Energy Storage Projects in AEP
- A Migratory Trend -

EESAT 2009
October 4-7
Seattle

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American Electric Power
Chairman, Electricity Storage Association
AEP Overview

- 5.2 Million customers
- 11 States
- 39,000 MW Generation
- 38,953 miles Transmission
- 212,781 miles Distribution
- $45.2 billion Assets (2008)
- $14.4 billion revenue (2008)
- 20,861 Employees
This Migration Trend is Driven by
Popularity of Customer-Owned Distributed Generation
and Customers’ demand for higher service quality
AEP’s View of Energy Storage Value

Storage Value

Central Units

Devaluators:
• Limited Value to Customer
• High Security Risk
• Less effective in removing Grid Congestions

Distributed Units

Devaluators:
• Aesthetics

Pumped Hydro
(Central)

765 kV
345 kV
138 kV
69 kV
4 to 34 kV
480 V
120/240 V

NAS
(Substation)

CES
(Community)

Limited Value to Customer
High Security Risk
Less effective in removing Grid Congestions
Devaluators:
Aesthetics

American Electric Power
Electricity Storage Association
Massive Electricity Storage – AEP’s Vision

2015 and Beyond
The Three Categories of Storage Benefits

1- Strategic Benefits
- Serve Net-Zero Customers
- Prepare for New Revenue Models

2- Service Benefits
- T&D Capital Deferral
- Buffering Renewables
- Service Reliability
- Voltage Support

3- Market Benefits
- Energy Arbitrage
- Frequency Regulation
- Generation Capacity

Electric Utilities Need to Focus On All 3 Benefits to Justify the Storage Cost and Survive the Coming Changes!
AEP’s First Substation Battery for Capital Deferral

- 2006
- 1MW, 7.2 MWh of NaS battery
- Deferring New Substation

This First Utility-Scale NAS Project was Partially Funded by DOE/Sandia
AEP Substation-Scale Storages – 11MW, 75MWh

1 MW, 7.2 MWh installed in 2006
  • Deferred substation upgrades

3 x2MW, 14.4 MWh installed in 2008
  • Demonstrated "Islanding"

4MW, 25MWh substation will be on-line in January 2010

The New “Islanding” feature was Partially Funded by DOE/Sandia
Dynamic Islanding – Backup Power

This First Community-Scale Backup Power with NAS Battery was Partially Funded by DOE/Sandia

NOT IntelliTEAM

IntelliTEAM

F5
5A
5A

F6
30A
3A

F7
1A
0A

F8
0A
0A

F9
0A
0A

SW1
30A
30A

SW2
1A
1A

SW3
3A
3A

SW4
1A
1A

SW5
14A
14A

SW6
0A
0A

SW7
0A
0A

SW8
2A
2A

F2
30A
1A

F3
1A
1A

F4
0A
0A

F5
1A
1A

F6
1A
1A

F7
2A
2A

Milton Station

Single Phase
Reclosers

NOTE: When sc side field is source color
and Id side field is gray it indicates
one phase of recloser has opened

AEP
APPALACHIAN
POWER
A unit of American Electric Power

Logo Copyright AEP, Columbus, OH

S&C IntelliTEAM II®

S&C
Electrical
Systems
Corporation

Bells Gap – DESS

AMERICAN ELECTRIC POWER

ESA
ELECTRICITY STORAGE ASSOCIATION
Live Islanding Test Information

- Test Site: Balls Gap, Milton, WV
- Test Date: July 8, 2009
- Island Size: 700 customers
- Time to island customers: 0.5 to 2 min.
- Power Outage Duration: 29 min.
- Time to Exit Island: 6 sec. (not Synchronized)
- Average Island Load: 0.8 MW

This First Community-Scale Backup Power with NAS Battery was Partially Funded by DOE/Sandia
Community Energy Storage (CES)

CES is a small distributed energy storage unit connected to the secondary of transformers serving a few houses or small commercial loads.

- **Uses New or Used PHEV-EV batteries**

- Offers All Values of Substation Batteries when *aggregated*,

- Offers Backup Power to customers

- Buffers Customer Renewable Generation

- Makes PHEV Charging Time a less critical issue
CES – A Virtual Substation Battery

CES is Operated as a Fleet offering a Multi-MW, Multi-hour Storage

**Local Benefits:**
1) Backup power
2) Voltage correction
3) Renewable Integration

**Grid Benefits:**
4) Load Leveling at substation level
5) Power Factor Correction
6) Ancillary services
Advantages of CES to Substation Batteries

While CES is, Functionally, a Multi-MW, Multi-hour Substation Battery, It has some Inherent Advantages:

1. More reliable Backup Power to customers (closer)
2. More Effective in providing Voltage Support (distributed)
3. More likely to be a standardized commodity (low cost)
4. More Efficient in buffering customer renewable sources
5. More synergy with Electric Vehicle batteries (competition)
6. Easier installation and maintenance (240 V)
7. Unit outage is less critical to the grid (smaller)
8. Lower resistive loss in wires (closer to customer)
9. A better fit into the Smart Grids & MicroGrids
**CES Functional Specifications – Open to Public**

AEP Specifications for CES is “OPEN SOURCE” for Public Use and Feedback.

Latest Version available from

www.aeptechcenter.com/ces

EPRI is Facilitating Industry-Wide Collaboration with Utilities and Vendors

<table>
<thead>
<tr>
<th>Key Parameters</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Power (active and reactive)</td>
<td>25 kVA</td>
</tr>
<tr>
<td>Energy</td>
<td>50 kWh</td>
</tr>
<tr>
<td>Voltage</td>
<td>120V / 240V</td>
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<tr>
<td>Round Trip AC Energy Efficiency</td>
<td>&gt; 85%</td>
</tr>
</tbody>
</table>
CES Cost Forecast

PHEV, and its battery development, is a **US National Priority** as well as having an extensive global competition

Pending the successful market penetration of PHEV, CES cost forecast (for a 2-hour system) over the next five years is:

- **$1,000 /kW** Commodity Pricing will keep this number low
- **$500 /kWh** PHEV Penetration will push this number down
Conclusion

We See Higher Value in
Utility Owned & Operated
Grid-Connected Energy Storage
Located
Closer to Our Customers