Introduction

Battery system maintenance and monitoring are key elements in the reliability of any DC battery powered system and are IEEE and NERC requirements. Also, most battery manufacturers require regular maintenance and maintenance records of purchased batteries for any warranty claims.

The nature of construction of VRLA batteries prevents internal inspection of cell plates and elements that are normally done as part of standard maintenance of flooded lead acid batteries. This limits the ability to identify and record problems with batteries or their cells.

However, there are still key elements of a cell's condition which can be identified and documented to show a battery or cell is operating normally or exhibiting a problem. These include: cell voltage, internal resistance value and temperature.

With the right equipment and measurement frequency, potential problematic cells can be identified and addressed before a failure occurs and renders the back up power source unavailable.

Theory

In flooded lead-acid batteries there are many indicators available to determine the state of condition of any given cell: voltage, specific gravity, temperature, internal resistance, visual plate appearance, sediment levels, plate coloration, etc.

VRLA batteries are assembled in containers designed to prevent the escape of gases by recombination and sealed to the atmosphere. Doing so eliminates many of the indicators which could identify potential problems with a cell or battery.

Over the past 30 years, internal resistance testing has become the standard for monitoring the characteristics of VRLA battery performance. Changes hidden within the batteries' opaque case material can be identified by their corresponding affect on the internal resistance of a cell.

As battery cells age and deteriorate, the internal resistance values in the cells increase, indicating a departure from healthy battery readings. One under-performing battery in a string can significantly reduce the life of the other batteries in the string, causing the entire system to fail or be in need of complete replacement. Sudden changes in the history of readings from one preventive maintenance performance to the next can indicate an upcoming problem with a battery before an actual catastrophic failure occurs.

Only by measuring, monitoring, and comparing these values to reference values supplied by the battery manufacturer can you get a sense of when a battery is good, poor, or will fail.

Chart 1

Maintenance of Batteries		
	Flooded Lead-Acid	**VRLA**
Voltage Float Range	Measurement	Measurement
Specific Gravity	Measurement	Not Available
Temperature	Measurement	Measurement
Internal Resistance	Measurement	Measurement
Plate Condition	Visual	Not Available
Plate Coloration	Visual	Not Available
Sediment Levels	Visual	Not Available
Condition of Separators	Visual	Not Available
Amount of Electrolyte	Visual	Not Available

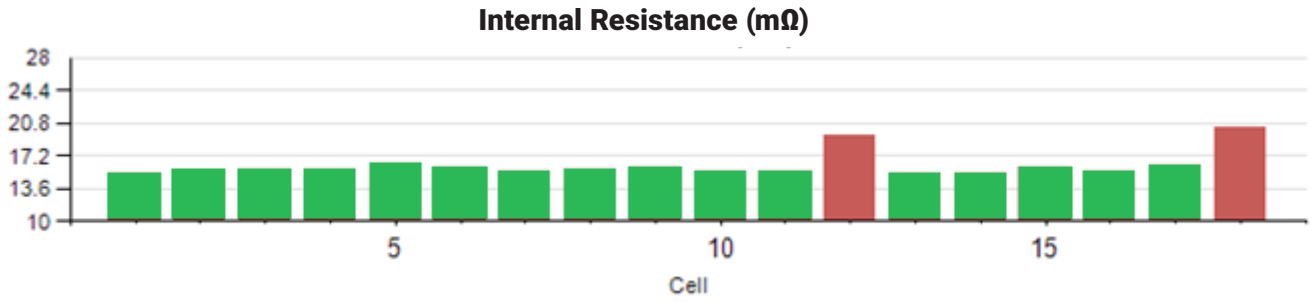
As demonstrated in Chart 1, the indicators of cell or battery condition and health when plates are not visible are greatly reduced. The available measurements that give an indication of battery health become even more valuable and necessary.

Historical Readings

Before measuring the internal resistance of a battery or cell, a baseline reference value needs to be established. Contact the battery manufacturer to provide baseline internal resistance reference values. Taking an initial reading of a string of batteries when they are initially installed will help determine a baseline for each battery or cell as well.

By measuring and tracking the internal resistance values, you can identify when a cell reaches a point of concern or failure based on pre-determined criteria, prior to the battery or cell failing under load when it is needed in an emergency situation.

Example 1



(Graph generated from SBS-6500 Battery Analyzer software)

Example 1-A

Cell	Impedance	Volt	SG	Temp	Result
1	15.25mΩ	13.65 V	----	68.2°F	Pass
2	15.48mΩ	13.58 V	----	68.4°F	Pass
3	15.81mΩ	13.67 V	----	68.5°F	Pass
4	15.70mΩ	13.60 V	----	68.7°F	Pass
5	16.32mΩ	13.55 V	----	68.8°F	Pass
6	16.05mΩ	13.54 V	----	69.1°F	Pass
7	15.58mΩ	13.58 V	----	71.3°F	Pass
8	15.80mΩ	13.54 V	----	71.4°F	Pass
9	15.91mΩ	13.46 V	----	71.5°F	Pass
10	15.48mΩ	13.49 V	----	71.6°F	Pass
11	15.42mΩ	13.51 V	----	71.7°F	Pass
12	19.49mΩ	13.33 V	----	71.9°F	Warning
13	15.34mΩ	13.46 V	----	72.5°F	Pass
14	15.39mΩ	13.49 V	----	72.5°F	Pass
15	15.95mΩ	13.44 V	----	72.5°F	Pass
16	15.48mΩ	13.46 V	----	72.6°F	Pass
17	16.10mΩ	13.41 V	----	72.7°F	Pass
18	20.36mΩ	13.21 V	----	72.8°F	Warning

Test Results generated from SBS-6500 Battery Analyzer

When looking at this example, two potential battery failures were identified by testing the internal resistance. Identifying these potential failures allow you to take corrective actions, whether it's replacing the batteries or monitoring them more closely.

Summary

Regular battery maintenance and testing is key to battery system reliability, adhering to NERC and IEEE requirements, redeeming a manufacturer's warranty and helping predict a battery's performance. Due to the limited number of indicators of a cell's condition in VRLA batteries, it is critical to use information that is available with internal resistance testing. The recommended practice of regularly monitoring battery and battery cell conditions can identify potential problems prior to them causing equipment failures.

About Storage Battery Systems, LLC

Battery testing and maintenance is the only true way to predict a battery's performance and available life. As an industry-leading manufacturer of stored energy Power Solutions™, Storage Battery Systems has been in the forefront in the development of devices used in analyzing, recording and monitoring critical battery operating parameters required by many government and safety regulatory agencies.

Dating back to the late 1980s, Storage Battery Systems was the first North American battery manufacturer to market a "Digital Battery Hydrometer" to quickly test and record electrolyte specific gravity, temperature and cell voltage in lead-acid batteries. Storage Battery Systems will continue to be on the forefront of the industry with new, unique, innovative, reliable products which are easy to use and operate with superb customer service and support.

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SBS-6500 Battery Analyzer