

Minnesota Power

Smart Grid Advanced Metering Infrastructure Project

Scope of Work

Minnesota Power's Smart Grid Advanced Metering Infrastructure (AMI) project deployed 8,030 smart meters, two-way communication network infrastructure, and a new web portal to help customers better understand and manage their energy usage. It also implemented 1,571 direct load control (DLC) devices and piloted distribution automation (DA) equipment on one circuit. Minnesota Power leveraged the new AMI system to conduct a rigorous consumer behavior study to measure and validate demand responses to a time-based rate and education program.

Objectives

The project aimed to improve customers' understanding of their electricity usage, reduce operations and maintenance (O&M) costs, and improve awareness of and response to distribution system outages.

Deployed Smart Grid Technologies

- **Communications infrastructure:** Minnesota Power installed a wireless radio frequency network and leveraged cellular backhaul to enable two-way communication between meters and utility data systems. These networks also allowed for monitoring and control of the piloted DA equipment.
- **Advanced metering infrastructure:** The AMI system provides the capability for a variety of current and future customer pricing programs and service options. Remote collection of interval usage and meter event data enables significantly enhanced theft detection, meter maintenance efforts, and outage and restoration management. The system also provides the ability to differentiate between momentary and sustained outages, as well as determine exact time and duration of outage occurrences. A meter data warehouse serves as a central repository for multiple uses of the AMI data, including analysis of aggregated distribution system operational data for improved predictive maintenance modeling.
- **Direct load control devices:** A number of Minnesota Power's AMI meters are equipped with a remote connect/disconnect feature and act as direct load control devices during winter peak loads for their dual-fuel program. Opt-in customers allow the utility to activate the switch to curtail electric load during periods of high demand while switching to an alternate fuel source to supply heat to the home.

At-A-Glance

Recipient: Minnesota Power, a Division of Allete

State: Minnesota

NERC Region: Midwest Reliability Organization

Total Project Cost: \$3,088,008

Total Federal Share: \$1,544,004

Project Type: Advanced Metering Infrastructure
Customer Systems
Electric Distribution Systems

Equipment Installed

- 8,030 Smart Meters
- AMI Communications Systems
 - Meter Communications Network (Radio Frequency Mesh)
 - Backhaul Communications (Cellular)
- Customer Web Portal
- 1,571 Direct Load Control Devices
- Distribution Automation Equipment for 1 out of 336 Circuits
 - Automated Distribution Circuit Switches
 - Equipment Condition Monitors

Time-Based Rate Programs Targeting up to 2,300 Customers

- Time of Use
- Critical Peak Pricing

Key Benefits

- Reduced Meter Reading Costs
- Improved Electric Service Reliability and Power Quality
- Reduced Costs from Theft

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- **Distribution automation system:** The DA system integrated data collected from the 3,600 AMI meters on the piloted circuit with data from two recloser monitors, five automated switches, and other systems to assess the technology's potential to improve reliability and reduce operational costs, as well as interoperability issues.

Benefits Realized

- **Direct load control:** Minnesota Power achieved significant O&M cost savings. With the data collection and communications capabilities that are part of AMI meters, Minnesota Power is now able to verify the magnitude of the load reductions for every customer soon after load control events have been implemented. Timely feedback has proven to be an effective tool for reinforcing positive customer behavior changes.
- **Reduced operational costs:** Installation of an AMI system promotes operational cost savings by greatly reducing manual meter reading costs and enabling remote meter diagnostics and troubleshooting capability.
- **Improved power quality and reliability:** Remote switching and meter outage event information improves the resiliency of the circuit by enabling faster outage response and restoration.
- **Shorter outage duration:** The AMI system's outage notification functionality enables Minnesota Power to respond to outages and customer requests more efficiently. On the piloted circuit, the project team demonstrated that the DA equipment effectively enables automated sectionalization and self-healing of circuits experiencing faults.

Lessons Learned

- Minnesota Power actively reached out to peer utilities for lessons learned and best practices which informed the development of their own processes, procedures, and technology specifications. Examples include the following:
 - Direct Load Control Program Using Disconnect Meter for Electric Heat (Central Vermont Public Service)
 - Application Integration (Lakeland FL Utilities)
 - Distribution Automation (Chattanooga EPB)
 - Cyber Security (NV Energy, Southern Cal Edison, Georgia Power)
- Significant cost savings and cost offsets were achieved by leveraging the existing capability of the dual-fuel system coupled with industry standard load control products for an innovative combination of technologies.
- Project schedules were heavily affected by vendor development schedules for advanced products, which required extensive interoperability and product testing prior to implementation.
- Leveraging the DA pilot experience and lessons learned will be critical to future expansion of DA on the system.

Future Plans

Minnesota Power's AMI system has grown from 10,000 jointly funded customer endpoints in 2010 to more than 30,000 in 2013. The DA system has more than doubled in size and now encompasses both the 13.8 kilovolt (kV) and 34.5 kV distribution systems in Duluth, Minnesota. The utility plans to continue to leverage its initial investments in AMI and DA to expand technology implementation in these areas.

Contact Information

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