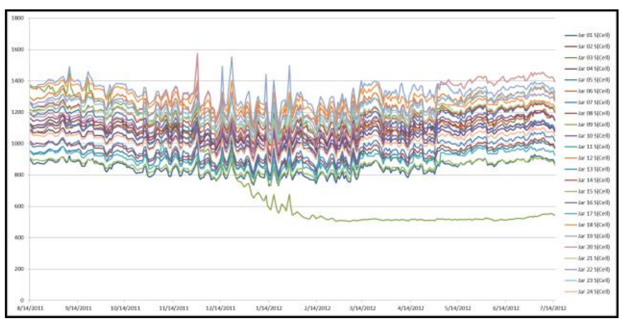
Walt Wilczewski
VP Business Development
Phoenix Broadband Technologies

JOHN HENRY VS AUTOMATION

The tale of John Henry is one of a mighty steel driving man, whose physical prowess allowed him to do his job better than anyone else could. Henry, a man who radiated passion, pride and integrity, faced down automated technology in a contest pitting man against machine (a steam powered hammer) that lasted 12 hours. At the end of the contest, each contestant's progress was measured and John had won. He may have died trying (stories differ depending on the source) but he did win. Even with John Henry's Herculean effort, he could not stop the march of progress and eventually automation just made too much sense to resist. We are at a similar crossroads today with remote battery monitoring technology.

In industries like CATV, telecomm, utilities, cellular and others, it is common for operators to have hundreds or thousands of critical infrastructure sites that rely on backup power. At each site, combinations of equipment, including rectifiers, inverters, batteries, generators and transfer switches, all must work together seamlessly to provide un-interrupted power. Other systems at these facilities, such as commercial power and HVAC systems, can also impact performance of backup power systems and, especially, battery health.

Historically batteries, which are the heart of power back-up power systems, have been maintained locally, with each site or small group of sites being maintained by a local "John Henry", contractor or employee. Manual battery maintenance involved measurements made with hand held meters, logging data (on paper, or stored in meters and downloaded to software), or storing data (locally in a log book or electronically and compiling local data for review). This took a lot of time and effort and was, at best, partially effective. Battery parameters were measured once, twice or four times a year at most, and at intervals far enough apart to miss events.



Jar Admittance 1

The graph above, "Jar Admittance 1," shows the admittance of 24 two-cells (250AH lead acid wet cells) during a period of one year. Jar 9's admittance measurement dropped 30% in less than one month. Manual maintenance would likely miss such an event.

With the John Henry approach, an operator who had tens, hundreds or thousands of sites over a large geographical area could not count on timely, consistent, comprehensive or accurate enterprise-level reporting without a herculean effort from multiple departments. There just aren't enough John Henrys in the world.

Walt Wilczewski
VP Business Development
Phoenix Broadband Technologies

While remote battery monitoring systems have been a significant technology leap, lowering operating costs, improving network availability and more effectively managing resources it is no longer enough. Most monitoring systems were site centric and didn't address the enterprises' needs. The CATV industry, for example, is one of the most advanced in managing batteries and the UPS. The CATV industry uses 1.5-2 million batteries in their outside plant, with more than 80% of those sites being remotely monitored. Along with collecting all power-related metrics from the cabinet, CATV operators have the ability to test batteries in each OSP cabinet under load and to produce meaningful reports at an enterprise level.

PS Alarms

Region	Battery Voltage Alarm <= 11.0 - >= 16.5 VDC	Battery Conductance Alarm <= 60% Change	String Voltage Alarm <= 33.0 - >= 49.5 VDC	Output Current Alarm >= 15A	Input Voltage Presence Alarm " Lost "	Inverter Status Alarm " Line Failed "	Total Alarms	Average Alarms Per PS: Current Week	Average Alarms Per PS: Previous Week
Central	62	7	49	2	9	23	152	0.16	0.24
E3I	55	2	57	20	50	47	231	0.39	0.70
West	23	2	144	1	5	48	223	0.50	0.32
Southeast	150	14	136	0	104	154	558	0.55	0.41
West	428	16	227	24	114	75	884	0.52	0.58
NC Division	718	41	613	47	282	347	2048	0.44	0.47

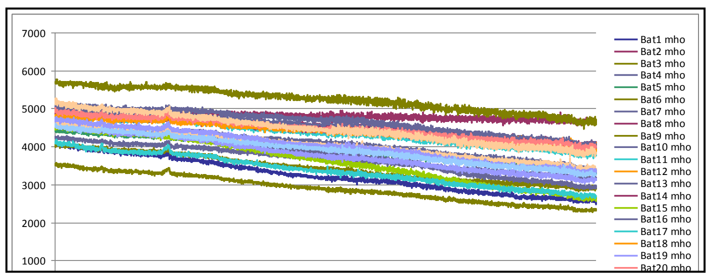
Auto Test Results

Region	Change in String Voltage: Good < 9%	Change in String Voltage: Warning 9% - 12%	Change in String Voltage: Alert > 12%	Test Type: Auto	Test Type: Manual	Test Dropped: Yes	Test Dropped: No
Central	18	3	88	109	0	17	92
E3I	0	0	1	1	0	0	1
Southeast	0	0	0	0	0	0	0
West	45	34	203	282	0	104	178
West	21	9	37	67	0	22	45
NC Division	84	46	329	459	0	143	316

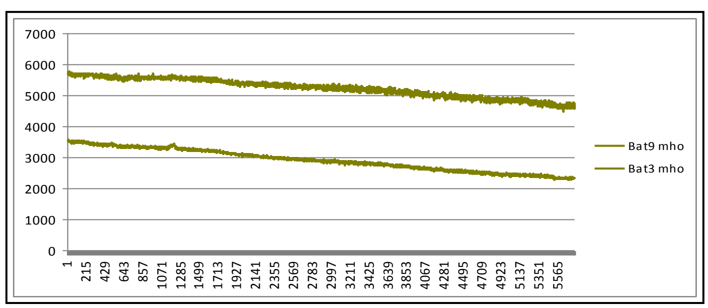
Alarm and test report 2

By collecting accurate data consistently and continuously, we see hundreds or thousands of meaningful data points per year instead of only 2 or 4 measurements. Consistent and continuous measurements eliminate the inaccuracies and data variations caused by differences in technicians, meters, probe placement and force applied.

The graph to the right shows jar admittance for 24 two-volt (1000AH) VRLA cells, with over 5000 data points, during a period of close to three years. Even John Henry would be hard pressed to maintain this pace. The string was in service for three to four years before monitoring was implemented. The second graph to the right shows the highest and lowest reading jars from the same string. The downward admittance trend is clear (about 20 percent decline) during this period of time. Also noted is battery three's admittance, which at the end of the graph is more than 60% lower than an expected baseline. This string was replaced shortly after the last date on this graph.

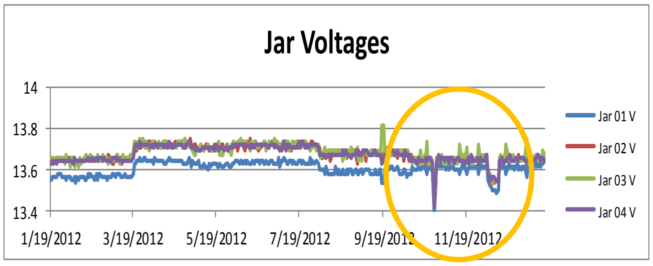


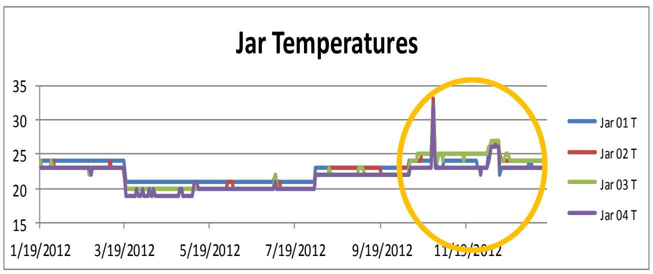
Jar admittance 24 jars 34



Jar admittance high and low 43

Walt Wilczewski
VP Business Development
Phoenix Broadband Technologies





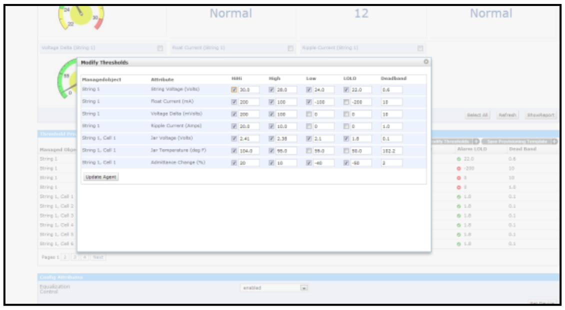
Remote monitoring also provides for a more holistic view of the battery's environment, its history and its health. It is very important to have as complete a picture as possible of the battery's environment since many things can affect battery life and performance. In addition, it creates a central repository for site data. Though, historically, many sites were not easily networked together.

The two charts to the left show a clear correlation between string voltage and temperature. The string voltage increased as the temperature decreased and the opposite occurred as the temperature increased. The areas circled in yellow represent the after-effects of short discharge events. The logging interval was set to once per day, so the entire event is not described. Discharge logs, however, provide more detail on the event.

So this is where John Henry's eyes might glaze over at the daunting task ahead! Now that we have all of this great data, we need to turn this into information. There are multiple groups of stake holders who have different interests and all must be satisfied. System or region level users are more than likely interested in day to day information such as "What do I need to do now?" or "What do I need to do this week?" NOC (Network Operations Center) personnel are interested in real time status of the enterprise, alarm reporting and how to more effectively direct emergency resources. Executive planners want information regarding replacement of strings and resource savings (such as more intelligent use of contractors and local personnel). John Henry didn't just became infinitely more useful.

To accomplish the goals of the stake holders we need to start with hardware at each site which is ***fully*** capable of remote access, including real-time web access to data, full remote monitoring and ***provisioning*** (alarm thresholds, labels, control) capabilities via standard protocols, remotely downloadable firmware, remote access to log information and remote diagnostics, all of which must use standard protocols. Standards allow many disparate devices to be integrated into different software platforms. Higher level systems typically integrate inputs from EMS (element management software) or directly from power related devices (including generators, transfer switches, rectifiers, batteries and more) for correlation purposes. Typically however, the more direct the path, the better the performance. For event correlation to be accurate, all monitored devices must be tied to a networked time server.

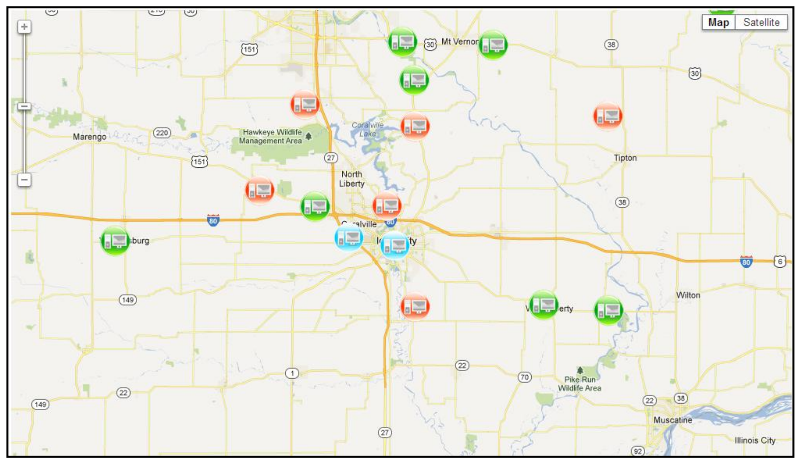
Walt Wilczewski
VP Business Development
Phoenix Broadband Technologies



To be truly useful, these systems must be able to fully provision controller devices directly and either globally, regionally or individually. This is critical since things change over time and removes the chance of manual error, which creates extra site visits. For example, alarm templates for different battery models should be able to be applied to the monitoring hardware on a string basis, controller basis, site basis, region basis or global basis.

During emergencies the system should be able to provide visibility into how the event is impacting enterprise performance and to help operators direct assets (e.g., portable generators) more intelligently. John Henry couldn't imagine this in his wildest dreams.

In addition, the system should be able to automate interpretation of data. No longer necessary are battery gurus who live in the power fiefdom to prevent all from entering their domain. Decision processes can and are being automated.



SUMMARY

John Henry was a heck of a guy, but even John Henry has no chance of keeping up with today's battery monitoring requirements. It is no longer acceptable to look at a few points of annual data and to try to interpolate what has been happening to the battery all year. A more complete picture is required. Operators want to consolidate information from many sites easily and to have instant visibility into the health of all batteries in the enterprise. During emergencies, automation will provide valuable information about event impact and will help direct resources. Software will make determinations for things like battery replacement and direction of battery maintenance resources. John Henry may be a little dejected, but the rest of the battery industry should be far more assured that their back-up systems will be there when needed.