ETAC Presentation - NorthWestern Energy Battery Storage Project

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NorthWestern Energy - DSM Engineer
Today’s Presentation

- **Battery Storage Project**
  - Project Description
  - System Description
  - Installation
  - Testing
  - Integration

- **Distributed Generation**
  - Smart Grid Project
Project Description

**Battery Storage Project with Renewables Integration**

- Purchase, install and test small scale battery storage system
- Project funded with USB $ in 2011 & 2012
- 30 kW system with 4 hour battery backup
- Install on NorthWestern Energy distribution line
Project Description

- **Schedule**
- **Status**
  - Installation location selected – Helena Service Center Yard
  - Equipment purchase and delivered (Butte warehouse)

<table>
<thead>
<tr>
<th>Activity</th>
<th>2013</th>
<th>2014</th>
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<tbody>
<tr>
<td>Purchase Equipment</td>
<td></td>
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<tr>
<td>Installation Design</td>
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<tr>
<td>Installation</td>
<td></td>
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<tr>
<td>Testing</td>
<td></td>
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<tr>
<td>Analysis &amp; Reporting</td>
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System Description

- Technology - Joule.System™
System Description

- **Manufacturer**
  - Demand Energy Networks
    - Headquartered in Liberty Lake, WA
    - Launched business in 2008
    - First commercial deployment in 2011
    - Funded by private investors
      - Senior team of professionals from utility and telecom fields (Itron and World Wide Packets/Ciena)
System Description

- Manufacturer
  - Demand Energy Networks
    - 7 patents/patents pending in the core areas of power/energy conversion, power switching, batteries, battery management and network management
    - Successful commercial systems
      - several electric utilities in Pacific NW
      - high rise buildings in NYC
      - China
System Description

- **Grid.DNA™**
  - Distributed Network Architecture
    - Manages load to and from storage devices
      - No matter where located
    - Detects frequency fluctuations and reacts
    - Millisecond response
    - Instantly releasing or absorbing power to regulate load and transmission capacity
  - Cloud Based Managed Service
    - Provides infinite scalability
    - Minimizes IT infrastructure and OA&M costs
    - No software upgrades to manage
  - Open source Infrastructure
    - No time spent building core functionality
    - Speeds up development time while minimizing the size of team required
    - Multiple options allow for best of breed components when assembling the system
  - Fresh Software Approach
    - No legacy “baggage” to prevent embracing emerging technologies and solutions
System Description

- **Grid.Balancer™**
  - 30 kW Power Conversion System (PCS) & 4 Hour Energy Storage System (ESS)
    - Other sizes available
    - System size can increase down the road

<table>
<thead>
<tr>
<th>Available System Sizes</th>
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<tbody>
<tr>
<td><strong>PCS</strong></td>
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<tr>
<td><strong>ESS</strong></td>
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</table>
System Description

- **Grid.Balancer™**
  - Solid state converter system (DC → AC and DC → DC)
  - Renewable Energy Integration

![Diagram of Grid.Balancer™ system](image_url)
System Description

- **Grid.Balancer™**
  - Modular, scalable energy storage
  - Advanced battery technologies with innovations in power conversion and battery management
    - **Lead acid batteries (VRLA)**
      - low energy density, lower cycle life, established supply chain, 98% recyclable, and proven safety record
    - **Lithium (LiFe)**
      - great energy density, rare earth metal with supply chain constraints, thermal concerns in multi-cell-higher voltage applications, unknown recycling, with increasingly problematic safety record. Highest lifecycle costs

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NorthWestern Energy
System Description

- **Grid.Balancer™**
  - Batteries Will Be Lead Acid

<table>
<thead>
<tr>
<th></th>
<th>Lead Acid (VRLA)</th>
<th>Lithium-Iron Phosphate (LiFe) *</th>
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<tbody>
<tr>
<td>Wh/kg</td>
<td>23</td>
<td>100</td>
</tr>
<tr>
<td>Cycle Life at 50% DoD</td>
<td>1800</td>
<td>3600</td>
</tr>
<tr>
<td>Charge Efficiency</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>$/KWh</td>
<td>$328</td>
<td>$900</td>
</tr>
<tr>
<td>$/KWh/ Cycle</td>
<td>$0.18</td>
<td>$0.25</td>
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* Does not include weight or cost of required safety monitoring equipment (BMS)
System Description

- **Grid.Balancer™**
- **Battery Management Interface**
Installation

- Helena Service Center Yard
  - 2 Control Cabinets and 4 Battery Cabinets
Installation

- Connected to distribution line in yard – 480V secondary from new transformer
- Mounted on concrete pad
- Local control system and operator interface
- Net metered
- Install 10 kW solar array in Fall 2013
- Additionally - Cooper Recloser for distribution system interruption when required
Testing

- ~ 18 month test period
  - Purpose: Test performance of system over different conditions
- Automated control
  - Schedule Charge/Discharge Cycles via Software
    - Select duration and start/stop day & time
  - Real Time Monitoring for Load and Generation
    - Conduct Load Following
  - Firing of Renewables
    - Frequency of Solar PV and Frequency of Grid
- Manual control
  - Start a charge or discharge immediately
Testing

- What will this tell us?
- Real performance data
  - Measurements included in system
    - How they relate to performance
    - Measured kW on feeder
    - Adjusted Demand
    - Ramp up/down cycle and repetition of cycles
    - Battery measurements
Renewable Integration

- Installation of small scale solar PV - fall 2013
  - 10 kW solar array
  - Used to charge batteries
  - Net metered
Idaho Falls Power -10 kW Solar Support
Distributed Generation

- **Pacific Northwest Smart Grid Demonstration Project**
  - One of 16 smart grid demonstration projects funded by U.S. DOE under ARRA
  - 11 utility representatives across 5 states in Pacific Northwest
  - Chance for NorthWestern Energy to learn about distributed generation from other project participants
Distributed Generation

- **Pacific Northwest Smart Grid Demonstration Project**
  - Portland General Electric - test how smart grid technologies can help maintain and improve the electrical system’s reliability
    - Integrating variable renewable power resources such as wind and solar – compensation methods only
    - Creating a high-reliability zone for customers using a 5-MW (1.25 MWh battery) energy storage system in concert with customers’ back-up generators
    - Oldest DG with over 75 MW
Distributed Generation

- Pacific Northwest Smart Grid Demonstration Project
  - City of Ellensberg - Renewables Park
    - Help mitigate regional over-generation (high-wind, high-water events) by using the project’s transactive control system to automatically take the Park off and on-line as necessary
    - Test of centralized small renewables verses dispersed small renewables
  - Benton PUD (Washington State) - small-scale distributed energy storage and generation
    - Demonstrate how devices could be dispatched to firm intermittent wind generation and to reduce peak electrical demand
Wind Integration Project

- Pacific Northwest Utilities
  - 3 - 10 kW / 40 kWh Systems
  - Coordinated operation across 3 local utilities to use storage to balance wind integration