

**Fortress 1 Harsh
Harsh Environment
Emergency Central Lighting Inverter (CLI)
Technical Specifications**

PART 1 GENERAL

1.1 SUMMARY

- A. This specification describes a single phase, on-line, double conversion, solid state Lighting Inverter System utilizing Patented ECM Technology here after referred to as the CLI.

The CLI shall operate in conjunction with the existing electrical system to provide high quality power conditioning, back-up power protection and distribution for Lighting loads and other critical loads.

The system shall consist of a solid-state inverter, a temperature compensated rectifier/battery charger, a 100% rated for continuous duty static switch, an internal maintenance bypass switch, battery plant, status/control panel, and synchronizing circuitry.

The enclosure is a Nema 4 (outdoor) or a Nema 12 (indoor) rain / weather proof enclosure designed for harsh environmental conditions as described herein.

1.2 STANDARDS

- A. The CLI shall meet the requirements of the following standards:
1. IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand Ability
 2. FCC rules and regulations of Part 15, Subpart J, Class A
 3. Listed under UL 924, Standards for Lighting Inverter Equipment
 4. NEMA PE 1 (National Electrical Manufacturers Association) - Lighting Inverter Systems
 5. NEMA 250 (National Electrical Manufacturers Association) – Enclosures for Electrical Equipment (1000 Volts Maximum)
 6. NFPA 70 – National Electrical Code
 7. ISO 9001

8. Occupational Safety & Health Administration (OSHA)

1.3 SUBMITTALS

- A. Submittals for engineering approval shall contain the following documentation:
1. Installation Drawings: Indicate electrical characteristics and connection requirements. Provide cabinet dimensions; battery type, size, dimensions, and weight and location of conduit entry and exit; single-line diagram, control, and external wiring requirements; heat rejection and air flow requirements.
 2. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
- B. Upon delivery of the CLI system the following submittals shall be included:
1. An operators and users manual showing safe and correct operation of all CLI functions.

1.4 QUALIFICATIONS & QUALITY ASSURANCE

- A. Manufacturers Certification: The manufacturer shall specialize in manufacturing of on-line, double conversion, single phase CLI modules specified in this document with a minimum of twenty years documented experience, and with a nation wide service organization. The manufacturer will use only patented ECM technology. The manufacturer shall comply with ISO 9001 and shall be designed to internationally accepted standards.
- B. Factory Testing: Prior to shipment the manufacturer shall complete a documented test procedure to test all functions of the CLI module and batteries (via a discharge test) and guarantee compliance with the specification. The manufacturer shall provide a copy of the test report upon request.
- C. Materials and Assemblies: All materials and parts comprising the CLI shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. All active electronic devices shall be solid state and not exceed the manufacturers recommended tolerances for temperature or current to ensure maximum reliability. All semiconductor devices shall be sealed. All relays shall be provided with dust covers. The manufacturer shall conduct inspections on incoming parts, modular assemblies and final products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by all modes of ground transportation and air transportation where specified.

- B. Prior to shipping all products shall be inspected at the factory for damage.
- C. Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.
- D. Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a period of eight hours to recharge the batteries.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. The CLI shall operate under the following environmental conditions:
 - 1. Temperature:
 - a. CLI Module
 - (1). Operating: -20° to 50°C (4°F to 122°F)
 - (2). Non-Operating: -30°C to +60°C (-22°F to 140°F)
 - b. Batteries: 25°C (77°F)
 - 2. Relative humidity (operating and storage): 5 to 100% non-condensing
 - 3. Barometric Pressure:
 - a. Up to 1000 meters above sea level
 - b. Up to 2000 meters with ambient temperature less than 28°C
 - c. Up to 12,000 meters above sea level non operating
 - 4. Audible Noise: 45 DBA at 3 feet
 - 5. Enclosure is a Nema 4 – outdoor completely sealed or Nema 12X – indoor completely sealed, either enclosure includes heat exchanger for complete environmental control of electronics and batteries.

1.7 WARRANTY

- A. CLI Module: The CLI shall be covered by a full parts and labor warranty from the manufacturer for a period of twelve (12) months from date of installation or acceptance by customer or eighteen (18) months from date of shipment from the manufacturer, whichever occurs first.

- B. Battery: The battery manufacturer's warranty shall be passed through to the final customer and shall have a minimum period of one year, 4 years prorated.

1.8 SERVICE AND SPARES PARTS

- A. The manufacturer shall upon request provide spare parts kits for the CLI module in a timely manner as well as provide access to qualified factory trained service personnel to provide preventative maintenance and service on the CLI module when required.

1.9 MAINTENANCE, ACCESSIBILITY AND SELF DIAGNOSTICS

- A. All CLI subassemblies, as well as the battery, shall be accessible from the front only. CLI design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the CLI shall be equipped with a self-test function to verify correct system operation. The electronic CLI control and monitoring assembly shall therefore be fully microprocessor based.
 - 1. Auto-compensation of component drift;
 - 2. Self-adjustment of replaced subassemblies;
 - 3. Extensive acquisition of information vital for computer-aided diagnostics (local or remote);
- B. The CLI shall be repairable by replacing standard subassemblies. Communication via an RS232 with maintenance system shall be possible.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. DSPM Fortress Harsh 1 Emergency Lighting System
- B. Engineer permits substitutions, subject to meeting all the requirements of this specification and having written approval no less than 10 days prior to bid closing.

2.2 PRODUCT SPECIFICATION

- A. CLI Design Requirements
 - 1. Output Power Continuous Rating: The continuous output power rating of the CLI shall be shall be _____ KW (refer to product data sheet for power levels).
 - 2. Input Voltage: _____ VAC – 15% / +10%, single phase, 2-wire plus ground.

3. Output voltage(s): _____ VAC single phase, 2 wire plus ground.
4. Battery Autonomy: The CLI shall be capable of operating at full load for 90 minutes at unity PF output.
5. Battery Type: Valve regulated, sealed, Lead Calcium (AGM).

B. AC Input Characteristics

1. Input Frequency: 60 Hz
2. Power walk-in: 0 to 100% over a 10-second period.
3. Magnetizing Inrush Current: Less than nominal input current for less than one cycle.
4. Input Surge Protection: The CLI is equipped with standard input filter assembly will withstand surges per IEEE 587-1980/ANSI C62.41

C. AC Output Characteristics

1. Voltage Regulation: $\pm 3\%$ for no-load to full load and full 90 minute battery run mode.
2. Frequency: 60 Hz ($\pm 0.1\text{Hz}$ when free running).
3. Voltage Distortion: Maximum 5% total (THD) @ 100% linear loads.
4. Voltage Transient (Step Load) Response:
 - a. $+ 5\%$ for 50% step load change
 - b. $\pm 8\%$ for 100% step load change
 - c. $\pm 3\%$ for loss or return of AC input power or manual transfer at full load.
5. Voltage Recovery Time: Return to within 3% of nominal value within 50 milliseconds.
6. Non-Linear Load Capability: Output voltage total harmonic distortion shall be less than 8% when connected to a 100% non-linear load with a crest factor not to exceed 2.5%.
7. Slew Rate: 1 Hz/second maximum
8. Power Factor: Unity power factor.

9. Inverter Overload Capability:
 - a. 125% of rated load for 1 minute
 - b. 145% of rated load for 10 seconds
10. Bypass Overload Capability: > 200% for one cycle; > 150% for 30 seconds
11. (LCD Monitor only) Every 30 days a self testing / self-diagnostics will be activated. The system will log (store in memory) any alarms and make available through the front panel LCD all information. The RS 232 / 485 will also make information available. The system will monitor all working parameters before, during and after testing.

D. DC Bus

1. DC Bus Voltage: 2.3 VDC/cell nominal Float level. The battery charger will compensate for temperature changes in accordance with the battery manufacturer's requirements. CLI will utilize our watch-dog interface software to control DC voltage; this control will extend life of batteries by 50%.

2.3 MODES OF OPERATION

- A. The CLI module shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.
1. Normal: The inverter shall continuously supply power to the critical load. The rectifier/battery charger shall derive power from the utility AC source, supply DC power to the inverter and simultaneously float charging the battery.
 2. Emergency: Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any switching, shall obtain its power from the battery.
 3. Recharge: Upon restoration of the utility AC power source (prior to complete battery discharge), the rectifier/battery charger shall power the inverter and simultaneously recharge the battery.
 4. Bypass Mode: The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.
 5. Manual Bypass Switch: A manual make before break internal bypass switch shall be provided to isolate the CLI inverter output and static bypass and connect the load directly to the utility until service personnel can arrive to repair unit.

2.4 COMPONENT DESCRIPTION

- A. Rectifier / Battery Charger: Incoming AC power shall be converted to a regulated DC output voltage. The rectifier / battery charger shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
1. Input Current Limiting: The CLI shall be equipped with a system designed to limit the battery recharge current to conform to UL924 standard.
 2. Modular Assembly: The rectifier/battery charger assembly shall be constructed of modular design to facilitate rapid maintenance.
 3. Charging Levels: The battery charging circuitry shall be capable of being set for automatic battery recharge operation, float service and equalizing operation.
 4. Temperature Compensated Charging: The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25°C.
 5. Capacity: The rectifier/battery charger shall have sufficient capacity to support a fully loaded inverter and fully recharge the battery to full capacity in accordance with UL 924 specifications.
- B. Inverter: The CLI output shall be derived from a Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing precise output power while operating over the battery voltage range. The inverter assembly shall be constructed as a modular assembly to facilitate rapid maintenance.
- C. Static Bypass: The static bypass transfer switch shall be solid-state, rated for continuous 100% duty and shall operate under the following conditions:
1. Uninterrupted Transfer: The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
 2. Inverter overload exceeds unit's rating
 3. Inverter failure
 4. Automatic Uninterrupted Forward Transfer: The static bypass transfer switch shall automatically forward transfer power from the bypass to the rectifier / inverter, without interruption, after the CLI inverter is turned "ON", after an instantaneous overload-induced reverse transfer has occurred and the load current returns the CLI's nominal rating or less.

- D. Microprocessor Controlled Logic: The full CLI operation shall be provided through the use of microprocessor controlled logic. All operation and parameters are firmware controlled. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level.
- E. Standard Communication Panel: The CLI will include a standard easy to use communication panel. Included will be a LCD (LED for 10 KW and below) display. The CLI communication panel will include pushbuttons that will permit the user to safely command the CLI.

2.5 SYSTEM CONTROLS AND INDICATORS

- A. Front Panel LCD Display: The CLI control panel shall provide a LCD (LED for 10 KW and below) display. The indication of CLI status, metering, battery status, alarm event log and advanced operational features will be available. The display provides access to:
 - 1. Measurements, status indications and events
 - 2. Menu protected by a password, used to make specific settings
 - 3. Event log with time stamping
 - 4. Access to all measurements
- B. System Parameters Monitored (data displayed): The visual display will display the following system parameters based on true RMS metering:
 - 1. Measurements
 - a. Input voltage indicator
 - b. CLI output voltage indicator
 - c. CLI output current indicators
 - d. DC voltage indicators
 - 2. Status indications and events
 - e. Load on battery
 - f. Load on CLI
 - g. Load on automatic bypass

- h. Low-battery warning
 - i. General alarm
 - j. Additional indications shall provide maintenance assistance
2. Time-stamped historical events: This function shall time-stamp and store all important status changes, anomalies and faults and make this information available for automatic or user-requested consultation; it shall interpret the events and indicate remedial measures if applicable.
 3. DB-9 RS232 Connector: One DB-9 connector with serial output will be provided for field diagnostic actions.
 4. Dry Contacts (Optional): The CLI shall be capable of providing optional relay contacts. The contacts will be a form "C" contact and will change state to indicate the operating status. The contacts will be rated at 2.0 A (125 VAC / 30 VDC). Contacts shall be programmed as:
 - a. CLI on Line
 - b. Load on Bypass
 - c. CLI on Battery

2.6 MECHANICAL DESIGN AND VENTILATION

- A. Enclosure: The CLI shall be housed in a freestanding locking enclosure. The mechanical structure of the CLI shall be sufficiently strong and rigid to withstand handling and installation operations without risk. Access to CLI subassemblies shall be through the front only. The sheet-metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, powder coating, epoxy paint or an equivalent.
- B. Cable Access: The standard CLI available shall accommodate side, top and bottom entry cables.
- C. Ventilation and Heat Rejection: The CLI shall be designed for forced air-cooling. Air inlets shall be provided from the front bottom of the CLI enclosure. Air exhaust shall be from the top or side portions of the unit.

2.7 BATTERY

- A. The CLI module shall use a valve regulated sealed Lead Calcium heavy-duty industrial battery, designed for auxiliary power service in a CLI application. The primary battery shall be furnished with battery with impact resistant plastic case and housed in matching battery cabinet (s).

1. Protection against Deep Discharge and Self-Discharge: The CLI shall be equipped with a device designed to protect the battery against deep discharge depending on discharge conditions, with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge.
 2. Battery Self-Tests: The battery monitoring system shall be to perform the following automatic functions:
 - a. Battery circuit check
 - b. Partial discharge test customer selectable (12 KW and above).
- 2.8 External Maintenance Bypass (Optional): The maintenance bypass provides a wrap around bypass configuration for total CLI isolation during maintenance. Maintenance bypass transfers shall be without interruption and shall have mechanical interlocks to protect the CLI from damage in the event of an out of sequence transfers.

PART 3 EXECUTION

3.1 SITE TESTING START-UP

- A. The CLI system will be checked, start-up and tested by a manufacturer's qualified field service engineer.

3.2 MAINTENANCE TRAINING

- A. The manufacturer shall make available to the customer various levels of training ranging from basic CLI operation to CLI maintenance.

END OF SECTION