REMOTE BATTERY MONITORING - THE DATABASE IS GROWING

by

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ABSTRACT

Since our last paper presented in 1994 at the Power Quality Conference Sept., 1994 in Dallas, a lot has happened.

Currently we have data on over 7,100 battery units. This population is composed of 75% valve regulated types across five manufacturers, and 25% Vented type across four manufacturers.

Our database contains history and events regarding this population which reaches back to mid 1993, or over four years of data.

The primary vehicle used to collect this data is BTECH's Battery Validation Manager which is a windows based database, archiving, and analysis program designed to communicate with BTECH's Battery Validation System's that are located at many battery sites in the USA and at other world locations.

DATA POWER MONITORING CORPORATION's primary business is to remotely monitor critical battery systems and help our clients make informed decisions regarding the health of their battery systems.

As we move out in time and digest all of this data, several conclusions and opinions are beginning to form. These conclusions will probably become sharper, and some may change, as we progress out further in time, with much more data.

An IEEE standard was released in 1996 for Maintenance and Replacement of Valve Regulated Batteries (IEEE 1188-1996.) On the valve regulated side of the business (about 75% of the data we have collected), we are finding that Ohmic measurements, coupled with voltage and discharge data, is providing more effective predictive data to the battery using client. This data base did not exist before the advent of efficient accurate remote monitoring also incorporating Ohmic measurements.

In the case of the other 25% of the population (vented cells), we are finding that there is also much predictive value to collecting this data. One key item we are finding is the identification of interconnect problems as they are occurring.

This paper will present, in interesting and pertinent detail, the value of remote monitoring and why human analysis is essential to the health maintenance of all critical battery systems.

RISING COSTS OF MANUAL SURVEILLANCE AND MAINTENANCE

Costs of manual surveillance and maintenance increase as today's labor costs increase. These costs accelerate as battery systems reach their end of life. Typically, the frequency of surveillance and subsequent maintenance increases as the batteries sulfate, corrode, leak, and become unstable. The connections or straps present additional surveillance concerns as the system ages.

Impedance/Conductance/DC Resistance has been proven to be a very strong indicator of future battery performance and is being accepted by battery vendors and maintenance organizations as standard procedure in their maintenance routines. The diagnostic equipment designed for these tests is expensive and the use of this equipment proves to be labor intensive. Rather than curbing costs, labor can add another cost dimension.

Load tests, the tried and true favorite, while expensive and labor intensive are still necessary. When these tests are performed, they must follow industry standards such as IEEE 450 and IEEE 1188. The unfortunate fact about load testing is that while it provides quantitative data on how well the battery system just performed, it still does not provide any predictive data on future battery system performance. Weeding out failed (less than 80% capacity) batteries on load tests is essential. It is an odds game between load tests (usually years apart) for future battery failures,

THE CASE FOR REMOTE MONITORING

Battery System performance integrity requires that continual data be collected by remote monitoring means and interpreted on a weekly basis. As data is collected, trends over time and parameter limits can predict future performance and identify failure mechanisms. While Remote Monitoring is a powerful tool, it is not to be viewed as a complete substitute to Manual Maintenance activity.

Remote Monitoring can save costs associated with Manual Maintenance procedures, record keeping, and labor intensive manual tasks. Data collected over time and at frequent intervals can be archived and easily interpreted using powerful software systems which automate this procedure.

TYPICAL MANUAL MAINTENANCE AND SURVELLIANCE PROCEDURES

Typical routine maintenance steps for battery systems consist of the following:

1. **Voltage Checks** - Each cell's readings are recorded from one to two decimal places.
2. **Interconnect Resistance Checks** - Each cell's strap to post resistance is measured with a Micro Ohmmeter and recorded
3. **Strap to Post Torque Check** - Each strap to post bolt connection is checked and re-torqued to manufacturer's specifications
4. **Specific Gravity Check** - Specific Gravity readings are measured and recorded indicating state of charge in vented or flooded systems.

5. **Visual Inspection** - Each cell, jar, and interconnect is inspected for sedimentation, plate alignment, sulfation crystals, and electrolyte leakage. Valve-regulated cells/modules have opaque containers so inside visual inspection is not possible.

6. **Watering** - Each cell is checked for water (electrolyte) level and replenished as necessary during routine maintenance. This is not possible for most Valve Regulated cells.

7. **Impedance/Conductance/DC Resistance Checks** - Each cell and interconnect is measured for these Ohmic values and results are recorded.

8. **Load Tests** - Each cell can be placed on load or the total battery system can be placed on load to determine conformance to discharge specifications.

9. **Data Analysis** - The above collected data is analyzed for trending data over time, and may be compared to base or average value of the cells in the string.

Frequency - Manual Maintenance is conducted on a quarterly, semi annual, or annual basis. The frequency depends on the condition and application of the battery system under test, IEEE Standards, and the user's preference.

TYPICAL REMOTE MONITORING SURVELLIANCE PROCEDURES

Remote Monitoring Systems perform a majority of the functions listed above on an automatic, unattended basis. Measurements are automatically made with greater frequency, while the battery system remains on line. Parameters measured, archived, and the subsequent analysis methods vary from manufacturer to manufacturer.

With comprehensive cell or jar level monitoring systems, the following test functions can be programmed to occur, and the data collected, during a fixed span of time. During an outage (load on battery), the system will provide individual cell data logged on a programmable test interval. Typical items collected are as follows:

1. **Voltage Checks** - Collection and recording each cell or battery's dc voltage value to two decimal places.

2. **Interconnect Resistance** - The strap and post connection resistance is usually included with the Monitor's ohmic value measurement. If a strap connection problem causes an alarm state, a simple diagnostic procedure can determine where the cause of the increased impedance lies.

3. **Strap to Post Torque Check** - The Ohmic value data will indicate when this service would become necessary. Unfortunately, no system will preclude the necessity of cleaning and correcting cold flow in copper to lead connections.

4. **Specific Gravity Tests** - Specific Gravity can change due to the charge state of the battery. It has been shown that this charge state can also impact Ohmic values. The lower the state of charge, the higher the internal cell Ohmic value.

5. **Ohmic Tests** - The BTECH Battery Validation System (BVS) used for this paper is an impedance monitor. The term "impedance" will be used to describe this type of Ohmic

test. The BVS measures the internal cell and interconnect impedance on each cell/module at a pre-programmed test frequency. These values are stored and can be retrieved remotely by using the BVS PC software and a modem.

NOTE: This paper is presented with data collected with this type of remote monitor. Other monitors which incorporate ohmic measurements can also provide similar data.

6. **Load Tests** - To accommodate IEEE 450 and IEEE 1188 maintenance standards, the load test can be performed with the Monitoring unit installed. While the battery is under load, intentionally or not, the monitor will scan each cell/module in the system for voltage and record its performance at specified intervals. This is in addition to battery system voltage and/or current scans and logging.

7. **Data Analysis** - The monitor data is downloaded, on demand, or at a specified frequency of time. This is handled by software which is installed on a host PC. If the software is capable of automatic analysis, the data will be downloaded and interpreted automatically.

8. **Thermal Runaway** - The precursor to thermal runaway can be cell dryout which is identifiable by an increase in Ohmic values. Other mechanisms can also cause this phenomenon.. The difference between ambient and battery temperature is monitored frequently. A difference of greater that 15 degrees F (battery higher than ambient) will alarm the monitor and could be a thermal runaway condition which requires immediate action.

One personal computer along with one copy of analysis and archiving software can communicate and analyze data from multiple monitors with communications ability.

SOME JUSTIFICATION ITEMS

When manual maintenance costs are compared against an installed monitor and Remote Monitoring investment, it becomes apparent that performing unnecessary maintenance and tests to determine battery system integrity is not the answer. Rather, just in time battery replacement, and budgeting of battery maintenance predicted by collected Voltage and Ohmic data is much more cost efficient.

This is further enhanced when comparing the cost of manual Voltage and Ohmic testing along with the manual record keeping against automatic data retrieval, analysis and archiving. Further savings can be realized by the outsourcing of Remote Monitoring activity which allows facilities management to devote its attention to more systems oriented tasks.

NOTE: ***Whether the Remote Monitoring activity is outsourced or not, the monitor system becomes an expensive wall ornament if the collected data is not interpreted!***

In the case of the more temperamental valve-regulated cells/modules, Ohmic values and voltage levels combined with full discharge load testing at recommended intervals are the only true predictor of cell and interconnect health. If VRLA cells were specified because of an intended lack of maintenance, the Monitor coupled with the lower cost valve-regulated cells may be an attractive alternative to Vented battery systems. Environmental and regulatory costs associated with handling vented cells could be eliminated as well. In the case of Vented battery systems, Remote Monitoring can also defray some maintenance costs and becomes very important in identifying poor or corroded connections. In addition, battery cycling and warranty issues can be resolved by a permanent record of all cycling events which is collected by the monitor.

The most important justification for the Ohmic value monitors, is the value of this form of predictive technology. Ohmic values along with voltage is directly related to battery system health. This valuable technology is increasingly being embraced by battery vendors and users alike.

Statistics have shown that 70% of Valve Regulated Lead Acid batteries with 10 year warranties fail from 4 - 6 years into their life.

The worst time to find out that the battery system is not going to work, is when it is needed under emergency conditions!