

## PPL Electric Utilities

### *PPL Smart Grid Project*

#### Scope of Work

PPL Electric Utilities' smart grid project deployed new distribution automation (DA) equipment at 10 substations and on 50 circuits to understand installation, integration, and operational challenges and benefits in anticipation of automating the remainder of the circuits over a 5 year period. The pilot project included installation of new grid communications and control systems and focused on upgrades in South Central Pennsylvania, largely in the vicinity of the City of Harrisburg, and northeastern Pennsylvania, in the Pocono region.

#### Objectives

The DA equipment enhances system reliability through better protection and faster response and isolation of outages, while simultaneously lowering costs for operations and maintenance of the system. An additional objective was to improve voltage management capability for delivered electricity, reducing demand requirements and deferring the need for additional power generation capacity in the region.

#### Smart Grid Tools and Technologies

- **Communications infrastructure:** PPL installed a new WiMAX communications network and a fiber backhaul at eight main base stations with four repeater locations. New DA equipment was equipped with supervisory control and data acquisition (SCADA) capabilities for integration with the communications and monitoring network.
- **Distribution system reliability improvements:** Vacuum reclosers and load break air switches have been installed on 50 circuits. These devices are equipped with advanced fault diagnostic capability and fault-locating functionality, enabling operators to identify the approximate location of line faults and more efficiently deploy field crews for repairs. The system also collects data on the operational state of capacitors, reclosers, and air break switches.
- **Distribution system volt/volt-ampere reactive (VAR) improvements:** Automated capacitor banks have been integrated with a power quality monitoring system. Distribution management system (DMS) algorithms include logic to optimally operate the capacitors to maintain voltages within prescribed limits.

#### Benefits Realized

- **Improved distribution system reliability:** The DA systems and communications upgrades give the operator the ability to obtain data remotely. Identification of and response to grid events are much faster, reducing the impact and duration of power fluctuations and outages on customers. Automated switching provides a more effective

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#### At-A-Glance

Recipient: PPL Electric Utilities

State: Pennsylvania

NERC Region: ReliabilityFirst Corporation

Total Project Cost: \$38,109,032

Total Federal Share: \$19,054,516

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Project Type: Electric Distribution Systems

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#### Equipment

- **Distribution Automation Equipment for 50 out of 1,153 Distribution Circuits**
    - Distribution Management System
    - Distribution Automation Communications Network (WiMAX, Cellular, and Fiber Optic Cable)
    - SCADA Communications Network
    - Automated Distribution Circuit Switches
    - Automated Capacitors
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#### Key Benefits

- Improved Electric Service Reliability and Power Quality
  - Reduced Operating and Maintenance Costs
  - Reduced Costs from Equipment Failures
  - Deferred Investment in Distribution Capacity Expansion
  - Reduced Truck Fleet Fuel Usage
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**PPL Electric Utilities** *(continued)*

response to power outages and helps to reduce the number of customers out of service. To determine effectiveness, PPL compared smart grid circuits to non-smart grid circuits in the project area from October 2012 through November 2013. Results show the System Average Interruption Duration Index (SAIDI) for the smart grid circuits at 32.7 minutes versus 75.7 minutes for the non-smart grid circuits.

- **Improved power quality:** The automated capacitors improve volt/VAR control and power quality, as well as increase distribution capacity by reducing energy losses on the distribution system.
- **Reduced operating and maintenance costs:** The DA systems and equipment reduce the need to perform field inspections to understand component status, reducing costs for grid operations and maintenance. Furthermore, automated switching applications prevent overload conditions that deteriorate equipment, prolonging equipment life.
- **Reduced truck rolls and fleet fuel usage:** Remote monitoring equipment reduces the need for line personnel to physically visit grid sites, lowering system maintenance costs and truck fleet fuel usage.

**Lessons Learned**

- Robust communications infrastructure is critical and may require a combination of technologies. The PPL team installed a WiMAX network, in Harrisburg, PA and is transitioning to cellular communication technology for other area deployments. The cellular network provides coverage across varying terrain and leverages pre-existing public infrastructure.
- Existing distribution circuit load capacities are an important component of the cost-benefit analysis required to determine upgrade priorities. The PPL team is planning to upgrade load transfer limited ties in some locations to improve transfer capabilities. This has a significant impact on the business case for new DA deployments, as device installations that do not require capacity upgrades result in significantly cheaper reliability gains.

**Future Plans**

- PPL plans to complete DA upgrades on the remainder of the utility's distribution circuits within five years and install sensing on all three-phase capacitors over the next three years.
- PPL is currently piloting automated switching technology on the sub-transmission system similar to the DA technologies deployed on the distribution system.

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