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SPACE GATEWAY SUPPORT (SGS) **SGS-26 33 53.00 99 (November 2006)**

Preparing Activity: SGS-DE **Superseding SGS-26 33 53.00 99 (July 2006)**

SGS GUIDE SPECIFICATIONS

References are NOT in Agreement with UMRL dated 09 October 2006

Revised throughout - changes not indicated by CHG tags
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DIVISION 26 - ELECTRICAL

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STATIC UNINTERRUPTIBLE POWER SUPPLY

11/06

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SECTION 26 33 53.00 99

STATIC UNINTERRUPTIBLE POWER SUPPLY
11/06

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NOTE: This guide specification covers the requirements for three-phase continuous duty, on-line, solid state uninterruptible power systems at Kennedy Space Center and CCAFS/PAFB..

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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PART 1 GENERAL

1.1 SUMMARY

This specification describes a three-phase continuous duty, on-line, solid state uninterruptible power system, hereafter referred to as the UPS. The UPS must operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads, and interface with remote communication systems. The UPS consists of the UPS module, one or more battery strings, external maintenance bypass with output distribution and other features as described in this specification.

The UPS must comply with IEEE C62.41, IEC 62040-2, IEC 62040-3, NEMA PE 1, MIL-HDBK 217F, FCC Part 15,NFPA 70, UL 1778 and UL 94.

1.2 UPS MODULE DESCRIPTION

1.2.1 UPS Module Components

The UPS module must consist of the following main components:

a. Rectifier/Charger
b. Static Inverter
c. Bypass
d. Output Isolation Transformer
e. Control Panel
f. Monitor Panel
g. Communication Panel

h. Remote [KSC][CCAFS][PAFB] Communication Interface

1.2.2 UPS Module Modes of Operation

The UPS Module must operate as an on-line, fully automatic system in the following modes:

1.2.2.1 Normal

The critical load must be continuously supplied by the Inverter. The Rectifier/Charger must derive power from the commercial AC source and supply DC power to the Inverter while simultaneously float-charging the battery.

1.2.2.2 Battery

Upon failure of the commercial AC power, the critical load must continue to be supplied by the Inverter, which obtains power from the batteries without any operator intervention. There can be no interruption to the critical load upon failure or restoration of the commercial AC source.

1.2.2.3 Recharge

Upon restoration of the AC source, the Rectifier/Charger must recharge the batteries and simultaneously provide power to the Inverter. This must be an automatic function and cause no interruption to the critical load.

1.2.2.4 Bypass

If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch must automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation must be automatic. Bypass mode must be capable of being initiated manually, without operation of the static switch from the front control panel.

1.3 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this section and the work requirements:

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
IEEE C62.45	(2002) Surge Testing for Equipment Connected to Low-Voltage (1000v and less)AC Power Circuits
IEEE Std 485	(1997) Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60801-2	(1991) Electromagnetic Compatibility For Industrial-Process Measurement And Control Equipment Part 2: Electrostatic Discharge Requirements
IEC 62040-2	(2005) Standard for UPS Electromagnetic compatibility (EMC)requirements, ED 2.0 b
IEC 62040-3	(1999) Standard for Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements, Ed. 1.0

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA PE 1	(2003) Uninterruptible Power Systems -- Specification and Performance Verification

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK 217F	(1997; Rev A; Notice 1 & 2)) Standard for Reliability Prediction of Electronic Equipment.

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	(2004) 47 CFR 15-Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1778	(2005) Uninterruptible Power Systems, 4TH Edition
UL 94	(2004; R 2006) Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy, Air Force, and NASA projects.

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Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

Supply sufficient documentation for the UPS, including the following manuals:

SD-02 Shop Drawings

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NOTE: Typical installation and module arrangement must be based in accordance with manufacturer's installation drawings. For NAVFAC projects, installation drawings may be obtained from NFESC ECDet, Code 65.

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Overall dimensions, front view, and sectional view

Typical Installation and Module Arrangement

Ventilation and Exhaust System

Submit drawings for [UPS] and [battery] installation.

Detail drawings must consist of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE Std 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

SD-03 Product Data

Pertinent performance data for the UPS system, using a copy of the data sheets supplied with this specification. Data sheets must be certified by a responsible officer of the UPS manufacturer.

Inter-rack and inter-tier cables[; G]

Control cable

Cable lugs

Spare parts data, as specified.

Field Training[; G][; G, [_____]]

Lesson plans and training manuals for the training phases, including type of training to be provided and proposed dates, with a list of reference materials.

SD-06 Test Reports

Factory Testing
Field Supervision, Startup and Testing

SD-08 Manufacturer's Instructions

Furnish one copy of the Installation Manual with sufficient detail and clarity to enable the owner's technicians to install the UPS equipment.

Submit one set plus an electronic copy of the following drawings and data sheets:

Receiving and Installation Instructions
UPS One-Line Drawings
Equipment Outline Drawings
Interconnection Drawings
Battery Wiring Diagram
Accessory Wiring Diagrams

SD-10 Operation and Maintenance Data

Furnish one copy of the Operation Manual in sufficient detail and clarity to enable the owner's technicians to understand and operate the UPS equipment. Describe the UPS in full by including

the following major items:

Operating Procedures/Manual
Performance Data and Technical Data
General Description
UPS Module Description
Communications Capability
Battery Description
Accessory Description

1.5 PRECONSTRUCTION REQUIREMENTS AND QUALIFICATIONS

Prior to commencement of construction, submit the following to the Engineer of Record for review and approval:

Installation Manual
Receiving and Installation Instructions
UPS One-Line Drawings
Equipment Outline Drawings
Interconnection Drawings
Battery Wiring Diagram
Accessory Wiring Diagrams
Operation Manual

The UPS manufacturer must have a minimum of ten years experience in the design, manufacture and testing of solid-state UPS which are compliant with NEMA PE 1. Supply a list of installed UPS of the same type as the manufacturer proposes to furnish for this application with the proposal. Submit documentation of a Typical Installation and Module Arrangement (TIMA). Drawings must indicate overall dimensions, front view, and sectional view.

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

A detailed description of proposed Factory Testing and field test procedures, including proposed dates and steps outlining each test, how it is to be performed, what it accomplishes, and its duration, not later than [_____] months prior to the date of each test.

Submit all factory and field test reports in booklet form tabulating factory and field tests and measurements performed, upon completion and testing of the installed system. Factory and field test reports must be signed by an official authorized to certify on behalf of the manufacturer of the UPS system that the system meets specified requirements. The reports must be dated after the award of this contract, stating the Contractor's name and address, name of the project and location, and include a list of the specific requirements which are being certified.

1.6 ENVIRONMENTAL REQUIREMENTS

The UPS must withstand any combination of the following external environmental conditions without operational degradation.

1.6.1 Operating Temperature

0 degrees C to +40 degrees C 32 degrees F to 104 degrees F without derating (excluding batteries).

1.6.2 Storage Temperature

Storage temperture must remain within -20 degrees C to +70 degrees C -4 degrees F to 158 degrees F. Prolonged storage above +40 degrees C 104 degrees F will cause rapid battery self-discharge.

1.6.3 Relative Humidity (Operating and Storage)

95% maximum non-condensing.

1.6.4 Elevation

1500 m 5000 ft maximum at 40 degrees C 104 degrees F without derating.

1.6.5 Acoustical Noise

Noise generated by the UPS under normal operation must not exceed 65 dbA at one meter from any operator surface, measured at 25 degrees C 77 degrees F and full load.

1.6.6 EMI Suppression

The UPS must comply with FCC Part 15 for Class A devices.

1.6.7 Electrostatic Discharge (ESD)

The UPS must conform to IEC 60801-2and withstand up to 25 kV without damage and with no disturbance or adverse effect to the critical load.

1.6.8 Efficiency

The typical UPS efficiency must be 92% at full unity power factor load and nominal input voltage.

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

If present, an input isolation transformer may reduce the UPS efficiency an additional 3%.

1.6.9 Input Surge Withstand Capability

The UPS must comply with IEEE C62.41, Category A & B (6 kV). Test in compliance with IEEE C62.45

1.7 RELIABILITY AND MAINTAINABILITY

1.7.1 Reliability

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

The calculated mean-time-between-failure for the UPS module, which would result in a successful emergency transfer to internal bypass, must be no less than 62,000 hours. This calculated MTBF must be derived in accordance

with MIL-HDBK-217E guidelines (ground benign conditions at 25C) and assume the availability of bypass input power to the UPS module.

The calculated mean-time-between-failure for any UPS module component, must be no less than 43,000 hours. This calculated MTBF must be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C).

The UPS module must feature redundant power supplies. Power to the control power supplies must originate from the Rectifier/Charger input, Bypass input and UPS module output. Submit product data on Control cable, Cable lugs, Inter-rack and inter-tier cables[; G]. In the event one of the power supplies fails, the UPS module must continue to operate in Normal mode without load derating. A failed power supply condition must be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm must automatically clear when the failed power supply is replaced.

The UPS module must feature redundant cooling fans. In the event one of the fans fails, the UPS module must continue to operate in Normal mode without load derating. A failed cooling fan condition must be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm must automatically clear when the failed fan is replaced.

The UPS module must utilize high-reliability wiring and connectors. The UPS module must not use ribbon cables.

The inverter controls, rectifier/charger controls, bypass controls and monitoring/communication controls in the UPS module must be contained, in their totality, on a maximum of four control printed circuit boards.

All power cable connections to power transformers and chokes must be secured with permanent cold weld crimps which require no maintenance or periodic retorquing. These cold weld crimps must be Underwriters Laboratories recognized components.

1.7.2 Maintainability

Calculated and demonstrated mean-time-to-repair (MTTR) must not exceed 30 minutes, including time to diagnose the problem and replace the subassembly.

1.8 SAFETY

The UPS must be certified by Underwriters Laboratories in accordance with UL 1778.

1.9 WARRANTY

1.9.1 UPS Module

The UPS module warranty must be no less than [12][24] months after acceptance and must include all costs including repair, parts, labor, travel and living expenses for the manufacturer's service personnel, within the 48 contiguous United States.

1.9.2 Battery

The UPS manufacturer must warrant their battery cabinets against defects in material and workmanship on a prorated basis for [ten years][_____ 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 C77 degrees F. The battery manufacturers' warranty must also apply to external battery systems.

The term of the warranty for battery cabinets must include full replacement or repair for a period of twelve[_____] months from the date of equipment start up and acceptance, or eighteen[_____] months from the date of equipment shipment, whichever occurs first, plus an additional pro-rated period of nine[_____] years.

1.9.3 Service Plan

Include a service plan within the warranty offering the following:

a. One year 7x24 corrective maintenance
b. One 7x24 annual performance check
c. Discounted spare parts, discounted parts
d. Labor, travel expenses for additional services
e. Guaranteed eight hour response time
f. 7x24 technical support.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Approved Manufacturers

Powerware Corporation or equal

2.2 UPS MODULE STANDARD FEATURES

The UPS module must consist of the following standard components:

2.2.1 Rectifier/Charger

The Rectifier/Charger must convert incoming AC power to regulated DC output for supplying the Inverter and for charging the battery. The Rectifier/Charger must be of a six-pulse, phase-controlled, solid-state design. The modular design of the UPS module must permit easy removal of the Rectifier/Charger without removal of any other assembly.

2.2.2 Inverter

The Inverter must feature insulated gate bi-polar transistors (IGBTs) in a three-leg, pulse-width-modulation (PWM) design with a switching speed of 4500 HZ. The Inverter must also have the following features:

a. The Inverter must 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.

b. The modular design of the UPS module must permit easy removal of each phase of the Inverter and DC electrolytic capacitors without removal of any other assembly.

c. Uninterrupted manual transfers must be initiated from the control panel. Uninterrupted manual transfers to Bypass and from Bypass must be possible with the Inverter logic, without using the emergency bypass control logic or the static switch. During manual

transfers to Bypass mode, the Inverter must verify proper Bypass operation before transferring the critical load to the Bypass.

d. The Inverter must feature protection circuitry which prevents the IGBTs from sourcing current in excess of their published ratings.

2.2.3 Bypass

The Bypass must serve as an alternate source of power for the critical load when performing maintenance on the UPS module or when a failure prevents operation in Normal mode. The Bypass must consist of a naturally-commutated static switch, for high-speed transfers, and wrap-around switchgear. The modular design of the UPS module must permit removal of the static switch without removal of any other assembly. The static switch must only be necessary for controlling emergency make before break transfers. The Bypass must feature the following transfer and operational characteristics:

Uninterrupted transfers to Bypass must be automatically initiated for the following conditions:

a. Output overload period expired.
b. Critical bus voltage out of limits.
c. Over temperature period expired.
d. Total battery discharge.
e. UPS module failure.

Uninterrupted automatic retransfer must take place whenever the Inverter is capable of assuming the critical load.

Uninterrupted automatic retransfers must 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 must limit "cycling" to three (3) operations in any ten minute period. The fourth transfer must lock the critical load on the Bypass source.

c. UPS module failure.

All transfers and retransfers must 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.

The Bypass must be manually energized with a keyswitch on the control panel. No additional control logic must be required.

The logic power required to perform an emergency transfer to bypass must be derived separately from the logic power required to operate the inverter controls.

The control circuitry required to perform an emergency transfer to bypass must operate independently from the inverter control circuitry.

The Rectifier/Charger input circuit breaker must have no effect on Bypass operation

2.2.4 Monitoring and Control Components

The following components must provide monitor and control capability:

a. Micro-controller driven circuitry: Embedded 20 MHZ, 16 bit, single chip controller.

b. Monitor Panel with status indicators

c. Alarm and metering display

d. Building alarm monitoring

e. Input circuit breaker

f. Inverter and bypass contactors

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

2.2.5 Output Isolation Transformer

The UPS module must contain an output isolation transformer featuring two primaries (an Inverter Delta winding and a Bypass Wye winding) and a single secondary (a Wye winding to the UPS module output terminals). The Wye/Wye transformation of the Bypass through the transformer must produce a zero degree phase shift. This transformer must provide isolation between the primaries and secondary and must qualify the UPS as a separately derived source when in both Normal and Bypass modes.

2.2.6 Battery Contactor

The UPS module must contain a two pole contactor for disconnecting the battery from the rectifier output and the Inverter input. A contactor enable switch must be located on the UPS module control panel. With the UPS module in Bypass mode, this contactor must permit the rectifier, Inverter, DC capacitors and associated control boards to be safely serviced without opening a battery breaker external to the UPS module.

2.2.7 Battery Management System

The UPS module must contain a battery management system which has the following features:

a. The battery management system must provide battery time available, or percent remaining, while operating in Normal mode and Battery mode. Battery time available information must be displayed real-time, even under changing load conditions. Once commissioned, the battery time available information must be accurate within +/- 3%.

b. The battery management system must automatically analyze the UPS battery during a user defined periodic test cycle (quarterly, monthly, etc.). During the test, the Rectifier/Charger must not de-energize, but must share load with the battery. The battery must be tested under the same load for each user defined periodic

test to determine battery time remaining information. Should the battery be weak or defective, the battery management system must detect and enunciate the battery failure condition without transferring the critical load to Bypass.

c. The periodic test performed by the battery management system must not remove more than 10% of the available battery run time from the battery. The periodic test, if performed on a monthly basis, must not reduce overall battery life.

d. If a utility outage occurs while a test is in progress, the test must be discontinued and subsequently conducted at the next programmed interval. The occurrence of the periodic test must be user programmable for day, date and time.

e. The battery management system must record and display the pass/fail status, battery voltage and health indicator value of the previous thirty (30) periodic tests.

f. The battery management system must provide battery health information in the form of a health indication value. When the health indication value approaches 0.80, it must correspond with battery string end of life.

g. The battery management system must enunciate a user programmable battery time remaining warning when the UPS module is on battery power.

h. The battery management system must provide an imminent shutdown alarm to signal a low battery condition.

i. The battery management system must work with either wet cell batteries or valve-regulated batteries.

2.2.8 Wiring Terminals

The neutral output compression terminal must be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module must contain mechanical compression terminals (adequately sized to accommodate 75 degree C wiring) for securing user wiring to the following locations:

a. Rectifier/Charger input connections(3 phases)
b. Bypass input connections (3 phases)
c. DC link connections for battery cabinets (positive and negative)
d. AC output connections (3 phases and 1 neutral)

2.3 UPS MODULE OPTIONS AND ACCESSORIES

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

2.3.1 Input Filter with Power Factor Correction

The input filter must reduce the harmonic feedback current to less than 10% total harmonic distortion (THD) reflected onto the utility by the rectifier. Additionally, the filter must improve the input power factor to approximately 0.95. The input filter must be housed in the UPS module. The UPS module must 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 UPS module rated capacity.

2.4 UNINTERRUPTIBLE POWER SUPPLY OPTIONS AND ACCESSORIES

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

2.4.1 Battery Cabinets

The battery cabinets must 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 must be flame retardant in accordance with UL 94V2 requirements. The battery cabinets must have the following features:

a. Battery Capacity Protection Time (at 25 degrees C): [30][_____] minutes at full kW.

b. The battery cabinets must the same depth and height as the UPS module. The battery cabinet must be [43][_____] inches wide.

c. The battery cabinets must feature a mechanical enclosure of like appearance to the UPS module and must feature casters. Each battery cabinet must require front access only for installation, service and maintenance. The battery cabinets must provide top and bottom cable entry.

d. Each battery cabinet must feature 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray must be firmly secured to the battery cabinet frame with fasteners. Each battery tray must be removable from the front of the battery cabinet.

f. The battery cabinets must be available in an integral configuration (line-up & match), where multiple battery cabinets must be secure together. In this configuration the number one battery cabinet must provide the electrical connection to secure all the battery cabinets to the UPS module with a single quick disconnect device. All power wiring and control wiring must be provided by the manufacturer. All power wiring and control wiring must pass through the battery cabinets. All power wiring and control wiring connections between multiple battery cabinets and the UPS module must be secured with quick disconnect devices.

g. The battery cabinets must be available in a remote configuration, where multiple battery cabinets stand apart from the UPS module and but must be installed secured to each other. Power wiring and control wiring between battery cabinet must pass through the battery cabinets. All power wiring and control wiring connections between multiple battery cabinets and the UPS module must be secured with quick disconnect devices. All power wiring and control wiring between the number one battery cabinet and UPS module must be provided by others.

h. The battery cabinets must be available in a remote configuration,

where multiple battery cabinets stand apart from the UPS module and must be installed separate from each other. The power wiring and control wiring between multiple battery cabinets and the UPS module must be provided by others.

i. The battery cabinets must each feature a DC rated circuit breaker. The circuit breaker within an individual battery cabinet must only provide protection to the battery string with that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.

j. The circuit breaker in each battery cabinet must feature an A/B auxiliary switch. The UPS module must be capable of monitoring and alarming an open battery cabinet circuit breaker condition.

k. The circuit breaker in each battery cabinet must feature a 24 VDC shunt trip.

2.4.1.1 Expected Battery Life

200 complete full load discharge cycles when operated and maintained within specifications.

2.4.1.2 Final Discharge Voltage

Full Load: 1.66 V per cell (adjustable).

No Load: 1.75 V per cell (adjustable). The UPS module must automatically select the final discharge voltage (either 1.66 or 1.75 Volts per cell) based on the rate and length of discharge.

2.4.1.3 Nominal Float Voltage

2.25 V per cell.

2.4.1.4 Maximum Equalizing Voltage

2.40 V per cell.

2.4.2 Maintenance Bypass Panel

The Maintenance Bypass Panel (MBP) must provide electrical power to the critical load from the UPS module output or utility bypass and must have the following features:

a. The MBP must provide a make before break power transfer to the critical load between the UPS module output and utility bypass.

b. The MBP must provide disconnect devices enclosed within galvanized steel boxing with code gauge steel trim painted ANSI 61 gray. Integral bussing must be factory installed, tin-plated [aluminum][copper] for [250][800][_____] ampere panel at [_____][65kA].

[Three Device - This configuration must include the UPS module wrap around (maintenance bypass) disconnect, UPS module output disconnect and UPS module bypass input disconnect devices.]

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

c. The MBP disconnect devices must be [molded case switches][molded case circuit breakers] rated at [_____]KAIC.

d. The MBP must be rated [_____] amps, [_____] volts AC.

e. An interlock key must be available which provides electrical isolation between the UPS module inverter output power and the utility bypass circuit while transferring power to the critical load.

f. A breaker auxiliary switch must be available which provides 2NO and 2NC contacts suitable for remote signaling and indication of the circuit breakers main contact position.

g. A breaker shunt trip device must be available which provides remote controllable tripping of circuit breakers with 24 VDC.

h. The enclosure must be [floor mounted][_____] which is suitable for [indoor][exterior] use.

j. The MBP must have [four][_____] output distribution breakers with space for a [fifth][_____]. The out distribution breakers must be rated at [450A][_____][225A][_____] and [two][_____][25A][_____] and the space rated for at least [225A][_____]. All breakers must be rated for [65kAIC][_____].

[2.4.3 Remote Emergency Power Off (REPO) Station

The REPO station must be connected to an UPS module. The REPO must feature a red push-button switch which, when depressed, opens the associated UPS module's breakers and contactors, and de-energizes the UPS module's critical load. Provide a key for reset of the push-button. The REPO station must be approximately 4.5 inches square and may be surface wall mounted (interior) next to the door.

][2.4.4 Kennedy Space Center (KSC) Remote Monitoring Interface (RMI)

KSC adapter (RMI) must provide a communications interface between the UPS module (via the RS232 port) and KSC compatible network management systems. This capability allows the unit to be monitored remotely by KSC. The UPS manufacturer is responsible for all protocol development, software interface, and layout of all computer screens required for remote monitoring by KSC.

][2.4.5 Remote Monitor Panel (RMP)

Connect the RMP to the UPS module to monitor the operation of the UPS system at a remote location within 500 feet. The RMP must contain backlit status indicators and a local horn. Staus indicators must include (as a minimum): system normal, UPS alarm, battery on bypass unavailable, bypass on, and shut down imminent.

]2.5 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

2.5.1 UPS Continuous Ratings

The UPS must be rated at [_____] kVA maximum for a load power factor range of 0.8 lagging to 0.9 leading (

The UPS must be rated at [_____] kW

2.5.2 Rectifier/Charger Input

2.5.2.1 Nominal Input Voltage

[480][208] VAC, 3-phase, 3-wire plus ground

2.5.2.2 Operating Input Voltage Range

+10%, -15% of average nominal input voltage without battery discharge.

2.5.2.3 Operating Input Frequency Range

Operating input frequency range is within 3 Hz of the nominal input frequency:

a. For a 60 Hz UPS module, the range is 57 to 63 Hz.

b. The frequency range is adjustable to nominal $\pm$ 5 Hz, factory set.

2.5.2.4 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).

2.5.2.5 Normal Input Current Limit

The UPS module must include the following programmable input current limit settings while operating in Normal mode:

a. Rectifier/Charger Input Current Limit: must be adjustable from 50% to 100% of full-load input current.

b. Battery Input Current Limit: Battery charge current limit must be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.

2.5.2.6 On Generator Input Current Limit

The UPS module must have the following programmable input current limit settings while operating in Normal mode on generator:

a. Rectifier/Charger Input Current Limit: must be adjustable from 50% to 100% of full-load input current.

b. Battery Input Current Limit: Battery charge current limit must be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.

2.5.2.7 Input Current Total Harmonic Distortion (THD) With Optional Input Filter

7% Maximum.

2.5.2.8 Magnetizing Inrush Current

Typically 800% of the largest model's full load rectifier input current. The input isolation transformer doubles this value.

2.5.2.9 Power Walk-In

Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

2.5.3 Bypass Input

2.5.3.1 Synchronizing Bypass Voltage Range

+/-10% of average nominal input voltage.

2.5.3.2 Synchronizing Bypass Frequency Range

Synchronizing bypass frequency range is centered on the nominal frequency 60 Hz.

2.5.3.3 Magnetizing Inrush Current

Typically 800% of the largest model's full load rectifier input current.

2.5.3.4 Input Surge Withstand Capability

The UPS must be in compliance with IEEE C62.41, Category A & B (6 kV). Testing method must comply with IEEE C62.45.

2.5.4 Rectifier/Charger Output

2.5.4.1 Nominal DC Voltage

Nominal DC voltage must be 540

2.5.4.2 Steady State Voltage Regulation

+/- 0.5%

2.5.4.3 Voltage Ripple

less than 0.5% (peak to peak)

2.5.4.4 Capacity

The Rectifier/Charger must 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.

2.5.4.5 Low Line Operation

The Rectifier/Charger must 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 must enunciate operation in this

mode.

2.5.4.6 Battery Equalize

Automatic and manual means must be provided for battery equalization

2.5.4.7 DC Sensing

Redundant DC voltage sensing methods must be incorporated for providing battery overvoltage protection.

2.5.5 UPS Output in Normal Mode

2.5.5.1 Nominal Output Voltage

[480][208] VAC, 3-phase, [3-wire plus ground][4-wire plus ground].

2.5.5.2 Steady-State Voltage Regulation On Inverter

Within +/-1% average from nominal output voltage.

2.5.5.3 Transient Voltage Response

Within +/-5% from nominal voltage for a 100% load step, full load re-transfers and full load drop on battery.

2.5.5.4 Transient Voltage Recovery

25 ms to within +/-1% of steady state.

2.5.5.5 Linear Load Harmonic Distortion Capability

Output voltage THD of less than 3% into 100% linear load; 2% for a single harmonic.

2.5.5.6 Non-Linear Load Harmonic Distortion Capability

Output voltage THD of less than 5% for 100% non-linear load with a 3:1 crest factor.

2.5.5.7 Manual Output Voltage Adjustment

+/-5% from nominal.

2.5.5.8 Line synchronization Range

+/-0.5 Hz, adjustable to +/- 5 Hz.

2.5.5.9 Frequency Regulation

+/-0.005 Hz free running.

2.5.5.10 Frequency Slew Rate

1 Hz/second maximum (adjustable).

2.5.5.11 Phase Angle Control

Balanced Linear Loads: +/-1 degree from nominal 120 degrees.

Unbalanced Linear Loads: +/-3 degrees from average phase voltage for 100% load unbalance.

2.5.5.12 Phase Voltage Control

Balanced Linear Loads: +/-1% from average phase voltage.

Unbalanced Linear Loads: +/-3% for 100% load unbalance.

2.5.5.13 Overload Current Capability (with nominal line and fully charged battery)

The unit must maintain voltage regulation for 125% for 10 minutes and 150% for 10 seconds.

2.5.5.14 Fault Clearing Current Capability

160% phase-to-phase for 10 cycles; 300% phase-to-neutral for 10 cycles.

2.5.5.15 Static Transfer Time

Make-before-break transfer completed in less than 4 ms.

2.5.5.16 Common Mode Noise Attenuation

-65 dB up to 20 kHz, -40 dB up to 100 kHz.

2.5.6 UPS Output in Bypass Mode

2.5.6.1 Nominal Output Voltage

[480][208] VAC, 3-phase, [3-wire plus ground][4-wire plus ground].

2.5.6.2 Static Transfer Time

Make-before-break transfer completed in less than 4 ms.

2.5.6.3 Common Mode Noise Attenuation

-65 dB up to 20 kHz, -40 dB up to 100 kHz.

2.6 MECHANICAL DESIGN

2.6.1 Enclosures

The UPS module must be housed in free-standing, double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures must be designed for industrial or computer room applications in accordance with the environmental requirements. The enclosures must line up and match up in style and color for an aesthetically pleasing appearance. Each of the enclosures must be shipped separately with joining hardware to be bolted together at the time of installation.

2.6.2 Ventilation

The UPS module must be designed for forced air cooling. Air inlets must be in the lower front. Air outlets must be in the rear of the top. Twelve inches of clearance over the UPS air outlets must be required for proper

air circulation. Air filters for the UPS module must be in commonly available sizes. Submit details of the Ventilation and Exhaust System.

No back or side clearance or access must be required for any enclosure. The back & side enclosure covers must be capable of be located directly adjacent to a wall.

2.6.3 Cooling Fans

The modular design of the UPS module must permit removal of each fan without removal of any other assembly. Fan replacement must be accomplished by removing no more than one fastener per fan and must not require the removal of another subassembly.

2.6.4 Cable Entry

Standard cable entry for the UPS module must be through either the enclosure bottom or top. A dedicated wireway must be provided within the UPS module for routing user input and output wiring.

2.6.5 Front Access

All serviceable subassemblies must 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 must be located within the front 12 inches of the UPS module enclosure for easy maintenance access. Removal and replacement of any subassembly must not require the removal of another subassembly. Side or rear access to the UPS module must not be required for UPS module installation, service, repair or maintenance.

2.6.6 Service Area Requirements

The UPS module, battery and options enclosures must require no more than thirty inches (30") of front service access room, and must not require side access for service or installation.

2.6.7 Size

The UPS module must not exceed a depth of 31.5 inches or a height of 73.5 inches. The UPS module input voltage configurations must not exceed a width of 34" and installation weight of 2,075 lbs.

2.7 CONTROLS AND INDICATORS

2.7.1 Micro-Controller Operated Circuitry

The UPS controls must have the following design and operating characteristics:

Fully automatic operation of each UPS module must be provided through the use of micro-controllers. (Digital signal processing must eliminate variances from component tolerance or drift, and provide consistent operational responses.)

All operating and protection parameters must be firmware controlled, thus eliminating a need for manual adjustments. All adjustments and calibrations must be performed without the use of potentiometers. Printed circuit board replacement must be possible without requiring calibration.

Start-up and transfers must be automatic functions.

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

All configuration, setup and calibration information must be stored in non-volatile memory that does not require a control battery for data storage.

Emergency transfers to Bypass due to UPS module failure, must be independent of the control logic controlling the Rectifier/Charger, Inverter and Monitor panel. Emergency transfer circuitry must contain all the necessary circuitry to perform an emergency transfer without any other functioning logic.

Monitoring and communications logic must be independent of the Rectifier/Charger and Inverter control logic. Circuitry and firmware required for monitoring and communications logic must be functionally isolated from the Bypass, Rectifier/Charger and Inverter controls. Monitoring firmware must be field upgradeable.

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

2.7.2 Monitor Panel Indicators

The UPS module must be equipped with a monitor panel providing the following monitoring functions and indicators (each alarm and notice condition must be accompanied with an audible alarm):

2.7.2.1 NORMAL

This symbol must be lit when the UPS module is operating in Normal mode.

2.7.2.2 BATTERY

This symbol must be lit when the UPS module is operating in Battery mode. The Normal indicator also remains lit.

2.7.2.3 BYPASS

This symbol must be lit when the UPS module is operating in Bypass mode. The critical load is supported by the Bypass source. The Normal indicator must not be lit when the UPS module is in Bypass mode.

2.7.2.4 NOTICE

This symbol must be lit when the UPS module needs attention. Some notices may be accompanied by an audible horn. Notices must include:

Bypass not available
Battery undervoltage

2.7.2.5 ALARM

This symbol must be lit when a situation requires immediate attention. All alarms must be accompanied by an audible alarm. Alarms must include:

a. Over temperature
b. Output overload
c. Inverter failure
d. Rectifier/Charger failure
e. Shutdown imminent (Low battery in Emergency mode.)

2.7.2.6 STANDBY

This symbol must be lit when electricity is present in the rectifier and Inverter while the Normal indicator is not lit. During normal startup this indicator must remain lit until the UPS module transfers to Normal mode, at which time the Normal indicator must light. During normal shutdown the Standby indicator must remain lit until all energy in the UPS module is dissipated and shutdown is complete.

2.7.3 Monitor Panel Controls

The UPS module must be equipped with a monitor panel providing the following control functions:

2.7.3.1 Menu and Cursor Controls

Selects, displays and scrolls data on the LCD.

2.7.3.2 Load Off

Shuts down the UPS module, de-energizes the critical load and opens the UPS module's breakers and contactors.

2.7.3.3 Horn Silence

Silences the current audible alarm(s). The Horn must sound again if new alarms occur.

2.7.3.4 Screen Adjust

Controls the liquid crystal display contrast.

2.7.4 Monitor Panel Liquid Crystal Display (LCD)

The UPS module must feature a liquid crystal display measuring 6" by 7.5" with 30 lines of information, 80 characters wide. The display must feature an autoblanking feature. Graphical user screens must be provided on the Monitor panel LCD to display the UPS module's operating parameters. The monitor panel pushbuttons must be used to access information in these screens. Information in the meter screen and alarm history screen must be available to a remote terminal or printer through the RS-232 (EIA/TIA-232) communication port. The screens must include:

2.7.4.1 Common Information

The following information must be presented on the LCD panel at all times:

a. UPS Module Identification: A user programmable UPS module identification of up to 45 characters.

b. UPS module status.

c. Highest priority active alarm.

d. Highest priority active notice.

e. Real time clock, featuring time and date indications, which is programmable from the monitor panel.

f. Real-time battery time available (in the event a utility outage occurs) for the current critical load.

2.7.4.2 UPS Module Meter Screen

Real-time digital metering of:

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

b. UPS module outputs: voltage (per phase, RMS), current (per phase plus neutral), frequency, kW, kVA, power factor. Output voltage and current sensing must independent of the Inverter controls.

c. Bypass inputs: voltage (per phase, RMS).

d. DC link voltage.

e. Battery charge and discharge current.

2.7.4.3 Output Current Screen

Bar graph display of the percent output current of each phase.

2.7.4.4 Event History Screen

must display up to 400 of the most recent events by date and time. Time must be displayed in tenths of seconds (0.1 sec) and recorded in thousandths of seconds (0.001 sec). The screen must define and display events as either alarms, notices, commands or status. A brief description must be provided for each event recorded on this screen. When a system event occurs, a message must be added to the Event History Log. The message must optionally appear on the Monitor Panel of the UPS. The Event History Log must support the following system event messages, whether or not they were displayed on the Monitor Panel.

INVERTER MESSAGES - ALARMS

Inverter DC Over Voltage
Inverter AC Over Voltage
Inverter AC Under Voltage
Inverter Over Frequency
Inverter Under Frequency
Over Temperature Shutdown
100% Overload Shutdown
125% Overload Shutdown
Battery Contactor Failure
Bypass Contactor Failure
Bypass Control Failure
Inverter Contactor Failure
Inverter Failure
Load Off

Inverter Contactor Open
Bypass Contactor Failure

INVERTER MESSAGES - NOTICES

Bypass AC Over Voltage
Bypass AC Under Voltage
Bypass Over Frequency
Bypass Under Frequency
Battery DC Under Voltage
Battery Not Charged
Bypass Is Not Available
Input Breaker Open
Inverter Logic Power Failure
Phase A Current Limit
Phase B Current Limit
Phase C Current Limit
Load Transferred to Bypass

INVERTER MESSAGES - COMMANDS

Bypass Mode
Keyswitch On
Inverter Commanded On

INVERTER STATUS MESSAGES

Inverter On
Battery Contactor Closed
Total Battery Discharge
Bypass Contactor Closed
Input Breaker Closed
Inverter Contactor Closed
Inverter Shutdown
Inverter Normal
Load Transferred to Bypass
Auto Mode

RECTIFIER MESSAGES - ALARMS

Rectifier DC Over Voltage
Rectifier DC Under Voltage
Rectifier Over Temperature
Rectifier Over Temperature Warning
Rectifier Temperature Sensor Failure
Rectifier Failure
Rectifier Alarm

RETIFIER MESSAGES - NOTICES

Input AC Over Voltage
Input AC Under Voltage
Input AC Over Frequency
Input AC Under Frequency
Rectifier Logic Power Supply OV
Rectifier Logic Power Supply UV
Rectifier DC Too Low
Input Voltage Transient
Rectifier Logic Power Failure

Battery Current Limit
DC Too High

RECTIFIER MESSAGES - COMMANDS

Rectifier Commanded On

RECTIFIER STATUS MESSAGES

Rectifier On
Rectifier Shutdown

MONITOR PANEL ALARMS

Load over 100%
Overload 100%
Overload 125%
Power Supply Failure
Fan Failure

MONITOR PANEL NOTICES

Output AC Over Voltage
Output AC Under Voltage
Output Over Frequency
Output Under Frequency
Phase AC Over Voltage
Phase AC Under Voltage
Phase Over Frequency
Phase Under Frequency
Power Fail
Power Off Switch
Building Alarm 1
Building Alarm 2
Building Alarm 3
Building Alarm 4
Building Alarm 5
Building Alarm 6
Rectifier Network Down
Inverter Network Down
Monitor Network Down

2.7.4.5 Active Events Screen

must automatically display a list of all active alarms and notices.

2.7.4.6 Statistics Screen

This screen must display the following:

a. Time on battery: A record must display the duration and frequency of utility outages in the life of the batteries and in the current month.

b. Building alarms: A record must display the frequency of each building alarm enunciation in the life of the UPS module and in the current month.

c. Operational History: A record must display the total amount of

time the UPS module has been in the each of the following modes of operation: Normal, Bypass and Battery. A record must display the total amount of time the UPS module has been on generator.

d. Availability: The observed availability of the Normal mode must be displayed. In addition, the availability of the Bypass supply as a backup source must be displayed.

e. Startup Date: The date the UPS module was initially energized must be displayed.

2.7.4.7 UPS Module Mimic Screen

A graphic display of the UPS module operational mode and power flow through the UPS module to the critical load must be displayed in real-time. The operational status of the Inverter, Rectifier/Charger, Bypass and Battery is also indicated. Circuit breaker and contactor states must be indicated.

2.7.4.8 Setup Screen

must permit setting time and date for the UPS module clock with controls on the Monitor Panel. must permit configuration of the RS232 and RS485 communications ports, with controls on the Monitor Panel, for the following modes of operation:

a. Terminal Mode: UPS module events must be logged immediately as they occur.

b. Calibration Mode: must be used by service personnel for UPS module diagnostics.

c. UPS Module Configuration Mode: must allow setup and configuration of user level functions like battery test and building alarms. must 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, and must allow the six building alarms to be programmed to initiate UPS module commands upon contact closure.

d. Computer Mode: must allow the user to interface with the UPS module in Binary Computer Mode.

e. Remote Monitor Mode: The RS485 port must be configured to interface with a Remote Monitor Panel, Supervisory Contact Module or Relay Interface Module.

2.7.4.9 Control Panel

The UPS module must be equipped with a control panel providing UPS module control functions. (A key must be required to turn on the UPS module.) The following controls must be provided on the control panel:

a. The Keyswitch must initiate the energize sequence to place the UPS module in either Normal mode or Bypass mode, as defined by the Mode switch position.

b. The Mode switch must control the manual transfer of the UPS module to and from Bypass mode.

c. The Battery switch must enable or disable the internal battery contactor closure.

d. A circuit breaker must enable operation of the rectifier.

e. A Load Off Reset switch must reset the UPS module, following a Load Off command.

2.7.4.10 Communication Panel

The UPS module must be equipped with a communication panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:

a. Alarm and Notice Contacts: Dry contacts for summary alarms and notices must be provided for external use.

Alarm: Indicates the UPS module is experiencing an Alarm condition.

Notices: Indicates the UPS module is experiencing a Notice condition.

b. RS-232 (EIA/TIA-232) and RS-485 Communication Interface: Provide circuitry 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.

c. Remote Monitor Panel Connection: Provide circuitry for connection of up to two accessory remote monitor panels, relay interface modules or supervisory contact module.

d. Building Alarms: Provide six inputs monitoring the status of external dry contacts. One input must be dedicated to monitoring an external battery disconnect, and one must be dedicated to monitoring an auxiliary generator and initiating reduced input current limit. The remaining four inputs must be user selected (smoke, temperature, water, etc.) Building alarms must be set up through the UPS module configuration mode function of the RS-232 (EIA/TIA-232) port. The building alarms must also provide the following capabilities:

Building alarms must 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.

Building alarms must be programmable to initiate a transfer of the UPS module from Normal Mode to Bypass Mode upon contact closure.

Building alarms must be programmable to initiate a transfer of the UPS module from Bypass Mode to Normal Mode upon contact closure.

2.8 UPS MODULE PROTECTION

Rectifier/Charger protection must be provided by thermal-magnetic or RMS current sensing molded-case circuit breakers and transient suppression circuitry.

Bypass protection must be provided through individual fusing of each phase.

The static switch must feature a thermal switch which will open the backfeed contactor in the event the static switch temperature exceeds normal operating parameters

Battery protection must 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.

Output protection must be provided by electronic current limit circuitry and fuses in the Inverter circuit.

Input wiring to the Rectifier/Charger input and Bypass input must be monitored for proper sequencing. If wiring is installed out of sequence, the

UPS module must detect and enunciate this condition (on the Monitor Panel) when power is supplied to the inputs. The UPS module must not allow operation in Normal mode until the wiring error is corrected.

Inverter circuitry must be provided which automatically inhibits the Inverter IGBT switching currents should they exceed normal operating parameters.

The UPS module must remain in Normal mode during a failure condition where the Bypass backfeed protection fails. Manual transfers between Normal mode and Bypass mode must be possible with this failure condition

The UPS module must 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 must be possible with this failure condition

To comply with agency safety requirements, the UPS module must not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

The following procedures and tests must be performed by Field Service personnel during the UPS startup:

3.2.1 Visual Inspection

Visually inspect all equipment for signs of damage or foreign materials.

Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.

3.2.2 Mechanical Inspection

Check all the power connections for tightness.

Check all the control wiring terminations and plugs for tightness or proper seating.

3.2.3 Electrical Precheck

Check the DC bus for a possible short circuit.

Check input and Bypass power for proper voltages and phase rotation.

Check all lamp test functions.

3.2.4 Initial UPS Startup

Verify that all the alarms are in a "go" condition.

Energize the UPS module and verify the proper DC, walkup, and AC phase on.

Check the DC link holding voltage, AC output voltages, and output wave forms.

Check the final DC link voltage and Inverter AC output. Adjust if required.

Check for the proper synchronization.

Check for the voltage difference between the Inverter output and the Bypass source.

3.2.5 Operational Training

Before leaving the site, the field service engineer must familiarize responsible personnel with the operation of the UPS. Submit a detailed plan for Field Training[; G][; G, [_____]]. The UPS equipment must be available for demonstration of the modes of operation.

3.3 MANUFACTURER'S FIELD SERVICE

3.3.1 Field Engineering Support

The UPS manufacturer must directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. Submit a detailed plan for Field Supervision, Startup and Testing procedures. The organization must consist of local offices managed from a central location. Field engineers must 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.

3.3.2 Spare Parts Support

Parts supplies must be located in the field to provide 80% of all emergency needs. The factory must serve as the central stocking facility where a dedicated supply of all parts must be available within 24 hours. Submit Spare parts data, as specified

3.3.3 Maintenance Contracts

A complete range of preventative and corrective maintenance contracts must be provided and offered with the proposal. Under these contracts, the

manufacturer must maintain the user's equipment to the latest engineering levels as they are developed.

3.3.4 Product Enhancement Program

The UPS manufacturer must make available feature upgrade service offerings to all users as they are developed. These products must be proposed as a field-installable, optional kit.

-- End of Section --