LITHIUM BATTERY SYSTEM
GUIDE SPECIFICATION
For
Eaton UPS

PART 1 - GENERAL

1.01 SUMMARY

A. This specification describes a lithium-ion, cabinetized battery backup system including the batteries, switchgear, and management system, hereinafter referred to as the 128S battery cabinet(s). The 128S battery system shall operate in conjunction with a UPS system to provide battery backup times for critical electrical loads. The battery cabinet shall house a single complete battery string, and multiple cabinets may be paralleled for longer backup times, as described in this specification.

1.02 LITHIUM-ION BATTERY SYSTEM DESCRIPTION

A. Battery System Components: The S128T system shall consist of the following main components:

1. Battery cabinet containing multiple battery modules comprised of lithium-ion battery cells.
2. Battery management system (BMS), The 'rack BMS' is modular, internal to each cabinet, with internal communication capabilities. In each battery system, either a single or multiple-cabinet system, one of the cabinets will house a 'system BMS' for system level and external communications to the UPS and building management system
3. Switchgear module, for main DC power terminations, protection circuit breaker (MCCB) and fusing, internal to the cabinet.

B. Battery System Modes of Operation: The Battery Module shall operate as a constantly connected, fully automatic system in the following modes:

1. Normal: the battery system shall be connected to the DC circuit in the UPS.. The BMS shall monitor voltage, current and temperature at all times.
2. Discharge: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the UPS Inverter, which shall obtain power from the batteries without any operator intervention. The battery system shall monitor DC discharge current and terminate the discharge [disconnect] if current or temperature limits are exceeded. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source. The 128S battery system shall be applied with UPSes that use 480VDC battery systems.
3. Recharge: Upon restoration of the AC source, the UPS Charger shall recharge the batteries and simultaneously the UPS Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load. Battery recharge current shall be limited by the UPS, and monitored by the battery system to disconnect the string if protection limits are exceeded.

1.03 REFERENCES

A. UL 1642 (Underwriters Laboratories) – Standard for safety for lithium batteries

B. UL 1973 --Standard for batteries for use in stationary applications

C. UL 991 – UL Standard for Safety Tests for Safety-Related Controls Employing Solid-State Devices.

D. UL 1998 – Standard for safety software in programmable components

E. EN 61000-6-2:2005 -- Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments

F. EN 61000-6-4:2007 -- Generic standards—Emissions standard for industrial environments

1.04 SUBMITTALS

A. The battery system shall be supplied with sufficient documentation, including the following manuals:

1. Installation Manual, UPS Interface Manual, and Operation and Maintenance Manual: One copy of each these manuals shall be furnished. Together, they shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the battery equipment and accessories, including the top wiring kit. The manuals shall include the following major items:

a) Battery system description

b) Site planning and unpacking

c) Battery cabinet(s) installation

d) Operating procedures

e) System events

f) Battery maintenance

g) Performance and technical specifications

h) Wiring requirements from battery cabinet to and from UPS

i) Physical features and requirements

j) Cabinet dimensions

1.05 QUALIFICATIONS

A. The battery manufacturer shall have a minimum of 6 years of experience in the design, manufacture and testing of lithium-ion battery systems for UPS applications.

B. The battery manufacturer shall have ISO TS 16949, ISO 26262 and ISO 14001 certifications for engineering/R&D, quality and functional safety.

C. The UPS manufacturer shall maintain a call center for technical and emergency support for this battery system.

D. Field Engineering Support: The UPS manufacturer supporting this battery system shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS and related equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices shall be submitted with the proposal.

E. Spare Parts Support: Parts supplies shall be available to provide emergency needs in a timely fashion, based on field population.

F. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal.

1.06 ENVIRONMENTAL REQUIREMENTS

A. The battery system shall withstand any combination of the following external environmental conditions without operational degradation.

1. Operating Temperature: 23 +/- 5 degrees C (64 to 82 degrees F) recommended.

2. Storage Temperature: 23 +/- 5 degrees C (64 to 82 degrees F) recommended. Storage temperature of less than 10 degrees C (50 degrees F), is optimal. Prolonged storage above + 40 degrees C (104 degrees F) will cause rapid self-discharge and permanent damage to the battery, and will impact warranty coverage.

3. Relative Humidity (operating and storage): 5-85% non-condensing.

4. Elevation:

a) Operational: 5000 ft. (1500 m) maximum without de-rating.

b) Transportation: Capable of air transport, up to 15,000m.

1.07 SAFETY

A. The battery system shall be Listed by Underwriters Laboratories in accordance with UL 1973.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers: Samsung.

2.02 BATTERY CABINET STANDARD FEATURES

The battery cabinet shall consist of the following standard components, housed in a metal frame cabinet. Each cabinet contains 16 battery modules, 1 switchgear assembly, and one SMPS assembly. A top wiring kit is provided at the top of the cabinet to facilitate power and control cable landing.

A. Battery Module

- Nominal capacity: 67 Ah
- Nominal voltage: 30.40 V
- Weight: 17 kg (37.48lbs)
- Dimension (L x W x H): 414.00 mm x 216.00 mm x 163.00 mm (16.30 in x 8.50in x 6.42in)

B. Switchgear Assembly

The Switchgear assembly consists of protection devices and a rack battery management system, BMS. The key component of protection devices are as follows

- Fuse: 500A
- MCCB UL/CE: 600A

- Switchgear Weight: 18kg (39.68lbs)
- Switchgear Dimension (L x W x H): 583.00 mm x 235.00 mm x 411.00 mm (22.95 in x 9.25 in x 16.18in)

C. SMPS Assembly

Type A (with System BMS), Type B (without System BMS) :

The system BMS assembly provides data to the external systems (i.e. building management system, UPS, etc.) while controlling and monitoring all connected Rack BMS's.

- Weight: Type A or B: 5kg (11.02lbs)
- Dimension (L x W x H): 397.00 mm x 338.00mm x 86.00 mm (15.63in x 13.31in x 3.39in)

SMPS Assembly provides RS485 (via RJ-45). Optional user monitoring software will utilize this connection.

D. The rack frame (cabinet),is used to mount modules, switchgear and SMPS assembly.

- Weight: 190 kg (418.87 lbs)
- Dimension (L x W x H): 650.00 mm x 600.00 mm x 2055.00 mm (25.59 in x 23.62 in x 80.91in)
- System weight (cabinet and contents): 525kg (1,153 lbs)

E. Monitoring and control components: The following components shall provide monitor and control capability:

1. Status panel: located on the front of the switchgear assembly, using color LED status indicators:
   a) Alarms, major and minor
   b) Status of MCCB circuit breaker
   c) Battery charging or discharging condition
2. Communication ports: RS-485 (RJ-45 connector), located on front of SMPS module, and shall accommodate Modbus protocol.

F. Battery management system, (BMS): Each cabinet shall contain a rack battery management system which has the following features:

1. The rack BMS shall monitor voltage current and temperature for all battery modules in that rack.

G. System BMS: In a multi-cabinet system, one cabinet shall contain its rack BMS and additionally, the System BMS. The system BMS assembly provides data to the external systems (i.e. building management system, UPS, etc.) while controlling and monitoring all connected Rack BMS's via CAN bus.

H. Wiring Terminals: The battery cabinet top wiring kit shall provide a conduit landing plate and all power and control wiring terminals for the installer. The top wiring kit will be connected to the appropriate points inside the cabinet as described in the UPS Interface Manual provided.

1. Switchgear module, internal to the cabinet: will contain DC power connections, positive and negative, via busbars provided from the top wiring kit.
2. SMPS module: will contain terminals for 480VAC wiring derived from the UPS input and output busses, RS-485 connections, and aux. contacts and shunt trip

connections for the cabinet circuit breaker. Note that this shunt trip circuit is not intended for EPO use .

2.03 LITHIUM-ION BATTERY SYSTEM RATINGS AND OPERATING CHARACTERISTICS

A. Acceptable battery cabinet input sources and capabilities:

1. Nominal DC voltage: 486VDC, 3.8V/cell
2. Float voltage: 538VDC
3. Nominal input current: 0– 22A when charging depending upon state of charge of the battery

B. Battery cabinet output

1. Nominal voltage: 486VDC
2. Discharging method: constant power.
3. End of discharge voltage: 408VDC

2.04 MECHANICAL DESIGN

A. Enclosures: The battery rack frame shall be steel construction, and house battery modules, SMPS, switchgear module, and all associated interconnect wiring. The enclosures shall be designed for computer room applications. Front doors shall have locks to prevent unauthorized entry.

B. Ventilation: The battery cabinet shall be designed for convection cooling. Air inlets shall be on all sides of the unit.

C. No rear or side clearance or access shall be required for the system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.

D. Cable entry: Standard cable entry for the battery cabinet shall be through the enclosure top.

E. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the cabinet (front access only required). Side or rear access for installation, service, repair or maintenance of the system shall not be required.

F. Service area requirements: The system shall require no more than thirty six (36) inches of front service access room and shall not require side or rear access for service or installation.

2.05 CONTROLS AND INDICATORS

A. Battery status display: the switchgear module in the battery cabinet shall feature a 4-LED status display. This display shall describe the following alarms and status conditions using color coded and flashing LEDs.

1. Status
    a) System normal; breaker closed
    b) System normal; breaker open
    c) Monitoring system power off
    d) System discharging

e) System charging

2. Alarms

a) Major protection; system automatically disconnected due to over/under voltage, overcurrent or over temperature

b) Minor protection; voltage imbalance, voltage sensing error, under-temperature, temperature imbalance, fuse blown, communication failure.

2.06 COMMUNICATIONS

A. Communications panel: The battery cabinet shall be equipped a communication panel housed on the front of the SMPS module.

B. Remote Monitoring:

1. RS-485 Modbus protocol communication capabilities will be available for all systems.

2. The battery system communication capability should be able to integrate into industry standard Building Management System (BMS) and/or Network Management Systems (NMS).

2.07 BATTERY MODULE, RACK/STRING/CABINET, AND SYSTEM LEVEL PROTECTION

A. Module management is provided by the BMS that is included in each battery module. Voltage, current and temperature are monitored, and cell balancing is performed.

B. Rack management is provided by the rack BMS. It monitors all battery module BMSs. If a major alarm is detected, the BMS will trip the cabinet circuit breaker. This breaker must be manually reset in order to restore the battery cabinet to service.

C. System management is provided by the system BMS. It monitors all rack/cabinet BMS activity, and communicates status or alarms to the UPS, and can receive a disconnect command from the UPS, if available.

D. To comply with agency safety requirements, the battery cabinet(s) shall not rely upon any disconnect devices outside of the cabinet or system, to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

3.02 COMMISSIONING

A. Factory start-up shall be provided on a 5x8 basis (7 x 24 optional). Start-up service shall be provided and shall include one visit to perform all procedures and tests specified within battery system Installation and Operation manual. UPS manufacturer shall also offer the following optional services:

1. Pre-energize visit to inspect installation and provide guidance to installers as required.

2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.

B. The following procedures and tests shall be performed by Field Service personnel during the battery system startup:

1. Visual Inspection:
   a) Visually inspect all equipment for signs of damage or foreign materials.
   b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
2. Mechanical Inspection:
   a) Check all the power connections for tightness.
   b) Check all the control wiring terminations and plugs for tightness or proper seating.
3. Electrical Pre-check:
   a) Check the DC bus for a possible short circuit.
   b) Verify all power and control wiring
4. Initial battery system startup:
   a) Configure battery cabinets and system using Service software.
   b) Verify that all the alarms are in a “go” condition.
   c) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
   d) Check the battery string voltage
   e) Optional on site battery discharge tests using supplier furnished load bank, shall also be offered.
5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the battery system. The UPS equipment shall be available for demonstration of the modes of operation.

3.03 WARRANTY

All components of the battery system shall be covered by a standard three-year limited factory warranty, and ten-year performance warranty.

Limited warranty labor coverage is for 90 days after product startup.

Vendor shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for the battery system, with guaranteed response time, and battery preventive maintenance visit(s). Vendor shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

END