Hawai‘i Natural Energy Institute Research Highlights

Electrochemical Power Systems

Battery Energy Storage Systems Durability and Reliability

OBJECTIVE AND SIGNIFICANCE: The objective of this work is to better understand the degradation of batteries in grid deployed systems. The knowledge gained in this project will inform best practices to improve durability and safety of large batteries deployed on the electric grid.

BACKGROUND: Battery Energy Storage Systems (BESS) show promise in mitigating many of the effects of high penetration of variable renewable generation. HNEI has initiated an integrated research, testing, and evaluation program to assess the benefits and durability of grid-scale BESS for various ancillary service applications. BESS were deployed at 3 sites. The first one was deployed in December 2012 on the Big Island of Hawai‘i. The other two were deployed on Moloka‘i and O‘ahu in 2016 (Appendix B1). Usage was closely monitored and maintenance cycles using protocols recommended by the manufacturer, as well as custom HNEI protocols, were applied.

PROJECT STATUS/RESULTS: Usage from the BESS was carefully analyzed to facilitate laboratory testing of individual cells representative of actual operating conditions.

All cells used in the demonstrations and laboratory testing were Li-ion titanate from Altairnano. Close to 100 cells were tested in the lab to monitor aging patterns, reproduce the aging observed in real life, and accelerate the degradation.

This project showed that, because of the lower voltages, these cells are far less sensitive to degradation induced by calendar aging and high state of charges than traditional Li-ion batteries. Moreover, their capacity fading pace is also slower. Based on our results, we are projecting that accelerated degradation, a typical occurrence in traditional lithium ion batteries, remains of concern under certain conditions, notably if the cells are kept consistently above 35ºC (Figure 1). Research conducted for this project is completed in the **PakaLi Battery Laboratory**.

This is an ongoing project, which has led to 10 publications so far including: “**Battery Energy Storage System battery durability and reliability under electric utility grid operations: Analysis of 3 years of real usage**” in the Journal of Power Sources, Vol. 338, pp. 65-73 and “**Battery durability and reliability under electric utility grid operations: Representative usage aging and calendar aging**” in the Journal of Energy Storage, Vol. 18, pp. 185-195.

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Contact: Matthieu Dubarry, matthieu@hawaii.edu; Richard Rocheleau, rochelea@hawaii.edu

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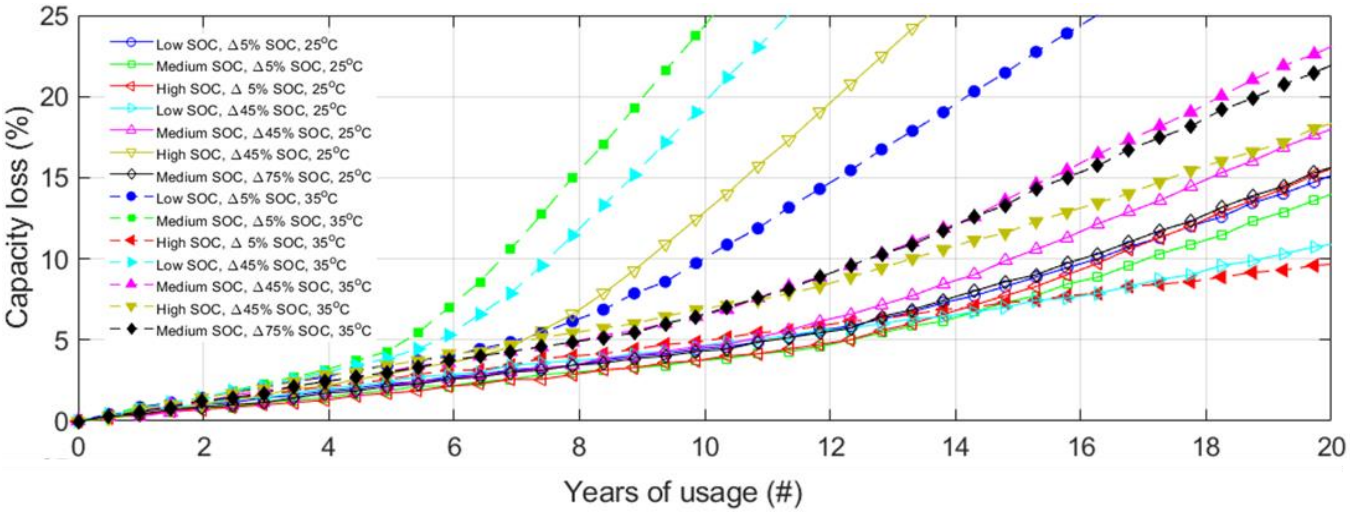

Hawai‘i Natural Energy Institute | School of Ocean & Earth Science & Technology
University of Hawai‘i at Mānoa, 1680 East-West Road, POST 109 • Honolulu, HI 96822
Phone: (808) 956-8890 • Fax: (808) 956-2336 • www.hnei.hawaii.edu