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# Testing of EV Battery Cells for Stationary Applications

## Introduction

Until very recently, the energy storage industry did not have a codified test cycle or testing protocol for testing the effect of energy storage devices on the grid. With a newly established performance testing protocol developed by PNNL and SNL with industry participation and endorsement, it will be possible to determine the performance of these batteries for grid services, and also reduce the uncertainty about life-time impacts on vehicle batteries that are exposed to grid services. This project will address this uncertainty and concern by the industry and, thus, will build confidence in the understanding of how to test transportation batteries for grid services. This may ultimately lead to wider acceptance by the automotive industry to utilize an EV/PHEV battery as a grid resource.

## Project Objectives and Outcomes

The main objective of this project is to provide insights into the performance of and life-time impacts on transportation batteries when used for specific high-value grid applications, often referred to as Vehicle-to-Grid (V2G) applications. The project will fill the current gap of how grid services may impact the usable life of a transportation battery. The long term degradation for various grid services will be quantified for cells.

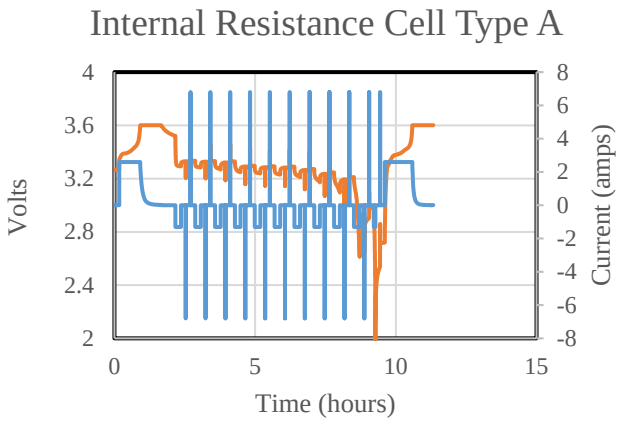

Figure 1. Internal resistance and response time/ramp rate test for cell type A.

Two high value grid services, regulation service and peak shaving, will be used. It is anticipated that additional grid services such as a) load following, b) PV Smoothing and combination of grid services will also be performed in the scope of this project. The outcome of the project will be insights and clarity on economic benefits and performance degradation of transportation batteries when providing grid services. This increased understanding would provide general recommendations to the automotive industry for limiting degradation while maximizing performance and benefits when subjecting a transportation battery to grid services. Validation on battery modules in the future would further enhance the significance of this work.

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**Sponsoring Agency:** DOE/EERE/VTO/BMR program

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Selected Publications:


[1] VV Viswanathan, Conover DR, M. Kintner-Meyer, S Ferreira, D. Rose and D Schoenwald. 2012. Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems. PNNL-22010, Pacific Northwest National Laboratory, Richland, WA; 2014. PNNL-22010, Rev. 1.

[2] VV Viswanathan, Conover DR and AJ Crawford. 2014. Determination of Duty Cycle for Energy Storage Systems Integrated with Microgrids. PNNL-23390, Pacific Northwest National Laboratory, Richland, WA.

[3] V.V. Viswanathan, M.C. Kintner-Meyer, “Repurposing of batteries from electric vehicles”, Chapter 15, in Advances in Battery Technologies for Electric Vehicles, 1st Edition, B. Scrosati, J. Garche. W. Tillmetz Eds., Woodhead Publishing, An imprint of Elsevier, May 28, 2015.

[4] VV Viswanathan and Michael Kintner-Meyer, Second Use of Transportation Batteries: Maximizing the Value of batteries for Transportation and Grid Services, IEEE Trans. Vehicular Technology, 2011, 60 (7), 2963-2970

[5] VV Viswanathan, D Choi, D Wang, W Xu, SA Towne, RE Williford, J Zhang, J Liu, and Z Yang. "Effect of entropy of lithium intercalation in cathodes and anodes on Li-ion battery thermal management." Journal of Power Sources**,** 2010, 195 (11), 3720-3729.