TECHNICAL GUIDE SPECIFICATIONS

POWER RIDE 4

THREE-PHASE, (48 TO 160 KW)
UL924 CENTRAL LIGHTING INVERTER

(Also Available up to 400KW)

PERFECT POWERSYSTEMS

1. GENERAL

1.1 STANDARD

The Emergency Central Lighting Inverter complies with the following standards:

- **Certified per UL1778,**
- **UL 924 and CSA 22.2 No. 107.1.**
- **UL 924/UL 924A – Life Safety for Emergency Backup Lighting**
- **FCC rules and regulations, Part 15, Subpart J, Class A**
- **NEMA PE-1**
- **NFPA 101 (Life Safety Code)**
- **ANSI C62.41 (IEEE 587)**
- **ANSI C62.42.45 (Cat. A and B)**
- **TVSS UL1449 4th Editions - UL Standard for Safety Transient Voltage Surge Suppressors (Type 3, 4)**

1.2 SCOPE

This guide provides technical information and specifications for Perfect Power Systems Power Ride 4. The Power Ride 4 equipment herein shall be referred to as the Emergency Central Lighting Inverter.

The Emergency Central Lighting Inverter features high reliability solid-state double conversion digital signal processing and a High Frequency Pulse-Width Modulated (PWM) system that harnesses the advantages of IGBTs (Insulated-Gate Bipolar Transistors) in its design.

The Emergency Central Lighting Inverter meets UL 924 requirements for emergency lighting system applications and provides the security of 90-minutes of battery backup power. It is suitable for all lighting loads including any combination for electronic and security systems, Power Factor Corrected Self-Ballast Fluorescent, Incandescent, Quartz Restrike, Halogen, HID, HPS and LED Lighting during battery backup operation.

NOTE: This Guide Specification is subject to change without notice due to product improvement and/or enhancement.

Please use this document as a guide specification and do not hesitate to contact our Application Engineering Department if you have any further questions or special requirements.

You can contact us at: (800) 227-8899 or via e-mail: sales@perfectpowersystems.com

1.3 APPROVED MANUFACTURER

The Inverter shall be an Emergency Central Lighting Inverter system and shall be manufactured by:

Perfect Power Systems

Website: www. perfectpowersystems.com

1.4 QULIFICATION AND QUALITY ASSURANCE

1.4.1 Manufacturer's Certification

A minimum of twenty years' experience in the design, manufacturing and testing of solid-state UPS is required. The manufacturer shall specialize in manufacturing of on-line,

double conversion, high frequency, UPS (Inverter) modules as specified in this document. The manufacturer shall hold a current ISO 9001 certificate and shall design and develop the units in accordance with internationally accepted standards.

1.4.2 Materials and Assemblies

All materials and parts in the UPS shall be new, of current manufactured and unused, except for the purpose of factory testing. All active electronic components shall be solid state and designed so as not to exceed the manufacturer's recommended ratings and tolerances for ensuring maximum reliability. All IGBTs and other semiconductor devices shall be sealed. All incoming parts, modular assemblies and sheet metal shall undergo detailed receiving quality inspection.

1.4.3 Factory Testing

Every unit shipped will have completed a documented functional test of the UPS system. A copy of the test report shall be available at the customer's request.

1.5 PRODUCT DESCRIPTION

The specification defines a high reliability three-phase, on-line, True Galvanic Isolated Emergency Central Lighting Inverter - Double Conversion, Digital Signal Processing, High Frequency Pulse Width Modulated (PWM) system, utilizing IGBTs.

The system shall include a user programmable (monthly and yearly) battery test scheduling and report with printing capability for UL924 compliancy.

To reduce operating cost while the unit is charging the battery system during normal utility power operation, the system shall also include the following features:

- **Multi-CPU design**

  The Emergency Central Lighting Inverter shall employ several CPUs in the control circuit, and critical functions design with parallel redundancy to improve reliability. Therefore, in case of one CPU failure, the other CPUs keep the Emergency Central Lighting Inverter operational, and the output AC is not affected.

- **Intelligent Charger:**

- **The Emergency Central Lighting Inverter shall automatically recharge (boost charge) the batteries every time the batteries are depleted to a voltage level equal to 2V/Cell. Thus, the batteries can be restored to full capacity as soon as possible, and made ready for the next back-up requirement. To keep the batteries in the best condition, the Emergency Central Lighting Inverter will boost charge the batteries for several hours (selectable) automatically every month. To avoid over charging the batteries, boost charge will stop when the ambient temperature is over 35°C (95°F).**
- **Programmable automatic system testing capabilities (10 seconds monthly and 90 minutes yearly).**
- **No break in transfer time (from Utility to Battery) mode.**
- **Visual displays of all alarms.**
- **DC to AC converter (Inverter)**
- **Input surge protection**
- **EMI suppression**
- **Plug & Play Modular design**
- **Cold Start function**

The Emergency Central Lighting Inverter shall start without an AC source, (with battery power only)

- **Accepts wide input range:**

The Emergency Central Lighting Inverter shall accept wide input range, so that it can work effectively under an unstable AC source. All the input components used are specifically selected to handle extreme high voltage and high current.

- **Protection against misuse:**

The Emergency Central Lighting Inverter shall be designed with a breaker on/off sensor, power supply sensor

- **Redundant power supply:**

A supplemental power supply is added to provide redundancy for supplying power to the static switch, so that there will be AC output no matter what happens to the Emergency Central Lighting Inverter.

- **DC Input Breaker**
- **Battery bank sized for the system's runtime requirements (Min. 90 Minutes for UL 924)**
- **Full KW rating.**
- **Communication Interface Provisions:**
  - (RS232, RS485) for dedicated computer
  - Web Communication
  - Facility Interface (Dry Contacts)
- **Manual Test Switch**
- **Optional integrated output distributions (N/ON, N/OFF with or without time delay).**
- **100% Unbalance Load - Output Voltage Regulation – ±1%, Phase Shift – 120° ±0.5%.**

1.6 INVERTER DESIGN REQUIREMENTS

- **Output Load Capacity – The continuous output power rating of the Inverter shall be [Select Unit Capacity] at 0.8 PF**
- **Input Voltage – [Select Input Voltage.], ±15%, 3-phase, 50/60 Hz, 4 wires plus-ground.**
- **Output Voltage – [Select Output Voltage], 3-phase, 4 wires plus-ground.**
- **Battery Type – [Select Battery Type from drop down menu].**
- **Battery Run Time – 90 Minutes Standard**

2. SYSTEM DETAILS

2.1 SYSTEM OVERALL SPECIFICATION

- **Operation Mode –**
  - Double Conversion Mode
  - Green Mode: Hybrid design; customer selectable for Green Mode (Fast Transfer less than 2ms).
- **Overall System Efficiency (Double Conversion Mode) – 91%~93% (varies by KVA)**

- **Overall System Efficiency (Green Mode) – 96%~98% (varies by KVA)**
- **Overload –**
  - 110-125% – 15 minutes
  - 125-150% – 5 minutes
  - Higher than 150% – 30 Seconds
- **Protections-**
  - Short Circuit for Rectifier/By-pass
  - MOV for Lightning
  - EMC Filter for Input and Output
- **Status Panel-**
  - It shall consist of 4 X 40 characters LCD display for real time status, Data or Historical Events
  - 24 Status LEDs, 8 Warning LEDs
  - Mimic Display
  - Audible Alarm
  - Inverter ON/OFF Switch.
  - LCD control Switch.

2.1.1 AC Input

- **Input Power Factor ≥ 0.97**
- **Power Walk-In time – 20 sec from 0 to 100%**
- **Frequency – 50/60 Hz ± 7**
- **Input Current Harmonics –**
  - 33% for 6 Pulse Rectifier unit.
  - 15% for 12 Pulse Rectifier unit.
  - 9% Input Filter option is available.

2.1.2 Inverter and Output Specification:

- **DC Input Voltage Range to Inverter – 285-420VDC (inverter can be started without an AC source).**

- **Output Waveform – Sinusoidal Wave**
- **Output Power Factor – 0.8 PF**
- **Output Voltage Regulation at 100% Unbalanced Load – ±1%**
- **Output Frequency Tolerance – ±0.1 Hz**
- **Phase Shift Under 100% Unbalanced Load – 120° ±0.5%**
- **Output Voltage Total Harmonics (THD) – Less than 2%**
- **Output Maximum Peak Current (AMP) – +125% of Rated Output current.**
- **Overload –**
  - Less than 110% Load: Continuous
  - 125-150%: 5 minutes
  - Higher than 150%: 30 Seconds
- **Output Distribution – The Emergency Central Lighting Inverter shall have an optional Internal or External Distribution: Main Output Breaker, Auxiliary Breaker: Normally ON, Normally OFF, Normally OFF with time delay.**
- **Communication Interface Optional – The Emergency Central Lighting Inverter shall have RS232, RS485 for dedicated computer, Web Communication provision, Facility Interface (Dry Contact).**

2.1.3 Battery Specification

Sealed, Maintenance-Free VRLA (Valve-Regulated Lead–Acid) Batteries shall be provided. The batteries shall have an expected life of 10 years or a minimum of 250 complete discharge cycles. The batteries shall be contained in the external cabinet(s) with dedicated circuit breaker (no fuses) for battery protection and convenient power cut-off, and servicing. The battery run time (based on 100% full load) shall be no less than the specified time. Runtime shall comply with UL924 providing a minimum of 90-minutes at full load. Specified extended runtimes shall be provided only as an option. Optional 20 years battery life expectancy and high temperature are available.

- **Standard Run Time – 90 minutes at full load, based on UL924**
- **Extended Run Time – As required (Optional)**
- **Battery Type – Sealed, Maintenance-free, Lead-Acid, VRLA (Standard) 10 years**
  - Optional High Temperature (35°C)

- Optional 20 years

- **Voltage – 348VDC (Range: 295-410VDC)**
- **Low Battery Warning Voltage – 320VDC**
- **Low Battery Shut-down Voltage – 295VDC**
- **Boost Charge Voltage – 402VDC**
- **Float Charge Voltage – 390VDC**

2.2 STATIC SWITCH SPECIFICATION:

- **Voltage Range:**
  - 96-144VAC (Line to Neutral) for 208/120V units
  - 222-332VAC (Line to Neutral) for 480/277V units.
- **Efficiency: 99.5%**
- **Transfer Time:**
  - From Main Input Source to Inverter: 0.2ms
  - From Inverter to Main Input Source: 0.2ms
- **Overload:**
  - 100% for 30 Seconds
  - 300% for 7 Seconds
- **Isolation with Output**

2.2.1 Mechanical Design and Constructions

A. Physical Specifications

Cabinet floor mount design, forklift capable, black finish with a maximum depth of 32” to maximize front accessibility. The cabinet shall be no more than a 56” width for best layout (bookshelf style). The cabinet height shall not exceed 80” to allow access through a standard door.

B. Enclosure

All system components shall be housed in a single floor mounted freestanding NEMA 1 enclosure. The cabinet should have front access, allowing easy component access. Cabinet doors shall require a key for gaining access. Front

access only shall be required for safety and servicing, adjustments, and installation. The cabinet shall be structurally adequate and have provisions for hoisting, jacking and forklift handling.

C. Construction

Only quality, unused material shall be used to build the unit, under strict observance of quality standards and workmanship. The cabinets shall be cleaned, primed, and painted matt black. The unit shall be constructed with rigorously tested, burned-in, replaceable subassemblies. Only two electronic subassemblies, a Heat Sink Assembly with IGBTs and drivers and a Control PCBA shall be used for maximum reliability and ease of servicing. All printed circuit assemblies shall have plug connections. Like assemblies and like components shall be interchangeable.

D. Earthquake Protection:

The cabinet shall be evaluated for earthquake zone 4 installation with the addition of optional earthquake brackets.

2.2.2 Environmental (Electronics)

Operating Temperature:	**0° to 40°C (0 to 104°F)**
Storage Temperature:	**-20° to 70°C (-4° to 158°F)**
Altitude:	**Less than 1500 meter (5000 feet) Above Sea level**
Relative Humidity:	**0 ~ 90% (Non Condensing)**
Audible Noise:	**Less than 65dBA at 1 meter/39.4 inches**

2.3 MODES OF OPERATION

2.3.1 Green

Customer selectable Green Mode (Fast Transfer, less than 2ms). This mode bypasses the Double Conversion operations during normal steady state enabling higher efficiencies, greater that 97%.

2.3.2 Normal

The rectifier converts the AC input to DC power to supply the inverter and charge the batteries simultaneously. All the fluctuations, surges and spikes of the AC input are

removed during AC to DC conversion. Therefore, the AC supplied by the inverter is clean and stable.

2.3.3 Backup

Since the batteries are connected directly to the DC bus, when the AC fails, the batteries change immediately from receiver to donor, supplying energy to the inverter instead of receiving energy from the rectifier. The output AC is not interrupted. Therefore, the load connected to the output is protected.

2.3.4 Reserve Mode

When the inverter is in an “abnormal condition”, such as over temperature, short circuit, abnormal output voltage or overloaded for a period exceeding the inverter’s limit, the inverter will automatically shut-down in order to protect itself from damage. If the utility power is normal, the static switch shall transfer the load to the reserve source without interruption of AC output.

2.3.5 Maintenance Bypass Mode

In case of Emergency Central Lighting Inverter maintenance or battery replacement, and where the load cannot be interrupted, the user can turn off the inverter, close the bypass breaker and then open the rectifier and reserve breakers. The AC output will not be interrupted during manual bypass transfer procedure.

Generally, the Emergency Central Lighting Inverter is expected to run 24 Hours a day in normal operation mode once it is installed, except when the utility power fails, under overload conditions, or during maintenance.

2.4 COMPONENT DESCRIPTIONS

2.4.1 Input Terminal Block

For ease of installation, an input terminal block is hard wired and located in a convenient location for incoming power cables. The conduit entries are located on the top or bottom (raised floor) entry.

2.4.2 Input Circuit Breaker

A circuit breaker is provided and hard wired at the Emergency Central Lighting Inverter input for protection of overload conditions. Optionally, higher KAIC breaker is available and should be specified when required.

2.4.3 Input Contactor

The Emergency Central Lighting Inverter will have a line contactor to disconnect the input line when an outage occurs so that there is no back feeding of power into the power line.

2.4.4 Output Circuit Breaker

An output circuit breaker is provided and hard wired at the Emergency Central Lighting Inverter output for protection from overload conditions. Optionally, a higher KAIC breaker is available and should be specified when required.

2.4.5 DC (Battery) Breaker

The Emergency Central Lighting Inverter will have a DC Battery Circuit Breaker to disconnect the DC power from the batteries to allow for service.

2.4.6 Input Transformer

The input transformer adjusts the input voltage for proper rectifier DC voltage, depending on the unit rated power and back-up capacity.

2.4.7 Rectifier

The main function of a rectifier is to convert the AC input to DC power and supply it to the inverter. The inverter then converts the DC power to AC power for the load. The Emergency Central Lighting Inverter uses the DC power to charge the batteries as well, which is the most efficient method of charging.

The Emergency Central Lighting Inverter units 10KVA to 60KVA uses 6-pulse, fully controlled rectification (optional 12-pulse). An inductor is added before the rectifier to improve the power factor, smooth the current waveform, and eliminate the harmonic current. The control circuit regulates the DC bus within 1%. Soft Walk-In circuitry (approximately 20sec.) and Current Limit circuitry is used to prevent over current or instantaneous surge currents.

The power component used in the rectifier is specifically selected to handle extreme high voltage and high current. The rectifier is designed to operate under a wide range of AC input, from 177 to 300VAC, and to operate under poor power conditions found in some areas.

2.4.8 Inverter

The inverter is composed of IGBTs, inductors, capacitor, snubbers, control circuits and protection circuits. The inverter converts the DC power from the DC bus to AC power to supply the output load. The Emergency Central Lighting Inverter uses IGBT technology which switches at frequencies beyond the audible range, therefore producing no audible noise.

An independent inverter is used for each phase. Although it is more expensive, each inverter has its independent feedback, so that the voltage is unaffected when load is added to the adjacent phase, producing excellent voltage regulation under 100% unbalanced load.

The Emergency Central Lighting Inverter shall use redundant protection circuitry to protect the inverter. A robust snubber is added to suppress the spikes and noise, oversized, semi-conductor fuses are provided, with maximized ventilation the design is a more reliable.

2.4.9 Static Switch

The static switch is composed of two pairs of SCRs, connected back-to-back. The switch can transfer the load from reserve to inverter or from inverter to reserve without losing power at the output. Therefore, it is a very important portion of an Emergency Central Lighting Inverter.

2.4.10 Maintenance Bypass

The Maintenance Bypass Switch shall use 3 circuit breaker schemes:

- **Rectifier**
- **Reserve**
- **By-pass**

The maintenance bypass switch is already installed inside the Emergency Central Lighting Inverter for convenience and It should be open under normal operation, and only closed

during maintenance. All power supplies inside the Emergency Central Lighting Inverter should be disconnected before touching any parts inside the Emergency Central Lighting Inverter. The maintenance bypass switch is necessary to maintain AC power at the output and yet keep maintenance personnel safe at the same time. If the bypass breaker is closed under normal operation, the inverter will stop, and the load will be automatically transferred to reserve to prevent the inverter connecting directly to the AC source.

Note: To properly use the maintenance bypass breaker, switch off (Rectifier Breaker) first. The static switch will automatically transfer the load to reserve without delay. Then close the maintenance bypass breaker, and then open the reserve breaker, so that the load gets power from the output without interruption.

2.4.11 Output Transformer

The Output isolation transformer (True Galvanic Isolation) can solve the problem of poor input grounding, allowing a different ground between input and output, avoiding the annoying problem of ground leakage current, and can be tied to any potential provided on site.

2.4.12 Inverter Test Switch

Inverter Test Switch is a push button switch for testing the unit for proper operation. When the unit is running and the switch is pressed, the unit will automatically transfer to battery operation. The unit will continue to run on batteries until the switch is released. When the switch is released, the unit returns to normal operation (provided input power is present).

2.5 SYSTEM DIAGNOSTICS AND ALARMS

The front panel is located at the front of the PCB holder. It gathers the real time information of the Emergency Central Lighting Inverter and shows them clearly to the user. It also provides switches for controlling and setting the Emergency Central Lighting Inverter. Through this panel, the Emergency Central Lighting Inverter can be not only a stand-alone machine supplying the load, but also closely monitored by the user. Each part of the panel is explained in the Installation and Operation Manual.

2.5.1 LCD display

Real time status, data or historical events are displayed on the LCD. The Emergency Central Lighting Inverter parameters, real time clock, inverter, and buzzer also can be set through this LCD. The LCD is backlit by LED's to provide a sharp display. To lengthen the LED's lifetime, the LED's are automatically shut off 3 minutes after no key is activated but will light up again when one of the up/down/enter keys are pressed.

2.5.2 Status LEDs

24 LED's, representing all the important information of the Emergency Central Lighting Inverter provide the most up to date information to the user. These LED's are especially important when abnormal conditions occur.

2.5.3 Warning LEDs

When an abnormal condition occurs, the LED's will light up to warn the user according to the cause of the faulty condition. Under normal conditions, the LED's are not illuminated.

2.5.4 Audible (Buzzer) Alarm:

For abnormal conditions, an audible sound should be emitted to warn the user to check the status of the Emergency Central Lighting Inverter. The alarm buzzer will beep under an Inverter Overload, Back Up Mode, or and Inverter short circuit condition.

2.6 OPTIONS

2.6.1 Normally On / Normally Off (with or without time delay) Output Auxiliary Circuit Breakers

These circuit breakers are single pole, 20 Amp din-rail mountable devices for protection of the customer's load circuits. Up to 20 circuit breakers can be added to the unit.

2.6.2 Normally On/Normally Off Output Auxiliary Circuit Breakers with trip indicator

2.6.3 Seismic Mounting Brackets for Emergency Central Lighting Inverter and Battery Cabinets:

The seismic floor mounting brackets include one left bracket and one right bracket per cabinet (UPS and Battery).

2.6.4 OSHPD Rated Units: (Shaker Table Tested and Certified for Operation)

Our System has also received special seismic certification from the California Office of Statewide Health Planning and Development (OSHPD), which are the most rigid seismic standards available. They have been Shake-Table-tested in accordance with the ICC-ES AC156.

2.6.5 Local on PC - Via RS232 or RS485 Communication Port

This option requires a PC and LabView monitoring software on a Windows platform. Data sent to the PC are displayed as a control room panel for real-time monitoring. The distance from the PC for RS232 cable should be limited to between 25 and 150 feet. By using the RS485 port, the range can be extended to 1000 feet.

2.6.6 Dry Contacts

8 terminals of dry contacts are provided. These terminals are normally open (non-conducting). When an event occurs, the terminal will close (conduct). Maximum contact rating is 16A/250VAC (16A/30VDC). The connections provided are:

- **Inverter On (INVON),**
- **Overload (OVL),**
- **Fault (UPS encounters a fault),**
- **CHRG OFF (battery charger is off),**
- **BYPASS (Bypass Breaker is closed),**
- **BACKUP (Battery Backup), BATL (Battery Low), COM.**

Battery Monitoring is also provided through the RS485 port, DCMAN-Battery Monitoring Module. Monitors for individual battery voltage, battery impedance and (optional) battery temperature.

For fire prevention, a battery thermal runaway control option provides protection in case of an over-temperature condition in the battery compartment. If such a condition occurs, this option shuts off the charger. Charging resumes when the temperature returns to normal. A dry contact (N/O, N/C) relay interface is provided for user interface.

2.6.7 DB9 Connection

Four RS-485 and one RS-232 are provided to communicate with more sophisticated (option) modules. Each connector is especially dedicated to one type of external module. The following are some connection examples of optional modules.

2.6.8 Software for PC Monitoring – UPSCOM™

UPSCOM™ is a hardware/software combination installed on a PC to monitor multiple Emergency Central Lighting Inverters with a DB9 connection in series. The connector on the Emergency Central Lighting Inverter's side is RS-485 (for long distance transmission); therefore, an RS-485 ⇔ RS-232 adapter (hardware) is required to modify the signal. The software and hardware together form a package called UPSCOM™. See the UPSCOM™ specification for further information. Software on a CD, cable harness and an SNMP CARD are provided with the UPSCOM option.

2.6.9 Input Transient Voltage Surge Suppressor (TVSS) To UL1449 Type 3, 4

TVSS is a DIN rail mounted device, connected to the Inverter input. Its plug-in phase modules are easily replaceable. The device contains energy absorbing components and has a two-stage protection. When a protection component is damaged by absorbed transient, the device will display a flag indicating a need for replacement.

2.6.10 Web/Simple Network Management Protocol (SNMP) Communication Card

This option is a web enabled monitoring device for a unit with Internet or network connection. The SNMP/Web card can monitor the Inverter on the network through a standard web browser. Connection can be made through Ethernet and or a WIFI Modem. Independent IP address automatically provided.

2.6.11 UPSCOM™

Is a hardware/software combination installed on a PC to monitor multiple Emergency Central Lighting Inverters with DB9 connection in series. The connector on the Emergency Central Lighting Inverter's side is RS-485 (for long distance transmission); therefore, an RS-485 ⇔ RS-232 adapter (hardware) is required to modify the signal. The software and hardware together form a package called UPSCOM.

2.6.12 Wireless Battery Monitoring System (Battery String and or Individual Battery)

This option provides monitoring of individual battery, string, or both on a local display, (without PC requirement), remote or web enabled display. It provides for assessment and warning of actual remaining battery capacity and block deterioration for maximum battery life and total run time availability to avoid backup failure, with the following capabilities:

- **User selectable measurement intervals (Second, Hour, Daily, Weekly and Monthly)**
- **To Measure, record and graph**

A. String Monitor

- **String voltage**
- **String current**
- **Cabinet temperature**
- **String Impedance**

B. Individual Battery Monitor

- **Battery voltage**
- **Battery Ohmic value (without loss of battery capacity)**
- **Individual Battery Impedance**
- **Battery temperature - Optional**

A wireless touch screen data collector (up to 75 feet with single antenna) is used to communicate with all sensors while it can provide an Ethernet port for remote monitoring and communications.

2.6.13 Battery Thermal Runaway Control (Without Shutting down the Battery)

Provides protection in case of over temperature condition in battery compartment by shutting off the charger and will resume charging when temperature has returned to normal temperature range, (without shutting down the backup battery bank).

2.6.14 External Auxiliary Output Circuit Breaker Panel Board

This option provides up to 42 single-pole panel auxiliary breakers with a main breaker for additional distribution.

2.6.15 Delta connection

- **Provides for Delta Input connected source**

2.6.16 Dual Inputs

- **Available Dual WYE or Delta Input Power**

2.6.17 Factory set Green Mode

- **Hybrid design allows customer to select this operation mode for higher efficiency, 98% (Fast Transfer less than 2ms).**

3. WARRANTY

3.1 INVERTER MODULE

The inverter manufacturer shall warrant the Inverter against defects in materials and workmanship for a period of twenty-four (24) months. The warranty shall cover all parts and labor for a 12-month period beginning with the factory startup, 13th through 24th months only valid with factory performed preventive maintenance, (extended warranty contract).

3.2 BATTERY

The battery manufacturer's standard warranty shall be transferred and assigned to the end user. It will have a minimum period of one (1) year (9 years pro rata) when operated in specified environment not to exceed 25°C (77°F).

4. FACTORY STARTUP, MAINTENANCE, & EXTENDED WARRANTY

4.1 FACTORY STARTUP

Offer factory trained service personnel to perform the initial startup of the Central Lighting Inverter System.

4.2 SYSTEM OPERATION

The system shall allow connection of either “normally on” or "normally off" (Dedicated Emergency Lighting) loads. Connected loads shall be carried via the transfer circuit by the utility during normal operation or by the system inverter during utility failures without interruption with zero transfer time.

4.3 SERVICE PERSONNEL

The Emergency Central Lighting Inverter manufacturer shall employ a nationwide service organization, with factory trained Customer Service Engineers dedicated to the startup, maintenance and repair of Emergency Central Lighting Inverter and power equipment. The manufacturer shall provide a fully automated national dispatch center to coordinate field service personnel scheduling. One toll free number shall reach a qualified support person 24-hours a day, 7-days a week and 365-days a year. For emergency service calls, response time from a local Customer Engineer shall be approximately 15-minutes.

4.4 CONNECTED LOADS

The Central Lighting Inverter system shall be designed to maintain the normal operation and performance integrity of all connected loads including voltage and frequency sensitive equipment by providing true "no break", continually conditioned sinusoidal output. Refer to plans for type and location of loads served by the system.

4.5 REPLACEMENT PARTS

Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country. Customer Support Parts Coordinators shall be on call 24-hours a day, 7-days a week and 365-days a year for immediate parts dispatch. Parts shall be delivered to the site within 24-hours.

4.6 MAINTENANCE TRAINING

In addition to the basic operator training conducted as a part of the system start-up, optional classroom courses for customer’s employees shall be made available by the manufacturer. The course shall cover Emergency Central Lighting Inverter safety, theory of operation, location of subassemblies, battery considerations and System operational procedures. It shall include AC/DC and DC/AC conversion techniques as well as control and metering, troubleshooting and fault isolation using alarm information and internal self-diagnostics with an emphasis on interpretation.

4.7 MAINTENANCE CONTRACTS

A comprehensive offering of preventive and full-service maintenance contracts shall be available. An extended warranty and preventive maintenance package shall be available. All services shall be performed by factory trained Service Engineers.

4.8 LOAD BANK TESTING AT SITE

The manufacturer's field service personnel shall provide optional load bank testing at site if requested. The testing shall consist of a complete test of the Emergency Central Lighting Inverter system and the associated options supplied by the manufacturer. The test results shall be documented, signed, and dated for future reference.

5. INSTALLATION

The Emergency Central Lighting Inverter shall be installed in accordance with all appropriate manufacturer's installation instructions and in compliance with all appropriate local codes.

5.1 WIRING INSTALLATION

The Emergency Central Lighting Inverter and battery cabinet(s) conduit entry arrangement shall allow for flexibility of user wiring installation. The wiring shall be routed through the top or Bottom (for raised floor) of the cabinet.

5.2 WIRING TERMINATION

The Emergency Central Lighting Inverter input, output and DC connections shall be hard wired within the cabinet. Hard wired DC connection in battery cabinet(s) shall be provided, Input, Output and DC terminal blocks shall be compression type.

Drawings and manuals supplied with each unit shall include:

- **Complete set(s) of shop drawings showing physical dimensions, mounting information and wiring diagrams.**
- **Installation and operation Manual(s) with complete instructions for locating, mounting, interconnecting, and wiring of the system including batteries and its required maintenance.**