Town of Danvers, Massachusetts

Smart Grid Implementation Program

Scope of Work

The Town of Danvers' Smart Grid Implementation Program included deployment of advanced metering infrastructure (AMI), a meter data management system (MDMS), and distribution automation (DA) technology on all thirty three circuits. Smart meters and AMI for Danvers' residential, commercial, and industrial customers support time-based rate programs and a home energy network pilot.

Objectives

Deployment of the new technologies targeted improvements in customer service, reductions in system losses and peak load, and the implementation of a distribution management system, while ensuring system operability and scalability and deferring costly upgrades to the main substation.

Deployed Smart Grid Technologies

- **Communications infrastructure:** The AMI and distribution management systems both use the same communications platform, which consists of 200 MHz, 3.65 GHz (Wi-Max), and 5.8 GHz radio network backhauling to the Town's fiber network. Data from the DA equipment are processed by energy management software, a new distribution management system, and an upgraded supervisory control and data acquisition (SCADA) system. The project fully integrated the various components of the communications infrastructure.
- **Advanced metering infrastructure:** The Town of Danvers installed 12,963 smart meters, covering all electric customers in the service territory. The project also deployed a MDMS for collecting, storing, and processing interval load data from smart meters, and integrated the system with the Town's existing customer information system for billing. The MDMS enables customized reporting, transformer load management reporting, alarm reporting, and outage and restoration reporting.
- **Advanced electricity service options:** A customer web portal was configured and integrated with MDMS. Features include presentment of account information, online bill payment, billing history, rate information, hourly interval data, portion of use concurrent with daily peaks, and weather trend information. Pilot programs were implemented for in-home displays,

At-A-Glance

Recipient: Town of Danvers

State: Massachusetts

NERC Region: Northeast Power Coordinating Council

Total Project Cost: $16,555,132

Total Federal Share: $8,277,566

Project Type: Advanced Metering Infrastructure
Customer Systems
Electric Distribution Systems

Equipment

- 12,963 Smart Meters
- AMI Communications Network (200 MHz, 3.65/5.8 GHz (Wi-Max))
- Meter Data Management System
- Customer Web Portal
- In-Home Display Pilot
- Distribution Automation Upgrades for 33 out of 33 Circuits
  - DA communications network (200 MHz, 3.65/5.8 GHz (Wi-Max))
  - Distribution Management System/Outage Management System
  - SCADA Communications Network
  - Automated Switches and Reclosers
  - Feeder Monitors
  - Substation Controllers and Human–Machine Interface (HMI)
  - Automated Capacitors

Key Benefits

- Improved Customer Service
- Informed Customer Energy Use
- Improved Distribution System Monitoring and Control
- Reduced Meter Reading CostsDeferred Distribution Capacity Investments
- Improved Safety and Resource Security

commercial customer demand response, and residential customer demand response. The demand response programs notified customers of peak load events and provided tips and incentives to reduce power consumption during specified times. The project also delivered a net metering program that provides incentives for customers to install and use distributed energy resources.

- **Distribution automation systems:** The Town of Danvers installed and retrofitted switches, reclosers, capacitor banks, feeder monitors, substation data concentrators, and substation controllers and human-machine interface. The devices are configured with two-way communications capability with the distribution management and outage management systems. This equipment provides new capabilities to remotely monitor, analyze, and manage the distribution grid. The 23-kilovolt backbone circuits of the local distribution grid received the new automation equipment. The systems will be used to shorten outages, improve reliability, and improve power quality.

Benefits Realized

- **Improved customer service:** AMI has enabled timely and accurate bills. This has resulted in significant reduction in estimated bills, bill adjustments, and customer complaints. When issues do arise, the AMI information allows customer service representatives to efficiently investigate the concern with the customer and resolve it expediently. Service is also enhanced through the web portal and online bill pay feature, which are frequently utilized by customers.
- **Informed customer energy use:** Information on the customer web portal helps customers understand their energy use and identify ways they may conserve. The outreach and incentive structured in the demand response program encourage each residential and commercial customer to become informed about and participate in peak load reduction. The new net metering program creates an equitable platform for customers to benefit from implementing renewable energy resources.
- **Reduced meter reading costs:** Operational cost savings are derived from the automation of on- and off-cycle meter reading and customer service activities through the AMI system.
- **Deferred distribution capacity investments:** Targeted demand response initiatives have allowed the Town to defer a $3 million investment required to increase capacity at a critical substation. These initiatives and supporting technologies enable the Town to monitor, control, and create incentive to lower peak demand.
- **Improved distribution system monitoring and analysis:** The system locates faults and identifies power quality issues in real time and records system performance and event information for historic record. The real-time information applications enable expedited reaction to service quality issues. The historic information applications enable informed proactive maintenance and improvement planning. Transformer load monitoring is enabled through the integration of meter data from the AMI system. In the coming years, the installed systems are expected to improve operational efficiency, grid resilience, and quality of service to customers.
- **Improved safety and resource security:** The AMI system allows the utility to identify unauthorized feeds and withdrawals from the system. Reverse power detection at locations not permitted for distributed generation allows the Town to identify circumstances that might otherwise become a safety concern when the utility must shut down a section of line. Consumption at inactive accounts and tamper detection allows the utility to identify unauthorized acquisition of resources and unauthorized access to the system. Tamper monitoring has enabled enhanced permit enforcement through tamper monitoring.

Lessons Learned

- Dedicate resources early in project development to planning improvements in local network and communications infrastructure which are the foundation for smart metering and distribution automation systems. Understand cybersecurity requirements and the risks of an evolving regulatory environment.
- Be aware of challenges associated with being an early adopter of technology. When planning a project that involves unproven technologies (and technology combinations), project teams may have to adapt to rapidly evolving solutions. For the Town of Danvers, software and equipment immaturity required a continuous process of testing, refinement, and improvement. Vendors and project team members often learned and developed solutions together.
- Plan for robust community outreach, which is critical to project success. When the Town of Danvers deployed smart meters, effective customer communications and education resulted in a very low number of opt-outs.
- Plan for a robust testing cycle to ensure interoperability between network components and operating systems. Lack of standards can cause implementation issues, especially with communications equipment.
- Consider staffing when implementing a project such as this. Personnel resources need to be considered and potentially augmented to account for additional work load that is required during construction and integration. Additionally, implementing a smart grid requires some augmentation or retraining of staff to adapt to the technology-oriented skillset required to operate and maintain the new systems.

Future Plans

- The project prepared the Town of Danvers to implement time-of-use pricing, critical peak pricing, and variable peak pricing in the future. These pricing programs will be configured to reduce peak demand by providing financial incentives to customers to shift consumption from on- to off-peak periods. Customers participating in time-based rate programs will have the ability to better manage their consumption and costs. In addition, reduced peak demand curtails operation of peaking power plants, saving energy and decreasing associated greenhouse gas emissions.
- The Town of Danvers will modify the pilot residential and commercial peak demand reduction programs based on current knowledge and equipment limitations.
- The Town will automate additional electrical distribution circuits, expanding on the benefits DA has enabled.

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