Presentation to:
Southern States Energy Board
Louisville, KY
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Manager Distribution System Planning - AEP
Evolution of the Electric Utility System

**Before** Smart Grid:
One-way power flow, simple interactions

**After** Smart Grid:
Two-way power flow, multi-stakeholder interactions

Adapted from EPRI Presentation by Joe Hughes
NIST Standards Workshop
April 28, 2008

BOUNDLESS ENERGY
AEP’s HISTORY WITH ENERGY STORAGE

Pumped Storage

NAS Battery Station

2MW, 14.4 MWh in Churubusco, IN

2MW, 14.4 MWh in Milton, WV
Energy Storage Deployments at AEP

- 1MW, 7.2MWh installed in 2006
  - Deferred substation upgrades
- 3 – 2MW, 14.4MWh commissioned in 2009
  - Demonstrated “load following” and “islanding (backup power)”
- 4MW, 25MWh substation commissioned in 2010
  - Islanding town of Presidio, Texas

The new ‘islanding’ feature is partially funded by DOE/Sandia
Peak Shaving Example

Scheduled trapezoidal Charge & Discharge profiles

Summer Month Peak Days

Improved the feeder load factor by 5% from (75% to 80%)

2006

DAYS WITH BATTERY, JUNE - AUGUST 2006

- 1.0 MW Discharge
- 1.2 MW Charge

2007

- 1.2 MW Charge

2008

- 0.9 MW Charge

- 0.9 MW Discharge
## Islanding Examples

<table>
<thead>
<tr>
<th></th>
<th>Event 1</th>
<th>Event 2</th>
<th>Event 3</th>
<th>Event 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Milton, WV</td>
<td>Milton, WV</td>
<td>Milton, WV</td>
<td>Milton, WV</td>
</tr>
<tr>
<td><strong>Customers on Backup Power</strong></td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td><strong>Duration on Backup Power</strong></td>
<td>1hr 17 mins</td>
<td>10 hours</td>
<td>4 hours</td>
<td>3hr 7 mins</td>
</tr>
<tr>
<td><strong>Cause of Outage</strong></td>
<td>Vehicle Accident</td>
<td>Electrical Fault</td>
<td>Fault</td>
<td>Fallen Tree</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Nov 2010</td>
<td>Mar 2011</td>
<td>Aug 2011</td>
<td>June 2012</td>
</tr>
</tbody>
</table>
Frequency Regulation Update
(Balls Gap Station- Milton, WV)

- Battery Capacity: 2MW, 14MW Hours
- Initial filing to include battery in 2016 PJM queue completed
- 1MW in 2016 after distribution line upgrade
- 2MW in 2017 after new Balls Gap 138/34.5 kV station completion
- Currently performing in the PJM Frequency Revenue Market
Energy Storage – Cost/Benefit

ANALYZING THE VALUE OF STORAGE

Disposal
Operations and Maintenance
Balance of Plant
Power Electronics
Battery Cost

Costs of Storage

Frequency Regulation
Energy Time-shift
System Capacity
Distribution Investment
Deferral
Power Quality and Reliability

Benefits of Storage

Developing a business case usually requires stacking multiple benefits

For Illustration Only
Energy Storage - Capacity Deferral

- Low growth
- Traditional project is mostly capacity addition with little incremental reliability improvement (new station, transformer, feeders)
- Area not likely to get block loads
- Future load growth questionable
- Future T & D plans uncertain / evolving
- Traditional project has long lead time
- Hybrid capacity and reliability project
- Automated circuit reconfiguration with limited capacity
Energy Storage—Reliability

• Parts of circuits needing reliability improvement requiring costly traditional project (long feeder project, new station/T line)

• Automated or manual backup ties available but capacity constrained in peak load periods

• Parts of circuits with critical loads (water/sewer, emergency operations centers, industrial customers with critical processes, etc.)
Example Feeder – Summer Peak Load

0.5 MW Reduction 8 – 11 PM

1.0 MW Reduction 6:30 – 11:30 PM
Energy Storage Challenges

- Battery system costs
- Certainty of load forecast
- Additional benefit streams and ability to monetize
- Reliability / availability of Energy Storage
AEP is known as a leader in utilizing Energy Storage Technology

AEP is evaluating multiple applications of Energy Storage and Microgrids to improve customer experience and lower costs.
QUESTIONS?

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