Dynamic Islanding: Improving Electric Service Reliability with Energy Storage

Emeka Okafor
American Electric Power
Nov 2nd, 2010

Funded in part by the Energy Storage Systems Program of the U.S. Department Of Energy through Sandia National Laboratories
Project Description

• Outages on distribution system can last several hours.
• Energy Storage Systems can be leveraged to reduce impact of outages.
• Project demonstrates ability of Energy Storage to mitigate outage impact.
• Three 2-MW systems commissioned in 2009.
• Demonstrated ability to provide backup power.
2006 - Battery in a Substation for Capital Deferral

- Installed 1MW, 7.2 MWh of NAS battery on a feeder to defer building a new substation
- Daily Peak Shaving
AEP 2006 Project – Performance Data

• Scheduled trapezoidal Charge & Discharge profiles

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

• AC Efficiency 80% - Effectively 90% due to reduced T&D losses

Three Successful Years of Peak Shaving
New Features in the 2009 Storage Devices: Load Following

- Increase battery life with fewer shallow discharges
- Increase availability for backup power and other valuable services

Performance of Balls Gap’s 2MW Battery from 12/17 to 12/19/2008
PERCENTAGE OF CUSTOMER OUTAGES THAT MAY BE REDUCED WITH BACKUP POWER. (AEP OHIO 2008)

Assumption: excludes traditional major events and momentary outages.
2008 Projects – To Improve Service Reliability

- 2MW, 14.4 MWh in Bluffton, Ohio
- Two other identical sites in West Virginia and Indiana (2008)
- All with dynamic islanding
2008 Projects – To Improve Service Reliability

2MW, 14.4 MWh in Churubusco, IN
2MW, 14.4 MWh in Milton, WV
Churubusco, IN: Battery Islanding Zones.
System Normal:
Grid connected. Battery disconnected.
Fault at F8; loss of grid power. All reclosers and switches in the island open.
Battery picks up island based on last load information.
Grid power restored.
Battery disconnected. Load connected back to the grid.
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: 28 min.
- Time to Exit Island: 6 sec. (not Synchronized)
- Average Island Load: 0.8 MW

This First Community-Scale Backup Power with NAS Battery is Partially Funded by DOE/Sandia
Islanding Data – Battery Load & Energy

Islanding period = 28 min

This First Community-Scale Backup Power with NAS Battery is Partially Funded by DOE/Sandia
Old Islanding Scheme at Milton

LEGEND
PCS - Power Conditioning System
SM - Intelligent Switches
R - Reclosers
DV - DVs

MILTON STATION
DESS
ISLAND

DV1, SM2, SM3, SM4
R-1, R-2
New Islanding Scheme at Milton

LEGEND
PCS - Power Conditioning System
SM - Intelligent Switches
R - Reclosers
Live Islanding Experience

- **NaS Storage Site:** Balls Gap, Milton, WV
- **Outage Date:** Dec 18, 2009
- **Outage Cause:** Heavy snow
- **Island Size:** 25 Customers (small area)
- **Time to island customers:** 2 min.
- **Power Outage Duration:** 2 Days
- **Time to Exit Island:** 6 sec. (not Synchronized)
- **Average Island Load:** 167 kW
Lessons Learned

• Islanding automation improvement.

• Design Improvement : Scheme should work with loss of 1-MW string.

• No opportunity at other sites.
Battery used for voltage support

- Transferred load and brought Battery on Line. Load reading lost for a brief time at Hash Ridge.
- Cut battery output from 2MW to 1.25MW to increase time battery could stay on line before discharging.
- Took Battery off line with approximately 30% capacity remaining.
Conclusion

• Successful deployment of energy storage systems.
• Demonstrated “Islanding”.
• Automation and Design improvement.
• Demonstrated load-following and voltage support.