# SPECIFICATION FOR THE SUPPLY OF A BATTERY MONITORING SYSTEM

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# Table of Contents

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## 1. INTRODUCTION

This document describes in detail the specification requirement for a Battery Monitoring System (BMS) purchase, installation, documentation, testing and training.

## 2. GENERAL REQUIREMENTS

The supplier shall provide a complete system for the monitoring of lead acid batteries, Wet, VRLA, and/or NiCad as defined in the detail requirement below. In particular the system shall consist of a means for monitoring battery voltages, ohmic value (defined as Resistance, Impedance or Conductance), temperature and current. 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.

## 3. BATTERY MONITORING SYSTEM (BMS) REQUIREMENTS

The BMS shall have the following individual capacity limits for each one of its configuration parameters:-

- From 1 to 30,000 voltage and ohmic value measurement points.
- From 1 to 124 current sensors.
- From 1 to 124 temperature sensors.

The above parameters shall then be configurable under software control to reflect actual jar, mono-block, string and battery assignments either locally at the BMS during installation or remotely prior to delivery of the system.

In addition, the BMS shall have the ability to measure key parameters (voltage and ohmic values) of remotely located generator batteries, EMS and Switchgear, all on one system. This data should be stored and displayed alongside all other battery data and trigger the same or similar alarms.

The BMS shall have the following measurement ranges:-

- Measurement point voltages from 2vDC to 12vDC nominal.
- Temperature measurement capability for pilot cell and ambient temperature measurement.
- Temperature measurement capability in the range +2ºC to 80ºC (36ºF to 176ºF).
- Ohmic value capability on a measurement point by measurement point basis in the range of 250 to 25,000$\mu\Omega$.
- Current measuring range from – 2,500Amps to +2,500 Amps.

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. The DC battery voltage on any electrical measuring instrument will be no more than 60vDC in total.

The BMS computing component will contain a Windows XP computer capable of storing and computing collected battery data for later display and analysis. In addition the computing

component must be able to communicate BMS alarms via a number of different means. These shall include:-

- Volts free relays.
- Serial port communication via an open protocol.
- E-mail.
- Across a Windows compatible Ethernet network.
- Via MODBUS TCP/IP
- To a web browser.

All BMS system components shall be capable of operating in the following temperature ranges.:- 0ºC to 35ºC

The Battery Monitoring System shall comprise of commercially, off-the-shelf, equipment, manufactured by a ISO9002 registered company that regularly manufactures, installs and provides complete technical support for its BMSs. The system proposed shall have been of a type that is proven and been in operational service for a period of at least 12 months before the date of offer.

In the interest of cost effectiveness, the components of the BMS shall be reconfigurable. In the event that the battery / string organization changes in future, the components of the system should be reconfigurable, with the addition or removal of components, to be able to monitor a new battery lay-out with the minimum of obsolescence. BMS component design improvements will be backward compatible to previous versions.

## 4. BMS INTERCONNECTION

The BMS system will be interconnected in such a way as to ensure that no piece of equipment other than equipment being powered from the 110vAC to 240vAC is connected to a continuous voltage of more than 60vDC at any time in, any operational mode.

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

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

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

## 5. MONITORED PARAMETERS

The following shall be monitored or calculated from monitored data.

5.1. Individual cell/jar/monoblock voltage during float.

5.2. Individual cell/jar/monoblock voltage during discharge.

5.3. Total string voltage.

5.4. Individual cell ohmic value (including the inter-cell link resistance).

5.5. Discharge current.

5.6. Charge current.

5.7. Pilot cell temperature.

5.8. Ambient temperature.

The above parameters will be measured with the following periodicity ranges:-

**5.9 Continuously measured (more frequently than once per minute)**

5.9.1 Charge current.

5.9.2 Discharge current.

5.9.3 Pilot cell temperature.

5.9.4 Ambient temperature.

5.9.5 Each Cell/jar/monoblock voltage during a discharge

**5.10 Measured at a rate of 4 or 24 times per day:-**

5.10.1 Cell/jar/monoblock individual float voltage.

**5.11 Measure at a rate of 1 or 2 times per day, but no less than once a day:- utilizing a load of not greater than 1 -4 amp automatic switching**

5.11.1 Cell/jar/monoblock ohmic value

The BMS shall be able to detect deteriorating inter-cell resistances caused by but not limited to; corroding inter-cell link bars and poor connection torque.

In the event that any of the above measured parameters fall outside predetermined and pre-programmed limits then an alarm condition will be registered and will be communicated in accordance with the section titled communications.

In the event that a current outflow is detected that exceeds predetermined and pre-programmed limits, the BMS shall suspend all other monitoring and measure and record cell voltages on the battery where discharge is detected. Following completion of the current outflow, a graphical analysis of the discharge will be available with all cell voltage curves available for performance analysis.

## 6 MONITORED PARAMETER DISPLAY AND ANALYSIS

The following parameters shall be averaged daily for archival, trend analysis and display:-

6.1 Current flow.

6.2 Temperature.

6.3 Cell/jar/monoblock voltage.

6.4 Cell/jar/monoblock ohmic value.

The following analysis graphs shall be made available either on the computing component or on a remote computer using remote communications software:-

6.5 Each cell/jar/monoblock’s detail measurement history for the current day.

6.6 Each cell/jar/monoblock’s averaged measurement history for at least 120 days.

6.7 An entire string's latest voltage and ohmic value reading.

6.8 A battery voltage and ohmic value trend for each year of operation. This graph to include current and temperature data.

6.9 Following a battery discharge, a graph showing best and worse performing cell/jar/monoblock in a battery, with the capability of adding all other cells in the battery.

All graphs must be capable of being displayed as line graphs or bar charts except for discharge and trending curves which shall be line graphs. All data sets must be programmable as to which colour is used for representation. All graphs will be able to individually identify cell or jar(s) on screen interactively.

All graphs must be printable, either individually or all together.

## 7. ELECTRICAL REQUIREMENTS

The BMS shall meet the requirements of the National Electrical Code.

Each component that connects to the 110vAC to 240vAC utility power and is connected in some way to any part of the system that is humanly accessible shall be UL approved.

The 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.

The low voltage components of the BMS connected to the battery shall not draw from the battery being measured, more than 25mA average during any 24 hour period, for the entire battery monitoring system.

## 8. REGULATORY APPROVALS

The BMS shall have; UL, CSA and CE approvals.

In particular it will meet the following specifications or international equivalents:-

### 8.1. For electrical noise emissions and susceptibility.

- EN55022:1994 Class A for conducted and radiated emissions.
- EN61000-3-2:1995
- EN61000-3-3 1995
- EN50082-2:1995/ENV50140:1993
- EN50082-2:1995/ENV50141:1993
- EN50082-2:1995/EN61000-4-2:1995
- EN50082-2:1995/EN61000-4-4:1995
- EN55024:1998/EN61000-4-8:1993UL31111-1

### 8.2. For electrical safety.

- CAN/CSA C22.2 No 1010-1
- UL3111-1
- IEC61010-1

## 9. MANUFACTURING CAPABILITY AND QUALITY STANDARDS

The supplier shall be able to assure continuity of supply by having a minimum of two, existing, approved source for all major manufactured components.

All computers shall be from a Internationally recognised manufacturer with international service and support facilities and spares holdings.

The BMS components shall be manufactured by a company certified and currently registered with a National Quality Approval Agency to ISO9002.

## 10. DELIVERY REQUIREMENTS

The supplier shall deliver all hardware, software, installation material, on-site spares, tools, test equipment, drawings and documentation necessary for the BMS installation.

The BMS supplier will be capable of supply and delivery of spare parts for the system, from stock holdings for up to seven years after the date of installation.

## 11. SAFETY

The BMS shall be connected to the battery in such a way as to ensure there is no risk of high DC voltage transmission to an operator panel or other human interface. For this requirement high DC voltage shall mean a voltage that is regularly over 60vDC.

To avoid the risk of short circuit and / or fire, cables connected to the battery shall be limited to a maximum length of 5 metres (15 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 clearly identified either with cable markers or by using colour coded cables.

All measuring circuits connected to the battery shall be protected by high impedance circuits or fuses to avoid the risk of accidental discharge.

No components, cables, cases, displays connected to the battery or forming part of the human interface shall be flammable, nor shall they rise to a temperature that presents a hazard to operators, maintenance technicians or other service personnel.

## 12. TEST DOCUMENTATION

The supplier shall be able to supply, on request, copies of all system test and quality approval documentation for all components of the BMS.

## 13. SOFTWARE REQUIREMENTS

The software running the BMS shall be capable of operating on Windows XP operating systems. It will load and operate immediately Windows XP is started without operator intervention. It 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.

The software will come equipped with diagnostic tools for the investigation, correction and test following a system fault however induced. This diagnostic tool to be protected by a secure password to avoid interference with the system.

The diagnostic capability will have the ability to:-

- Clearly identify for the purpose of faulty cell/jar/monoblock verification the precise correlation between actual cells and reported faulty cells.
- Test all parts of the BMS for the purpose of installation or maintenance fault finding.

## 14. COMMUNICATION ABILITY

The BMS shall have the ability to communicate to an other system by at least the following means:-

### 14.1. As standard.

- Via a VGA output socket for the purpose of connecting either a VGA display or a KVM switch..
- Via volts free alarm relays to permit interface to external enunciators or other equipment.
- Via an audible alarm system that permits user disablement.
- Via a modem dial in from an external Windows XP computer to provide the full features of the BMS computer on the external computer.
- Via an Ethernet Network to allow status messaging on other Windows XP computers using either a Windows Browser (Windows Explorer 6.0 or above) or MODBUS TCP/IP or pcAnywhere.

### 14.2. As optional extras.

- Via a RS232 serial port with an open protocol to allow other computers to interrogate and receive simple status data.
- Via E-mail to allow operators, management, service personnel or anyone else to receive E-mail notification of BMS status.

## 15. DOCUMENTATION

The BMS shall be supplied with one copy of the following information:-

- Installation manual.
- Hardware description.
- Software operation.
- Simple use instructions.

## 16. SPARE PARTS LIST

A spare parts list detailing all part numbers shall form part of the documentation package.

## 17. TRAINING

The supplier of the system shall be factory trained and certified and able to provide on site user training on the BMS. The training shall commence immediately upon successful installation of the system and shall include such topics as:-

- Operation.
- Diagnosis.
- Trending.
- Alarm-status.
- Data retrieval.
- Interpretation of battery data and use of data to troubleshoot batteries.