
USACE / NAVFAC / AFCEA / NASA UFGS-26 32 33.00 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-16262N (February 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Latest change indicated by CHG tags.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 32 33.00 20

INSTALLATION OF UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Uninterruptible Power Supply (UPS)
 - 1.2.2 Battery System
 - 1.2.3 Electrolyte
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Government-Furnished Equipment (GFE)
 - 1.4.2 Pick-Up
 - 1.4.3 Delivery

PART 2 PRODUCTS

- 2.1 CONTRACTOR FURNISHED MATERIAL AND EQUIPMENT
- 2.2 GOVERNMENT-FURNISHED MATERIAL

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Control Cable
 - 3.1.2 Grounding Conductor
 - 3.1.3 UPS Output Conductors
 - 3.1.4 DC Power Conductors
 - 3.1.5 Emergency Control Contacts
 - 3.1.6 Cable Lugs
 - 3.1.7 Seismic Protection
 - 3.1.8 Conduit Entries
 - 3.1.9 Battery Rack Assembly
 - 3.1.10 Battery Cabinet
 - 3.1.11 Battery Installation
 - 3.1.11.1 Positioning Cells
 - 3.1.11.2 Connecting Cells

- 3.1.11.3 Inter-Rack and Inter-Tier Cables
- 3.1.12 UPS Spare Parts and Manuals
- 3.2 UPS TECHNICAL REPRESENTATIVE
 - 3.2.1 Contractor Duties
 - 3.2.2 Installation Inspection
- 3.3 BATTERY FILLING AND CHARGING
 - 3.3.1 General Instructions for Lead Calcium Alloy Battery
 - 3.3.1.1 Hydrogen Gas Safety Instructions
 - 3.3.1.2 Sulfuric Acid Safety Instruction
 - 3.3.1.3 Battery Filling Instruction
 - 3.3.2 General Instructions for Sealed Type, Valve Regulated Battery
 - 3.3.3 Electrical Safety Instructions
 - 3.3.4 Battery Charging Instructions
 - 3.3.5 Battery Refreshing Charge Instructions
 - 3.3.6 Float Charge
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 UPS Unit Performance Test
 - 3.4.1.1 Emergency Generator Operation
 - 3.4.2 Battery Performance Test (Constant KW)
- 3.5 FINAL ADJUSTMENTS
- 3.6 DISPOSAL

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEA / NASA UFGS-26 32 33.00 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-16262N (February 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Latest change indicated by CHG tags.

SECTION 26 32 33.00 20

INSTALLATION OF UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM 04/06

NOTE: This guide specification covers the requirements for Installation of Government-furnished\Contractor installed Uninterruptible Power Supply (UPS) System.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

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

NOTE: This guide specification will be used in the preparation of project documents for installation of Government-furnished UPS systems. (Navy-type UPS).

NOTE: This section contains Appendix A, "UPS Manufacturer's Installation Drawings" and Appendix B, "Battery Manufacturer's Rack Assembly and Battery Installation Instructions."

Appendices must be obtained from NFESC ECDDET, Code 65, BLDG 218, 901 M Street SE, Washington Navy Yard, Washington, DC 20374-5063, Telephone: (202) 433-2515, DSN 288-2515, Fax (202) 433-6379.

All plans/specifications having uninterruptible

power supply systems, which were procured as Government-furnished/Contractor installed equipment, must be reviewed and concurred by NFESC ECDDET, Code 65.

PART 1 GENERAL

1.1 REFERENCES

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.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2005) National Electrical Code

1.2 DEFINITIONS

1.2.1 Uninterruptible Power Supply (UPS)

The uninterruptible power supply system described herein shall denote a solid state power system which will provide continuous regulated single phase or three phase AC power at its output terminals, while operating from either an AC power source or from a battery system.

1.2.2 Battery System

NOTE: Sealed battery or valve regulated is more commonly known as maintenance free battery. The term maintenance free is a misnomer, since all battery systems require maintenance. The term "maintenance free" signify that no water may be added to the cell.

The battery is an electrochemical device that stores energy at one time for use at another. The energy is stored in chemical form and converted to electrical form during discharge, in the event of AC power failure. Battery system may be lead calcium alloy type, water must be added in the cells, or sealed type, (valve regulated), water cannot be added in the cells.

1.2.3 Electrolyte

The acid solution surrounding the plates of a battery cell, usually consisting of 1.250 specific gravity sulfuric acid.

1.3 SUBMITTALS

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.

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.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

NOTE: Typical installation and module arrangement shall be based in accordance with manufacturer's

installation drawings. Installation drawings may be
obtained from NFESC ECDet, Code 65.

Overall dimensions, front view, and sectional view; G

Typical installation and module arrangement; G

Ventilation and exhaust system; G

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

SD-03 Product Data

Inter-rack and inter-tier cables; G

Control cable; G

Cable lugs; G

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Government-Furnished Equipment (GFE)

The Government will furnish various components and equipment listed in article entitled "GOVERNMENT-FURNISHED MATERIAL" for installation by the Contractor.

[1.4.2 Pick-Up

The GFE will be available on [____]. Contractor shall pickup, transport form [____], unload, unpack and install all GFE. The Contractor shall notify Contracting Officer [____] calendar days in advance of the date the GFE is required for installation. The GFE shall be unpacked by Contractor in the presence of Contracting Officer to determine damage or missing parts. Contractor shall be responsible for damages sustained by the materials and equipment after this inspection. UPS equipment is heavy and easily damaged. Do not bump or bounce equipment at any time. When lifting, do not tip beyond 0.087 radians 5 degrees.

] [1.4.3 Delivery

Activity will receive, store and deliver the GFE to jobsite. Contractor shall unload, unpack, and install GFE. Notify Contracting Officer [____] calendar days prior to when delivery on the site is required. GFE shall be unpacked in the presence of Contracting Officer to determine damage or missing parts. Contractor shall be responsible for damage sustained by the materials and equipment after this inspection. UPS equipment is heavy and easily damaged. Do not bump or bounce equipment at any time. When lifting, do not tip beyond 0.087 radians 5 degrees.

] PART 2 PRODUCTS

2.1 CONTRACTOR FURNISHED MATERIAL AND EQUIPMENT

Materials, equipment, and devices not specifically indicated or specified to be Government Furnished-Contractor Installed, shall be Contractor Furnished-Contractor Installed (CFCI). Such equipment required to provide the completely operable UPS installation includes, but is not necessarily

limited to, conduit, conduit fittings, insulated conductors, compression lugs, cable trays, supports, fasteners, and other such items.

2.2 GOVERNMENT-FURNISHED MATERIAL

The Government will furnish the following components of the UPS system:

NOTE: This information may be obtained from NFESC
ECDet, Code 65.

- a. [_____] [One] - [_____] KVA - [_____] (Volts) UPS Systems. Type:
[Non-Redundant] [Parallel Redundant].
- b. [_____] [One] - [Maintenance Bypass Cabinets] [System Control
Cabinet(s)]
- c. [_____] [One] - Remote Monitor Panels
- d. [_____] [One] - 3 Pole Motor Operated Battery Circuit Breakers
- e. [_____] [One] Battery system(s) each consisting of [182] [192]
[210] [240] [_____] cells, inter-cell connecting hardware,
terminal connectors, connector bolt package, solderless lugs, cell
identification decals, and miscellaneous hardware. This does not
include tier-to-tier or rack-to-rack cables specified in paragraph
entitled "Inter-Rack and Inter-Tier Cables." The battery cells
are as follows:

Cell type: [_____]

Cell dimensions: [_____]

Cell weight (dry): [_____]

Electrolyte per cell: [_____]

f. [_____] (Each) - [_____] foot battery rack(s) [standard], [shock
protected], [seismic] type, each weighing [_____] kg [_____] lbs.
- g. [_____] (Each) battery cabinets each weighing [_____] kg [_____] lbs.
- h. [_____] (Each) 56.83 liters 15 gallon DOT 37P-2U poly-lined steel
drums of electrolyte. Each drum of electrolyte weighs
approximately 77 kg 170 pounds.

PART 3 EXECUTION

3.1 INSTALLATION

NOTE: Manufacturer's installation drawing, wiring
diagrams, battery, racks and cabinets' information
shall be obtained from NFESC ECDet, Code 65.
Appropriate information and data will form an
integral part of these specifications.

Conform to the requirements for electrical equipment installations specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, to the requirements specified herein, and in strict accordance with NFPA 70, and manufacturer's installation drawings and wiring diagrams to include overall dimensions, front view, and sectional view, typical installation and module arrangement, and ventilation and exhaust system. During and after installation, until the system is accepted by the Contracting Officer, Contractor shall protect UPS equipment, including batteries, from moisture, dust, and contamination. Upon completion of the UPS system installation, Contracting Officer and UPS manufacturer's technical representative will inspect the installation for contract compliance. Contractor shall correct installation deficiencies as directed.

3.1.1 Control Cable

NOTE: UPS sizes 200 KVA and above are shipped in sections. Control wiring between module sections will be connected by the UPS manufacturer's technical representative.

UPS control wiring shall be stranded type and must be installed in individual separate rigid steel conduits. Tag control wires with numeric identification tags corresponding to the terminal strip location to where the wires are connected. In addition to manufacturer's requirements, provide four additional spare conductors between UPS module and remote alarm panel in same conduit. When routing control cables inside UPS module, maintain a minimum 155 mm 6 inches separation from power cables.

3.1.2 Grounding Conductor

Provide an insulated equipment grounding conductor in feeder and branch circuits. Conductor shall be separate from the electrical system neutral conductor. Ground battery racks and battery breaker cabinets with a separate equipment grounding conductor to the UPS cabinet.

3.1.3 UPS Output Conductors

Isolate the UPS output conductors from the UPS cabinet to the critical load panels and from other conductors by installing in separate conduit. Isolation shall prevent inductive coupling from other conductors.

3.1.4 DC Power Conductors

When installed in conduits, place DC power conductors from the UPS cabinet to the battery circuit breaker such that each conduit contains an equal number of positive and negative conductors, for example, two positive and two negative conductors in each conduit.

3.1.5 Emergency Control Contacts

Provide normally open contacts for each UPS system to signal when power is supplied to the UPS from emergency engine generators. Installation shall conform to manufacturer's installation drawings.

3.1.6 Cable Lugs

Provide appropriate compression type lugs on all AC and DC power

connections to the UPS system and battery as required. Aluminum or bare copper cable lugs are not suitable.

3.1.7 Seismic Protection

NOTE: If zone is not considered to be seismic, text below shall be deleted. If seismic zone, applicable local regulations shall be referenced.

For UPS installations within Seismic zones [1] [2] [3] [4], provide equipment anchor to protect against seismic shock in accordance with applicable local regulations.

3.1.8 Conduit Entries

Provide conduits using the available conduit areas shown on manufacturer's installation drawings. Conduit entries shall not be made through the front, side or rear panels of the UPS or [Maintenance Bypass Cabinets] [System Control Cabinet].

[3.1.9 Battery Rack Assembly

NOTE: Choose this paragraph or the one below entitled "Battery Cabinet".

Battery racks are shipped dismantled in separate rail, frame, and brace packages. Ensure that necessary assembly hardware is included in the frame packages. Installation of battery racks shall conform to the manufacturer's instructions provided as Attachment B to this section.

] [3.1.10 Battery Cabinet

Battery cabinets are factory assembled and are suitable for 25, 50 and 100 KVA UPS systems.

] 3.1.11 Battery Installation

Installation of battery shall conform to the manufacturer's instructions provided in Attachment B.

NOTE: Appendix B provides information on the type of battery used in the UPS application. This information will include battery and racks data, mounting information, charging instruction, etc. It is the Contractors responsibility to familiarize himself with this information prior to the start of work.

3.1.11.1 Positioning Cells

Use lifting belt and spreader when lifting the cells with mechanical equipment such as a crane or hoist. Install cells on racks in accordance with manufacturer's instructions. Ensure each hydrometer tube is located

on aisle side of each cell.

3.1.11.2 Connecting Cells

Cleaning contact surfaces, application of no-oxide grease, and connection of cells shall be in accordance with the manufacturer's instructions. No-oxide grease is applied only on connection surfaces.

3.1.11.3 Inter-Rack and Inter-Tier Cables

Provide flexible, welding type cable for all inter-rack and inter-tier connections. Number and size shall be as indicated. Battery cables shall have a long bending radius to avoid excessive stress at the point of termination.

3.1.12 UPS Spare Parts and Manuals

NOTE: Three (3) volumes of UPS maintenance manuals are provided as part of the UPS package. These manuals are not commercially available and contain proprietary information. Additional manuals must be procured by NFESC ECDet, Code 65.

Three volumes of the UPS maintenance manuals and one package of spare parts are shipped with the UPS equipment. Perform inventory and store these items until notified by the Contracting Officer.

3.2 UPS TECHNICAL REPRESENTATIVE

NOTE: The UPS manufacturer's technical representative will inspect the completed UPS and battery installation as part of the UPS procurement package, and at no additional cost to the activity. The representative's visit to the site must be scheduled by NFESC ECDet, Code 65. If the station or Contractor requests UPS technical representative's services without notifying Code 65, they may incur additional expenses.

Contractor shall notify Contracting Officer in writing at least 45 calendar days prior to completion of the UPS system installation. At this time the Contracting Officer, via NFESC ECDet, Code 65, will schedule the UPS manufacturer's technical representative to inspect the completed installation. The UPS technical representative will provide 15 days of service including five days of instruction for activity personnel. The following items shall be completely installed by the Contractor and be operational prior to the arrival of the UPS representative for inspection, unit start-up and testing:

- a. Ventilation equipment in the UPS and battery rooms.
- b. Battery [racks][cabinets] and cells. Cells shall not be filled with electrolyte until directed by the Contracting Officer. This is not applicable for maintenance free battery.

- c. Battery connections including cell-to-cell, tier-to-tier, and rack-to-rack connections, with correct polarity;
- d. DC power and control connections between UPS and battery circuit breaker, with correct polarity;
- e. DC power connection between battery circuit breaker and battery, with correct polarity;
- f. Clockwise phase rotation of AC power connections;
- g. AC power to rectifier input bus;
- h. AC power to UPS bypass input bus;
- i. AC power to UPS maintenance bypass circuit breaker;
- j. AC power from UPS output to UPS maintenance bypass output circuit breaker;
- k. Remote monitors and control wiring;
- l. UPS system and battery system properly grounded;
- m. Emergency shower and eye wash;
- n. Control connections between UPS and emergency engine generator signal contacts;
- o. Control connections between UPS modules and [UPS maintenance bypass cabinet][system control cabinet]; and
- p. Clean and vacuum UPS and battery room floors, battery cells, and UPS equipment, both inside and outside.

3.2.1 Contractor Duties

Prior to the arrival of the UPS technical representative, Contractor shall furnish the following for testing:

- a. Load bank with temporary jumper cables, unless provided as CFCI equipment in the contract, and
- b. Calibrated digital voltmeter with 0.01 volt resolution.

3.2.2 Installation Inspection

The UPS technical representative and the Contracting Officer, in the presence of the Contractor, will inspect the completed installation. The Contractor shall correct construction or installation deficiencies as directed.

3.3 BATTERY FILLING AND CHARGING

NOTE: Battery system provided is either lead calcium alloy type or sealed (valve regulated) type. Use appropriate instructions.

Inspection of the battery installation, filling, charging and testing shall be supervised by an authorized representative of the battery manufacturer. Representative shall supervise and instruct the Contractor as to the proper installation, charging, and testing procedures described herein for the battery system. Contractor shall be responsible for arranging and paying costs of the battery manufacturer's representative. The following instructions shall be read completely before commencing work on the battery:

[3.3.1 General Instructions for Lead Calcium Alloy Battery

**NOTE: Delete paragraph and subparagraph if sealed
(valve regulated) battery is used.**

- a. Only authorized personnel who have been thoroughly familiarized with battery installation, charging, and maintenance procedures will be permitted access to the battery room.
- b. During initial activation, monitor the battery continuously for electrolyte level, specific gravity, temperature, voltage, and current. Record measurements every hour.
- c. Use only distilled water in the battery cells.
- d. During the activation charging cycle it may be necessary to provide additional ventilation to maintain a low ambient temperature in the area of the charging cells. This is to prevent a possible heat induced boil-over of the cell's electrolyte.
- e. During the activation charging cycle, Contractor shall provide a chemical agent, such as soda ash or baking soda, capable of neutralizing electrolytic fluid, in sufficient quantity to safely neutralize any spill or boil-over of electrolyte.
- f. At all times while in the battery room, personnel shall wear the proper safety items as deemed necessary by their task. This shall include, but not be limited to, face shield, impermeable apron, and acid resistant boots and gloves. Contractor shall provide one extra set of safety equipment for Contracting Officer.

[3.3.1.1 Hydrogen Gas Safety Instructions

- a. During activation and operation of the battery, hydrogen gas is formed. Hydrogen gas is extremely explosive when ignited. Contractor shall ensure sufficient ventilation is provided to prevent the hydrogen level from exceeding a one percent concentration by volume of the space in the battery room.
- b. An essentially fully charged battery will generate a maximum of 0.00045 cubic meter 0.016 cubic feet of hydrogen (measured at 25 degrees C and 760 mm Hg absolute pressure) per hour from each cell for each ampere of charging current. When necessary, additional ventilation may be required during activation charging cycle.
- c. Never bring burning material such as lit matches, cigarettes, lighters, or any type of spark producing material or devices into the battery room or adjacent to any cell.

] [3.3.1.2 Sulfuric Acid Safety Instruction

- a. During handling of the electrolytic fluid, personnel shall wear the appropriate safety clothes, as previously specified.
- b. Exercise the utmost caution to avoid spilling electrolyte. When acid comes in contact with the eyes or skin, immediately flush and rinse with water and consult a physician. Bicarbonate of soda solution (one pound per gallon of water) will neutralize acid spilled on clothing or material. Apply the solution until bubbling stops, then rinse with clear water. In the event of acid spill or accident, notify the Contracting Officer as soon as practical.
- c. Utilize only approved hydrometers and thermometers for monitoring the cells. Automotive hydrometers are not acceptable. Contractor shall provide sufficient quantities of both instruments so as to provide time efficient and accurate specific gravity and temperature measurements.

] [3.3.1.3 Battery Filling Instruction

After the UPS technical representative has inspected the UPS and demonstrated proper operation of the UPS rectifier, Contracting Officer will instruct Contractor to perform battery filling and charging in accordance with the following instructions:

- a. Clean each cell thoroughly with a cloth dampened in clear water and wipe dry with a clean cloth prior to filling the cells with electrolyte.
- b. Ensure battery connections are properly torqued to manufacturer's specifications. Torque values are given in **mN-m** **inch-lbs**. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings before placing battery in service. Remake connections having a resistance of more than 10 percent above the average. Test equipment and procedure must be approved by the Contracting Officer.
- c. Electrolyte in the containers may have stratified. Contractor shall ensure the specific gravity is between 1.205 and 1.220 by agitating each electrolyte container until the specific gravity is within the required range.
- d. Once a specific gravity between 1.205 and 1.220 is measured, and the UPS rectifier is fully operational, remove the shipment vent plug from each cell and fill cells with electrolyte. Use the screw-in plastic shut-off nozzles provided with the electrolyte containers. Contractor shall provide all hoses necessary for filling the cells. Equipment used for filling the cells shall be free of any metal to prevent electrolyte contamination.
- e. The filling height of the electrolyte shall not be higher than **6 mm** **1/4 inch** below the bottom of the low level line.
- f. Install a flame-arrestor vent in each cell immediately after filling the cell. Lock in place with a one-quarter turn in a clockwise direction. Then install a dust cover cap on the top of

each flame arrestor. CAUTION: Do not remove the flame arrestor vents after initial filling.

- g. Allow the battery to stand open circuit a minimum of four hours after filling the last cell. Add acid through the funnel of the flame arrestor or the electrolyte sampling tube to again bring the electrolyte level to 6 mm 1/4 inch below the bottom of the low level line.
- h. Commence charging after the required stand period but no later than 12 hours after the filling of the first cell.

]]3.3.2 General Instructions for Sealed Type, Valve Regulated Battery

NOTE: Delete paragraph if lead calcium alloy
battery is used.

- a. Only authorized personnel who have been familiarized with battery installation, charging, and maintenance procedures will be permitted access to the battery room.
- b. At all times while in the battery room, personnel shall wear the proper safety items as deemed necessary by their task. This shall include, but not be limited to, face shield, impermeable apron, and acid resistant boots and gloves. Contractor shall provide one spare set of safety equipment for Contracting Officer.
- c. These cells are sealed and do not present an acid danger. However if the container is damaged, exposure to acid could occur.
- d. Sealed batteries will vent potentially explosive gases, particularly in the event of a charger malfunction. Never bring any burning material such as lit matches, cigarettes, lighters, or any type of spark producing material or devices into the battery room or adjacent to any cell.
- e. Cells connected in series have high voltages that could produce a shock hazard. Do not ground the DC system. If a ground is placed at one end of the battery, an increased shock hazard exists between the opposite end of the battery and ground. Also, if another ground should develop within the system, it may create a short circuit which could start a fire.
- f. Ensure that bolted battery connections are torqued to the recommended values. Loose connections can cause excessive resistance between cells.
- g. Do not lift cell by its terminal posts as this can damage the battery. Under no circumstance attempt to remove the pressure relief valves, vents or vent covers as this will prevent proper function of the battery.

]3.3.3 Electrical Safety Instructions

- a. Cells connected in series have high voltage potentials that produce shock hazards.

- b. Discharge static electricity from the body before touching cell terminal posts by first touching a grounded surface such as the grounded battery racks.
- c. Only insulated tools shall be used when working on the battery cells during and after activation charging has begun. Never place metal tool on the top of cell.
- d. Only approved digital voltmeters shall be used in monitoring the cells. Digital volt meters shall provide a minimum of .01 volt resolution.

[3.3.4 Battery Charging Instructions

NOTE: This paragraph is applicable to the lead calcium alloy type battery. Delete if sealed (valve regulated) battery is used.

Contracting Officer will coordinate the battery charging process with Contractor and UPS technical representative. UPS technical representative will instruct the Contractor on adjusting the rectifier voltage as required by the procedure. Battery charging is the Contractor's responsibility. Contractor shall provide the manpower, including an authorized representative of the battery manufacturer, and equipment necessary to continuously monitor and control the battery charging process.

- a. The minimum charge required by each cell is [_____] Ampere-Hours.

The maximum charge current is [_____] Amps.

Therefore, the absolute minimum charging time is [_____] Continuous Hours.

Overtime will be required!

- b. Provide temporary cables required for charging. This cable shall be the same size as used for the tier-to-tier and rack-to-rack connections. Coordinate the charging configuration of the battery with the battery manufacturer's representative and UPS technical representative.
- c. Prior to the actual start of the activation charge, pilot cells shall be designated by the Battery manufacturer's representative. Pilot cells will be designated to obtain an average mean of the battery. A minimum of 19 cells within the battery will be designated as pilot cells. If, by feeling cell jars during charging, warmer cells are noted, they shall be made pilot cells also.
- d. Technical direction on the actual activation charging cycle will be provided by the UPS and Battery manufacturer's representatives. This direction includes but is not limited to analysis of individual and pilot cell data, adjusting the UPS rectifier output voltage and current, the removal of electrolyte and addition of distilled water for the adjustment of the cell specific gravity and ensuring the battery is charged to the minimum ampere hour-rating. The UPS technical representative will also provide

the Contractor with a phone number where he can be contacted after regular working hours should there be any problems with the UPS during the charging period.

- e. Immediately before starting the activation charge, measure and record the following:
 - (1) Voltage of each cell.
 - (2) Specific gravity of each cell.
 - (3) Temperature of each cell.
- f. Measure and record the open circuit voltage of the parallel connection. Turn-on the rectifier and adjust the voltage control to the open-circuit voltage reading. Close the battery circuit breaker and adjust the rectifier voltage control until charging current is at maximum limit specified herein. Continue charging at maximum rate (unless temperature limits are exceeded) for minimum ampere-hours specified herein.
- g. At the start of the activation charge the following measurements shall be taken and recorded :
 - (1) Time at start of charge.
 - (2) Current at start of charge.
 - (3) Voltage at start of charge taken at the battery terminals.
- h. The following measurements shall be taken and recorded on an hourly basis until the end of charge:
 - (1) Battery voltage taken at the battery terminals.
 - (2) Charging current.
 - (3) Cell voltage, specific gravity and temperature of each pilot cell.
- i. Do not permit cell temperatures to exceed 43 degrees C 110 degrees F. If temperature is exceeded, interrupt the charge until the cells cool down to 38 degrees C 100 degrees F. Then resume charging. Record times of interruptions. Ensure batteries are charged for the full number of minimum ampere-hours required.
- j. At the completion of the activation charge, as determined by the Battery manufacturers' representative, the following measurements of ALL cells shall be taken and recorded:
 - (1) Cell voltage.
 - (2) Specific gravity.
 - (3) Temperature.
- k. Upon completion of the activation charge, Contractor shall return the battery to its normal operating configuration.

] 3.3.5 Battery Refreshing Charge Instructions

NOTE: This paragraph is applicable to sealed (valve regulated) battery. Delete if lead calcium alloy battery is used.

NOTE: Recommended refreshing charge values are applicable to cell temperatures between 15 degrees to 32 degrees C 60 degrees to 90 degrees F. For cell temperatures 4 to 15 degrees C 40 degrees to 59 degrees F use twice the number of hours. For cell temperatures 4 degrees C 39 degrees F and below, use four times the number of hours.

Contracting Officer shall coordinate the battery refreshing charge process with Contractor and UPS technical representative. The only acceptable method of giving a refreshing charge is constant voltage. UPS technical representative will instruct Contractor on adjusting the rectifier voltage as required by this process. Battery refreshing charge is Contractor's responsibility. Contractor shall provide the manpower, including an authorized representative of the battery manufacturer, and all necessary equipment to monitor the refreshing charge process.

- a. The refreshing charge shall be determined by the maximum voltage that the connected equipment can tolerate, and of that which the charger can deliver.

Divide the voltage by the number of cells in the battery, and charge at that voltage; provided it does not exceed 2.40 volts per cell 25 degrees C 77 degrees F. After the charge current has tapered and stabilized for 24 hours, continue the charge for the number hours as follows:

Refreshing Charge

CELL VOLTS	MIN. HOURS TO CHARGE
2.22	[]
2.27	[]
2.30	[]
2.35	[]
2.40	[]

DO NOT EXCEED 2.40 VOLTS PER CELL 25 DEGREES C 77 DEGREES F.

] 3.3.6 Float Charge

- a. The UPS technical representative will adjust UPS for float operation.
- b. Allow battery to float for a minimum of 72 hours to permit cell voltages to stabilize.
- c. Measure and record voltage, specific gravity and temperature of each cell.

- d. Should the float voltage of any cell read below 2.08 volts DC or the specific gravity read less than 1.190 corrected to 25 degrees C 77 degrees F, remove cell from battery and connect the two adjacent cells with a short length of cable to maintain series connection of remaining cells. Discharge performance test may be conducted with one or more cells missing; however, discharge time will be reduced accordingly. NOTE: The rectifier output voltage to battery on float shall be reduced by 2.25 volts for each cell removed from battery. Additionally, when battery is on equalize, rectifier output voltage must be reduced by 2.33 volts for each cell removed. UPS alarms shall be adjusted as necessary. Notify Contracting Officer immediately if it becomes necessary to remove any cell. Defective cells should be replaced as soon as possible. Contractor, via Contracting Officer, shall contact NFESC ECDet, Code 65 for assistance.

3.4 FIELD QUALITY CONTROL

Contractor shall be on-site during UPS system testing. Provide equipment, test instruments, power, load bank, materials and labor required for tests. Contracting Officer will witness all tests and the tests shall be subject to his approval. Defects resulting from improper handling or installation shall be corrected by the Contractor and retested at no additional cost to the Government. Defects resulting from non-Contractor furnished equipment failure shall be repaired by equipment manufacturer. Contracting Officer will make final decisions as to whether a failure was due to improper installation or defective non-Contractor furnished equipment.

3.4.1 UPS Unit Performance Test

Upon completion of battery activation procedures and as directed by Contracting Officer, Contractor shall connect load bank to UPS output. Load bank required shall be determined by the following:

$$\text{UPS KVA RATING} \times 0.8 = \text{KW of LOAD BANK}$$

Performance test is to be run under the supervision of the UPS technical representative. UPS unit shall be operated under full load for a minimum of one hour. Contractor shall be required to operate feeder and bypass power feeder breakers during testing of the UPS.

[3.4.1.1 Emergency Generator Operation

NOTE: Delete this paragraph if an emergency generator is not required.

Test UPS to observe operation with emergency generator service. UPS technical representative shall verify UPS battery current limiting feature functions properly.

]3.4.2 Battery Performance Test (Constant KW)

Furnish all labor, material and test equipment necessary to conduct performance test under the direction of UPS technical representative. The following shall be accomplished:

- a. Install a calibrated voltmeter across the battery terminals to

measure voltage, and install a calibrated voltmeter across the UPS DC shunt to read charging current. UPS technical representative will advise connection to DC shunt.

- b. Record temperature of pilot cells in battery immediately prior to start of discharge performance test.
- c. Read and record total battery voltage and battery current at start of discharge and every minute during discharge test.
- d. Record minutes and seconds when battery voltage drops below minimum discharge voltage of 291 volts DC. On initial discharge test, a battery may be expected to deliver 95 percent of its rated capacity. This will increase to 100 percent after several complete discharge cycles or after 12 months of float charge service.
- e. Should battery fail to meet the requirements of the first discharge performance test, open the inverted output breaker. Then put battery on equalizing charge, with rectifier adjusted to normal equalizing voltage of [424] [_____] volts DC. Equalize for a minimum of [100] [_____] hours. Measure and record time and battery voltage. Run a second discharge performance test.

3.5 FINAL ADJUSTMENTS

- a. Remove load bank and reconnect system for normal operation.
- b. Equalize battery at [424] [_____] volts for a period of [72] [_____] hours.

NOTE: Delete this test if battery is sealed (valve regulated) type.

- c. Bring electrolyte level of all cells up to the bottom of the high level line by adding original filling gravity electrolyte.
- d. Resume charging battery at normal float voltage of [411] [_____] volts DC.
- e. Check battery connections are properly torqued to manufacturer's specifications. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings. Remake connections having a resistance of more than 10 percent above the average.
- f. All manufacturer's data and operation manuals, which are an integral part of, and shipped with UPS, shall be delivered to Contracting Officer.

3.6 DISPOSAL

Upon completion of UPS installation and testing, Contractor shall remove and dispose of empty, partially full and excess acid drums, including shipping containers, obsolete batteries, and obsolete UPS modules. Removal shall be accomplished off-base and in conformance with local laws and regulations regarding disposal of hazardous material.

-- End of Section --