase locked with the other UPM. This wireless paralleling method shall not rely on information to be shared between the UPMs.

P. UPS Performance During a Utility Outage

1. If all of the UPMs loose utility input power they shall share the critical load such that all if the UPM's kW load in the UPS are within 5% of each other.

2. If one or more UPMs lose their utility input power, their inverters shall remain on and connected to the critical bus. The UPM or UPMs that lose their utility input shall continue sharing the critical bus with their inverters supported by battery power such that all of the UPM's kW load in the UPS is within 5% of each other.

Q. UPS Selective Tripping Capability

1. Each UPM shall look only at itself to determine if it has failed. If a UPM failure does occur, the faulty UPM 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 UPM. This wireless selective tripping

method shall not rely on information to be shared between the two UPMs.

2. The selective trip method each UPM employs to identify an internal failure shall require the UPM to look for changes in UPM output voltage and output current data relative to recent output current and voltage data.

3. If a UPM does isolate itself from the critical bus, due to an identified internal failure, the UPM shall try three times to restart. If the UPM 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 UPM shall resume load sharing with the other UPM and UPS level redundancy shall once again be available.

4. The selective trip controls within each UPM shall be independent of the inverter controls. The inverter controls within each UPM shall also provide selective tripping capability for removing a faulty UPM from the critical bus.

5. The selective trip controls within each UPM shall be continuously monitored to assure they are functioning properly. Failure of a UPM's selective trip controls shall not impair its ability to share the critical load with the other UPMs supporting the critical bus. A UPM shall alarm if it determines its selective trip controls have failed.

R. UPS Fault Clearing Capability

1. With the UPS bypass source available, a fault on the critical bus shall result in the SBM transferring the critical load to the bypass source after 2 cycles when the fault exceeds the following UPM loading parameters:

   a) 160% RMS of the UPM phase to phase current rating.

   b) 300% peak of the UPM phase to phase current rating.

   c) 300% peak of the UPM phase to neutral current rating.

2. With the UPS bypass source not available, a fault on the critical bus shall result in the SBM transferring the critical load to the bypass source after 5 cycles when the fault exceeds the following UPM loading parameters:

   a) 160% RMS of the UPM phase to phase current rating.

   b) 300% peak of the UPM phase to phase current rating.

   c) 300% peak of the UPM phase to neutral current rating.

S. UPS Emergency Transfer to Bypass Capability

1. The UPS shall perform an emergency transfer to bypass immediately upon detection of the following conditions:

   a) Voltage on the critical bus less than 90% of nominal.

b) Voltage on the critical bus greater than 110% of nominal.

## 2.04 UNINTERRUPTIBLE POWER SUPPLY OPTIONS AND ACCESSORIES

The Uninterruptible Power Supply shall feature the following options and accessories:

A. (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.

B. (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 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 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 UPM wrap around (maintenance bypass) disconnect and UPS output disconnect devices.

   b) Three Device - This configuration shall include the UPS wrap around (maintenance bypass) disconnect, UPS output disconnect and UPS bypass 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 600, 800, 1200 and 2000 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 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.

C. (OPTION) Remote Emergency Power Off (REPO) Station: The REPO station shall be connected to the SBM and/or each UPM. The REPO shall feature a red push-button switch for activation. A REPO Station connected to the SBM shall, when activated, open the SMB's breakers, shutdown all of the UPMs via a command issued over both of the UPS monitoring networks and de-energize the critical load. A REPO Station connected to a UPM shall, when activated, shutdown the UPM. 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 SBM or UPM shall be 500 feet. Multiple REPO stations may be used with a single SBM or UPM.

D. (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 or UPM. 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 UPM shall be 500 feet. Each SBM and UPM shall be capable of driving up to two SCMs, RMPs or RIMs. The status indicators shall be:

1. UPM Normal

2. On Bypass

3. On Battery

4. Bypass Unavailable

5. UPM Alarm

6. Shutdown Imminent

7. On Generator

E. (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 or UPM. 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 UPM shall be 500 feet. Each SBM and UPM shall be capable of driving up to two SCMs, RMPs or RIMs. The status indicators shall be:

1. UPM Normal

2. On Bypass

3. On Battery

4. Bypass Unavailable

5. UPM Alarm

6. Shutdown Imminent

7. On Generator

F. (OPTION) Relay Interface Module (RIM): The RIM shall enunciate the current operating mode of the UPS or UPM 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 SBM or UPM shall be 500 feet. Each UPM shall be capable of driving up to two SCMs, RMPs or RIMs. The status indicators shall be:

1. UPM Normal

2. Bypass Unavailable

3. On Battery

4. Shutdown Imminent

G. (OPTION) SNMP Network Adapter: SNMP adapters shall provide a communications interface between the SBM or UPM (via the RS-232 port) and SNMP-compatible network management systems. This capability shall allow the UPS or UPM to be monitored remotely over an Ethernet or Token-Ring network.

H. (OPTION) UPS Monitoring System: This dedicated PC based system shall continuously monitor critical power elements associated with the UPS, using the communications ports on the SBM and UPM. 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 upgradeable, 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.

I. (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 are 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 nest 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.

## 2.05 UNINTERRUPTIBLE POWER MODULE STANDARD FEATURES

The Uninterruptible Power Module shall feature the following standard components and capabilities:

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 UPM 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. 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 UPM shall permit easy removal of each phase of the Inverter and DC electrolytic capacitors without removal of any other assembly.

3. The Inverter shall feature protection circuitry, which prevents the IGBTs from providing current in excess of their published ratings.

4. The Inverter shall feature protection circuitry, which prevents damage to the IGBTs in the event control power to the Inverter were suddenly lost.

C. Monitoring and Control Components: The following components shall provide monitor and control capability:

1. Micro-controller driven circuitry: A quantity of 4 embedded 20 MHz, 16 bit, single chip controllers.

2. Monitor Panel with status indicators

3. Alarm and metering display

4. Building alarm monitoring

5. Input circuit breaker

6. Inverter contactor

7. RS-232 (EIA/TIA-232) and RS-485 communication ports

D. Output Isolation Transformer: The UPM shall contain an output isolation transformer featuring a single primary (an Inverter Delta winding) and a single secondary (a Wye winding to the UPM output terminals). This transformer shall provide isolation between the primaries and secondary and shall qualify the UPS as a separately derived source when in Normal mode.

E. Battery Management System: The UPM 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.

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 UPM 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.

F. Wiring Terminals: The neutral output compression terminal shall be sized for 200% of UPM rated current to accommodate higher neutral currents associated with non-linear loads. The UPM 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. DC link connections for battery cabinets (positive and negative)

3. AC output connections (3 phases and 1 neutral)

## 2.06 UNINTERRUPTIBLE POWER MODULE MECHANICAL DESIGN

A. Enclosures: The UPM 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 UPM 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 UPM 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 UPM 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 be located directly adjacent to a wall.

D. Cooling Fans: The modular design of the UPM 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 UPM shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPM for routing user input and output wiring. The wireway section shall be capable of being completely removed from the UPM during installation to temporarily reduce the overall width of the UPM 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 UPM 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 UPM shall not be required for UPM installation, service, repair or maintenance.

G. Service Area Requirements: The UPM, 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 UPM shall not exceed a depth of 31.5 inches, a height of 73.5 inches and a width of _____. The UPM shall not exceed an installation weight of _____. (Choose values from Appendix 1, Table Five, columns 6 & 7).

## 2.07 UNINTERRUPTIBLE POWER MODULE CONTROLS AND INDICATORS

A. Micro-Controller Operated Circuitry: The UPM controls shall have the following design and operating characteristics:

1. Fully automatic operation of each UPM 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 when using a motor operated battery disconnect.

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 UPM 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 UPM shall be programmable to optionally provide automatic restart capability following loss of utility and a complete battery discharge. When utility power returns, the UPM shall automatically energize the output terminals and subsequently transfer to Normal mode.

B. Monitor Panel Indicators: The UPM 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 UPM is operating in Normal mode.

2. BATTERY: This symbol shall be lit when the UPM is operating in Battery mode. The Normal indicator also remains lit.

3. NOTICE: This symbol shall be lit when the UPM needs attention. Some notices may be accompanied by an audible horn.

4. ALARM: This symbol shall be lit when a situation requires immediate attention. All alarms shall be accompanied by an audible horn.

5. 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 UPM 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 UPM is dissipated and shutdown is complete.

C. Monitor Panel Controls: The UPM 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 UPM, de-energizes the critical load and opens the UPM'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 UPM shall feature a liquid crystal display measuring 6" by 7.5" with 30 lines of information, 80 characters wide. The display shall feature an autoblanking feature. Graphical user screens shall be provided on the Monitor panel LCD to display the UPM'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) UPM Identification: A user programmable UPM identification of up to 45 characters.

b) UPM 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. UPM Meter Screen: Real-time digital metering of:

a) Rectifier/Charger inputs: voltage (per phase, RMS), current (per phase), frequency, kW, kVA, power factor.

b) UPM 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) DC link voltage.

d) 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 UPM and in the current month.

c) Operational History: A record shall display the total amount of time the UPM has been in the Normal and Battery modes of operation. A record shall display the total amount of time the UPM has been on generator.

d) Availability: The observed availability of the Normal mode shall be displayed.

e) Startup Date: The date the UPM was initially energized shall be displayed.

7. UPM Mimic Screen: A graphic display of the UPM operational mode and power flow through the UPM to the critical load shall be displayed in real-time. The operational status of the Inverter, Rectifier/Charger and Battery is also indicated. Circuit breaker and contactor states shall also be indicated.

8. Setup Screen: Shall permit setting time and date for the UPM 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: UPM events shall be logged immediately as they occur.

b) Calibration Mode: Shall be used by service personnel for UPM diagnostics.

c) UPM 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 UPM commands upon contact closure.

d) Computer Mode: Shall allow the user to interface with the UPM 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 UPM shall be equipped with a control panel providing UPM control functions. (A key shall be required to turn on the UPM.) The following controls shall be provided on the control panel:

1. The Key switch shall initiate the energize sequence to place the UPM in either Normal mode or Offline mode, as defined by the Mode switch position.

2. The Mode switch shall control the manual transfer of the UPM between Normal mode and offline 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 UPM, following a Load Off command.

F. Communication Panel: The UPM 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 UPM is experiencing an Alarm condition.

b) Notices: Indicates the UPM 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 UPM configuration mode function of the RS-232 (EIA/TIA-232) port. 5. 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.

5. 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.

6. Remote Emergency Power Off: A set of contacts shall be provided to interface with a Remote Emergency Power Off (REPO) Station. Through these contacts, by utilizing the REPO Station, it shall be possible to completely shut down the UPM.

## 2.08 UNINTERRUPTIBLE POWER 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 UPM 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. UPM output protection shall be provided through 3 phase AC fusing of the inverter output on the secondary side of the UPM output isolation transformer.

F. UPM 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 shall be monitored for proper sequencing. If wiring is installed out of sequence, the UPM shall detect and enunciate this condition (on the Monitor Panel) when power is supplied to the inputs. The UPM 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 UPM 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 UPM 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

## 2.09 UNINTERRUPTIBLE POWER MODULE OPTIONS AND ACCESSORIES

The Uninterruptible Power Module shall feature the following options and accessories:

A. (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.

1. The input filter shall be housed in the UPM. The UPM shall be programmable to automatically disconnect the input filter during the following conditions:

a) With loss of Rectifier/Charger input power.

b) When the critical load is below a threshold, user programmable, from 0% to 25% of UPM rated capacity.

2. The UPM shall be programmable to automatically connect the input filter from 1 to 60 seconds following the connection of the UPM to the UPM bus. When multiple UPMs are featured in a UPS, this feature shall permit staged connections of the individual UPM input filters.

B. (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 the be same depth and height as the UPM. The battery cabinets shall be 43 inches in width.

3. The battery cabinets shall feature a mechanical enclosure of like appearance to the UPM 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 UPM 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 UPM shall be provided by others. All control wiring between the number one battery cabinet and the UPM shall be provided by others.

6. The battery cabinets shall be available in a remote configuration, where multiple battery cabinets stand apart from the UPM and shall be installed separate from each other. The power wiring and control wiring between multiple battery cabinets and the UPM 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 UPM.

8. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPM 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 a 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 UPM 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.

C. (OPTION) External Battery Disconnect: An enclosed DC circuit breaker shall provide a manual means of disconnecting a UPM from a battery that is not located adjacent to the UPM.

D. (OPTION) Input Isolation Transformer: The UPS shall feature a transformer, which 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.

E. (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 uninterruptible power module’s critical bus.

F. (OPTION) Outcall Capability: The UPM shall have outcalling capability with the following features:

1. The UPM 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 the UPM RS232 port. The outcalling feature shall allow the UPM to interface with either a personal computer running terminal communications software or a pager.

2. Over 190 programmable UPM alarms and notices shall initiate UPM out calling. Each of the six UPM building alarms, which may monitor other facilities equipment, shall have the capability to initiate UPM 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 UPM shall have the capability to leave the UPM phone number (up to 20 characters maximum). The UPM shall also leave a description of the event, which triggered the outcall (up to 40 characters maximum) when interfacing with either a numeric pager or personal computer.

5. The UPM 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 UPM modem, the UPM shall automatically store a successful out call attempt in the event log.

6. The UPM shall sequentially initiate out going calls and receive incoming calls through the same modem and same telephone line. After completing an out call, the UPM will wait with the RS232 port configured for an incoming call through the modem.

7. Information available to a personal computer connected to the UPM via modem shall include: Metering, Event Log, and Battery Test Log.

8. The UPM 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 UPM shall provide continuous error detection and correction for misconfigured and disconnected modems.

10. The UPM shall be capable of initiating outcalling through either a customer supplied Hayes compatible external modem or an optional internal modem.

## 2.10 SYSTEM BYPASS MODULE STANDARD FEATURES

The System Bypass Module shall feature the following standard components and capabilities:

A. The following SBMs shall be available:

1. Product: SBM 1200

a) The SBM 1200 shall be available in the following models and output current ratings:

(1) Model 1200: 1200 amps

(2) Model 1000: 1000 amps

(3) Model 800: 800 amps

(4) Model 600: 600 amps

b) The SBM 1200 shall be rated for a maximum amp interrupt capability of 24,000 amps.

c) The SBM 1200 shall have the following physical properties:

(1) Dimensions: 34″ Wide by 74″ High by 40″ Deep.

(2) Weight: 1000 pounds.

2. Product: SBM 2000

a) The SBM 2000 shall be available in the following models and output current ratings:

(1) Model 2000: 2000 amps

(2) Model 1600: 1600 amps

(3) Model 1200: 1200 amps

b) The SBM 2000 shall be rated for a maximum amp interrupt capability of 65,000 amps.

c) The SBM 2000 shall have the following physical properties:

(1) Dimensions: 68″ Wide by 80″ High by 40″ Deep.

(2) Weight: 2700 pounds.

B. The SBM shall provide the critical bus with an alternate source of power for clearing a fault on the critical bus, performing UPM maintenance, UPM overload condition or when a failure prevents operation in Normal mode. The SBM shall connect the output of one or more UPMs to the critical bus. The SBM shall also connect an emergency bypass to the critical bus. The SBM shall consist of a naturally-commutated static switch, for high-speed transfers, switchgear for backfeed protection and parallel wrap-around switchgear. The modular design of the SBM 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 SBM shall feature the following transfer and operational characteristics:

1. Uninterrupted transfers from Normal mode to Bypass mode shall be automatically initiated by the SBM for the following conditions:

   a) Critical bus voltage out of limits.

   b) UPM failure in non-redundant mode.

   c) Total battery discharge.

2. Uninterrupted automatic retransfer shall take place whenever the UPM bus 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-retransfer 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) UPM bus failure.

   d) Insufficient number of UPMs on UPM bus to support critical load.

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.

C. It shall be possible to manually close the SBM bypass breaker CBP with a single pushbutton. No additional control logic shall be required to perform this action.

D. The SBM logic power shall be derived separately from the UPM logic power.

E. The SBM shall feature redundant power supplies. Power to the control power supplies shall originate from the bypass input and the critical output bus. In the event one of the two control power supplies shall fail, the SBM and UPS shall continue to operate in Normal mode without load derating. A failed power supply condition shall be enunciated on the SBM monitor panel and available remotely through the RS232 port. A failure alarm shall automatically clear when the failed power supply is replaced.

F. The following SBM printed circuit boards shall be identical to those featured in the UPM:

1. Monitor printed circuit board.

2. Static switch printed circuit board (when featured in the UPM).

3. Control power supply printed circuit boards.

4. Network printed circuit board.

G. The SMB shall provide both top and bottom access for both power and control wiring.

H. 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.

I. The SBM shall not feature any cooling fans. All SBM cooling needs shall be accomplished through natural convection.

J. The phase orientation of the bussing within the SBM shall be Phase A, B, C; top to bottom, front to back, left to right. All bussing within the SBM shall be manufactured from tin plated copper.

K. Micro-Controller Operated Circuitry: The SBM controls shall have the following design and operating characteristics:

1. Fully automatic operation of the SBM 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. UPS start-up shall be fully automatic, requiring only a single key twist to start all of the UPMs, synchronize the UPM to the bypass source, connect the UPS to a common bus and then transfer critical load to the UPM common bus. This capability shall be enabled when each UPM features a motor operated battery disconnect.

4. Multiple micro-controllers shall be used, so no single controller is in a mission critical application.

5. All control 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 multiple UPM failures or a critical bus fault, shall be independent of the control logic controlling the SBM Monitor panel. Emergency transfer circuitry shall contain all the necessary circuitry to

perform an emergency transfer to Bypass without any other functioning logic.

7. Monitoring and communications logic shall be independent of the control logic. Circuitry and firmware required for monitoring and communications logic shall be functionally isolated from the Bypass controls. Monitoring firmware shall be field upgradeable while the SBM remains energized.

8. The SBM shall be programmable to optionally provide automatic restart capability following loss of utility and a complete battery discharge. When utility power returns, the SBM shall automatically energize the output terminals, bring the UPMs on-line and subsequently transfer the UPS to Normal mode. This capability shall be possible when each UPM features an optional motor operated battery disconnect.

9. The SBM shall have the ability to detect a shorted SCR in the SBM static switch under all load conditions. When a shorted SCR is detected, the UPS shall remain in Normal mode, the backfeed breaker FBP shall be opened and an alarm shall be enunciated on the monitor panel. The SBM shall have the ability to perform manual transfers to and from bypass with a shorted static switch SCR.

10. The SBM shall monitor the breaker positions of CBS, CBP & FBP with dual auxiliaries. The status of these auxiliaries shall be compared every 5 seconds for verification of breaker position and states of change.

L. Monitor Panel Indicators: The SBM 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 UPM are operating in Normal mode.

2. BATTERY: This symbol shall be lit when one or more of the UPMs is operating in Battery mode. The Normal indicator also remains lit. An alarm is enunciated if a UPM remains operating in Battery mode for more than 30 seconds.

3. BYPASS: This symbol shall be lit when the UPS is operating in Bypass mode. In this mode, the critical load is supported by the Bypass source. The Normal indicator shall not be lit when the UPS is operating in Bypass mode.

4. NOTICE: This symbol shall be lit when the UPS requires attention. Some notices may be accompanied by an audible horn.

5. ALARM: This symbol shall be lit when the UPS requires immediate attention. All alarms shall be accompanied by an audible alarm.

6. STANDBY: This symbol shall be lit when electricity is present in the UPS while the Normal indicator is not lit.

During normal startup this indicator shall remain lit until one or more UPMs are on line and the UPS 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 is dissipated and shutdown is complete.

M. Monitor Panel Controls: The SBM shall be equipped with a control panel providing UPS control functions. The control panel shall be an integral feature of the SBM. The following controls shall be provided on the control panel:

1. A Keyswitch shall be provided. A keyswitch shall be located on the monitor panel to energize the sequence to place the UPM in either Normal mode or Bypass mode. The use of a key in the keyswitch shall be required to change the UPS operating mode at the SBM control panel. The Keyswitch shall have the capability to initiate a transfer of the critical load from Normal mode to Bypass mode with a single key twist. The Keyswitch shall have the capability to initiate a transfer of the critical load from Bypass mode to Normal mode with a single key twist.

2. The SBM controls shall not permit a manual load transfer that jeopardizes the critical load.

3. Load Off Reset: A load off reset switch shall be located on the monitor panel to reset the UPM, following a Load Off command.

4. Menu and Cursor Controls: Pushbuttons shall be located on the monitor panel that provides the capability to select, display and scroll through data on the monitor panel LCD.

5. Load Off: A load off switch shall be located on the monitor panel to perform either one of the following two user defined functions when actuated:

   a) Transfer the critical load to bypass and shutdown all UPMs (Default function).

   b) Shut down the SBM, all UPMs and de-energize the critical bus as well as any critical loads on the critical bus.

6. Horn Silence: Shall silence the current audible alarm(s). The horn silence command shall be initiated by depressing any of the pushbuttons on the Monitor Panel. The Horn shall sound again if new alarms occur.

7. Screen Adjust: Shall control the liquid crystal display contrast.

N. Monitor Panel Liquid Crystal Display (LCD): The SBM shall feature a liquid crystal display measuring 6″ by 7.5″ with 30 lines of information, 80 characters wide. The display shall feature an autoblanking feature. Graphical user screens shall be provided on the Monitor panel LCD to display the UPS’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 Identification: A user programmable UPS identification of up to 45 characters.

   b) UPS 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. The SBM shall automatically synchronize the UPM clocks with the SBM clock when the SBM clock is set.

   f) Real-time battery time available (in the event a utility outage occurs) for the current critical load. For a UPS featuring a battery string to support each UPM, the reported battery time availability shall be the minimum UPM battery availability. For a UPS featuring one or more common strings to support all UPMs, the reported battery time availability shall be the actual UPS battery availability.

2. Meter Screen: The following real-time digital metering shall be presented on the SBM LCD Meter Screen:

   a) Highest of all the UPMs Rectifier/Charger inputs: voltage (per phase, RMS), current (per phase), frequency, kW, kVA, power factor.

   b) UPS output at the critical bus: voltage (per phase, RMS), current (per phase plus neutral), frequency, kW, kVA, power factor.

   c) SBM bypass inputs: voltage (per phase, RMS).

   d) DC link voltage. For a UPS featuring a battery string to support each UPM, the reported battery voltage shall be the highest of all the UPM battery strings. For a UPS featuring one or more common strings to support all UPMs, the reported battery voltage shall be the actual UPS battery string voltage.

   e) Total battery charge and discharge current.

3. Output Current Screen: A bar graph display of the percent output current of each phase shall be provided.

   - Event History Screen: The Event History Screen shall display up to 400 of the most recent events by date and time. Time shall be displayed with resolution of one

tenth of one second (0.1 sec) and recorded with resolution of one thousandth of one second (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. If the event pertains to a specific UPM, the Event History Screen of the particular UPM shall also record an event.

4. Active Events Screen: The Active Events Screen shall automatically display a list of all active alarms and notices.

5. Statistics Screen: The Statistic Screen shall display the following information:

   a) Time on battery: A log shall display the duration and frequency of utility outages in the history of the current batteries and in the current month.

   b) Building alarms: A log shall display the frequency of each SBM building alarm enunciation in the history of the SBM and in the current month.

   c) Operational History: A log shall display the total amount of time the UPS 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 has been on generator.

   d) Availability: The observed availability of the Normal mode shall be displayed. The availability of the Bypass supply as a backup source shall also be displayed.

   e) Startup Date: The date the UPS was initially energized shall be displayed.

6. UPS Mimic Screen: A graphic display, showing the operating mode and power flow through the UPMs and SBM to the critical load, shall be displayed in real-time.

   a) The operational status of each UPM and the SBM shall be indicated. The operational mode of the SBM circuit breakers and static switch shall be indicated. The following UPS devices shall be displayed and monitored on the mimic screen as indicated:

      (1) UPM: Each UPM in the UPS shall be graphically displayed. Each UPM shall be given an numerical representation (i.e., UPM1, UPM2, etc.). The graphical representation of each UPM shall change to indicate if the UPM is on or off. A graphical display of the UPM output contactor shall indicate if the UPM is connected to the common UPM bus. When active, the following UPM

enunciation shall be displayed on each UPM graphical representation:

(a) Normal

(b) On Battery

(c) Alarm

(d) Notice

(e) Standby

(2) Static Switch: The SBM static switch shall be graphically displayed. The graphical representation of the static switch shall change to indicate if the static switch is open or closed.

(3) CBS: The SBM breaker designated SBM shall be graphically displayed. The graphical representation of CBS shall change to indicate if this breaker is open or closed.

(4) CBP: The SBM breaker designated CBP shall be graphically displayed. The graphical representation of CBP shall change to indicate if this breaker is open or closed.

(5) FBP: The SBM breaker designated FBP shall be graphically displayed. The graphical representation of FBP shall change to indicate if this breaker is open or closed.

b) The following meters shall be displayed on the UPS Mimic Screen:

(1) UPS kVA capacity

(2) UPS kW capacity

(3) Actual UPS kVA load

(4) Actual UPS kW load

c) The UPS Mimic Screen shall display in real time the number of redundant UPMs available under the current load conditions.

7. Setup Screen: This screen shall permit setting time and date for the SBM and UPM clocks with controls on the SBM Monitor Panel. When the SBM clock is set using this screen, the clocks on each UPM shall automatically be updated to the same time within 1 second accuracy. The screen shall also 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 and SBM events shall be logged immediately as they occur.

b) Calibration Mode: The Calibration Mode shall be used by service personnel for UPM and SBM diagnostics.

c) SBM Configuration Mode: The SBM Configuration Mode shall allow setup and configuration of user level functions like building alarms. This configuration mode shall also allow the six SBM building alarms to be customized with a description of up to 30 characters for display locally on the monitor panel screens and remotely. This configuration mode shall allow the six building alarms to be programmed to initiate SBM commands upon contact closure.

d) Computer Mode: This configuration mode shall allow the user to interface with the SBM in Binary Computer Mode.

e) Remote Monitor Mode: This configuration mode shall provide the communications interface between the SBM and the Remote Monitor Panel, Supervisory Contact Module or Relay Interface Module options.

O. Communication Panel: The SBM shall be equipped with a communication panel, located on the top of the SBM behind a protective cover. The Communication Panel shall provide the following signals and communication features in a Class 2 environment:

1. Alarm and Notice Contacts: Two dry A/B contacts for summary alarms and notices shall be provided for external monitoring capability of:

a) Alarms: The default ON mode for this summary alarm contact indicates the UPS or SBM is experiencing an Alarm condition. This contact shall be programmable to enunciate the presence of any Alarm or Notice condition.

b) Notices: The default ON mode for this summary notice contact indicates the UPS or SBM is experiencing a Notice condition. This contact shall be programmable to enunciate the presence of any Alarm or 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 for monitoring an external battery disconnect, and one shall be dedicated to monitoring an auxiliary generator

for 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 UPM 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 SBM Monitor Panel or remotely through the communication ports.

b) Building alarms shall be programmable to initiate a transfer of the UPS from Normal Mode to Bypass Mode upon contact closure.

c) Building alarms shall be programmable to initiate a transfer of the UPS from Bypass Mode to Normal Mode upon contact closure.

5. Remote Emergency Power Off: A set of contacts shall be provided to interface with a Remote Emergency Power Off (REPO) Station. Through these contacts, by utilizing the REPO Station, it shall be possible to completely shut down the SBM, all UPMs and de-energize the critical bus as well as any critical loads on the critical bus.

6. Outcall Capability: The SBM shall have outcalling capability with the following features:

a) The SBM 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 the SBM RS232 port. The outcalling feature shall allow the SBM to interface with either a personal computer running terminal communications software or a pager.

b) Over 190 programmable SBM alarms and notices shall initiate SBM out calling. Each of the six SBM building alarms, which may monitor other facilities equipment, shall have the capability to initiate SBM out calling to report facilities equipment failures.

c) 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.

d) When out calling to a pager or personal computer, The SBM shall have the capability to leave the SBM phone number (up to 20 characters maximum). The SBM shall also leave a description of the event, which triggered the outcall (up to 40 characters maximum) when

interfacing with either a numeric pager or personal computer.

e) The SBM 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 SBM modem, the SBM shall automatically store a successful out call attempt in the event log.

f) The SBM shall sequentially initiate out going calls and receive incoming calls through the same modem and same telephone line. After completing an out call, the SBM will wait with the RS232 port configured for an incoming call through the modem.

g) Information available to a personal computer connected to the SBM via modem shall include: Metering, Event Log, and Battery Test Log.

h) The SBM 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.

i) The SBM shall provide continuous error detection and correction for misconfigured and disconnected modems.

j) The SBM shall be capable of initiating outcalling through either a customer supplied Hayes compatible external modem or an optional internal modem.

## 2.11 SYSTEM BYPASS MODULE OPTIONS AND ACCESSORIES

The System Bypass Module shall feature the following options and accessories:

A. (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 SBM’s critical bus.

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 UPM 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: SBM Types, Models & Continuous Ratings

| SBM | Model | Maximum Amps |
|---|---|---|
| 1200 | 600 | 600 |
| 1200 | 800 | 800 |
| 1200 | 1000 | 1000 |
| 1200 | 1200 | 1200 |
| 2000 | 1200 | 1200 |
| 2000 | 1600 | 1600 |
| 2000 | 2000 | 2000 |

Table Two: UPM Types, Models & Continuous Ratings

| | | | | Number Of UPMs | |
|---|---|---|---|---|---|
| UPM | Model | KVA | kW | Minimum | Maximum |
| 200 | 200 | 200 | 160 | 1 | 8 |
| 225 | 225 | 225 | 180 | 1 | 8 |
| 250 | 200 | 200 | 160 | 1 | 8 |
| 250 | 250 | 250 | 200 | 1 | 8 |
| 300 | 225 | 225 | 180 | 1 | 8 |
| 300 | 300 | 300 | 240 | 1 | 8 |
| 400 | 300 | 300 | 240 | 1 | 8 |
| 400 | 400 | 400 | 320 | 1 | 8 |
| 500 | 400 | 400 | 320 | 1 | 8 |
| 500 | 500 | 500 | 400 | 1 | 8 |

Table Three: UPS Upgrades

| | From | To |
|---|---|---|
| UPM | Model | KVA/kW |
| 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 Four: Nominal Voltage Configurations & Acoustic Noise

| UPM | Models | UPM Volts In | UPM Volts Out | Battery DC Volt | Acoustic Noise (dbA) |
|---|---|---|---|---|---|
| 200 | 200 | 400 | 400 | 420 | 65 |
| 225 | 225 | 208 | 208 | 480 | 65 |
| 225 | 225 | 480 | 208 | 480 | 65 |
| 225 | 225 | 480 | 480 | 480 | 65 |
| 250 | 200, 250 | 400 | 400 | 420 | 65 |
| 300 | 225, 300 | 480 | 480 | 480 | 65 |
| 300 | 225, 300 | 600 | 600 | 480 | 65 |
| 400 | 300, 400 | 400 | 400 | 420 | 69 |
| 500 | 400, 500 | 480 | 480 | 480 | 69 |

Table Five: UPS Size Limits

| UPM | Model | Volts In | Volts Out | Xfmr Type | Width (In.) | Weight(lb.) |
|---|---|---|---|---|---|---|
| 200 | 200 | 400 | 400 | None | 65 | 3812 |
| 200 | 200 | 400 | 400 | Isolation | 103 | 6312 |
| 225 | 225 | 480 | 480 | None | 65 | 3863 |
| 225 | 225 | 480 | 480 | Isolation | 103 | 6363 |
| 225 | 225 | 480 | 208 | None | 65 | 3863 |
| 225 | 225 | 480 | 208 | Isolation | 103 | 6363 |
| 225 | 225 | 208 | 208 | Isolation | 103 | 6363 |
| 250 | 200, 250 | 400 | 400 | None | 65 | 4177 |
| 250 | 200, 250 | 400 | 400 | Isolation | 103 | 6677 |
| 300 | 225, 300 | 480 | 480 | None | 65 | 4177 |
| 300 | 225, 300 | 480 | 480 | Isolation | 103 | 6677 |
| 300 | 300, 300 | 600 | 600 | Isolation | 103 | 6677 |
| 400 | 400 | 400 | 400 | None | 74 | 5250 |
| 500 | 400, 500 | 480 | 480 | None | 74 | 5250 |

END OF SECTION