Energy Storage Test Pad

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Energy Storage Test Pad (ESTP)

- **Challenge**: Unbiased, third party evaluation is a necessary step to bring new technologies to market
  - The equipment and expertise necessary to perform testing of energy storage systems can be cost prohibitive, especially at the MW level
- **Approach**: Offer third party testing that provides a real picture of how energy storage systems operate
  - This in turn provides confidence to developers, users and adopters of energy storage
- **Goal**: Utilize infrastructure and expertise at Sandia to perform high value testing of energy storage systems
  - Generate reliable data by performing validation testing
  - Research new and advanced testing methodologies
  - Organize and participate in standards activities
Energy Storage Systems Testing

- Testing Validation
  - Altairnano
  - East Penn
  - RedFlow DC
  - RedFlow AC
  - Boeing Flywheel

- Testing Methods
  - Service Modeling
    - Stacked Profiles

- Testing Standards
  - DOE
  - IEEE
  - IEC
Testing Validation (systems)

- Energy Storage Test Pad (ESTP)
  - Capabilities (MW and beyond)

- RedFlow System Development Kit (SDK)
  - DC System, preliminary report released in February
  - Temperature testing performed since then
  - Full report pending on completion of R510US testing

- RedFlow R510US
  - AC System, preliminary commissioning and cycling data

- Boeing 3kW 5kWh Flywheel with superconductive bearings
  - Low speed testing complete at Boeing
Energy Storage Test Pad (ESTP)

- Can test for both power and energy applications including energy time shift, capacity, load following, area regulation, voltage support, T&D deferral, demand charge management, and power quality and reliability.
- Programmatically integrated with Distributed Energy Technologies Lab (DETL)
- Test duration can range from one day to multiple months.
- Scalable from 1 KW to 1 MW, 480 VAC, 3 phase.
Testing Validation RedFlow SDK

- Released Initial Test Results Report in February
  - Covered initial characterization
- Progress:
  - Completed temperature testing
  - Will begin telecom service cycling soon

RedFlow SDK Undergoing Temperature Testing
Testing Validation RedFlow R510US

- Islanding data from real power outage

- Cycling

- RedFlow R510US Commissioning Cycle

- Voltage Sag 1

- Voltage Sag 2

- Breaker Trip Island Test
Testing Validation Flywheel

Initial Test Plan
- Capacity
- Efficiency
- Self Discharge
- Response Rate

Long term plan
- Utilize as a research and development asset to test new control schemes and hardware
Testing Methods

- Application Characterization and Modeling
  - Statistical analysis of day-to-day variations in application requirements.
  - Autoregressive Modeling to Generate Statistically Representative Profiles

- Effect on Cell Life of Stacked Profiles
  - Frequency Regulation & Peak Shaving
Testing Standards

- **DOE Performance Protocol**
  - Application Specific Performance

- **IEEE P2030.2 Interoperability of Energy Storage**
  - Continuing Contributors
Outreach

- Released a Call for Collaboration
  - Generated interest from many industry partners including: Samsung SDI, Primus Power, Altairnano
- Energy Storage at Forward Operating Bases (Fort Devens)
  - RFI requires validation at ESTP before demonstration
- Collaboration with the Electric Power Research Institute (EPRI)
  - Demonstration project in 2013 to be validated at ESTP
- Ongoing pursuit of collaborators
Summary/Conclusions

- **Validation**
  - Report released in February 2012 on the initial test results of the RedFlow DC system
  - RedFlow AC system
  - Boeing System being prepared for shipment to Sandia

- **Methodology**
  - Frequency regulation model data has been statistically validated
  - Life cycle cell testing with stacked applications has begun at KEMA

- **Standards**
  - DOE Performance protocol published
  - IEEE activity is ongoing
Future Tasks

- Continue testing systems
  - RedFlow
  - Boeing
- Continue to refine our testing methodology
  - Completion and publication of stacked waveform and stochastic application testing
- Continue to contribute to energy storage standards
  - IEEE
  - IEC
- Find new collaboration opportunities for testing
  - End Users
  - Manufacturers
  - You!
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