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Energy Storage Test Facility (ESTF)

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Sandia National Laboratories

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Energy Storage Testing Activities

Issues

- There is a need to evaluate energy storage an Energy Storage System (ESS) as a whole rather then component by component
- Unbiased, third party evaluation is a necessary step in bringing new technologies to market but here is no accepted standard for how this evaluation will take place
- The equipment necessary to perform systems tests at the Megawatt (MW) level can be prohibitively expensive

Resulting Problems

- There is considerable uncertainty in how economical an ESS will be
- Companies are less willing to design and build an ESS and so the markets for them is stymied
- New technologies are held back form their potential applications

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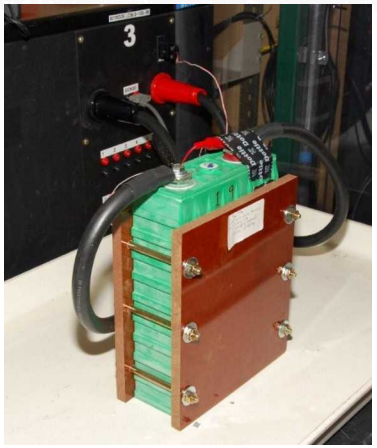
SNL Energy Storage System Testing Laboratory

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

- Testing capabilities for supercapacitors, primary and secondary storage from cells to MW batteries. Testing programs are designed to evaluate and validate battery performance.
- Testing capabilities include :
  - 72 V 1000 A Bitrode (2 Parallel Channels)
  - 60 V 200 A Arbin (2 Channels)
  - 36 V 100 A Bitrode (3 Channels)
  - 36 V 25 A Bitrode (5 Channels)
  - 2 V 10A Arbin (48 Channels)
- New Energy Storage Test Pad (ESTP) expands testing capabilities to include megawatt (MW) scale energy storage
- Temperature chambers for thermal control
- Currently testing energy storage devices :
  - Altairnano 11 Ah and 60 Ah Lithium-titanate oxide cells
  - International Battery 160 Ah Li-ion $FePO_4$ cells
  - East Penn1000 A 24 V ultrabattery modules
  - Redflow 10 kWh Zn-Br flow Battery



International Battery Li-$FePO_4$ Cell

East Penn Ultrabattery Module

Energy Storage Test Pad (ESTP) (April 2010)

Availability in FY 12 for testing cells to MW systems

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RedFlow Testing

Progress

- Arrived at Sandia on October 12th
- Initial Filling and Commissioning Concluded October 14th
- Completion of Phase I testing scheduled for November 18th
- Completion of Phase II testing scheduled for January 13th
- Long term Cycle life Testing to commence concurrent with Phase II

RedFlow SDK Under Test

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ESTP

- Commissioned in April 2011
- Expands testing capabilities to include megawatt (MW) level energy storage
- Testing at ESTP will increase industry confidence in large scale energy storage systems

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ESTP Testing

750 KVA Uninterruptable Power Supply (UPS) Under Test

- Validates and Demonstrates High Power Testing Equipment
- Helps Streamline Future Testing Activities

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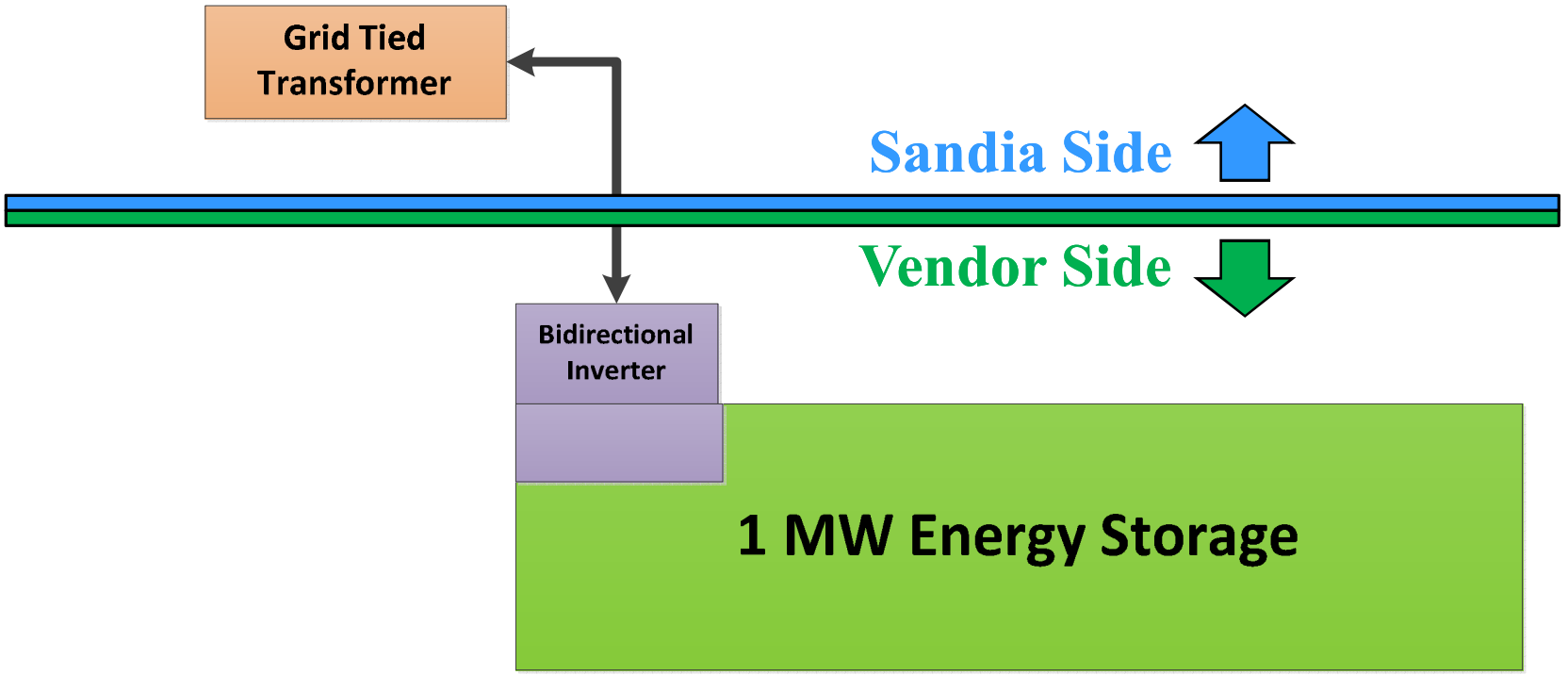
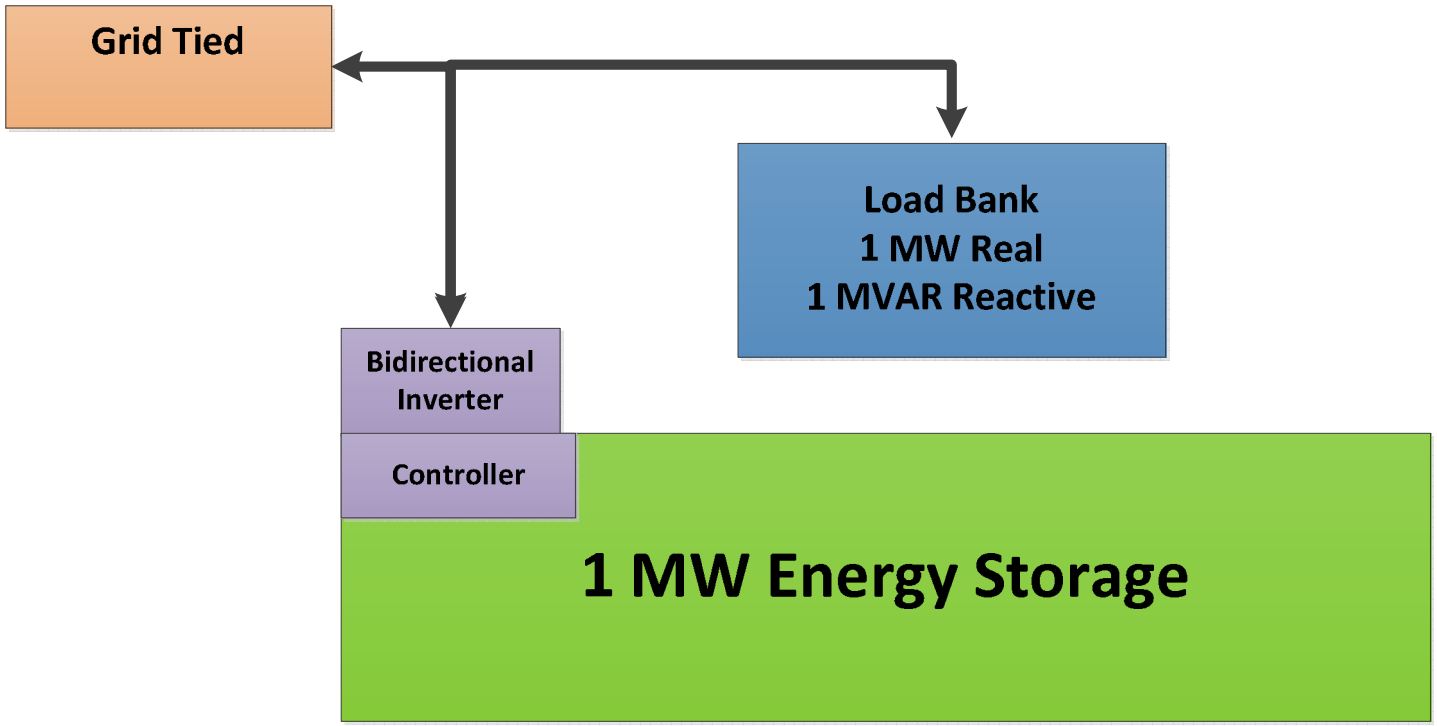
Configuration One

Testing: Frequency Regulation and Energy Shifting Applications



Configuration Two

Testing: Grid Tied Reactive Power Support Applications



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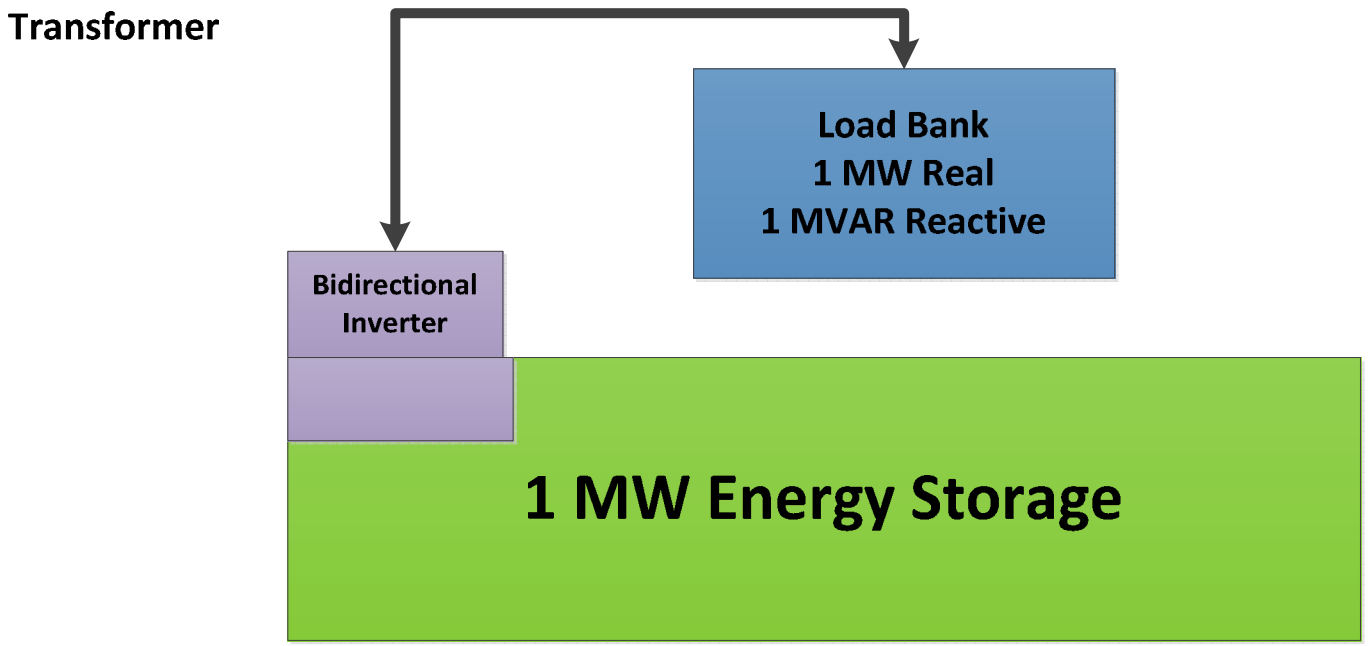
Configuration Three

Testing: Islanded Load Following & Power Quality Applications



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Summary of Systems Testing

- **The RedFlow system is under test**
- **The ESTP is finished and ready to test MW level energy storage systems in a verity of applications**

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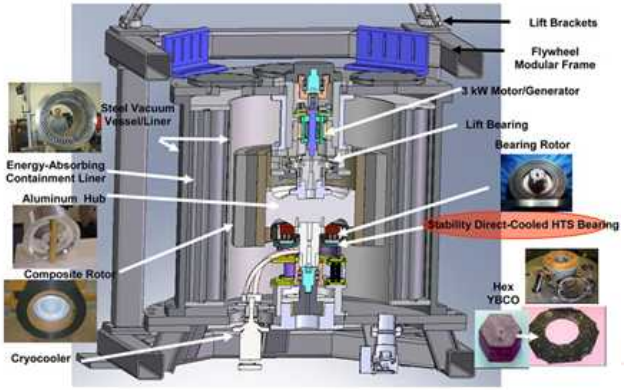
Future Tasks

- Support Third Party and Collaborative Testing of Energy Storage Systems
  - RedFlow Flow Battery
  - Boeing Flywheel (in negotiations for May 2012)
- Automate Control and Telemetry of the Megawatt Loadbank at the ESTP with a Process Logic Controller (PLC)
- Exploration of Advanced Testing Methodologies
  - Application Specific Test Profiles
  - Superposition of Multiple Applications

RedFlow ZBM



Boeing Flywheel

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Questions?

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Acknowledgments

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