Pepco–District of Columbia
Smart Grid Project

Scope of Work

The Pepco–District of Columbia Smart Grid Project in Washington, DC, involved distribution automation (DA), advanced metering infrastructure (AMI), and demand response programs that involved load control devices and time-based rates. DA included deployment of smart substation devices, automated distribution circuit reclosers/switches, and network and substation transformer monitors.

Objectives

The AMI deployment was designed to provide Pepco and its customers with detailed electricity usage information that, when combined with the demand response programs, helps customers reduce electricity usage and peak demand on the system. DA equipment was installed to improve system reliability while decreasing operations and maintenance costs.

Deployed Smart Grid Technologies

- **Communications Infrastructure**: Pepco installed a wireless mesh network for the AMI system and designed it to be able to route DA traffic through the battery-backed wireless communications devices. This approach ensures that DA traffic remains on energized communications devices during power outages. The same backhaul cellular network is used to transport AMI and DA data to the appropriate collection systems.

- **Advanced metering infrastructure:** Pepco installed 277,222 smart meters across the entire Washington, DC, service territory from project initiation through December 31, 2013. These meters can be used to detect power outages and meter maintenance issues remotely. AMI supports demand response, load control, and time-based rate programs, as well as reducing the cost of meter operations.

- **Advanced electricity service options:** Through the project, electric customers were offered programmable communicating thermostats (PCTs) to manage energy usage and a web portal to access consumption data. The web portal allows customers to view the data collected from their smart meters and obtain information about the amount, timing, and costs of electricity usage. The web portal also provides the platform for customers to view and control the PCTs.

At-A-Glance

Recipient: Pepco Holdings, Inc.

State: Washington, DC

NERC Region: ReliabilityFirst Corporation

Total Project Cost: $92,745,331

Total Federal Share: $44,576,686

Project Type: Integrated and/or Crosscutting Systems

Equipment
- **277,222 Smart Meters**
- **AMI Communications Systems**
  - **Meter Communications Network (Wireless Mesh)**
  - **Backhaul Communications (Cellular)**
- **Meter Data Management System**
- **Customer Web Portal**
- **27,393 Direct Load Control Devices**
  - **11,383 Programmable Communicating Thermostats**
  - **16,010 Air Conditioner Direct Load Control Outdoor Cycling Switches**
- **Distribution Automation Equipment for 19 out of 779 Circuits**
  - **Distribution Automation Communications Network (Wireless Mesh)**
  - **Control of 64 Automated Distribution Circuit Reclosers/Switches**
  - **41 Network Transformer Monitors**
  - **14 Transformer Health Sensors/Monitors**
  - **6 Substation Upgrades with Smart Devices**

Time-Based Rate Programs
- **Peak-Time Rebate**

Key Benefits
- **Improved Electric Service Reliability and Power Quality**
- **Reduced Costs from Equipment Failures and Theft**
- **Reduced Meter Reading Costs**
- **Reduced Operating and Maintenance Costs**
- **Reduced Truck Fleet Fuel Usage**

- **Direct load control devices:** Using these devices, Pepco can cycle air conditioner control equipment off and on during peak demand periods and system emergencies in the summer months. In addition to helping Pepco manage overall system demand, the 27,393 load control devices installed as of December 31, 2013, help customers control their electricity costs.

- **Distribution automation:** Pepco deployed new automated feeder reclosers/switches and associated controllers, electronic substation relays, substation distributed remote terminal units (DRTUs), and an automatic sectionalizing and restoration (ASR) program. These devices work together to detect and isolate faults more precisely, reducing the number of customers affected by a power outage. DA involved installation of network transformer protector monitors, which provide real-time transformer status information such as phase current, transformer loading, and power factor. Pepco also installed on-line dissolved gas analysis monitors on substation transformers. These devices monitor fault gases and other key parameters for timely assessment of transformer conditions.

Benefits Realized

- **Advanced customer service options and peak load control:** Through 2013, Pepco operated 4 curtailment events, reducing demand by 15 megawatts. Participating customers received a total of $1,671,931 in bill credit incentives, and each participating customer had a web-programmable thermostat or outdoor direct load control switch installed on his or her home.

  Furthermore, customers are accessing AMI data through charts showing hourly, daily, and monthly usage on Pepco's web interface, "My Account." Customers can access monthly bills to date and the usage charts from the previous five days on a single page. Customers can also download their energy use via Green Button, a secure and standardized electronic energy usage data format; Pepco was the first utility to provide enterprise-to-enterprise energy data via Green Button Connect.

- **Reduced operating and maintenance costs:** The AMI system provides the ability to send a signal to the meter to disconnect or reconnect service. Pepco began using this feature for credit collections in May 2014, resulting in decreased monetary value of write-offs, fewer past-due accounts, and reduced interest costs from carrying the debt on the past due accounts. Pepco estimates that this function will allow the utility to avoid over 5,000 truck rolls in 2014.

  Furthermore, AMI enables Pepco to avoid thousands of unnecessary truck rolls each year for "single no-lights" calls that turn out to be "okay on arrival." AMI provides the capability to "ping" a meter to determine whether the meter is communicating. Power is required at the meter in order for the meter to respond to the ping request. Therefore, Pepco is able to use the meter ping to verify that a customer has service without sending a crew, thereby avoiding costs and emissions associated with unnecessary truck rolls.

- **Reduced meter reading costs:** The elimination of manual meter reading saved Pepco over $2 million in 2012 and 2013 combined. In addition, Pepco can remotely execute on-demand reads that would have previously necessitated field visits; this capability has eliminated over $500,000 in off-cycle meter reading costs over the same period.

- **Improved system reliability:** During 2013, the new technologies helped Pepco prevent over 6,000 customer outages, and in 2014, over 2,900 customer outages had been prevented as of mid-September. Furthermore, Pepco has begun to use AMI data for transformer load management. The accuracy of transformer loading data allows for a more proactive replacement under a planned outage strategy (as opposed to the prior practice of waiting for transformer over-loading leading to asset failure). Transformer replacement under a planned outage results in a

lower outage duration than that associated with emergency repairs and has a positive impact on SAIDI, SAIFI, and CAIDI reliability indices.

Lessons Learned

- **Advanced metering infrastructure:** Deploying the mesh radio network in advance of AMI meter installations made activations of the meters more efficient. Utilities implementing AMI should survey areas where communications are challenging and plan/resolve such challenges in advance of meter deployment. In addition, vendor contracts should include quality audits.

- **Direct load control:** Customer education was vital to project success and entailed significant effort. Customers generally do not have the same level of understanding about kilowatt hours as they do about miles per gallon. A variety of communications tactics is needed to increase awareness and understanding of smart grid technologies. A blend of traditional "snail" mail and online outreach tactics allowed Pepco to reach out to different customer segments.

- **Cyber security and distribution automation:** Cyber security should be addressed during planning activities. While Pepco has taken steps to add security to data transmissions, the utility continues to work with equipment manufacturers to enforce the value of application-level encryption and encourage them to develop solutions. While smart systems can reduce operational costs, additional maintenance funding is needed to keep added equipment and systems operational. In addition, newer telecommunications and smart devices will not follow traditional utility asset life assumptions (e.g., 10–15 years versus 30 years), and planning should account for these differences.

- **General:** Having a central program management office to provide project management, change management, and process improvement and coordinate earned value reporting proved to be very effective. In addition, new skill sets were required to design, deploy, and maintain Smart Grid systems, which will change the paradigm of the utility worker.

Future Plans

Pepco will continue to develop advanced analytics based on asset-level data to further enhance asset management capabilities. The objective is to focus increasingly on predicting system/equipment health, identifying deficiencies, and optimizing investments and maintenance decisions.

The company will also continue to optimize the communications network that supports DA and direct load control to maximize the benefits gained from these technologies. DA technologies will continue to be deployed as the need arises.

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