Southwest Transmission Cooperative

Arizona Cooperative Grid Modernization Project

Scope of Work

Three electric cooperatives in Arizona joined forces together to upgrade their electric grid infrastructure: Southwest Transmission Cooperative (SWTC), Mohave Electric Cooperative (MEC), and Sulphur Springs Valley Electric Cooperative (SSVEC). SWTC provides transmission service to distribution cooperatives MEC and SSVEC.

All three projects installed or upgraded communications networks and deployed or enhanced supervisory control and data acquisition (SCADA) systems or energy management systems (EMSs). SWTC upgraded the communications infrastructure of their transmission network by installing optical ground wire (OPGW) cables between several substations. SSVEC expanded their existing fiber optic communications infrastructure. MEC expanded the power line carrier (PLC)-based meter communications network as well as fiber optic and microwave radio communications between the substations and their call center.

SWTC further enhanced the transmission network with microprocessor-based protective relays and equipment monitors. SSVEC and MEC jointly provided 59,745 smart meters to 59,358 customers and deployed a meter data management system (MDMS) to process and package the data to be leveraged by other back-office applications.

Objectives

The Smart Grid Investment Grant project provided a critical technology foundation for a larger initiative (Arizona Cooperative Grid Modernization, or AGCM) to integrate substations and transmission and distribution lines of the three cooperatives. The project installed equipment outfitted with communications, monitoring, and switching devices, and applicable software capable of enabling smart grid functions. The modernized system services customers more reliably and efficiently, improves electrical service and reduces costs.

Deployed Smart Grid Technologies

- **Communications infrastructure:** All three utilities made investments in the communications networks to tie intelligent field devices back to individual operators' centers through an

At-A-Glance

Prime Recipient: Southwest Transmission Cooperative

State: Arizona

NERC Region: Western Electricity Coordinating Council

Total Project Cost: $64,488,970

Total Federal Share: $32,244,485

Key Partners: Mohave Electric Cooperative, Sulphur Springs Valley Electric Cooperative

Project Type: Advanced Metering Infrastructure
Electric Distribution Systems
Electric Transmission Systems

Equipment Installed

- 59,745 Smart Meters
- AMI Communications Systems
  - Meter Communications Networks (Power Line Carrier)
  - Backhaul Communications (Fiber, Microwave Radio)
  - 296 Miles of Fiber Optic Lines/OPGW
- Upgrades to 52 Substations
- 47 Remote Terminal Units
- Meter Data Management System
- Web Portal
- Geographic Information System
- Maintenance Data System
- Energy Management System
- Distribution Automation Equipment
  - Distribution Automation for 39% of Circuits
  - 22 Automated Feeder Switches
  - 78 Automated Regulators, 10 Capacitors, and 18 Reclosers
  - 54 Remote Fault Indicators
  - 154 Smart Relays
  - 78 Regulators
  - 64 Breakers
  - Circuit Monitors
  - 10 Gang Operated Air Break (GOAB) switches
- SCADA/Emergency Management System Network Upgrades

Key Benefits

- Reduced Operating and Maintenance Costs
- Improved Electric Service Reliability and Power Quality
- Reduced Costs from Equipment Failures and Theft

Southwest Transmission Cooperative *(continued)*

enhanced fiber/microwave radio network with cross-connect capabilities to share information. MEC installed fiber optic lines between substations and the MEC call center. SSVEC installed an OPGW fiber optic-based communications network to transfer meter and distribution automation data to the SSVEC control center.

- **Advanced metering infrastructure:** The electric cooperatives installed 59,745 smart meters capable of providing accurate and automated meter reading, outage notification, outage reporting, and improved theft detection. The smart meters also provide information to members via an interactive web application (Smart Hub) and allow MEC customer service representatives to respond to customer billing and power quality questions more efficiently. MEC's smart meters were deployed with remote connect/disconnect switches to enable pre-paid account members service options such as connection and disconnection and processing member transfers.
- **Distribution automation equipment:** SSVEC deployed automated switches, capacitors, reclosers, regulators, remote fault indicators, breakers, circuit monitors, gang operated air break (GOAB) switches, and smart relays on 39% of its distribution circuits. These upgrades provide rapid and effective responses to grid disturbances, improving reliability and reducing the frequency and duration of outages.
- **Planning, operations, and back office systems:** MEC implemented a geographic information system (GIS) that has been integrated with their customer information system (CIS), accounting and business system, and outage management system (OMS). Along with the benefits associated with the individual systems, system integration allows MEC to query meters, which helps determine the scope and size of an outage or other problems. In addition, SSVEC developed and implemented an underground distribution system inspection program using GIS software, infrared cameras, and GIS image linking.
- **SCADA and energy management systems:** SWTC upgraded the SCADA/energy management system to improve reliability and the performance of the entire electrical transmission network. MEC also implemented electronic relays in substations to allow electronic data collection (EDC) to provide information to the call center and an application that collects and analyzes the electronically provided substation information.
- **Advanced transmission systems:** Protective transmission relays have been upgraded to new smart devices that replace existing electromechanical equipment. The new relays automate many of the protective functions and create detailed digital reports on power interruption events.

Benefits Realized

- **Reduced operating and maintenance costs:** At SSVEC, the reduced operating and maintenance costs are attributable to poles and equipment replacements, the use of engineering and technical services telemetry, the utilization of SCADA automated switching, the integration of "mobile workforce" technology, and advanced metering infrastructure. SWTC is now able to remotely communicate to smart devices installed in substations. This technology has allowed SWTC personnel to determine a device's health or review its operating parameters remotely, thereby reducing the need to travel to these substations.
- **Improved operational efficiency and safety:** SSVEC no longer operates a SCADA center that is staffed 24–7. Instead, the cooperative gives field crews responsibility for SCADA devices. Control operators have remote devices which now allow them to monitor the SCADA system and take action if needed. The procedure has increased safety for the crews and provides SSVEC with the flexibility needed to manage a limited operator workforce.
- **Improved distribution reliability and power quality:** SSVEC monitors and controls all breakers remotely to obtain improved load and fault event data for analysis. The same equipment allows SSVEC to restore 69-kilovolt (kV) outages quicker by pinpointing outages and then use motor-operated switches to isolate faulted areas. SCADA

Southwest Transmission Cooperative *(continued)*

systems control voltage regulators remotely to improve efficiency and energy use and control three-phase automatic circuit reclosers (ACRs) and line switches remotely to reduce customer outage time. A fiber communications backbone provides better security and larger bandwidth, and allows the utility to control substation equipment remotely and gather significantly more data for outage management. The increased number of SCADA monitoring points allows SCADA operators to rapidly identify system disturbances.

- **Improved transmission reliability:** SWTC's upgraded SCADA/EMS system provides real-time contingency analysis, which in turn gives operators the necessary information for the reliable operation of the high-voltage transmission network. The GIS installed by SWTC is used to provide real-time positioning for faults thereby improving maintenance and repair processes.
- **Reduced costs from equipment failures:** System integration between mapping, SCADA, and engineering systems has provided a mechanism to manage equipment overloads and has reduced costs associated with equipment failures. The underground distribution system inspection program has also been successfully used in preventive maintenance.
- **Advanced electricity service options:** SSVEC and MEC offered AMI-enabled customer services and energy management options through various pilot programs. Successful pilots included prepaid metering and remote connect/disconnect services, which are now included as standard service offerings. This option is popular with some customers, as they can purchase a certain amount of service in advance without having to pay a large initial deposit.
- **Facilitates short- and long-term planning:** Bringing end-of-line voltage data into a modeling tool has resulted in more accurate prediction of future delivery requirements. The distribution automation systems have allowed SSVEC to accurately model the entire distribution system, which is necessary for planning and helps the utility predict how and when to make changes to the system to increase efficiency and accommodate growth.

Lessons Learned

- MEC initially experienced low meter read rates of 78% and spent a significant amount of time working with the AMI provider to optimize the new AMI network to improve read rates. The reads are now consistently above 90%. Initial read rates can be improved as the system is optimized and fully integrated.
- It is important to consider and integrate cyber security requirements up front. Be diligent in understanding and establishing communication system requirements. SSVEC was required to provide evidence that their Mobile WiMAX deployment would fall within constraints set forth by the FCC for RF transmissions along the Mexican border.
- Some vendors do not have the best training available for their installed equipment. Be prepared to learn through trial and error with some newer devices.

Future Plans

- SSVEC will continue installing and/or upgrading communications networks, installing fiber, and expanding the capability of their SCADA and AMI systems. MEC's eastern territory entails long-distance truck rolls for many metering services. MEC will be deploying remote-disconnect-under-glass meters in the eastern territory to further lower costs and provide improved customer service. MEC is also continuing to work with the vendor to continue to improve meter read rates.
- MEC is looking into the use of a faulted circuit indicator that communicates with their modular utility energy management application. With the additional information provided, the utility could better pinpoint an outage

location when long lines are involved. MEC will continue to seek improvements to system monitoring and to be proactive with system planning, identifying maintenance and power quality concerns. The utility will continue to enhance the EDC system and improve reliability with the use of electronic relays, reclosers, and sectionalizers.

- MEC will continue to improve and expand customer service options such as pre-paid accounts, outage reporting, and provision of remote billing information.
- SWTC will upgrade the remote terminal units that provide the interface between substation equipment and intelligent devices to the utility's new EMS. The upgrade will allow the use of a single communications protocol, reducing maintenance and expansion costs. SWTC will also continue expanding its fiber-based communications network. The utility is also evaluating the potential for new pricing structures.

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