Specification for Battery Back-up System For Traffic Signals

GENERAL

The battery back-up system (BBS) shall include, but not be limited to the following: inverter/charger, power transfer relay, batteries, a separate manually operated non-electronic bypass switch and all necessary hardware and interconnect wiring. The BBS shall provide reliable emergency power to a traffic signal in the event of a power failure or interruption.

The BBS shall be capable of providing power for full run-time operation for an intersection (all colors red, yellow, and green) or flashing mode operation for an intersection not exceeding the full load capacity of the BBS.

The BBS shall be designed for outdoor applications, in accordance with the Caltrans Transportation Electrical Equipment Specifications (TEES), dated November 19, 1999, Chapter 1, Section 8 requirements.

1.0 OPERATION

1.1

The BBS shall provide a minimum 1-hour of full run-time operation for an intersection, with 80% minimum inverter efficiency). Optional backup times will be 2 hour and 3 hour, contact factory for pricing and physical sizing.

1.2
The maximum transfer time from loss of utility power to switchover to battery backed inverter power shall be 150 milliseconds.

1.3
The BBS shall provide the user with 3-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) relay contact closures, available on a panel-mounted terminal block, rated at a minimum 120V/1A, and labeled so as to identify each contact.

1.3.1
The first set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked “On Batt”.

1.3.2
The second set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked “Low Batt.”

1.3.3
The third set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked “Timer.”

1.4

Operating temperature for both the inverter/power transfer relay and manual bypass switch shall be -37 °C to +74 °C.

1.5
The BBS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 4.0 mV/°C per cell.

1.6.1
The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 2 meters (6'6") of wire.

1.7
Batteries shall not be recharged when battery temperature exceeds 50°C ± 3°C 1.8

1.8
BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage Range: 100 Vac to 130 Vac (± 2 Vac).

1.9
When utilizing battery power, the BBS output voltage shall be between 110 Vac and 125 Vac sine wave, with ≤ 3 % harmonic distortion, 60Hz ± 3 Hz.

1.10

The BBS shall be compatible with Caltrans Model 332 Cabinets, Model 170 Controllers Model 2070.

1.11

When the utility line power has been restored at above 105 Vac ± 2 Vac for more than 30 seconds the BBS shall return to normal operation and begin recharging the batteries automatically.

1.12
When the utility line power has been restored at below 125VAC ± 2 VAC for more than 30 seconds, the BBS shall dropout of battery backup mode and return to utility line mode.

1.13
BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

1.14
In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC state, where utility line power is reconnected to the cabinet.

1.15
Recharge time for the battery, from "protective low-cutoff" to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.

2.0 MOUNTING/ CONFIGURATION

2.1 GENERAL

2.1.1
Inverter/Charger Unit shall be rack or shelf-mounted.

2.1.2
Power Transfer Relay and Manual Bypass Switch shall be mounted on the 332 Cabinet standard

2.1.3
All interconnect wiring provided between Power Transfer Relay, Bypass Switch and Cabinet Terminal Service Block shall be no less than 2 meters (6'6") of #10 AWG wire.

2.1.4
Relay contact wiring provided for each set of NO/NC relay contact closure terminals shall be 2 meters (6'6") of #18 AWG wire.

2.1.5
See Figure 4, which provides clarification as to how BBS Power Transfer Relay and Manual Bypass Switch are interconnected with Model 332A Cabinets in order to ensure that the unit can be hot swappable, there will be no reason the shut down the intersection while swapping out the unit for a field replacement .

2.1.6
All necessary hardware for mounting (shelf angles, rack, etc) shall be included with the BBS. A minimum of 6 bolts/fasteners shall be used to secure swing-trays to the 332 Cabinet standard EIA 482.6mm (19") rack. All bolts/fasteners and washers shall meet the following requirements: Screw type: Pan Head Phillips machine screw

2.2 INTERNAL BATTERY OPTION

2.2.1
Complete BBS, including batteries, shall fit inside a typical, fully equipped Caltrans Model 332 Cabinet that includes one Model 170 or 2070 controller.

2.2.2
Mounting method shall be shelf-mount, rack-mount, swing-tray mount or combination of either. Front-mounted available rack space is 3U or approximately 152.4mm (6"). For additional space, see Figure 2 – BBS Mounting Diagram

2.2.3
Batteries mounted below the controller shelf shall be swing-tray mounted. Batteries may be shelf mounted in area behind controller so long as shelf and batteries do not interfere with controller unit and C1 plug.

2.3 EXTERNAL BATTERY CABINET OPTION

2.3.1
Inverter/Charger, Power Transfer Relay and manually operated Bypass Switch shall fit inside a typical fully equipped Caltrans Model 332 Cabinet that includes one Model 170 or 2070 controller.

2.3.2
Batteries shall be housed in a NEMA 3R rated cabinet mounted to the side of the Model 332Cabinet (see Figure 5 for details). This external battery cabinet shall conform to TEES Chapter 7, Section 2-Housings for the construction and finish of the cabinet.

2.3.3
Batteries shall be mounted on individual shelves.

2.3.4
Four shelves shall be provided. There shall be a minimum of 304.8mm (12") clearance between shelves. Each shelf shall be a minimum of 228.6mm (9") X 635.0mm (25"), and capable of supporting a minimum of 57kg (125 lbs.)

2.3.2
The external battery cabinet shall mount to the Model 332 Cabinet with a minimum of eight bolts. (See Figure 5)

2.3.3
The dimensions of the external battery cabinet shall be as shown in Figure 5.

2.3.4
The external battery cabinet shall be ventilated through the use of louvered vents (2), filters, and one thermostatically controlled fan as per TEES Chapter 7 Section 2-Housings.

2.3.5
External battery cabinet fan shall be AC operated from the same line output of the Manual Bypass Switch that supplies power to the 332 Cabinet.

2.3.6
The external battery cabinet shall have a door opening to the entire cabinet. The door shall be attached to the cabinet through the use of a continuous stainless steel or aluminum piano hinge. The door shall use a padlock clasp in order to lock the door.

2.3.7
The BBS with external battery cabinet shall come with all bolts, conduits and bushings, gaskets, shelves, and hardware needed for mounting.

3.0 MAINTENANCE, DISPLAYS, CONTROLS AND DIAGNOSTICS

3.1
The BBS shall include a display and /or meter to indicate current battery charge status and conditions.

3.2
The BBS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.

3.3
The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.

3.4
The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.

3.5
The BBS shall include a reset front-panel event counter display to indicate the number of times the BBS was activated and a front-panel hour meter to display the total number of hours the unit has operated on battery power.

4.0 BATTERY SYSTEM

4.1

Individual batteries shall be 12V type, 65 amp-hour maximum, and shall be easily replaced and commercially available off the shelf.

4.2
Batteries used for BBS shall consist of 4 to 8 batteries with a cumulative minimum rated capacity of 240 amp-hours.

4.3
Batteries shall be deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Valve Regulated Lead Acid).

4.4

Batteries shall be certified by the manufacturer to operate over a temperature range of – 25 °C to +74 °C.

4.5

The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.

4.6
Batteries shall indicate maximum recharge data and recharging cycles.
4.7
Battery interconnect wiring shall be via modular harness. Batteries shall be shipped with positive and negative terminals pre-wired with red and black cabling that terminates into a typical power-pole style connector. Harness shall be equipped with mating power-pole style connectors for batteries and a single, insulated plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed and wired to ensure proper polarity and circuit configuration.

4.8
Battery terminals shall be covered and insulated so as to prevent accidental shorting.

5.0 QUALITY ASSURANCE

5.1
Each BBS shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) Design quality assurance and (2) Production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of BBS units built to meet this specification and a documented process of how problems are to be resolved.

5.2

QA process and test results documentation shall be kept on file for a minimum period of seven years.

5.3

Battery Backup System designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

5.4 DESIGN QUALIFICATION TESTING

5.4.1
The manufacturer, or an independent testing lab hired by the manufacturer, shall perform design Qualification Testing on new BBS designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the system, or results in a different circuit configuration.

5.4.2
A quantity of two units for each design shall be submitted for Design Qualification Testing.

5.4.2.1

Test units shall be submitted to Caltrans TransLab, Electrical Testing Branch after the manufacturer's testing is complete.

5.4.2.2
Manufacturer's testing data shall be submitted with test units for Caltrans verification of Design Qualification Testing data.

5.4.3 Burn in
The sample systems shall be energized for a minimum of 5 hours, with full load of 700 watts, at temperatures of +74 °C and -37 °C, excluding batteries, before performing any design qualification testing.

5.5 PRODUCTION QUALITY CONTROL TESTING

5.5.1
Production Quality Control tests shall consist of all of the above listed tests and shall be performed on each new system prior to shipment. Failure to meet requirements of any of these tests shall be cause for rejection. The manufacturer shall retain test results for seven years.

5.5.2
Each BBS shall be given a minimum 100-hour burn-in period to catch any premature failures.

5.5.3
Each system shall be visually inspected for any exterior physical damage or assembly anomalies.

6.0 WARRANTY

Manufacturers shall provide a one (1) year factory-repair warranty for parts and labor on the BBS from date of shipment.