

Standards for Facilitating Grid Integration

Isolated Power Systems Connect Conference

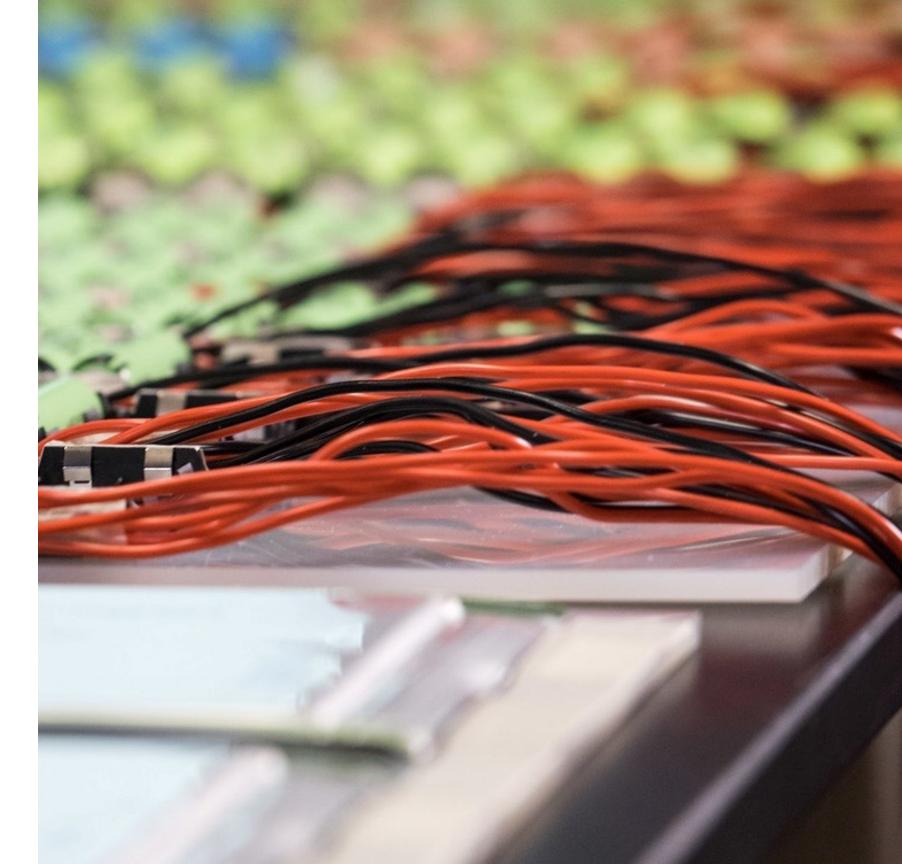
> Cordova, AK July 29, 2022

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Sr. Technical Advisor



PNNL is operated by Battelle for the U.S. Department of Energy





Legislation & Policy Driving Clean Tech Adoption

• Energy Policy Act (2005) Cites and requires consideration of IEEE 1547 Standards and Best Practices for Interconnection; all states use or cite 1547.

• Energy Independence and Security Act (2007) IEEE cited as a standards development organization partner to NIST as Lead to coordinate framework and roadmap for Smart Grid Interoperability standards and protocols {IEEE 1547 & 2030 series being expanded};





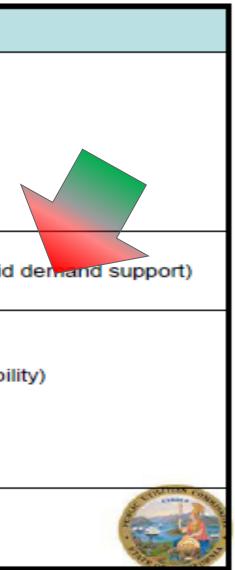


Avoiding Barriers to Clean Tech Adoption

Category	Storage "End Use"
ISO/Market	 Frequency regulation Spin/non-spin/replacement reserves Ramp Black start 1547-2003 vs. new CA 21 & Black start 1547Revision Real time energy balancing Energy price arbitrage Resource adequacy
VER Generation	 Intermittent resource integration: wind (ramp/voltage support) Intermittent resource integration: photovoltaic (time shift, voltage sag, rapid Supply firming
Transmission/ Distribution	 Peak shaving: off-to-on peak energy shifting (operational) Transmission peak capacity support (upgrade deferral) Transmission operation (short duration performance, inertia, system reliabit Transmission congestion relief Distribution peak capacity support (upgrade deferral) Distribution operation (Voltage Support/VAR Support) Outage mitigation: micro-grid
Customer	 Time-of-use /demand charge bill management (load shift) Power quality Peak shaving (demand response), Back-up power

Source (original table): CA PUC Staff, AB2514 workshop, 3/25/2013







DOE OE ES Reliability C&S Program Activity, **Filling Gaps in Standards for Clean Tech**

Technical Standards Development Activities Supported by OE ES

- IEEE P2686 Battery Management System (BMS) Recommended Practice, Rosewater, Searles
- IEEE P2688 Energy Storage Management System (ESMS) Recommended Practice, Schoenwald, Nguyen, Searles
- IEEE P1679.3 Adv. Battery Characterization Guide (Flow battery volume), Viswanathan
- IEEE 2800 Inverter Based Resources Standard, *Elizondo*
- IEC TC-120, *N. American rep, Viswanathan*
- MESA Specifications, Testing & Certification program, Kolln
- SAE/IEEE, Coordinating IEEE 1547 and Emerging V2G Standards, Asgeirsson
- (future) NERC Gen. Availability Data System (GADS), update for large BESS, Labs, EPRI
- IEEE 1547 DER Interconnection Standard Revision project plan approved, Vartanian, Schneider
 - ✓ This significant new IEEE Standard activity will begin early in 2023

ES Technical Standards or References Created or Updated

- IEEE 1547.9 Guide for ES Interconnection completed, Ropp, Vartanian
- MESA-DER Certification testing procedure completed, Kolln



PNNL Energy Storage R&D Program



Grid Storage Efforts at Pacific Pacific Northwest Northwest National Laboratory (PNNL)



Electricity Delivery & Energy Reliability

Cost Competitive Technologies

Redox Flow

Sodium

Zn-MnO₂

Safety and Reliability





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Cordova Electric Coop Energy Storage Integration (CECESI) Project Objective & Expected Outcomes

- Cordova Electric Cooperative installed a 1MW/1MWh battery energy storage system (BESS) in 2019 with a primary objective of reducing diesel fuel consumption
- To support the BESS's primary objective, the CECESI project will:
 - further improve integration of the BESS into CEC's utility monitoring and controls environment,
 - support CEC's use of recorded operating data to verify the benefits from BESS operation, and
 - inform CEC's continued improvement to the BESS's dispatch algorithms







Sandia National Laboratories



CECESI 2020 Scope Update, Add Resiliency to Medical Center Load Service

- In 2020, the CECESI project scope was updated
- Addition of a microPMU at the Cordova Community Medical Center with the following goals:
 - Provide additional information on the interrelationships between grid operations and major load operations
 - Expand the CECESI optimization solution
 - Help to further reduce diesel fuel use
 - Explore extending load service reliability through better visibility





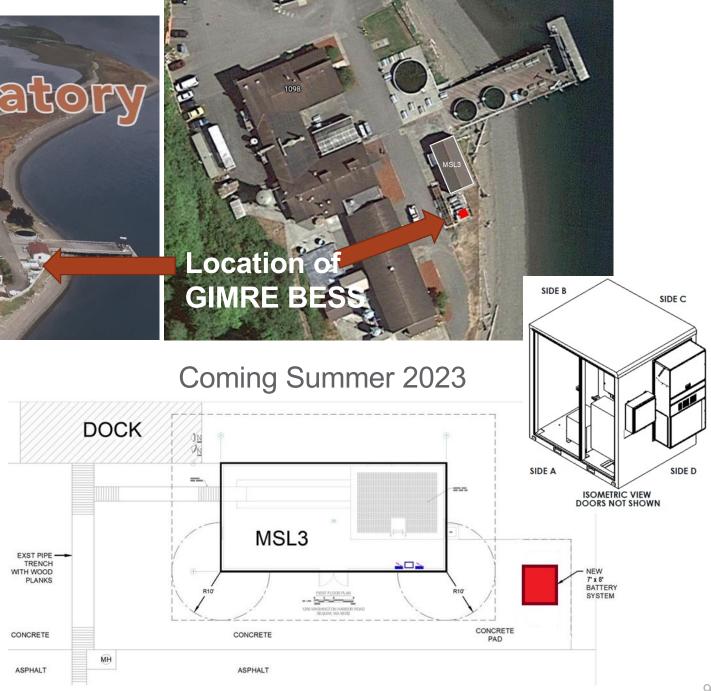
Grid Integrated Marine Renewable Energy (GIMRE), at PNNL's Marine & Coastal Research Laboratory

WELCOME TO THE Marine Sciences Laboratory

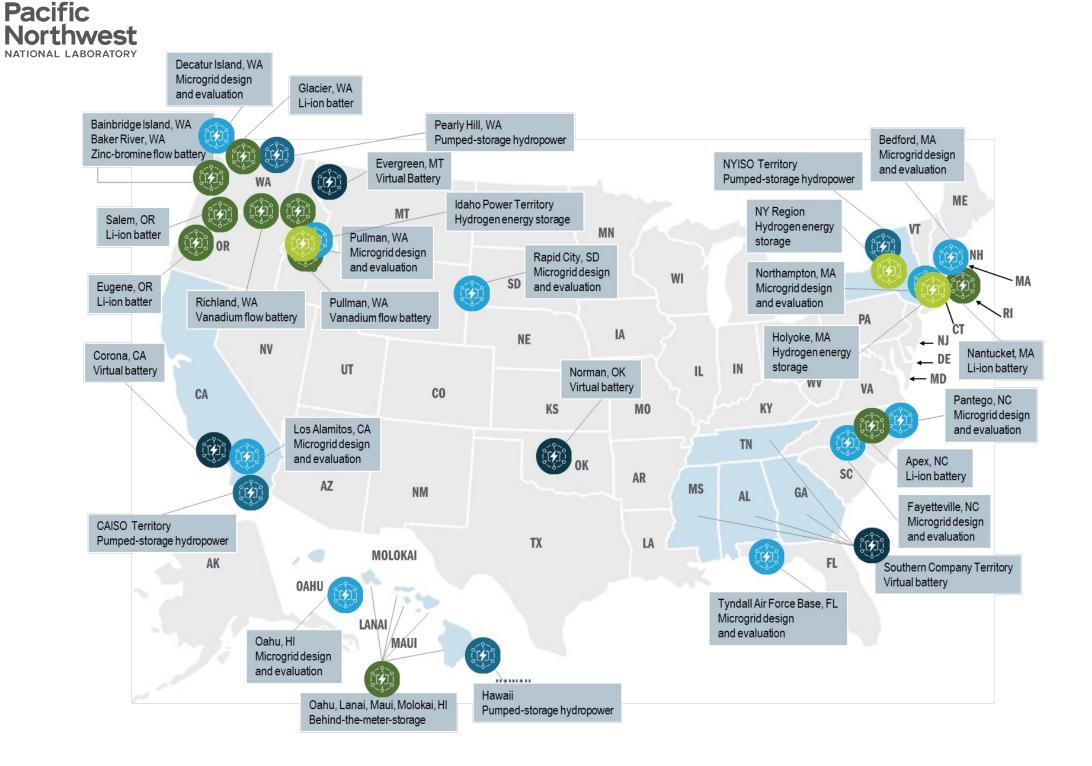
Delivering science and technology crucial to America's energy, environment and security future

GIMRE Project will use a 125kW/208kWh BESS to:

- Demonstrate BESS capabilities applied to mitigating the challenges of variable marine power output
- Demonstrate the feasibility of delivering clean MRE energy to loads while complying with electric utility interconnection requirements (IEEE 1547).
- Verify targeted performance metrics and electrical requirements that include grid disturbance ride through, utility voltage support, and interoperability with power systems communications and controls interfaces









Battery energy storage systems

Pumped-storage hydropower

Storage-enabled microgrid design and evaluation



Hydrogen energy storage



Virtual batterv



Department of Energy's GRID STORAGE LAUNCHPAD Coming to PNNL's Campus in 2023

GSL Vitals

85,000 square feet 105 workstations **30 Lab Modules Estimated Facility Cost:** \$75 Million Leveraged Funding: \$35 Million from State of Washington, Battelle, Pacific Northwest National Laboratory

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