EMPOWERING REDOX FLOW BATTERIES USING SUPERCAPACITORS

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Developing a Hybrid Energy Storage System (HESS) involves integrating technologies with complementary attributes. Feasibility analysis of HESS necessitates considering various specifications such as energy density, power density, and discharge time. Additionally, factors like cost, lifetime, shelf life, storage duration, ecological impact, safety, and design flexibility play crucial roles. Evaluating all these specifications for the currently available EESs (Energy Storage Systems) and assessing the potential technology combinations, the coupling of Redox Flow Batteries (RFBs) with Supercapacitors (SCs) emerges as one of the most promising options [1].

In this study, we present a laboratory-sized HESS comprising a Vanadium Redox Flow Cell (VRFC) and a SC, which are directly connected in parallel without using any power converter. Initially, individual tests were conducted on the standalone VRFB and SC using short discharge protocols (5 s). Subsequently, the two systems were interconnected in parallel and subjected to the same discharge protocol. An equivalent electrical model, resembling a parallel R-C circuit, was developed to elucidate the discharge mechanism of the direct parallel system.

The testing and modeling aimed to provide insights into the behavior and advantages of the VRFB-SC HESS. The tests revealed that the SC mitigates the VRFB's ohmic drop due to the transient behavior of the R-C circuit. Furthermore, the hybrid system demonstrated enhanced energy delivery at

higher currents compared to the standalone VRFB, a phenomenon elucidated by our proposed model. Additionally, the model facilitates appropriate sizing of the SC relative to VRFB performance.

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References

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