

## University of Houston Master Specification

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### SECTION 26 3305 - BATTERY EMERGENCY POWER SUPPLY

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information.

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in bold.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

##### 1.2 DESCRIPTION OF WORK

- A. Scope Furnish and install a Dual-Lite Spectron LSN (Life Safety Network) Series Inverter System to provide a reliable source of emergency power, designed to operate during periods of power system voltage excursions without any interruption in power supplied to the connected load. The transfer from utility power to battery power shall utilize a true no break system to prevent sensitive loads from losing power. The system shall provide a pulse width modulated sine wave output to the connected load, and be capable of powering any combination of electronic, power factor corrected, LED lighting. Other connected loads shall include but not be limited to: building management systems, motors, security systems and other critical voltage or frequency-sensitive electronic loads. The system shall operate from 0-100 percent loading, and be rated to deliver full KVA rated output at unity power factor for a minimum of 90 minutes. A boost-tap transformer shall provide regulated output during voltage sags within 10 percent of incoming line voltage without transferring to battery. Upon return to normal AC utility line power, the system shall recharge the batteries without any interruption of power supplied to the load.

##### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A minimum of five years' experience in the design, manufacture, and testing of solid-state UPS systems is required.

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- B. Manufacturer: The Central Inverter System specified herein shall be the Spectron LSN Series Inverter System manufactured by Dual-Lite, a Hubbell Lighting, Inc. Life Safety Products Brand or an approved equal.
- C. Factory Testing: Before shipment, the manufacturer shall fully and completely test the system to ensure compliance with the specification. These tests shall include operational discharge and recharge tests to ensure guaranteed rated performance.
- D. Codes & Standards: The battery emergency power supply shall be listed to or comply with these standards:
  - 1. UL 924 Standard for Emergency Lighting and Power Equipment, when equipped with Type S batteries and a 90-minute run time.
  - 2. UL 1778 Standard for Uninterruptible Power Supply Equipment, when equipped with Type G or Type N batteries, or run times other than 90-minutes.
  - 3. ANSI C62.41: ANSI C62.45 (Cat. A & B)
  - 4. Federal Communications Commission (FCC Part 15)
  - 5. National Electrical Code (NFPA 70)
  - 6. The Life Safety Code (NFPA 101)
  - 7. OSHA

### 1.4 WARRANTY

- A. The system shall be guaranteed, under normal and proper use, against defects in workmanship and materials for a period of two years from the date of shipment. Batteries supplied as part of the systems shall be covered under a separate pro-rata warranty as described below.
  - 1. • Sealed Lead Calcium VRLA, 10-year life expectancy (Type S) – one-year full replacement warranty plus an additional nine years pro-rata.
  - 2. • Sealed Lead Calcium, 20-year life expectancy (Type G) – One year full replacement warranty plus an additional fourteen years pro-rata.
  - 3. • Wet Cell Nickel Cadmium, 25-year life expectancy (Type N) – One year full replacement warranty plus an additional fourteen years pro-rata.

### 1.5 SUBMITTALS

- A. Shop Drawing submittals shall include, but not be limited to, the following:
  - 1. Completely identified and marked catalog cuts of all associated equipment and devices, with all non-applicable items crossed out, or applicable devices clearly hi-lighted and/or identified.
  - 2. A written description of the system operation (written in this specification format), with all exceptions and/or deviations clearly hi-lighted or identified.
  - 3. Complete bill of material for all equipment.
  - 4. A dimensioned drawing showing that the proposed equipment will fit in the space allocated and within the weight limits established for the system.
  - 5. Complete control panel wiring diagrams identifying all terminals and field connections.
  - 6. Written statement indicating a 5-year warranty and service agreement as specified.
  - 7. Written battery warranty.
  - 8. Additional information as required in Section 26 0001 “Electrical General Provisions”.

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### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver the emergency power system in factory-fabricated water resistant wrapping, and mounted on shipping skids.
- B. Store the emergency power system in a clean, dry conditioned space. Maintain factory wrapping until installation and then provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle the emergency power system carefully to avoid damage to material components, enclosure and finish. The UPS shall be provided with adequate lifting means.

### PART 2 - PRODUCTS

#### 2.1 EMERGENCY POWER SYSTEM

- A. Category and Type: Furnish and install a self-contained Battery/Inverter Emergency Power System that shall supply a minimum of [\_\_\_\_ KVA] and [\_\_\_\_ KW] @ unity power factor, for a period of 1.5 hours upon interruption, brownout, or failure of the monitored AC utility line.
- B. Operation: System operation shall be fully automatic and include a linear transformer with boost tap and surge protection. In emergency mode, true “no break” Pulse Width Modulated (PWM) power shall be supplied to the load at all times. The charging system will maintain the batteries at full capacity at all times. Three on-board microprocessors will continuously monitor charger settings and the system’s overall readiness. Diagnostic circuitry shall include a multi-rate, software-controlled charger, continuous monitoring of 265 operating parameters, and programmable system testing capabilities. Thirty individual alarms and nine system logs shall be provided. All alarms and logs shall be automatically recorded and readily displayed via the User Interface Display (UID). The system shall also include one RS232/485 serial port and a TCP/IP Ethernet connection for remote communications. Spectron® Automatic overload and short circuit protection in normal and emergency mode shall consist of 150 percent momentary surge capability, 120 percent overload for 5 minutes, and 110 percent overload for 10 minutes. Protection shall also include a low battery voltage disconnect, AC input circuit breaker, a DC input breaker, and an AC output fuse. A digitally generated sinusoidal output waveform (PWM) with less than 5 percent total harmonic distortion at rated linear load shall be provided to the connected load. A boost tap transfer protection circuit shall maintain the desired output voltage during low voltage sag “brownout” conditions without continuously switching to batteries, thereby preserving battery capacity.
- C. Input Voltage: Available input voltage selection shall include 120, 208, 240, 277, and 347 volts, +10 percent to -15 percent, single phase, with a frequency of 60Hz. The AIC rating shall be 42,000 RMS symmetrical amperes.
- D. Output Voltage: Available output voltage shall include 120, 208, 277, 120/240, 120/277, 120/208, 347, 120/347 volts, +/- 5 percent, single phase sine wave, with a frequency of 60Hz + 0.05Hz. The output frequency, when on utility power, shall be as supplied by the utility.
- E. System Diagnostics: The user interface display (UID) shall include an array of 5 LED’s, a 2-line, 40-character LCD display, and a keypad for system input. The UID shall be menu-driven and display individual system parameters using a numbered code (Hot Key). The LED array shall indicate, by color code, the following status modes: AC output presence (green), system ready (green), battery charging (red), inverter “ON” (amber), and alarm functions (red). To ensure only authorized personnel have system access, a multi-level password shall be required to change all functions and operating parameters.

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1. A continuous scrolling display of the following metered functions shall be provided:
  - a. AC input voltage
  - b. AC output voltage
  - c. AC output amps
  - d. Battery voltage
  - e. Battery charging amps
  - f. Battery discharge amps
  - g. Output volt-amps (VA)
  - h. Output power (watts)
  - i. Power factor
  - j. Percent loading
  - k. Input frequency
  - l. Output frequency
  - m. Ambient temperature
  - n. Battery temperature
  - o. Last inverter run time
  - p. Total inverter run time
  - q. System run time
  - r. Date
  - s. Time
- F. Alarms: Thirty audible and visual alarms shall be provided, with automatic logging of the twenty-five most recent events. An alarm acknowledgement feature shall be provided, which will allow the user to silence only the current audible alarm without silencing other alarms or clearing the alarm condition until the fault has been addressed.
  1. An alarm shall be sounded if any of the following operating conditions occur:
    - a. Low battery voltage
    - b. Near low battery voltage
    - c. High battery voltage
    - d. High AC input voltage
    - e. High AC output voltage
    - f. Low AC output voltage
    - g. Output overload (VA)
    - h. Low remaining run time
    - i. High ambient temperature
    - j. High heat sink temperature
    - k. System test failure
    - l. High battery temperature
    - m. Temperature probe failure

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- n. High transformer temperature
- o. Tripped circuit breaker

### 2.2 MANUAL AND AUTOMATIC TESTING

- A. System Diagnostic Testing: Manual and automatic test modes shall be provided.
  - 1. Manual user-initiated system test at any time
  - 2. Automatic weekly, monthly and annual self-diagnostic tests
  - 3. Automatic recording of the last twenty events in a Test Results log

### 2.3 BATTERY CHARGER

- A. Type: A three-step float charger shall be software controlled and temperatures compensated, and charge the batteries continuously while in normal "standby" condition (non-emergency mode).
- B. Operation: Following a power failure, the constant current charger mode shall be initiated until battery voltage reaches the equalize stage. Equalize stage shall be maintained until the charging current drops to .5 amps, or 0.3 percent of the battery amp/hour rating. Battery voltage shall then enter the float stage.

### 2.4 BATTERIES

- A. Batteries: The following battery types shall be available:
  - 1. Sealed Lead Calcium, VRLA (Type S): Maintenance Free Construction: Standard battery supplied, unless otherwise specified. Requires no addition of water over its useful life. The case and cover shall be constructed of polypropylene, contain a UL recognized low-pressure safety release vent, and be non-gassing in normal use. Life expectancy is 10-years at 77°F (25°C) ambient temperature.
  - 2. Sealed Lead Calcium VRLA (Type G): Maintenance Free Construction: An optional long-life battery. Requires no addition of water over its useful. Life expectancy is 20-years at 77°F (25°C) ambient temperature.
  - 3. Wet Cell Nickel Cadmium (Type N): Wet cell construction: An optional long-life battery. Requires maintenance inspection and the addition of water to the cells when required. Pocket plate construction with a translucent case. Life expectancy is 25-years at 77°F (25°C) ambient temperature.
- B. Battery Capacity: Batteries shall be designed to provide a minimum 1.5 hours rated output voltage to the connected load in emergency mode without dropping below 87.5 percent of nominal battery voltage, to comply with UL Listing to Standard 924 (Emergency Lighting),
- C. Battery Enclosure: The batteries shall be enclosed in an enclosure that permits easy maintenance without requiring removal.

### 2.5 SYSTEM OPTIONS

- A. Options: The following optional factory-installed equipment shall be provided.
  - 1. Normally-On Output Circuit Breaker Options:
    - a. Monitored (recommended) \_\_\_\_\_ Voltage \_\_\_\_ Amp Rating (20 amp is standard)
    - b. Unmonitored \_\_\_\_\_ Voltage \_\_\_\_ Amp Rating (20 amp is standard)

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- c. A maximum of fourteen monitored positions (twenty positions without alarms - unmonitored) are available for all models. Single pole 120V and 277V breakers occupy one position each, while double pole 240V breakers occupy two positions (7 monitored, 10 unmonitored) each. When specifying circuit breaker options, decrease the available number of output breakers by the proper number of positions chosen.
  2. Normally-Off Output Breaker Options:
    - a. Monitored (recommended) \_\_\_\_\_ Voltage \_\_\_\_ Amp Rating (20 amp maximum)
    - b. Unmonitored \_\_\_\_\_ Voltage \_\_\_\_ Amp Rating (20 amp maximum)
    - c. Used when the lighting fixtures are to be energized only during a power outage. The normally-off circuit breakers are user programmable for a delay of up to 999 seconds. A maximum of eight positions are available for all models. Single pole 120V and 277V breakers occupy one position each, while double pole 208V or 240V breakers occupy two positions each. When specifying circuit breakers, decrease the available number of output breakers by the proper number of positions chosen.
  3. Alternate Run time (AR):
    - a. UL Listed to Standard 1778 (Uninterruptible Power Supply Equipment)
    - b. Up to four-hour run time is available. Example: AR240.
    - c. **[Note: The National Electrical Code (NEC) requires a minimum of 90-minute run times for emergency lighting installation requirements].**
  4. Short Battery Cabinet (SBC): For applications where headroom is limited, the Short Battery Cabinet (SBC) can be used to reduce the overall installation by 15 inches. Available with 1.0, 2.0, 2.7, 3.7, 5.5 and 6.6 KVA systems with Type S batteries only. Consult factory for additional details
  5. Cat 60: Cabinet Locks: (CL60): Universal cabinet locks for all electronic and battery cabinets
  6. Computer Port: System shall include a RS232/485 serial communications port and a TCP/IP Ethernet port for authorized access to view electrical parameters, system status, system set point programming and test/ alarm logs.
  7. Remote Status Panel (RSP): Provides remote system annunciation of inverter and alarm status. Operates up to 1,000 feet away. The following color-coded indicators are provided:
    - a. Alarm LED (Red)
    - b. Audible Alarm
    - c. Charging LED (Red)
    - d. Emergency Power LED (Yellow)
    - e. Ready LED (Green)
    - f. A/C On LED (Green)
  8. System Monitoring Terminals (SMT): Provides two PC-board mounted terminal blocks to allow customer access to RSP (Remote Status Panel) outputs, Inverter and Alarm active relays. These low power contacts (commonly referred to as "dry contacts") can be set for a time delay of up to 999 seconds. They incorporate normally-open and normally-closed contacts. Access to +12 Volts DC, DC ground and two normally-off relay driver signals are also provided.
  9. Charger Upgrades (C10 or C20): For enhanced battery recharge time:

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- a. • C10 – 10 Amp charger upgrade. Available on 1.0kVA – 4.8kVA Series
- b. • C20 – 20 Amp charger upgrade. Available on 5.5kVA – 17.5kVA Series
  - o Not available with 120V input on 6.6kVA and above.
  - o Not available with 208V input on 12.5kVA and above.
  - o Not available with 240V AC input on 15kVA and above.

10. Internal Maintenance Bypass Switch: (IBS): A factory-installed, internally-mounted three-position “make before break” switch. Compatible with all input/output combinations and any combination or quantity of output circuit breakers. Allows connecting the utility power supply to the load without placing the inverter in emergency mode.
11. Extended Training: (ATV): If user personnel are not available for training during the factory start-up procedure, a Dual-Lite technician shall be scheduled for a later visit at additional cost.

### 2.6 SYSTEM ACCESSORIES

- A. Accessories: The following accessories shall be provided:

1. External Maintenance Bypass Switch (MBB or BBM): The external maintenance bypass switch allows power to be removed from the inverter system and remain connected to the load. This allows the inverter system to be completely removed, replaced or repaired without interruption to the load. The switch is supplied in a wall mounted, NEMA 1 enclosure. Available in Make-Before-Break (MBB) or Break-Before-Make (BBM) configuration. Not for use with systems having more than one single-pole output circuit breaker, or systems with different input and output voltages.

### 2.7 MAINTENANCE, SERVICE AND ENHANCED WARRANTY PLANS

- A. Field Services: The following field services shall be provided to assure initial and long term viability of the system.

1. Factory Start-Up (FS): Factory Start-Up shall be supplied as an inverter system standard at no additional cost. The Factory Start-Up process shall verify correct installation and operation of the inverter system. Trained, factory-authorized technicians shall administer an on-site, point-by-point check of the system to include:
  - a. Internal electrical connections - AC input and Battery connections
  - b. System operating voltages - System operating parameters
  - c. Initial system “power-up - Battery discharge test
  - d. Correction of existing deficiencies - Final testing, calibration and recording
  - e. Training of available operating personnel
  - f. Battery load test
2. Monitoring Program (MP): The unique, optional Monitoring Program shall provide for the continuous monitoring of the inverter system by the Factory Technical Support Group. All weekly, monthly and annual system tests shall be reviewed and analyzed for early warning signs of system malfunction. Any failures shall be automatically relayed to the service department where corrective action can be recommended to the owner/operator. For activation, a user supplied dedicated analog phone line must be available.

### 2.8 PREVENTIVE MAINTENANCE PLAN

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- A. Preventive Maintenance Plan: Provide optional warranty system coverage beyond the standard two-year factory warranty. PMP warranty service excludes the batteries, which are covered under a separate warranty plan.
1. PMP-A1: Additional 1-year warranty and 1-year service coverage, weekdays, Monday- Friday, 8AM to 5PM EST.
  2. PMP-A2: Additional 2-year warranty and 2-year service coverage, weekdays, Monday-Friday, 8AM to 5PM EST.
  3. PMP-A3: Additional 3-year warranty and 3-year service coverage, weekdays, Monday- Friday, 8AM to 5PM EST.
  4. PMP-B1: Additional 1-year warranty and 1-year service coverage, 24 hours/day, 7 days/week, no holidays.
  5. PMP-B2: Additional 2-year warranty and 2-year service coverage, 24 hours/day, 7 days/week, no holidays.
  6. PMP-B3: Additional 3-year warranty and 3-year service coverage, 24 hours/day, 7 days/week, no holidays.
  7. PMP-C1: Additional 1-year warranty and 1-year service coverage, 24 hours/day, 7 days/week, including holidays.
  8. PMP-C2: Additional 2-year warranty and 2-year service coverage, 24 hours/day, 7 days/week, including holidays.
  9. PMP-C3: Additional 3-year warranty and 3-year service coverage, 24 hours/day, 7 days/week, including holidays.

### 2.9 SYSTEM CABINET

- A. General: The system shall be contained in a code gauge, steel NEMA 1 enclosure, finished in a scratch resistant, powder coat finish, with a key lock, conduit knockouts at the top and sides, and front opening doors with air filters. Enclosures shall be designed to allow stacking to minimize the overall system's footprint. The system shall include a plenum to expel heated air from inside the unit. All components shall be front accessible and incorporate a modular design and a quick disconnect means to facilitate servicing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF UPS SYSTEM

- A. General: Install the emergency power system where shown, in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the conditioners comply with the requirements and serve the intended purposes. The Contractors shall install all equipment per the manufacturer's recommendations.
- B. Standards: Comply with the requirements of NEMA and NEC standards and applicable portions of NECA's "Standard of Installation", for installation of UPS. The emergency power system shall be installed in accordance with all appropriate manufacturers' instructions and in compliance with all appropriate codes.
- C. Tightness: Torque terminals and tighten mechanical fasteners.

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- D. System and Related Equipment Mounting: The emergency power system shall be installed on a reinforced concrete housekeeping pad. Refer to Section 26 05 01, "Electrical Basic Materials and Methods" for additional requirements.
- E. Adjustment: Adjust operating mechanisms for free mechanical movement.
- F. Finish: Touch-up scratched or marred surfaces to match original finish.

### 3.2 WIRING

- A. Input and output conductors shall be enclosed in separate conduits.
- B. All load side wiring shall be sized as required for voltage drop conditions to assure proper operation of connected loads.

### 3.3 SYSTEM OPERATION

- A. The system shall allow connection of both "normally on" and "normally off" (optional) loads. Connected loads shall receive utility power during normal operation, and "no break" system inverter power during utility interruptions.

### 3.4 CONNECTED LOADS

- A. In emergency mode, the inverter system shall supply true digitally-generated AC sinusoidal output. Refer to plans for type and location of loads served by the system.

### 3.5 FIELD QUALITY CONTROL

- A. The following inspections and test procedures shall be performed by factory-trained field service personnel during the emergency power system start-up.
  - 1. Visual Inspection
    - a. Inspect equipment for signs of damage
    - b. Verify installation per drawings
    - c. Inspect cabinets for foreign objects
    - d. Verify neutral and ground conductors are properly sized and configured
    - e. Inspect all cell cases
    - f. Inspect each cell for proper polarity
    - g. Verify all printed circuit boards are configured properly
  - 2. Mechanical Inspection
    - a. Check all control wiring connections for tightness
    - b. Check all power wiring connections for tightness
    - c. Check all terminal screws, nuts, and/or spade lugs for tightness
  - 3. Electrical Inspection
    - a. Check all fuses for continuity
    - b. Confirm input and bypass voltage and phase rotation is correct
    - c. Verify control transformer connections are correct for voltages being used
    - d. Assure connection and voltage of the battery string(s)
- B. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 3 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

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### 3.6 UNIT START-UP

- A. Energize control power
- B. Perform control/logic checks and adjust to meet specification
- C. Verify DC float and equalize voltage levels
- D. Verify DC voltage clamp and overvoltage shutdown levels
- E. Verify battery discharge, low battery warning and low battery shutdown levels
- F. Verify fuse monitor alarms and system shutdown
- G. Verify inverter voltages and regulation circuits
- H. Verify inverter/bypass sync circuits and set overlap time
- I. Perform manual transfers and returns
- J. Simulate utility outage and verify system functionality
- K. Verify proper recharge

### 3.7 MANUFACTURER'S FIELD SERVICE

#### A. Service Personnel

- 1. The emergency power system manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up and maintenance of UPS and power equipment.
- 2. The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, 365 days/year. If emergency service is required, telephone response time shall be 20 minutes or less and on-site response time shall be four hours or less.
- 3. Two local customer engineers shall be assigned to the site with a regional office as a backup. Daily automated reports shall be supplied to the regional office to document failed equipment. Automatic escalation procedures shall notify the national support manager if a site is not functioning within 24 hours.

#### B. Replacement Parts Stocking

- 1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.
- 2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours a day, 7 days a week, 365 days a year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

### 3.8 EMERGENCY POWER SYSTEM MAINTENANCE TRAINING

- A. Maintenance training courses for customer employees shall be available by the emergency power system manufacturer. This training is in addition to the basic operator training conducted as a part of the system start-up.
- B. The training course shall cover emergency power system theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC-to-DC conversion and DC-to-AC inversion techniques as well as control, metering, and feedback circuits to

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the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics shall be stressed.

### 3.9 MAINTENANCE CONTRACTS

- A. A complete offering of preventive and full-service maintenance contracts for both the emergency power system and battery system shall be available.

### 3.10 OPERATOR TRAINING

- A. The manufacturer's startup representative shall provide a minimum of 8 hours of operating and maintenance training to the Owner's maintenance personnel. Training shall be provided at times convenient to the Owner. Approved Operating and Maintenance Manuals shall be available to the Owner prior to the training session.

### 3.11 IDENTIFICATION

- A. Refer to Section 26 0553 "Identification for Electrical Systems" for applicable painting, nameplates and labeling requirements.

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