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TECHNICAL NOTE

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Why is a Battery Monitor the Most Valuable Peripheral for a Load Bank?

There is no question in the mind of any battery professional that the only way to establish the capacity of a battery is to do a load test.

Yet, for many battery owners, the question is: why do I need to know the battery capacity when that was already calculated when the battery was sized? In a sense, that is true. However, all batteries will lose capacity as they age. And in order to meet the required load and runtime during its life, the battery should typically be oversized as part of the selection process, and therefore, should always exceed the capacity requirement until it reaches end of life.

ESTIMATED BATTERY LIFE EXPECTANCY

All batteries have a different life expectancy depending on their design and application. The manufacturer's datasheets will typically state the expected life of any specific model of battery. This estimation is based on the anticipated loss of capacity due to the aging process under ideal operating conditions. However, when the battery is operated outside the recommended temperature range, or is subject to more discharges than it was designed for, the rate at which aging occurs as well as loss of capacity can increase dramatically.

That is why, in the IEEE recommended maintenance practices for a specific battery type, the recommended frequency at which these discharge tests should be carried out is based on identifying any early loss of capacity due to operational conditions. This will ensure that the battery is replaced before it no longer will support the load for the required duration.

DISCHARGE TESTS

So, if the discharge tests are carried out on schedule, and exceed the required run time, is it a reasonable assumption that the battery is fully operational? As is the case with almost all answers to battery questions; it depends.

In this case, it depends which type of discharge test is carried out. If it is a performance test, then the oversized battery must be tested at the manufacturer's documented rate for the required runtime. Then, based on the actual runtime, the loss of capacity can be calculated. Typically for a lead-acid battery that had been properly sized, it will be at end of life when it reaches 80% of its original stated capacity, while still meeting the original design requirements.

The second type of discharge is referred to as a service test. This is when the battery is discharged at the original design load, and if it is still above the cut-off voltage at the end of the specified runtime, it is considered to have passed. If the level at which the battery voltage is above the cut-off voltage is tracked at each discharge, it will give a reasonable indication as to the remaining capacity but not an actual figure.

ANALYZING BATTERY VOLTAGE DATA

In both types of discharge, the measure of acceptance is based on the overall battery voltage, and it assumes that all the cells/units are aging at the same rate. That is seldom the case. So, to obtain a true assessment of a battery's condition, it is necessary to check the response of each cell/unit in the battery by measuring the individual cell/unit voltages.

On a low-voltage battery with a long runtime, that data could be collected manually. On the other hand, with a UPS battery with five battery cabinets, each with forty 12V units and a fifteen-minute runtime, manual collection is impossible and some form of automated data collection is required. Some of the latest generations of DC load banks incorporate cell/unit data collection, and this data then is included in the discharge test report generated with the load bank test report. This works well when a DC load is applied directly to the battery, as in communications or utility batteries. But, a load test of UPS batteries will normally involve the use of an AC load bank on the output of the UPS, so the cell/unit data collection is no longer integrated within the load bank and would require standalone data collection systems for each cabinet.

To easier facilitate the use of discharge testing, many of the new datacenters are incorporating switchable AC load banks into the electrical infrastructure. This will allow the output of any UPS to be transferred to a load bank for testing. Many of these data centers are also installing battery monitoring systems in order to automate as much of the battery maintenance as possible. One of the key parameters identified in 1491-2012, the *IEEE Guide for Selection and Use of Battery Monitoring Equipment in Stationary Applications* are the unit voltages. This means that in any compliant monitor, all the necessary discharge data should automatically be collected and analyzed by the monitor, hence the title of this article.

THE FUTURE OF BATTERY MONITOR ANALYSIS

As with everything battery related, there is always more to the story. Permanently installed battery monitors have been with us for over 30 years but have often been used to eliminate the labor associated with manual data collection rather than improve the analysis with an increased volume of data.

Because the traditional method of analyzing collected data was to treat each measured parameter in isolation, and to track it with limit or trend-based analysis techniques, the value in tracking the change in relationships between parameters under all operational conditions has not been fully realized. With the increasing use of what is known as Artificial Intelligence (AI) to analyze large volumes of interrelated data, this could be changing. Perhaps the rest of the story is that our title is out of date and it is the battery monitor with artificial intelligence that will use a load bank as a peripheral, at least initially, in order to verify the analysis capabilities as they are developed.