

DOE/Sandia National Labs Energy Storage Program

Daniel Borneo, P.E.
Sandia National Laboratories

NATTBATT

Member Update

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*Exceptional
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national
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Energy Storage (ES) Demonstration & Analysis



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Presentation Outline

- **Project Overview**
 - Mission Statement
 - Approach
- **Current Projects**
 - Geographical Location of Projects
 - Summary Chart of Projects
- **Path Forward - Next Steps**
 - Demonstration and Analysis
 - Commissioning
 - Safety & Reliability

SNL ES Program Overview

Mission Statement:

Encourage investment in Energy Storage (ES) by:

- Developing new ES technologies
- Developing new materials for ES devices
- Power electronics research and development
- Evaluation, analysis, and optimization of ESSS
- Conducting field demonstrations of new and existing technologies in various applications
- Commissioning support and operational evaluation
- Developing codes, standards and regulation
- Outreach

Advanced Membranes for VRFB



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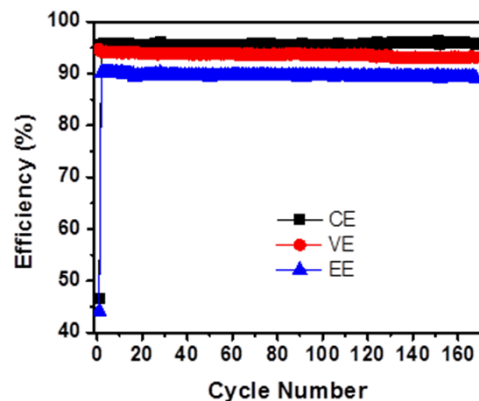
- VRFB are being explored by DOE and industry for large scale energy storage
- Several companies looking to commercialize the technology

UET UniEnergy
Technologies

WattJoule

IMERGY™ POWER SYSTEMS

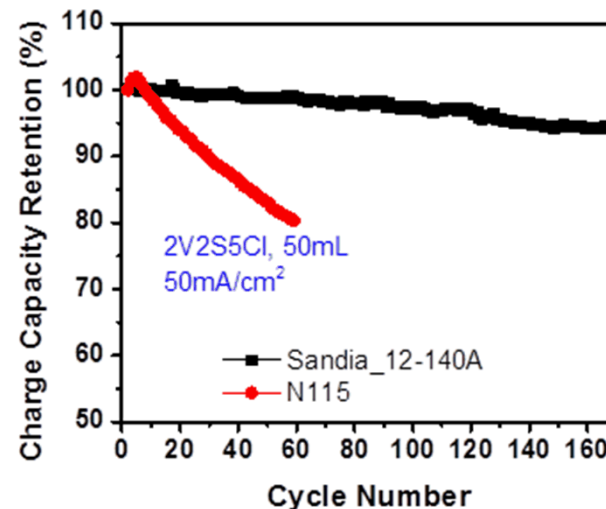
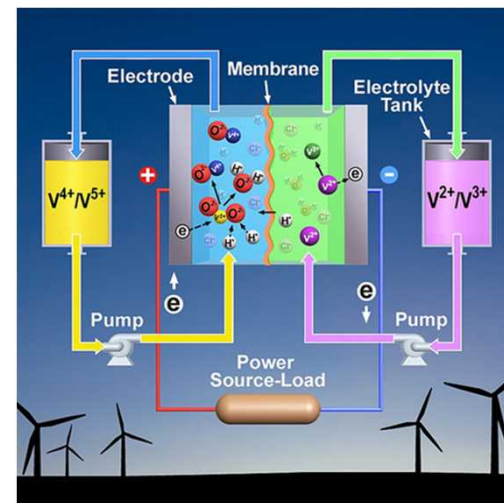
- Sandia is developing a low cost membrane separator that has been shown to have high efficiencies and able to maintain high charge capacity over 160 cycles (4 months of testing) while Nafion loses 80% of capacity after 60 cycles



Columbic efficiency 95%

Voltage efficiency 94%

Energy efficiency 90%



Energy Storage Power Electronics Program, SNL



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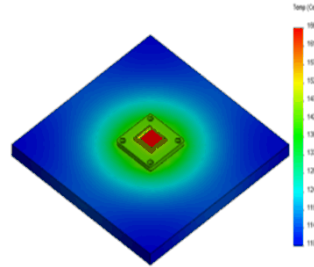


Using wide bandgap semiconductor devices, advanced topologies, and controls to reduce installed cost and footprint, improve control capability, and increase reliability



Arkansas Power Electronics
International
15kV Discrete SiC Package

$P_{dis} = 200 \text{ W}$, Max Temperature = 166°C



Recognition

- Four R&D100 Awards
- Three U.S. Patents, three pending
- Over 40 technical publications
- Stan Atcitty received Presidential Early Career Award for Scientists and Engineers
- Power Electronics for Renewable & Distributed Energy Systems book



FY15 Accomplishments

- Developed World's first high voltage (15kV at 100 amps, 200C) SiC multichip module
- Developed world's first normally-off 6.5 kV SiC Junction Field Effect Transistor (JFET) high voltage module
- Developed route for direct fabrication of advanced transformer cores for > 20 kHz high frequency converters

FY15-16 Plans

- Transition the SiC high voltage module into a manufactured product and commercialize
- Demonstrate continuous operation of the 6.5kV JFET module at 20 kHz, 60A, 200C for next generation ESS
- Optimize synthesis and fabrication of advanced transformer cores to maximize performance of high frequency DC-link converters

The Energy Storage Systems Analysis Laboratory (ESSAL)



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Providing reliable, independent, third party analysis and verification of advanced energy technologies for cell to MW systems

Cells and Modules



72V 1000A Bitrode (2 Channels)

Cell, Battery and Module Analysis

- 14 channels from 36 V, 25 A to 72 V, 1000 A for battery to module performance analysis
- Over 125 channels; 0 V to 10 V, 3 A to 100+ A for cell performance analysis
- Potentiostat/galvanostats for spectral impedance
- Multimeters, shunts and power supply for high precision testing
- Temperature chambers

Fully Integrated Systems

Lab Analysis



Energy Storage Test Pad (ESTP)

- Scalable from 5 KW to 1 MW, 480 VAC, 3 phase
- 1 MW/1 MVAR load bank for either parallel microgrid, or series UPS operations
- Subcycle metering in feeder breakers for system identification and transient analysis
- Thermal imaging
- System Safety Analysis (new)

Field Analysis (new)



Remote Data Acquisition System (RDAS)

- Portable, Modular, Remotely Reconfigurable, and outdoor-ready
- Subcycle metering
- Tractable calibration
- Command Signal Ready for Grid Operator Simulation
- No control over grid conditions

ES Demonstration & Analysis Project Overview



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Approach

- Work with National and International entities including DOD, State Energy offices, Utilities, ES Industry, Universities and Consumers to:
 - Provide **third party independent analysis and evaluation** for cells and systems
 - Support **grid-tied field demonstration** projects to monitor and analyze new and existing ES technologies in differing applications
 - Support State renewable/resiliency/ES initiatives
 - Develop public information programs

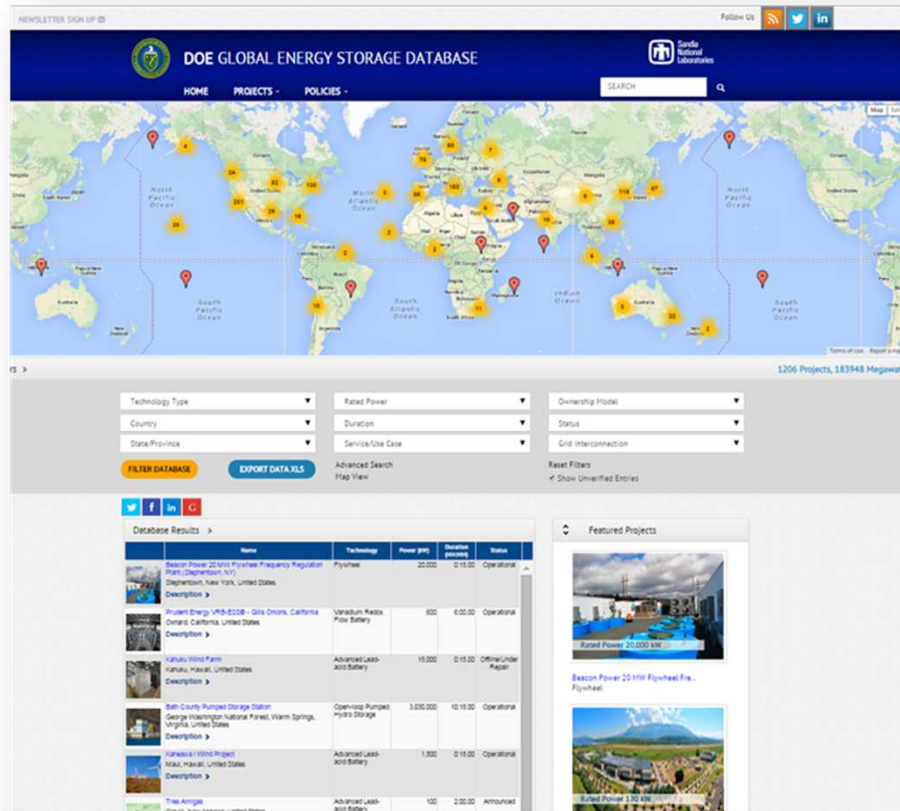
DOE Global Energy Storage Database



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www.energystorageexchange.org



Live Since June 2012

- 1,206 Projects
- 21 Policies
- Users in 189 countries
- 60+ data fields
- 50+ energy storage technologies
- Data Visualization

Help grow ES industry - providing data allowing analysis by a variety of users



www.energystorageexchange.org

Safety & Reliability Resource In Development: Battery Evaluation Website



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For more information, visit the website at:
www.sandia.gov/batterytesting

The 2015 Winter Call for proposals Will open end of September.

Application Deadline: January 15, 2015.
Notifications will be sent out February 2015.

The 4th Proposal Call is for testing:
January 16, 2015 - July 15, 2015.

The database is always open for [FAST-Track
Proposals](#).

Contact: Summer Ferreira
srferre@sandia.gov
or David Rosewater
dmrose@sandia.gov



Advanced Energy Storage Device Testing
Reliable independent evaluation of energy storage solutions.





Acknowledgements

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Thank You

Questions?

Contact Information:

Dan Borneo - drborne@sandia.gov

- Advanced Magnetics for high frequency power conversion system for energy storage - focus high density power electronic designs
- Advanced power semiconductor device development to significantly increase performance (efficiency and reliability) of PCS for energy storage
- Advanced capacitor development in increase power density of PCS for energy storage applications.
- Wide band gap device reliability characterization and optimization.