
INVITATION TO TENDER

BACS / English

BATTERY MANAGEMENT SYSTEM (BMS) SPECIFICATIONS

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PRE-PURCHASE SPECIFICATIONS
FOR
BATTERY MANAGEMENT SYSTEM (BMS)

PART 1 – GENERAL

1.01 EXECUTIVE SUMMARY

The abbreviation « BMS system » is either understood as (B)attery (M)onitoring (S)ystem or as Battery (M)anagement System.

A monitoring system is often seen as a luxury since it does not add any extra value for the end-user than the remote viewing of battery parameters. A monitoring system does not allow to run a battery system unmaintained since every single battery issue requires to take action on site. A management system makes a huge difference since it's not only including all features of a typical monitoring system but includes an auto-adaptive regulation of voltages, typically thru « balancing » (also known as « equalization ») which has a positive effect on the reliability and lifetime of the whole battery system and a reduction in the costs of ownership.

This Balancing adaptive regulation is well-known from Lithium Batterypacks, where such a regulation is an important safety feature and secures highest capacity and stability of such battery chemistries. At Lead-Acid, NiCd, NiMH or other lower capacity battery chemistries the effect of balancing is showing a massive impact on the battery SOC and therefore on the SOH which results in a much longer battery operation time and capacity, the more cells/blocks are regulated in a string.

Within Balancing, we distinguish between “passive” and “active” balancing. At a “passive” balancing system, the overcharged cells will be discharged and the excessive energy will be converted to “heat”, which is irrelevant for the system since such batteries are typically under float charge and balancing is switched off when the charger is not active. This is the most cost effective and efficient balancing system and ideal for all kinds of battery chemistries with smaller capacities and stationary applications.

For low capacity battery chemistries (Lead-Acid, NiCd, NiMH) passive balancing is usually sufficient, also for larger Cells (over 200Ah) since these are typically “wet-cells” and do not have a dramatic voltage deviation like AGM or other multiple cell battery blocks.

When higher cell capacities are installed, the user may want to avoid loss of energy and archive a higher efficiency and much faster balancing, (eg. For EV, traction and solar inverter applications) than “active” balancing might become interesting. “Active” Balancing avoids the conversion of the overcharged cell energy into heat, it transfers the energy to the neighboring cells and improves thus this the efficiency and the rate of balancing power. Due to the higher installation efforts (cables to every cell) such active balancing BMS systems are typical for EV automotive battery packs based on high density Lithium cells, and therefore quite costly.

In this invitation to tender we seek a higher level than Battery Monitoring, we seek for a BMS – a « Battery Management System » with such an adaptive control and regulation called “balancing”, preferable passive – and for larger lithium cells with active balancing.

Such a « Battery Management System » has the advantage that it automatically ensures the availability of a battery system at all times and guarantees the 100% SOC level of all Cells/Blocks in the system. As a secondary effect, this regulation extends the typical lifetime of the battery system up to 50% - compared to a battery monitoring system without such a balancing system.

1.02 DESCRIPTION

- A. The vendor shall provide turnkey installation for a complete and operating Battery Management System (BMS) as specified herein inclusive of installation, documentation, testing, training, and battery monitoring services. Provide all work following the contract documents as specified herein.
- B. The vendor shall provide a complete Battery Management System (BMS) for the monitoring of VRLA and Flooded Cell (All electrochemical technologies lead-acid, nickel-based, and lithium-based) batteries as defined in the detailed requirement below. In particular, the system shall consist of a means for monitoring battery voltages, ohmic value (defined as Resistance, Impedance or Conductance), individual flooded cell/VRLA jar temperature, and battery string current. It shall provide voltage balancing by maintaining each jar's target voltage within 0.01VDC. The system shall consist of all the hardware, software, cabling, and other components to permit the safe and reliable collection and display of battery data and fault conditions.
- C. The vendor shall provide one year of battery monitoring services for the batteries where the equipment has been installed and is monitoring battery conditions. -One-year free service.
- D. Supply equipment and services to: _____
(whom hereinafter is designated as the Owner),
in their facility at _____

This includes the following but is not limited to:

- 1) Supply equipment specified and shipped to location as directed by the Owner.
- 2) Supply complete Operating and Maintenance Instruction Manuals for the new Battery Management System (BMS).
- 3) Provide qualified on-site supervision during installation, commissioning, and training for the system supplied.
- 4) The Battery Management System (BMS) vendor shall be capable of supply and delivery of spare parts for the system for up to ten years after the date of installation.
- 5) Equipment shall be warranted against defects for 24 months from the time of delivery. A copy of the warranty is required in the bid proposal.

1.02 STANDARDS

- A. Battery Management System (BMS) hardware must comply with the applicable provisions and latest recommendations of the following and international equivalents:

- Underwriters' Laboratories (UL)
- European Conformity (CE)
- Canadian Standard Association (CSA)
- National Electrical Code (NEC)
- Institute of Electrical and Electronics Engineers (IEEE)
- National Electrical Manufacturers Association (NEMA)
- Federal Information Processing Standards Publication 94 (FIPS Pub 94)
- Local Codes Having Jurisdiction

- B. For electrical noise emissions and susceptibility:

International Test results

EN55022:2006 + A1:2007

North American Test results

FCC 47 CFR Part 15, Subpart B for Digital Devices

ICES-003 Issue 4 February 2004

- C. For electrical safety:

CAN/CSA C22.2 No 60950

UL60950-1

IEC60950-1 2nd ED (205-12)

1.03 EQUIPMENT OPERATION INSTRUCTION AND MAINTENANCE MANUALS

- A. Before the completion and acceptance of the work, furnish for review electronic copied of all instructions and manuals describing the proper operation and maintenance of all equipment and apparatus furnished with the Battery Management System (BMS).
- B. Instruction Manuals shall be provided with an index sheet listing the contents in alphabetical order, and shall contain the following material:
- 1) Manufacturer's equipment parts list of all functional components of the system listed on the Equipment Schedule drawings, control diagrams, and wiring diagrams of controllers. The list shall give System Number, Unit Number, Manufacturer's Model Number, and Manufacturer's Drawing Number.
 - 2) Step-by-step on-site operating instructions for the system including preparation for starting, shutdown, etc.
 - 3) Hardware description.
 - 4) Software operation.
- C. Furnish all of the foregoing to the Engineer for his review and to the Owner for information purposes as to the fulfillment of the specified requirements. All items shall be available at least two weeks before the substantial completion date, which will determine the time of the final inspection and the Owner's Instruction.
- D. All documents must be available to the expert staff of the own / executing company as well as the customer's specialist department at least 14 days before the system is completed by the vendor for both, checking for completeness and for checking compliance specifications. Furthermore, the experts have to check whether the vendor meets all official recommendations. When the documents are handed over, the time of final acceptance by the customer has also to be agreed.

1.04 QUALITY ASSURANCE

- A. Vendors shall have been Factory certified and trained in the assembly, installation, and service of this equipment.
- B. Battery Management System (BMS) components shall be warranted against defects for 24 months from delivery.

1.05 SPARE PARTS

- A. Provide a separate price and recommendation for providing a spare set of replacement parts.
- B. List all spare equipment and components, which are recommended for the Owner to stock on site.

1.06 TRAINING

- A. The Vendor shall be factory trained and certified and able to provide on-site user training on the Battery Management System (BMS). The training shall commence immediately upon successful installation of the system and shall include the following topics:
 - 1) Operation.
 - 2) Diagnosis.
 - 3) Trending.
 - 4) Alarm-status.
 - 5) Data retrieval.
 - 6) Interpretation of battery data and the
 - 7) Using data to troubleshoot batteries.
- B. The vendor shall provide classroom instruction on the maintenance and operation of the systems provided. The class shall be conducted at the Owner's facility or other suitable location designated by the Owner.

PART 2 – PRODUCTS

2.01 BATTERY MANAGEMENT SYSTEM MEASUREMENT CAPABILITIES

- A. The system shall be capable of measuring the following items through direct measurement at the flooded cell/VRLA jar level or calculation where direct measurement is not possible:
 - 1) Individual flooded cell/VRLA jar voltage while on float charge.
 - 2) Individual flooded cell/VRLA jar voltage while charging or discharging.
 - 3) Individual flooded cell/VRLA jar voltages and string voltage.
 - 4) Individual flooded cell/VRLA jar ohmic value (User-defined interval, default every 24 hours). Measurements should also be made for all types of batteries, but with different results compared to wet cells and VRLA
 - 5) Individual flooded cell/VRLA jar current and string current while charging and discharging.
 - 6) Individual flooded cell/VRLA jar temperature. (C or F)
 - 7) Individual flooded cell/VRLA jar balance charging settings and current values.
 - 8) Alarm limits should be able to be set for any measurement or calculated value.
- B. Optional Connectivity
 - 1) The management system should support UPS systems, charging systems (chargers) and similar devices and be able to monitor them with the batteries.
 - 2) Environmental control sensors for temperature and humidity, hydrogen sensors or level sensors should be supported and able to monitor in parallel to the batteries.
 - 3) Digital input / output relays should be available and should be monitored in parallel with the batteries.

2.02 BATTERY MANAGEMENT SYSTEM REQUIREMENTS

- A. Battery Management System (BMS) shall maintain individual jar voltages to within +/- 0.01VDC of target voltage as defined by the controller.
- B. Battery Management System (BMS) shall automatically adjust individual jar voltage during boost or equalize charge modes to maintain all batteries in a string remain within 0.01vdc of all other batteries in that string.
- C. Battery Management System (BMS) system shall be able to accommodate 512 batteries configured in up to 16 parallel strings, with voltage balancing, voltage metering, impedance and temperature readings per jar, and current metering per string.
- D. The Battery Management System (BMS) shall be able to accommodate the following system requirements:
 - 1) Individual voltage and ohmic value measurement points.
 - 2) String current sensors.
 - 3) Individual flooded cell or jar temperatures.
- E. The Battery Management System (BMS) software will operate automatically and continuously without operator intervention and shall display all alarm functions as described above on a visual display if connected or across a network as described above in this document.
- F. The Battery Management System (BMS) shall have the ability to make measurements on Auxiliary batteries, Electrical Switchgear backup batteries, remotely located Generator start batteries, and Substation backup batteries, with all flooded cells/jar viewable on one system.
- G. Battery data should be stored and displayed together and trigger the same alarms both locally and remotely.
- H. Each battery, string, and flooded cell/VRLA jar for the entire system shall be represented and individually identified/named by the end-user and viewable on the screen.
- I. The Battery Management System (BMS) shall be able to accommodate:
 - 1) The measurement of a wide range of backup battery applications from 1.2vDC nominal to 16vDC nominal. Measurement tolerance of less than 0.5%.
 - 2) Individual flooded cell/VRLA jar temperature measurement in the range of -35°C to 85°C (-31°F to 185°F) to aid in the prevention of conditions leading to Thermal Runaway. Measurement tolerance of less than 0.5%.
 - 3) Ohmic value measurement capability for the diagnosis of common problems involving flooded cells/VRLA jars such as failing cells/jar, corrosion, or poor connections. Measurement tolerance of less than 10%.
 - 4) Provide Optional Thermal Runaway Protection per International Fire Code 2018 1206.2.10.7
 - 5) String Current measurement range from – 2000Amps to +2000 Amps.
 - 6) Each electrical measuring instrument used to gather data on the battery will be electrically isolated from the other electrical measuring instruments and the central data gathering and computing components.

7) Alarming both locally and remotely via the following methods:

- i. Volts free relay (dry contact)
- ii. E-mail/Email traps
- iii. HTTP/HTTPS
- iv. SMS
- v. SNMP Traps
- vi. RCCMD (Remote Console Command for multiple OS shutdown management in networks)

8) Third-Party Integration:

- i. SNMP from UPS, generators, power distribution units, and other power supply devices accessible in the network
- ii. Modbus Serial/TCP
- iii. BACnet TCP
- iv. Syslog (Remote Syslog)
- v. Optional: LonWorks and Profibus

J. All Battery Management System (BMS) components shall be capable of operating in the following temperature ranges -0 C to 60C.

K. The Battery Management System (BMS) shall be comprised of commercially available, off-the-shelf equipment, manufactured by a company that regularly manufactures, installs, and provides complete technical support for its Battery Management System (BMS). The system proposed shall have been of a type that is proven and been in operational service for at least 12 months before the date of the offer.

2.03 ELECTRICAL REQUIREMENTS

A. Wiring practices, materials, and coding shall be following the requirements of the International Electrotechnical Commission, National Electrical Code, OSHA, and applicable local codes and standards.

B. Each component that connects to the system and requires power rated above 12V shall be UL approved. (UL or CE standard for the applicable regions)

C. The Battery Management System (BMS) shall be designed and manufactured in such a way as to survive over and under-voltage transients of any duration, and over current conditions caused by the primary 110v/240v AC power source.

D. The low voltage components of the Battery Management System (BMS) connected to the battery shall not draw power from the battery being measured except during ohmic value testing.

E. No custom manufactured wiring harness shall be necessary. All wiring should be fitted at the time of installation. All connections and cables should be serviceable by a competent, trained battery service technician.

F. The interconnection means it should be easy to install, maintain, and refit to allow for service technicians to repair/replace the battery.

G. Data connections should use commercially available cables and be easy to obtain, reroute, repair, and /or replace.

2.04 SAFETY

- A. The Battery Management System (BMS) will be interconnected in such a way as to ensure that no piece of equipment connected to a flooded cell/VRLA jar is connected to a continuous voltage at any time, in any operational mode.
- B. To avoid the risk of short circuit and/or fire, cables connected to the battery shall be limited to a maximum length of 1 meter (3.2 feet) and shall be constructed of cable approved to UL1015 of a gauge no less than 22AWG. For safe identification, all cables leading to or from the battery shall be identified either with cable markers or by using color-coded cables.
- C. To reduce the likelihood of confusion with live cables, all cables leading to or from the battery must be clearly marked, either with cable markings or with color-coded cables.
- D. To avoid the risk of damage due to improper installation or defective batteries, all measuring circuits connected to the battery must be protected by high-resistance circuits or corresponding fuse concepts.
- E. For the operational safety of the battery management system (BMS), only measuring cables supplied by the original manufacturer may be used during installation.
- F. The system components used, such as cables, housings and displays, which are connected directly to the battery or are part of the human interface, must neither be flammable nor reach a temperature that, when touched, poses a danger to direct users, maintenance technicians or service personnel.