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Power Electronics State of Charge Readings and Aquion Products

Application note for all Aquion batteries **August 30, 2016**

Summary

Battery state of charge (SOC) is an important parameter of any energy storage system. Many bi-directional inverters commercially available today include preinstalled algorithms for calculating and displaying the SOC of typical lead acid or lithium ion batteries. Aquion's Aqueous Hybrid Ion (AHI™) batteries use a fundamentally new and different electrochemistry. As is the case with other types of battery chemistries, the calculation of SOC for an AHI battery is unique. Accordingly, using the SOC algorithms contained in today's battery inverters to calculate the SOC for AHI batteries can sometimes lead inverters to report an inaccurate SOC for Aquion batteries. The degree of error in SOC reporting varies widely between inverters and also can depend on how they are configured. In some applications, this may not be an issue, and in others it may cause inefficiencies and suboptimization with the overall system integration, especially when SOC is used to trigger starting of generators or transferring load to the grid. This application note explains the issue and provides guidance on potential solutions.

Background

SOC is typically displayed on 24 V and 48 V battery inverters for information purposes, providing guidance on how much "gas is left in the tank." However, because SOC is an indicator of battery energy level, it is important to provide a reasonably accurate SOC, especially when the batteries are being integrated into a large or complex system that uses battery SOC as a critical input.

Some systems base their generator or grid connection dispatch decisions on the calculated SOC of the energy storage system. In these instances, overall system performance hinges on accurately understanding the battery's SOC at any given point in time or stage of operation.

The ubiquitous lead acid battery has been produced for over a century, has remained technologically unchanged, and is well understood and documented. Similarly, many types of lithium ion batteries have been in use for many decades. Accordingly, today's battery inverters traditionally include lead acid and often lithium ion SOC parameters that can be configured at the time of installation.

Because AHI is a new battery technology, existing battery inverters have not yet incorporated AHI-specific SOC algorithms into their parameter settings. The operating profile of AHI batteries more closely resembles that of lead acid, so customers commonly install AHI batteries using the preconfigured lead acid settings included with the battery inverter. Using this method does not compromise the overall

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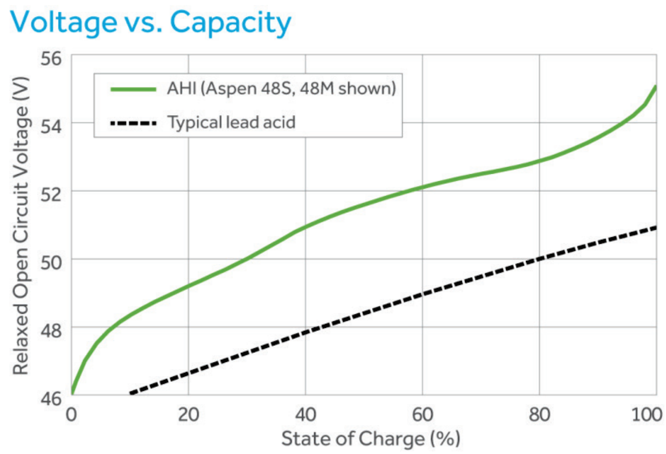
functionality of the system. However, some customers occasionally note that the SOC of their newly installed AHI system doesn't look like what they're used to seeing with lead acid batteries. This is because the SOC display on the battery inverter is not always reporting an accurate SOC when used in this configuration, though the battery itself is most likely performing normally.

Technical Details

Comparing the SOC versus open circuit voltage graphs of lead acid and AHI batteries shows why lead acid SOC algorithms don't map perfectly to AHI SOC. The lead acid curve shown is representative of typical valve-regulated lead acid (VRLA) batteries, with voltage scaled up to the AHI battery's voltage range.



To determine battery SOC, most inverters use a set of equations based on voltage measurements, temperature compensation, and charge/discharge current compensation. These equations are specific for lead acid electrochemistry, not for the AHI electrochemistry, which means lead acid calculations will not produce accurate SOC values for AHI batteries.

What does this mean for my system?

For many systems, provided that the battery charge and discharge parameters are correctly configured, displaying an accurate SOC does not have a direct impact on system effectiveness. However, if you have a stack-based Aquion battery system and require an accurate SOC measurement and readout, Aquion recommends installing its battery monitoring system (BMS-200) and stack sensing system (SMI-100). For module-based systems, Aquion recommends the BMS-200 and sensed battery modules. Aquion monitoring systems provide and display accurate SOC values for AHI batteries. In nearly all cases, if you install the Aquion BMS you won't need an SOC input from the battery inverter.

- BMS-200 specification sheet
- SMI-100 specification sheet
- Aspen 48S battery specification sheet
- Aspen 48M battery specification sheet

Future Products

Aquion realizes the importance of this issue and is committed to providing high-quality solutions for our customers. Aquion is in the final stages of developing a simplified and cost-effective monitoring solution

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for smaller, stack-based AHI energy storage systems that will also provide an SOC reading. This alternative will be available in the second half of 2016.

Finally, we're engaging with leading inverter manufacturers from around the world to help them include preinstalled algorithms and parameters specific for Aquion batteries into their products. Look for this in future product releases from those companies.

Contact Us for More Information

If you purchased your batteries from an authorized Aquion Energy dealer, please contact them directly for assistance. If you purchased your batteries directly from Aquion Energy, contact Aquion Technical Support: http://aquionenergy.com.

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