Bruce Braine
VP, Strategic Policy Analysis
American Electric Power
Thursday, May 15, 2014

Power Infrastructure:
Improving Reliability and Resiliency

- 5.3 Million customers
- 11 States
- 39,000 Miles Transmission
- 223,000 Miles Distribution
- $52.2 Billion Assets
- $15.1 Billion Revenue
- 19,000 Employees
AEP has added approximately 5,000 MW of new natural gas generation and over 2,000 MW of renewable generation to its portfolio over last 12 years.

- Reduced 1,000MW of demand through energy efficiency programs over past 5 years.
- Will retire 6560 Mw of coal units during 2014-16.
- Gas refueling and new gas units will help meet demand as coal units are retired.

*Capacity includes AEP’s ownership interest in OVEC/IKEC and purchased power agreements that include capacity attributes. Energy efficiency/demand response capacity does not represent a physical asset but avoided capacity. WinterNet Real Power Capability as of January 2014.
Power Infrastructure

- **Ongoing threats to power infrastructure and reliability**
  - Possibility of more serious storms and more powerful storms
  - Cyber threats
  - Physical security

- **Responses (historical and ongoing)**
  - Tree trimming & Right of Way maintenance
  - Hardening
  - Resiliency (e.g., Smart Grid)
  - Improved cyber and physical security (not discussing)

---

Event Types

**Wind above 60 mph**
- Wind blows trees into lines
- Tropical Storms & Category 1 Hurricanes
  - 74-95 mph
- Straight line winds
  - Derecho, “down bursts”, etc.

**Ice & Snow precipitation**
- Ice and heavy wet snows cause loads exceeding design criteria
- Ice load breaks conductors and poles, and causes trees to fall onto the system
- Snow load impacts trees near the system (and to the system, by extension)
The Current Reality

- High customer expectations for high reliability and short duration outages
- Recent high damage / high profile storms
  - “Derecho” and Hurricane Sandy
- Significant direct and societal costs for storm outages
  - ‘10–’12 AEP Restoration spend: ~$73.5M Capital and $286M O&M
  - ‘10–’12 AEP Customer Societal costs: ~$34B (DOE ICE Model)
- Regulatory / political scrutiny has increased
- Newer technologies available (e.g., smart grid)

Industry and AEP Initiatives

- Electric Utility Industry
  - Superstorm Sandy evaluation
    - Impediments identified (border crossings, toll booths, weigh stations, fuel availability, worker logistics, etc.)
    - Industry-led response, coordinating with fed/state gov’t’s.
  - New ‘National Response Event (NRE)’ framework
    - Supplements existing regional ‘Mutual Assistance Networks’ for larger scale events
    - Addresses impediments, improved info flow and coordination of emergency/restoration activities with gov’t agencies.
- AEP
  - Storm Preparedness Strategy Team
    - Incident Command System — crisis management tools
    - Technology improvements — work management, information management, etc.
    - ‘One Voice’ communications — accurate and timely communications; gov’t agency, media, employees, social media tools
    - 5-year rollout; Learn & adapt
AEP Basic Reliability Programs

- Cyclic vegetation management program (e.g., “tree trimming”) in all locations
  - Documented evidence of improvements

- Reliability Programs
  - Circuit inspection & repair of deteriorated material & equipment
    - Visual, EMF, and Infrared inspection methods
  - Sectionalizing improvement
  - Cyclic pole inspection / treatment / replacement
    - Target certain types of poles over 15 years old
  - Replacement of small wire

Basic infrastructure maintenance programs, consistently executed, improve reliability

Tree Trimming & ROW Maintenance

- Since 2009, AEP has invested ~$1.2 B in Ohio to improve the T&D system and increase reliability for customers.
  - $310 MM for an aggressive vegetation management program
  - $300 MM in distribution equipment maintenance and improvements
  - $600+ MM in transmission system improvements
  - Examples include stronger poles and wires as we replace equipment, build new substations and upgrade existing stations.
  - AEP Ohio’s proposal to continue implementing smart grid technologies will help improve reliability and the speed of restoration in the future.
Hardening vs. Resiliency

**Hardening:**
“Improves the durability and stability of infrastructure to withstand the impacts of severe weather events with minimal damage.”

**Resiliency:**
“Measures do not prevent damage; rather they enable facilities to continue operating despite damage and/or promote a rapid return to normal operations.”

Source: EEI “Before and After the Storm”, January 2013

---

**Hardening Activity**

- Target specific circuits for hardening
- Ascertain which actions produce the most benefit based upon circuit characteristics
  - Widen Rights of Way: $2k-$30k per mile
  - Hardening upgrade: $50k per mile
  - Relocate inaccessible circuits: $100k-$300k per mile
  - Place facilities underground: $1 M+ per mile
Resiliency Planning and Technology

- Strategic Design of Distribution System & Expand SCADA (Supervisory Control and Data Acquisition) for remote monitoring and control of physical grid system
- Sectionalizing circuits & Improve station breakers
- Increasing deployment of Distribution Automated Circuit Reconfiguration (DACR)
- Expanding smart meter deployment
  - Improves speed of outage notification
  - Improves precision on location and extent of outages
  - Helps determine status of restoration (e.g., single site outages that remain after major circuit is restored to service).

AEP gridSMART™ Deployment Status

Indiana Michigan Power (South Bend, IN)
- 10,000 Smart Meters
- Distribution Automation (DA) & Volt Var Optimization (VVO)
- Direct Load Control (DLC) and Programmable Communicating Thermostats (PCTs)
- Time-of-Use (TOU) tariffs

Public Service of Oklahoma (Owasso, OK)
- 13,500 AMI
- DA & VVO
- DLC; Home Area Networks (HAN)
- TOU & Variable Peak Pricing (VPP) tariffs

AEP Texas
- System-wide 4-yr deployment
- ~1 Million AMI
- Retail Electric Providers to offer programs to customers

AEP Ohio (Central Ohio NE sector)
- DOE Smart Grid Demo Project & Ratebase investment
- 3 ½ yr Project / Partnering with Battelle
- 110,000 AMI; 70+ circuits with DA & VVO
- DLC; PCTs; HANs; Grid-friendly appliances; PEVs; Community Energy Storage
- TOU, CPP, Real-Time Pricing trial
AEP Ohio gridSMART™ Phase II Proposal

Phase II (Filed with Public Utilities Commission of Ohio)

- Deployment to 31 communities across AEP Ohio service territory; mainly urban and small communities (rural cost-effectiveness difficult)
- Anticipate 4-year deployment timeline
- Built on proven technologies from Phase I deployment and evaluation project
- 900,000+ Smart Meters and related Infrastructure
- 250 circuits of Distribution Automation and Circuit Reconfiguration serving 330,000 customers
- 80 circuits of Volt Var Optimization serving 119,000 customers

Benefits include:

- Cost reductions in serving customer needs
- Enhanced reliability (up to 30% reduction in minutes of interruption)
- Quicker identification of outage locations
- Faster restoration times
- Remote monitoring, coordination, and operation of self-healing distribution circuits
- Improved billing accuracy with accurate measurement of energy usage
- Allowing customers more timely access to monitor their energy consumption
- Energy Efficiency (VVO: up to 2-3% reduction in energy use & demand)
- Environmental benefits