Knoxville Utilities Board

Knoxville Smart Grid Community Project

Scope of Work

The Knoxville Utilities Board (KUB) Knoxville Smart Grid Community project deployed advanced metering infrastructure (AMI) and distribution automation assets. The project achieved better power quality and reactive power management with fault current indicators and volt–ampere reactive (VAR) control at substations.

Objectives

The overall goal of the KUB project was to validate potential strategies to provide customers with safe, low-cost, and reliable electric service. Specifically, the project aimed to reduce operational costs, improve distribution system efficiency, increase the reliability of service provided to customers, improve billing accuracy, and provide customers with tools to control their energy expenditures.

Deployed Smart Grid Technologies

- **Communications infrastructure:** The project deployed an advanced network system that provides the backbone for the AMI. The system also collects and processes data from the distribution sensors for distribution automation and load management. The AMI and DA system uses a licensed radio frequency network with fixed based communications end points in a point-to-point architecture. AMI backhaul is primarily accomplished through cable and 4G cellular communications.
- **Advanced metering infrastructure:** The KUB project deployed 3,759 electric smart meters, including 702 for the largest commercial and industrial customers. An additional 1,179 water and 673 gas meters were installed outside the federally funded project. KUB also installed AMI network equipment is capable of covering 100% of the KUB service territory.
- **Advanced electricity service options:** The project provided residential, commercial, and industrial customers within the project area with access to an enhanced web portal. This portal facilitates information exchange and enables customers to better manage their electricity bills through improved understanding of electricity consumption patterns. Customers can access the web portal to see how much electricity they are using on an hourly, daily, weekly, or monthly basis. They can also configure their own alerts and notifications and overlay their usage with weather data.
- **Distribution automation systems:** The project deployed advanced automated equipment to improve distribution equipment performance. In particular, KUB deployed fault current indicators, load tap changer controllers, and

At-A-Glance

Recipient: Knoxville Utilities Board

State: Tennessee

NERC Region: SERC Reliability Corporation

Total Project Cost: $7,479,461

Total Federal Share: $3,585,022

Project Type: Advanced Metering Infrastructure
Customer Systems
Electric Distribution Systems

Equipment

- 3,759 Electric Smart Meters
- AMI Communications Systems
  - Meter Communications Network (Point-to-Point RF Network)
  - Backhaul Communications (Cable and Cellular)
- Customer System Communications Network
- Customer Web Portal
- Distribution Automation Equipment for 17 Out of 266 Circuits
  - Distribution Automation Communications Network
  - 117 Fault Current Indicators
  - 4 Load Tap Changer Controllers
  - 7 Power Quality Meters

Key Benefits

- Reduced Meter Reading Costs
- Reduced Operating and Maintenance Costs
- Reduced Costs from Distribution Line Losses and Theft
- Improved Electric Service Reliability and Power Quality
- Reduced Truck Fleet Fuel Usage

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power quality meters to complement and enhance the existing supervisory control and data acquisition (SCADA) and distribution systems. Improved fault isolation provided by fault current indicators, along with more accurate outage statuses provided by the smart meters, reduces power interruptions, thus improving distribution system reliability and operational efficiency.

- **Distribution system energy efficiency improvements:** The project integrated the operations of capacitors and regulators at substations with voltage information collected through the AMI. This integration improves voltage and VAR control, power quality, and distribution capacity by reducing energy losses on the distribution system.

Benefits Realized

- **Improved electric service reliability and power quality:** The newly deployed distribution automation assets increased distribution system efficiency, reliability, and power quality. KUB has saved an average of approximately $124,000 per year in reduced restoration costs for 2012, 2013, and 2014 in the project area. Knoxville has also observed significant reductions in several key reliability indices. Customer average interruption duration index (CAIDI) dropped 48% (39 fewer minutes per customer outage), system average interruption duration index (SAIDI) dropped 77% (48 fewer minutes per year), and system average interruption frequency index (SAIFI) dropped 51% (from 0.74 average outages per customer per year to 0.36 average outages per customer per year).
- **Reduced operational costs:** Meters can now be read remotely, reducing operations and maintenance costs associated with trips into the field for manual meter reads. This benefit also translates into fewer truck miles driven, which saves costs in fuel and truck maintenance and reduces greenhouse gas emissions. SGIG upgrades resulted in the avoidance of over 8,100 vehicle miles through the end of 2014. In addition, the new technologies support faster outage detection and remote meter diagnostics.
- **Reduced costs from theft:** KUB lowered operations costs through more frequent identification of electricity theft, having detected 47 real-time meter tamper events from project initiation through the end of summer 2014.

Lessons Learned

KUB recognized the importance of planning the “right-sized” project. The project team kept this in mind during planning and implementation, thus furthering resource optimization. The project was a cost-effective way to validate potential strategies using new AMI technology to provide customers with safe, low-cost, and reliable electric service. The project allowed KUB to learn—with limited cost and risk—more about AMI technologies and how best to integrate them into operations.

KUB learned that implementing emerging technology can cause dependency on vendors. By definition, emerging technologies can have a dynamic business environment, with constantly evolving vendors, partnerships, and technology. KUB’s limited scope for this project helped mitigate this risk.

Through this project, KUB gained a much greater appreciation for AMI’s potential effects throughout an organization. The AMI technology proved itself capable of having a positive customer and operational impact on numerous business processes. One example of the positive customer and operational impact is the AMI meter integration with the outage management system. This has reduced the duration of customer outages in the project area.

Future Plans

Owing in large part to the project’s success, KUB is exploring expanded smart grid deployment options starting in 2015.

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