

BATTERY POWER PRODUCTS & TECHNOLOGY

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Battery Monitor Users be Aware

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We are all aware that batteries are the weakest link in the power system and that battery monitoring has become an integral part of every critical system specification. We are not all aware, however, of the fact that owning a monitor by itself is not going to keep a system from crashing. This article will deal with some of the realities of properly maintaining a reliable battery backup system.

System Reliability

In today's digital world, millions of dollars are at stake when a computer hiccups. Users spend a great deal of money on the equipment required to ensure reliability (UPS, chargers, inverters, etc.). However, for some reason, when it comes to the batteries that support the UPS, they tend to look for the cheapest solution. With millions of dollars on the line, it is imperative to invest in the proper technology and preventative maintenance program to avoid battery failures entirely.

Guaranteeing is a strong word, but with the proper equipment and procedures, it is possible to approach 100 percent uptime. A critical system user must be aware of what the right monitoring equipment is and also understand what a monitor can and cannot do. For example, a monitor cannot perform corrective action such as replacing a failing cell or adjusting the room temperature. The system owner must be a willing participant for the process to be successful. This means either training in-house personnel or hiring a competent service company.

Too many monitor owners have a false sense of security, believing that just because the monitor is there, they are fully protected. Reliability comes from preventing problems and therefore requires early problem detection. Early warning of incipient problems comes from trending the state of health of the battery and recognizing when something abnormal is happening. Someone has to pay attention to the monitor and respond to the early warning alarms.

Being proactive means that some action must take place. The corrective action phase of the program is very important and it must be done in a timely manner by someone who understands the impact of the action on the overall string.

Monitoring Equipment

As with any purchase, the caveat "let the buyer beware" holds true. The buyer must be knowledgeable enough to determine his actual needs and not allow a monitor salesman to dictate what is required in the particular situation.

Some monitor specifications that appear in today's bid documents were most likely written by one of the battery monitor manufacturers and therefore reflect only the salient features of that manufacturer's product. Also, some of these specifications have clauses that are outdated and require updating based on technological advancements and consideration of the features available on the market today.

The IEEE has been working for quite a few years on a monitor guide for selecting and using monitors in the field. It is not a standard, but more of a tutorial type document that does not explicitly tell a user how and what to do.

This article will not discuss the details of why flooded and VRLA batteries fail (please see reference 1 for a detailed discussion or contact the authors directly), but will instead address the main failure modes and why a monitor must have certain capabilities.

Major Failure Modes Flooded Batteries

1. *Positive grid corrosion* - This leads to a reduced conduction path and grid growth. The grid growth causes the active material paste to break away from the grid causing high resistance connection. This is the most common failure mode, and will definitely show up as an increase in internal resistance.

Major Failure Modes VRLA:

1. *Grid corrosion*, same as flooded batteries.
2. *Dry out of the electrolyte* - This will lead to an increase in internal resistance, but not until 30 percent of capacity has been lost. This is the most common failure.
3. *Undercharged negative plates* - This new phenomenon, not seen in flooded batteries, will cause an increase in resistance and loss of capacity.

Buying a monitor is like buying most high tech electronic devices, there are different features and prices available. So what is the trade-off and how do you know what you need? Besides the normal voltage, current and temperature readings, there is a list of absolutely must have features. The following recommen-

dations do not come from a salesman's perspective; but rather from the first-hand experience.

1. *The ability to read internal resistance of a cell/module* - Every battery failure is preceded by an increase in the internal resistance. As a battery deteriorates, the effects can be seen by measuring the internal resistance.

2. *Ability to measure inter-cell and inter-tier resistance* - This is very important for high current applications where even a 1 milli-ohm connection can start a fire. Most catastrophic failures such as fires and explosions are the result of poor quality or corroded external battery connection.

3. *The ability to auto detect battery discharges* - When a battery goes under load, it is necessary to see how every single cell/module in the system responds. Since most UPS hits are typically only 20 second or less in duration, it is necessary for the monitor to be capable of scanning all parameters several times within that interval. This is also a key feature for battery warranty purposes.

4. *The ability to display real time battery data during a discharge* - During a scheduled discharge test such as a commissioning test, it is necessary to see the performance of each cell/module. There have been many incidents of poor or faulty intercell connections that lead to a catastrophic failure such as fire and/or explosions under load. Some monitors only record data during the discharge and then display after the fact. Who needs to see a failure after the fact? The idea is to see the poor connections and prevent the failure from occurring.

Without the above four capabilities, a battery monitor will not adequately protect against system failures.

Unfortunately, in today's world the decisions for system reliability end up in the hands of the financial departments. As a result, the number one selection criterion is driven by the price of the system. It is time for the technical people to step up and realize that price should only be a consideration if the system meets the needs of the requirement. Think about what is required and then write a spec that must be met before any proposal is accepted. After all, when your facility experiences downtime, it will not be the finance department that takes the heat.

Below is a list of items potential battery monitor users must be aware of:

1. Flooded batteries are much more reliable than VRLA.
2. VRLA batteries fail abruptly and therefore require more intensive monitoring. Cost and floor space savings are at the expense of reliability. Decisions must be made based on the reliability requirements.
3. Early problem detection is the key to reliability. Pro-active testing and state of health monitoring is a must when failure is not an option.
4. Capacity testing is the most reliable way to determine a battery's state of health; and a monitor must be capable of supporting or conducting this test.
5. New batteries are delivered without being fully formed. Therefore an acceptance test may show 90 to 100 percent capacity. This is not a problem.
6. Do not accept a new battery installation until all cells/modules float within the manufacturers specified limits. A lot of battery

problems appear early on and can be prevented. If cells do not float uniformly, then the low cells will sulfate and have low capacity problems. The high floating cells will gas excessively, venting out electrolyte and running the risk of going into thermal runaway.

7. When replacing faulty cells/modules, make sure the replacement cell/module is fully charged and is the same exact model. Some users/service companies replace cells/modules without paying attention to how the replacement module floats with respect to the rest of the battery. Typically a fully charged new battery will float at a much higher voltage than the rest of the string and therefore runs the risk of going into thermal runaway.

8. Some monitors offer voltage management, which controls the individual cells/module voltage. This is not a good idea. If a cell is having internal problems that cause the voltage to deviate from the norm, then that problem will be masked by forcing the cell voltage to be in line with all the rest. This control will mask what is really going on beneath the cover of that cell.

9. The benefits of monitoring outweigh the sometimes short-sighted financial decisions:

- a. The price of a monitor is insignificant in comparison with the cost of a failure. This does not even consider the cost of customer goodwill.
 - b. With monitoring, maintenance people can now focus on problem resolution instead of being data collectors
 - c. Warranty data is collected 24/7
 - d. Avoid abrupt power failure that could damage equipment
 - e. Keep maintenance people safe by reducing their exposure to dangerous high voltages
 - f. Avoid potential hazardous situations like battery room fires; by proactively replacing bad cells/modules and identifying bad/loose inter cell connections.
10. All monitors are not created equally. Do your homework and specify the required features to ensure a safe and reliable system.

Monitoring the Monitor

Now we know what the monitor can and should do, but all that pertinent information is wasted unless someone is monitoring the data and managing the system. It doesn't matter whose monitor is used or how good it is, if the system owner does not close the loop, system failure is sure to follow.

In a tough competitive world, it is hard to justify additional specialized personnel on the payrolls. Each company has its own ideas and philosophy on how to deal with this issue. However, a system failure resulting in millions of dollars worth of damage cannot be tolerated, so a choice between in-house trained personnel versus outsourcing must be made.

There are several service companies around the country that offer Battery Monitoring Services. There are also companies that will analyze data from the monitor sent to them, and then advise the battery owner what corrective action is required. There are also large companies working on a business plan to offer customers reliable power. These plans are based on the provider supplying the UPS, the batteries and the service required. Service may or may not include battery monitoring with remote access.

Summary

Be aware that monitor selection and user follow-on support are key to maintaining a failure-free battery system. The only way to approach the 100 percent guarantee that was mentioned earlier is to install a full-function monitor and to be diligent with taking the appropriate actions based on the information gathered from the monitor.

There is no substitute for doing it right. Why waste your company's money on a monitor that does not substantially improve the system reliability and that provides no financial paybacks?

References

1: *Guaranteeing Battery System Performance*. Sept 1995, *Power Quality Conference*, Glenn Alber & Marco Migliaro

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