

UNITY / I™

Three-Phase Uninterruptible Power Systems
UT3120, UT3160, UT3220
60 Hz

Guide Specifications

In this document, explanatory notes are set in *italics*. Each note provides additional information about the paragraph immediately preceding the note.

In this document, brackets [] are used to denote choices. If a paragraph contains bracketed choices, specify the **one** choice which applies for your application. For example, in paragraph 2.03.A, specify 120 kVA/120 kW **or** 160 kVA/160 kW **or** 220 kVA/220 kW. (*Note:* For paragraph 2.03.B, specify the load and reserve time requirements for your application. For paragraph 2.05.H, you can specify either battery cabinets or battery racks; select the appropriate paragraph.)

This document is formatted according to the guidelines set forth in Construction Specifications Institute (CSI) publications CSI MP-2-2 and CSI MP-2-3.

“Section 16611: Static Uninterruptible Power Supply” is the section number and title from the widely used CSI MASTERFORMAT system (1988 edition). The information contained in this guide specification could also be placed under “Section 16610: Uninterruptible Power Supply.”

SECTION 16611

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SUMMARY

This specification describes a three-phase, on-line, continuous duty, solid-state uninterruptible power system (UPS). The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up power protection, and power distribution for the critical loads.

1.02 SYSTEM DESCRIPTION

- A. Modes of Operation: The UPS shall operate as an on-line system in the modes listed below.
1. Normal: The inverter/battery charger shall operate in an on-line manner to continuously regulate the power to the critical load. The inverter/battery charger shall also derive power from the AC input source and supply DC power to float charge the battery.
 2. Emergency: Upon failure of the AC input source, the critical load shall continue to be supplied by the inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.
 3. Recharge: Upon restoration of the AC input source prior to complete battery discharge, the inverter/battery charger shall simultaneously recharge the battery and regulate the power to the critical load.
 4. Bypass: The static bypass switch shall be used to transfer the critical load to bypass with no interruption in power to the critical load. Automatic retransfer of the load shall be accomplished with no interruption in power to the critical load. The static bypass switch shall be capable of manual operation for partial isolation of UPS system components.
 5. Economy: In user-selectable economy mode, the load shall be powered via the static bypass switch. The inverter shall operate in standby and be synchronized to the AC input source. Upon failure of the AC input power source, the unit shall supply power from the battery with no interruption in power to the critical load. The unit shall periodically transfer to normal operation to charge the battery.
 6. External Maintenance Bypass (optional): The external maintenance bypass switch shall be used to supply the load from the bypass source while the UPS is isolated for maintenance.
- B. Future Expansion: The UPS shall be field-upgradable to allow parallel operation with additional UPS modules for increased capacity or for redundant operation. The parallel systems shall be capable of operation on a common DC bus and shall provide proportional load sharing. To provide a true fault tolerant control system, any individual UPS module shall be capable of automatically assuming control of the entire system. UPS modules operating in parallel shall not be required to be of identical power capacity ratings.

The ability to expand system capacity for future requirements means that the entire UPS system does not have to be replaced each time the load requirements expand beyond the UPS system's power rating. The ability to operate in a redundant configuration is important for applications where even momentary exposure to utility power (such as during maintenance) is to be avoided. Redundant systems assure no possible single points of failure.

1.03 STANDARDS

- A. UL listed under UL1778 - Standards for Uninterruptible Power Supply Equipment.
- B. cUL listed to Canadian Standards Association (CSA) C22.2 No. 107.1 - Standard for Power Supplies.
- C. FCC Part 15, Sub-Part J, Class A.
- D. ANSI C62.41-1991 - IEEE Recommended Practices on Surge Voltages and Low-Voltage AC Power Circuits.
- E. ANSI/IEEE C62.45-1987 - IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- F. The UPS shall be designed in accordance with the applicable sections of documents published by the following:
 - 1. National Fire Protection Association (NFPA).
 - 2. National Electrical Code (NEC).
 - 3. National Electrical Manufacturer's Association (NEMA).

1.04 SUBMITTALS

- A. Proposal Submittals:
 - 1. As bid system bill of materials.
 - 2. Product catalog sheets or equipment brochures.
 - 3. Product guide specifications.
 - 4. System single-line operation diagram.
 - 5. Installation information, including weights and dimensions.
 - 6. Information about terminal locations for power and control connections.
 - 7. Drawings for requested optional accessories.
- B. Delivery Submittals: Submit 4 sets of the following within 5 business days after receipt of order or formal request. Submit additional sets upon request.
 - 1. Complete set of proposal submittal drawings.
 - 2. Planning and installation manual which includes instructions for storage, handling, examination, preparation, installation, and start-up of the UPS.
 - 3. User manual which includes UPS operating instructions.

1.05 QUALIFICATIONS

- A. Manufacturer Experience: The manufacturer shall have a minimum of 12 years of experience in the design, manufacture, and testing of UPS systems.
- B. ISO 9001 Certification: The manufacturer shall be ISO 9001 certified.

ISO 9001 certification assures that the vendor's quality system has been certified by an accredited registrar and meets internationally recognized standards.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Storage Ambient Temperature: -13 to 158 degrees F (-25 to 70 degrees C).
- B. Operating Ambient Temperature: 32 to 104 degrees F (0 to 40 degrees C).
- C. Relative Humidity: 0 to 95%, non-condensing.
- D. Operating Elevation: Up to 3300 feet above sea level. Derate temperature for higher elevations.

1.07 WARRANTY

- A. UPS Module:
 - 1. The UPS manufacturer shall warrant the UPS module against defects in workmanship and materials for 2 years from the date of retail sale or the date of delivery to the initial user, whichever occurs first.
 - 2. If a factory start-up is purchased, the warranty shall also include on-site labor for the first 6 months.
 - 3. Optional 1, 2, and 3 year extensions of the standard warranty shall be available.
- B. Batteries: The battery manufacturer's standard warranty shall be passed through to the end user.

PART 2 PRODUCT

2.01 MANUFACTURER

Best Power UNITY/ITTM three-phase UPS system, or equivalent.

2.02 SYSTEM CONFIGURATION

Initially provided as a single module, non-redundant system, the UPS shall be field-upgradable for additional capacity or for redundant operation.

2.03 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

- A. System Continuous Rating: [120 kVA/120 kW] [160 kVA/160 kW] [220 kVA/220 kW] at unity power factor. The system shall support power factor corrected loads without derating the UPS.
- B. Battery Capacity: The system shall be capable of providing a [____] kW load with [____] minutes of battery reserve time, DC bus link of 408 VDC.
- C. Input Voltage Rating: 480Y/277 volts, three-phase, four-wire plus ground.
- D. Input Voltage Range: +10%, -15% (default; programmable range +/- 16%).
- E. Input Frequency: 60 Hz +/- 6% (other levels programmable).
- F. Magnetizing Inrush Current: 500% of nominal input current for less than one cycle.
- G. Power Walk-In: 0 to 100% over a 10-second period (longer duration programmable).

H. Input Power Factor: 0.82 lagging without correction.

I. Input Current Distortion: 5% THD maximum at full rated load and nominal input voltage without additional harmonic filters.

A UPS system with low input distortion has minimal impact on the customer installation, particularly on sites with a diesel generator back-up.

J. Output Voltage Rating: 480Y/277 volts, three-phase, four-wire plus ground.

K. Output Voltage Regulation (at default parameter settings):

1. +/- 1% steady state for a static 100% balanced load.
2. +/- 3% steady state for a static 100% unbalanced load.
3. +/- 5% within 50 milliseconds for a 0 to 100% load step.

L. Output Voltage Adjustment: +/- 5%.

M. Output Frequency: 60 Hz +/- 0.1 Hz free running (battery operation). Mains synchronized on normal operation.

N. Output Power Factor Range: 0.9 leading to 0.4 lagging at rated kVA. The unit's kVA capacity shall not require derating for a 1.0 load power factor.

Full unit kVA capacity at a 1.0 load power factor assures system compatibility for power factor corrected (PFC) loads.

O. Output Harmonic Distortion:

1. 3% THD maximum and 1% any single harmonic for a 100% linear load.
2. 5% THD, typical, for a 100% non-linear load (no crest factor limit).

P. Voltage Transient Response:

1. +/- 3% for a 50% load step.
2. +/- 5% for a 100% load step.

Q. Voltage Transient Recovery Time: +/- 5% within 50 milliseconds.

R. Phase Displacement:

1. 120 degrees +/- 1 degree for balanced load.
2. 120 degrees +/- 1 degree for 50% unbalanced load.
3. 120 degrees +/- 3 degrees for 100% unbalanced load.

- S. Overload Capability:
1. 250% for 60 seconds on normal operation.
 2. 150% for 10 minutes on normal operation.
 3. 150% for 60 seconds on battery operation.
 4. 125% for 10 minutes on battery operation.

High UPS overload capability is important to ensure that the UPS system does not fail to protect the load during system start-up and intermittent load operations (such as motor on/off cycles or faulted overcurrent protection devices).

- T. Short Circuit Withstand: The UPS shall withstand a bolted-fault short circuit on the output without damage to the UPS module.

This capability means that the UPS system will not catastrophically fail even under the most adverse load conditions.

- U. AC to AC Efficiency:
- 96% in normal operation, 97% in user-selectable economy mode, at nominal input voltage with batteries fully charged.

High system operating efficiency results in an attractive overall cost-of-ownership profile and minimal UPS impact on the facility (i.e. air conditioning requirement).

- V. Acoustical Noise: 65 dBA of noise, typical, measured at 1 meter from the operator surface.

2.04 UPS DESIGN AND FABRICATION

- A. Mean Time Between Failures: Field-proven minimum of 150,000 hours for critical bus failures.

- B. Modular Sub-Assemblies: For ease of maintenance and service, the UPS shall have field-replaceable modular sub-assemblies.

- C. Materials: All materials comprising the UPS module shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. The UPS module shall contain no PVCs.

- D. Inverter/Battery Charger:

1. The inverter/battery charger shall be a high-speed transistor switch module type and shall be controlled by a pulse-width modulation technique to regulate system output voltage and battery charge current.
2. Output Current Limit: The inverter shall be capable of supplying overload current of 150% of the system rating for 60 seconds and 125% of the system rating for 10 minutes.
3. Galvanic Isolation: The inverter/battery charger shall be galvanically isolated from the AC input and the AC output without additional transformers.
4. Temperature Protection: The inverter/battery charger shall be temperature protected. If the temperature reaches 194 degrees F (90 degrees C), the unit shall activate an alarm. If the temperature reaches 212 degrees F (100 degrees C), the unit shall activate an alarm and automatically transfer to static bypass operation with no interruption in power to the critical load.

5. Charging Operation Modes:
 - a. Float Charge: Under nominal operating conditions, the inverter/battery charger shall provide a nominal DC bus voltage (programmable).
 - b. Equalize Charge: The inverter/battery charger shall provide an equalize charge of 2.27 to 2.50 volts per cell (programmable) for a period of 1 to 24 hours (programmable).
 - c. Automatic Charge Sequence: If the unit is programmed for economy operation, the inverter/battery charger shall charge the batteries for a period of 60 minutes (programmable) for each 1 minute of battery discharge.
 - d. Timed Charge: If the unit is programmed for economy operation, the inverter/battery charger shall charge the batteries for a period of 1 to 255 hours (programmable) every 1 to 255 days (programmable).
6. Battery Charge Current Limit: The battery charge current limit shall be limited to 10% of nominal DC discharge current (programmable to lower level).

The combined inverter/battery charger (no separate rectifier required) provides the UPS system with superior operating efficiency and low input current distortion without compromising on-line critical load protection.

- E. Static Switch:
 1. The static switch shall be solid state and rated for continuous duty.
 2. Uninterrupted Transfer: The static bypass switch shall automatically cause a bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
 - a. Inverter overload beyond rating.
 - b. Battery runtime expired and bypass available
 - c. Inverter failure.
 - d. Battery circuit breaker open.
 3. Automatic Uninterrupted Retransfer: The static bypass switch shall automatically retransfer from bypass to the inverter/battery charger, without interruption, when one of the following conditions occurs:
 - a. After an instantaneous overload-induced transfer has occurred and the load current has returned to less than 150% of the system rating.
 - b. The UPS inverter/battery is turned on.
 4. Temperature Protection: The static switch shall be temperature protected. If the temperature reaches 194 degrees F (90 degrees C), the unit shall activate an alarm. If the temperature reaches 212 degrees F (100 degrees C), the unit shall activate an alarm and automatically transfer to battery operation with no interruption in power to the critical load.
 5. Main Static Switch: The main static switch shall automatically open to isolate inverter components during battery operation and during static bypass operation. The switch shall automatically return upon retransfer to normal operation.

2.05 BATTERY PLANT

- A. Battery Type: [Sealed valve-regulated] [Flooded] battery cells designed for UPS high rate discharge.
- B. Expected Battery Life: [5] [10] [20 (optional for flooded cells only)] years.
- C. DC Ripple: 1% of DC voltage, 2% of DC current.

These low DC ripple voltage and current charging characteristics meet and exceed the battery manufacturer requirements for optimum battery life.

- D. Low Battery Protection: To prevent total discharge or damage to the battery, the UPS shall transfer to standby operation when the battery voltage reaches a set voltage level (programmable in volts per cell). If the AC input source has not returned within ten minutes after low battery shutdown, the UPS shall electronically disconnect DC power from the battery.
- E. Battery Monitor: A battery monitor function shall be capable of monitoring and defining battery capacity. It shall be possible to program the unit to perform an automatic battery test every 90 days to test the condition of the battery.
- F. Isolation: The battery shall be isolated from the AC input and the AC output.
- G. Battery Manufacturing Controls: Each battery cell shall be clearly identified as to cell type, voltage, and capacity. All cells in the battery shall be tested to verify 100% system capacity. The equipment shall be designed and manufactured under a quality assurance program which is controlled and documented by written policies, procedures, or instruction.
- H. [Battery Cabinet Assembly: A free-standing, NEMA 1 cabinet that complements the appearance of the UPS and is designed to allow for ease of maintenance. The battery cabinet assembly shall include a battery disconnect to provide a positive means of isolating the battery from the rest of the system.]

[Battery Racks: [1] [2] [3]-tier certified for seismic zone [0] [1] [2] [3] [4]. To prevent warpage, racks shall have welded steel support frames and unitized rail construction. All metallic surfaces which contact the battery shall be insulated. Inter-cell connections, inter-tier connections, and terminal plates shall be included with the racks.]
- I. Battery Disconnect: Provide a positive means of isolating the battery from the rest of the system.
- J. Pre-charge/Discharge Circuit: A pre-charge/discharge circuit shall supply a means of pre-charging the DC filter capacitors to limit inrush current and a means of discharging the DC filter capacitors before maintenance or service.

2.06 DISPLAY AND CONTROLS

- A. Display Unit: A microprocessor-controlled display unit shall be located at the front of the UPS cabinet. The display unit shall consist of an alphanumeric display, an alarm LED, and a touch key pad. The primary display language shall be English, and an alternate display language shall be included. The following alternate display languages shall be available: Danish, Dutch, Finnish, French, German, Italian, Polish, Portuguese, Spanish, or Swedish.
- B. UPS Status Messages: The display unit shall display the following UPS status messages:
1. Normal operation, load power xxx%.
 2. Battery operation, time xxx minutes.
 3. Bypass operation.
 4. Standby.
 5. Economy operation, load power xxx%.
- C. Metered Parameters: The display unit shall allow the user to display the following metered parameters:
1. Input AC voltage (line-to-line, three-phase simultaneous).
 2. Input AC current (line-to-neutral, three-phase simultaneous).
 3. Output AC voltage (line-to-line, three-phase simultaneous).
 4. Output AC current (line-to-neutral, three-phase simultaneous).
 5. Output frequency.
 6. Percent of rated load on most fully loaded phase.
 7. Battery voltage.
 8. Battery current (charge/discharge).
 9. Inverter current.
 10. Battery temperature.
 11. Output peak current.
- D. Alarms: The display unit shall allow the user to display a log of all active alarms. The following alarm conditions shall be monitored:
1. Off button pushed.
 2. Mains is momentarily out of tolerance.
 3. Mains is out of tolerance.
 4. Mains frequency is out of tolerance.
 5. Bypass is momentarily out of tolerance.
 6. Bypass is out of tolerance.
 7. Bypass frequency is out of tolerance.
 8. Synchronization error.
 9. TSM (transistor switch module, i.e. inverter/battery charger) 1 temperature warning.
 10. TSM 1 temperature shutdown.
 11. TSM 2 temperature warning.
 12. TSM 2 temperature Shutdown.
 13. TSM 3 temperature warning.
 14. TSM 3 temperature shutdown.
 15. Inverter fuse blown.
 16. Fault in internal power supply.
 17. Fan fault (if fan monitor option is installed).
 18. RAM1 data error.
 19. Static switch 1 (i.e. main static switch) temperature warning.
 20. Static switch 1 temperature shutdown.

21. Static switch 2 (i.e. bypass static switch) temperature warning.
22. Static switch 2 temperature shutdown.
23. High temperature choke.
24. High temperature transformer.
25. High battery temperature (if battery charger temperature compensation is installed).
26. Low DC warning.
27. Low DC shutdown.
28. High DC warning.
29. High DC shutdown.
30. Charge regulation error.
31. Battery monitor warning.
32. Battery monitor alarm.
33. Battery MBC (i.e. external DC disconnect) is off.
34. External service switch activated.
35. High output voltage.
36. Output is momentarily out of tolerance.
37. Output is out of tolerance.
38. Output frequency is out of tolerance.
39. Output frequency is out of tolerance.
40. Overload: load is over 100%.

E. Events Log: The display unit shall allow the user to display a time- and date-stamped log of the 250 most recent UPS status and alarm events.

F. Controls: The following controls shall be accomplished with the display unit:

1. Silence an audible alarm.
2. Set the alphanumeric display language to English or the alternate language.
3. Display or program the time and date.
4. Enable or disable the automatic restart feature.
5. Transfer to or from static bypass operation.
6. Transfer to or from forced battery operation.
7. Program the unit for economy operation.
8. Program the battery charger.
9. Calculate battery reserve time.
10. Test battery condition on demand.
11. Program the unit to periodically test battery condition.
12. Program voltage and frequency windows.
13. Calibrate metered parameters.
14. Enable or disable adaptive slew rate. Set maximum slew rate.
15. Adjust set points for some alarms.
16. Program the remote shutdown contact on the optional communication interface board (enable/disable remote shutdown, polarity, delay).
17. Set the delay for the common fault contact.
18. Program line drop compensation for long cable runs.
19. Program the unit for soft start for use with a generator.

G. UPS On and Off Push Buttons: Momentary UPS “on” and “off” push buttons shall be provided in a user-accessible compartment. Upon activation of the “on” push button, the UPS shall automatically connect the UPS output to the critical load. Upon activation of the “off” push button, the UPS shall remove power from the critical load.

H. Form C Dry Contacts:

1. Common fault alarm.
2. Battery operation (30 second delay).
3. External maintenance bypass inhibit connected if system is outside limits.
4. Position indicator of DC disconnect switch.
5. Position indicator of external maintenance bypass switch.
6. Remote start/stop (closing contacts).
7. Emergency power off (EPO) upon activation of contact closure.
8. Emergency power off (EPO) if current loop is interrupted.

2.07 OPTIONS

- A. Optional External Maintenance Bypass: The external maintenance bypass shall supply the load from the bypass source while the UPS is isolated for maintenance. Thermal-magnetic breakers shall be provided for maintenance bypass, for the UPS input breaker, and for the UPS output breaker. Each circuit breaker shall have a minimum interrupting rating of 18 KAIC at 480 VAC. An optional key interlock system shall be provided. The maintenance bypass shall be housed in a NEMA 1 enclosure that complements the appearance of the UPS.
- B. Optional Input Isolation Transformer: The dry type transformer shall be constructed with fully isolated copper or aluminum windings and shall provide galvanic isolation from the AC input source. It shall perform the required voltage transformation and shall have four 2.5% taps below and two 2.5% taps above the rated voltage. When operating at full load and at the maximum ambient temperature, the hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material. The transformer shall be designed for continuous operation at 125% of full load. The transformer shall be housed in a cabinet that complements the appearance of the UPS.
- C. Optional Output Isolation Transformer: The K1 or K13 rated, dry type transformer shall be constructed with fully isolated copper or aluminum windings and shall provide galvanic isolation for the UPS loads. It shall perform the required voltage transformation and shall have four 2.5% taps below and two 2.5% taps above the rated voltage. When operating at full load and at maximum ambient temperature, the hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material. The transformer shall be designed for continuous operation at 125% of full load. The transformer shall be housed in a cabinet that complements the appearance of the UPS.
- D. Optional Fan Monitor: The fan monitor shall monitor fan operation. If the fan monitor detects a possible fan malfunction, an alarm shall activate. This alarm shall be independent of other temperature-related alarms.
- E. Optional Battery Charger Temperature Compensation: The battery charger temperature compensation shall monitor the temperature in one battery cabinet. To extend battery life, charger voltage shall compensate for changes in battery temperature.

- F. Optional Relay Board: The relay board shall provide the following normally open or normally closed Form C dry contacts:
1. Mains voltage outside limits.
 2. Battery charging failure.
 3. Overload.
 4. Fan failure.
 5. Inverter fuse blown.
 6. Low battery voltage.
 7. High temperature.
 8. Battery DC disconnect off.
 9. Output voltage outside limits.
 10. UPS on static bypass operation.
 11. External manual bypass on.
 12. Normal operation.
 13. Common fault.
 14. Bypass voltage outside limits.
 15. Battery operation.
- G. Optional Communication Interface Board: The communication interface board shall provide the following communication ports, and it shall be possible to use two or more ports simultaneously.
1. RS232 serial port.
 2. 0 to 20 mA current loop serial port.
 3. COM-PORT with the following normally open or normally closed Form C dry contacts:
 - a. UPS on.
 - b. Static bypass operation.
 - c. Battery operation.
 - d. Battery low.
- H. Optional Remote UPS Monitoring Kits: Remote UPS monitoring shall be possible via a communication interface between an existing computer system and a port on the optional UPS communication interface board.
1. The UPS manufacturer shall have available interface kits to support remote UPS monitoring for the following computer systems:
 - a. IBM AS/400.
 - b. Novell NetWare for PS/2 Mouse Port.
 - c. Novell NetWare.
 - d. LAN Manager.
 - e. LAN Server.
 - f. Lantastic.
 - g. Windows NT.
 - h. Banyan Vines.
 2. The UPS manufacturer shall have available remote UPS monitoring software kits for the following computer systems:
 - a. UNIX/XENIX and compatibles.
 - b. SunOS/Solaris.
 - c. DEC AXP/Open VMS.
 - d. DEC VAX/VMS.

- I. Optional SNMP Adapter: The Ethernet SNMP adapter shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX tar formats. The SNMP interface adapter shall be connected to the UPS via the RS232 serial port on the optional communication interface board.
- J. Optional Environmental Monitor:
 - 1. The environmental monitor shall monitor the following:
 - a. Any three normally open or normally closed contacts available on the UPS external connection board, optional communication interface board, and optional relay board. Any other normally open or normally closed contacts, such as water, door, or window sensors, can also be monitored.
 - b. Utility power outage lasting 5 minutes or more.
 - c. Ambient temperature (programmable high and low set points).
 - d. Any audible alarm, such as the UPS alarm or a smoke alarm.
 - 2. If an alert condition occurs, the monitor shall sequentially dial up to four user-programmable telephone numbers and announce the alert condition. The monitor shall continue calling the telephone numbers until the alert condition is acknowledged. The alert condition shall also be announced through a speaker on the monitor. The environmental monitor shall have the capability to receive incoming telephone calls so that the user may obtain a status report at any time.
- K. Optional Parallel Board: The parallel board shall allow UPS modules to be connected in parallel for increased capacity or for redundant operation. The parallel board shall ensure proper control of parallel units and proper load sharing. One parallel board shall be provided for each unit connected in parallel. Each parallel board shall include 23 feet of control-level interconnection cable.

2.08 MECHANICAL DESIGN

- A. Enclosure: The UPS shall be housed in a free-standing NEMA 1 enclosure. The enclosure shall be designed to blend into a computer room environment. The cabinet shall be equipped for fork truck lifting. The UPS cabinet shall be painted with the manufacturer's standard color. All service access shall be from the front and top. Cable entry shall be from the bottom.
- B. UPS Module Dimensions: Height x width x depth of 74.8 x 63.0 x 31.5 inches (1900 x 1600 x 800 mm).
- C. Floor Loading: Maximum UPS system floor loading shall not exceed 400 pounds per square foot (distributed).
- D. Ventilation: The UPS shall be cooled by forced air. External battery systems shall be cooled by free-air ventilation and convection.

PART 3 EXECUTION

3.01 FACTORY ASSISTED START-UP

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. Visual Inspection:

1. Inspect equipment for signs of damage.
2. Verify installation per manufacturer's instructions.
3. Inspect cabinets for foreign objects.
4. Verify correct electrolyte level of flooded cells (if applicable).
5. Inspect battery cases.
6. Inspect batteries for proper polarity.
7. Verify all printed circuit boards are properly configured.

B. Mechanical Inspection:

1. Check all UPS, external maintenance bypass cabinet, and DC disconnect switch internal control wiring connections.
2. Check all UPS, external maintenance bypass cabinet, and DC disconnect switch internal power wiring connections.
3. Check all UPS, external maintenance bypass cabinet, and DC disconnect switch terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Check all UPS fuses for continuity.
2. Verify correct input and bypass voltage.
3. Verify correct phase rotation.
4. Verify correct UPS control wiring and terminations.
5. Verify correct termination and voltage of battery strings.
6. Verify neutral and ground conductors are properly configured.
7. Inspect external maintenance bypass switch for proper terminations and phasing.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper firmware control functions.
3. Verify proper firmware bypass operation.
4. Verify proper maintenance bypass switch operation.
5. Verify system set points.
6. Verify proper inverter operation and regulation circuits.
7. Simulate utility power failure.
8. Verify proper charger operation.
9. Document, sign, and date all test results.

E. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.02 MANUFACTURER'S FIELD SERVICE

- A. Worldwide Service Center: The UPS manufacturer shall have available a service organization consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The Worldwide Service Center shall coordinate field service personnel schedules. One toll-free telephone number shall reach a qualified support person 24 hours a day, 7 days a week, 365 days a year. If emergency service is required, call-back response time shall be 20 minutes or less. Through normal escalation procedures, Worldwide Service Center management shall be notified if a site is not functioning within 24 hours.
- B. Replacement Parts Stocking: Parts shall be available through the Worldwide Service Center 24 hours a day, 7 days a week, 365 days a year. Recommended spare parts for local field service personnel shall be available from the Worldwide Service Center. The Worldwide Service Center will be capable of shipping parts within 4 hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

3.03 MAINTENANCE CONTRACTS

A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. Contract duration shall be 1, 2, 3, or 5 years. Contract work shall be performed by factory trained service personnel. On-site full service contracts shall include labor, mileage, travel, UPS parts, and shipping.

3.04 TRAINING

UPS Service Training Workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

END OF SECTION