Laboratory testing of LTO based cells for BESS applications

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The Hawai'i Natural Energy Institute (HNEI) is leading a team engaged in the research, development, deployment, and analysis of grid-scale battery energy storage systems (BESS) that are designed for system control and power quality support at the generation, transmission, and distribution levels. The program aims to identify high value BESS applications at various system levels, develop control algorithms that maximize the benefit to the grid/customer and the lifetime of the BESS, and evaluate and optimize those algorithms under real world operating conditions.

The focus is to deploy, operate, and validate the performance of four grid-scale BESS for various ancillary service applications on grid systems across the state. Large scale battery energy storage systems will become an important part of the electric grid in the near future and it will be essential to ensure their reliability. The objective of this project is to understand the degradation of the individual batteries to anticipate failures. Laboratory testing of advanced Li-ion battery cells is performed to support life-time analysis of technologies targeted for large-scale grid energy storage applications.

HNEI's battery testing efforts have focused on grid scale deployment lithium ion titanate battery technology which is successfully being used for a variety of purposes including frequency and power regulation of large scale wind and solar energy generation. There is currently a lack of understanding of long term performance of battery technology in general, and specifically lithium ion titanate, used under large scale, grid conditions. This work aims to fill that gap in knowledge through laboratory scale battery testing and the development predictive lifetime models of performance of grid battery technology.

Accelerated testing of identical lithium ion titanate battery technology was performed in the laboratory and those results will be used to develop predictive performance models. This model will combine existing modules [1-4] that account for single cell asymmetric degradation, single cell heat generation, string imbalance, and cell paralleling. As real world data is collected from the grid batteries, the predictive models will be compared and assessed for accuracy and ability to predict performance. This work will present preliminary results.

[1] M. Dubarry, N. Vuillaume and B. Y. Liaw, J. Power Sources 186(2), (2009) 500-507.
[2] M. Dubarry, C. Truchot and B.Y. Liaw, J. Power Sources 219 (2012) 204-216.
[3] https://www.soest.hawaii.edu/HNEI/alawa/
[4] M. Dubarry, C. Truchot, A. Devie and B. Y. Liaw, J. Electrochem. Soc 162(6), (2015) A877-A884.