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**Case Study of South Kentucky RECC's
Smart Grid Investment Grant Program
DE-FOA-0000058**



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Background

On August 6, 2009 South Kentucky Rural Electric Cooperative Corporation (SKRECC) applied for a Department of Energy Grant as part of the American Recovery and Reinvestment Act (ARRA) to install an Advanced Metering Infrastructure (AMI) system throughout our service territory. We received preliminary approval for the grant on October 27, 2009.

SKRECC is a rural electric distribution cooperative organized in 1938 and is located in South Central Kentucky. SKRECC provides electric service to the counties of Pulaski, Russell, Wayne, Clinton, McCreary, Casey, Lincoln, Adair, Rockcastle, Cumberland and Laurel in Kentucky and the counties of Pickett and Scott in Tennessee. We purchase our power from East Kentucky Power Cooperative (our Generation and Transmission provider). SKRECC currently has 66,472 active accounts and maintains 6,762 miles of distribution line and 51,676 transformers supported by 150,354 poles. Residential members represent the majority of our accounts representing over 93% of the active accounts and our member density is relatively low with only 9.83 members per mile of distribution line.

The SKRECC service area is located in western Appalachia with terrain that is mountainous to hilly and has significant forest land. Parts of the territory are somewhat isolated and scarcely populated with low meter density across large portions of our territory. The terrain does not allow for good penetration of radio frequency to all metering points therefore Power Line Carrier Technology was chosen for our AMI field communications.

SKRECC chose to install the Aclara Two-Way Automatic Communications System (TWACS®). Aclara is a proven company with TWACS technology installed by multiple electric utilities throughout the United States. TWACS utilizes power line carrier technology to communicate from the home to the electric utility substation and offers two-way communication back to the electric meter.

The total budget for the project was \$19,636,214 of which \$9,538,233 was obtained from grant funding through the ARRA Grant and \$10,097,981 was allocated matching expenditures from SKRECC. Upon final completion the total cost of the project was \$20,132,879, which exceeded budget by \$496,665. While this seems to be a significant amount it is only 2.5% of the total project cost. Most of the cost overrun was due to additional labor costs.

Goals of the Project

With the TWACS system, SKRECC can now effectively manage customer data and reduce costs while enabling innovation and providing superior customer service. The main objectives we anticipated accomplishing through the deployment of the system were:

- The elimination of monthly physical visits to the member's premises to read the meter for billing purposes thereby reducing our meter reading costs.
- Better service due to the elimination of persistent estimated meter reads.
- Elimination of billing errors through better monitoring and greater detail of electric usage.
- The ability for customer service representatives to access the member's recent detailed consumption history.
- Improved outage response time through monitoring of electric accounts along with the location and duration of each outage.
- The ability to verify restoration status of all members on a line when electric service is restored.
- New demand-side management options, including load management, load aggregation, and rate options.
- Member access to their own usage data through the Internet which will increase their awareness and ability to better manage their energy consumption.
- The elimination of physical visits for connecting and disconnecting electric accounts by selectively installing disconnect collars on accounts which have a history of being turned on or off repeatedly, such as rental properties, delinquent accounts or summer homes.
- Reduced potential for equipment damage from low and/or high voltage conditions as these will be monitored and investigated.
- Member's ability to avoid deposits with the use of pre-paid options along with the ability for seasonal accounts to pre-pay for their electric service.
- Avoid new construction of coal fired electric generation and reduce CO2 emissions through load control. Each megawatt of overall usage reduction will reduce carbon emissions by 2,000 pounds.
- Increased revenue through the reduction of line loss due to better collection and utilization of load data.
- Delayed upgrades to electric facilities resulting from a greater knowledge of line and transformer loading.
- Reduction of energy theft through the use of tamper detection and better monitoring of member usage.
- Better phase balancing through integration of loading data with our engineering system model.

Challenges

- Perhaps the greatest challenge was to gain 100% acceptance by our members. There has been a coordinated effort of misinformation through social media deploring AMI systems as a violation of privacy and claiming the systems can cause health concerns.
- Consumers are unwilling to adopt new smart grid technologies such as load control, pre-paid metering, and time-of-use rates.
- Potential cost overrun is possible due to the complexity of the equipment and size of the investment.
- Due to utilizing Power Line Carrier for two way communication, the electrical connections on the secondary wire serving each residence and business must be high quality. Ensuring these high quality connections will require a large portion of time from servicemen and construction personnel.
- Delay in the delivery of equipment due to the large number of electric utilities installing AMI systems.
- Governmental approval was required through the Kentucky Public Service Commission before installation could begin.
- AMI system cyber security must be maintained during the installation and must be ongoing throughout the life of the system.
- Determining who is responsible for the repair of the member owned meter base when old and damaged meter bases are found during the AMI installation.
- Interface of AMI software with existing customer information system and engineering software.
- The possibility that energy savings associated with member participation in the AMI project could lead to a reduction in revenues through load control and member energy efficiency gains. This could lead to a future rate increase to recover lost revenue which would also entail PSC approval.
- The concern that Kentucky's very low cost of energy will make demand response less appealing to members.

Goals Achieved

SKRECC has achieved most of the goals set out above. We have eliminated the physical visit to each members home to read the meter. We do still have an occasional meter that will not communicate and we must dispatch a serviceman to check the meter. On average we have one to two truck rolls per day to check a non-reporting meter. In most instances, a poor connection at the meter base is the reason communications with the meter was lost; however, in a few of these instances the power was found to be out to the residence due to a blown fuse on the primary electric line. These truck roll results were much better than we expected with approximately 250 – 400 truck rolls per year which is 0.004% to 0.006% of the total meters installed.

Estimated meter reads and billing errors have been almost completely eliminated; however there are still a few estimations that occur, in most instances due to power outages that occurred during the reading cycle.

Our customer service representatives can now routinely access the member's detailed consumption history and utilize this for high bill complaints or for member usage concerns.

One area that we have seen a significant improvement in is our electrical outage response time and reduced truck rolls. We have the ability to ping a meter and determine whether the electric is on or off at the residence. This has saved dozens of truck rolls due to the member having a main breaker thrown on the panel box inside the house. In the past we would have sent a serviceman to verify the outage. We can now check these before dispatching a technician. In addition, once power is restored after an electrical outage we have the ability to ping the entire distribution line that was out of service and verify if any members located on the line are still without electricity. This has greatly reduced return trips to an area to restore power to small or individual electrical outages that are served by the same electric feed as the main outage.

Along with the deployment of the AMI system we also introduced a new demand side management program in which we manually control electric water heaters, central air conditioners, and heat pumps. The Tariff for this rate was approved by the Kentucky Public Service Commission on November 20, 2012. As of October 1, 2013 SKRECC was controlling 1,172 water heaters and 1,448 heat pumps and air conditioners. The effect of load control on demand has proven to be slightly less than expected, as we are seeing a 0.4 KW reduction from water heater control in the winter and a 0.6 KW reduction in the summer with each heat pump and air conditioner controlled resulting in a 1 KW load reduction. This brings the total load currently under control to 1,917 KW (1.92 MW) in the winter and 2,151 KW (2.15 MW) in the summer. The corresponding reduction in CO2 emissions is approximately 4,000 pounds for each hour of load control.

Our Meter Data Management (MDM) system now allows members to view their electric usage by day and or by hour. This has resulted in a better understanding of their energy usage and a corresponding reduction in high bill complaints. The MDM also gives another tool to our member service advisors and customer service representatives (CSR's) when discussing billing issues with our members.

SKRECC installed over 15,000 remote disconnect collars which has allowed us to remotely connect and disconnect residential accounts. We selectively chose the accounts that received a collar for cost considerations. There are many residential accounts that have been active for decades and never turned on or off and we could not justify the expense of a disconnect collar on these accounts. We limited our collars to rental properties, summer homes, and habitually slow pay accounts to maximize their effectiveness and cost justification.

Since SKRECC first activated the voltage monitoring on the AMI system we have discovered 98 transformers in which the voltage was above accepted levels. Many of these were found during the initial roll-out phase, but a few have been found since the initial system startup. These were changed as soon as they were identified thereby saving damage to our member's appliances and electrical equipment.

While an exact quantification is not possible we feel we have seen a reduction in our line loss as it was averaging 6% over the last several years prior to the AMI rollout and we are now running less than 5.5%. This 0.5%+ savings in overall line loss represents an 8.5% reduction $[(1 - (5.5 / 6))]$. This reduction in line loss was accomplished through better line balancing, newer and more accurate meters, better tamper detection, earlier detection of stopped meters and more accurate meter reading.

Quantifiable Savings

The areas that are easiest to verify the exact savings from the AMI project are as follows:

- Meter reading cost savings – SKRECC was paying \$0.71 per meter to a meter reading contractor to read our meters monthly for billing purposes. Since the inception of the AMI project, through October 31, 2013 we have obtained 1,666,831 meter readings to be used for billing purposes and have saved \$1,116,776 in meter reading costs.
- Another area that we are able to quantify the benefit received is through remote connecting and disconnecting of accounts. We previously employed a contractor at a rate of \$11.00 per account to perform these account connects and disconnects. Through October 2013 we have performed 22,079 remote connects, and 21,103 remote disconnects of residential accounts with our AMI system for a minimum savings of \$475,002 in contractor reimbursements. This has resulted in a total quantifiable savings of \$1,591,778 due to meter reading and remote connect/disconnecting of accounts. This does not include additional savings from service changeovers through read-outs, meter re-reads, voltage monitoring, theft detection, and improved outage restoration as discussed below.

Non-Quantifiable Savings

Much of the efficiency and savings that occurred with the implementation of our AMI project is difficult to quantify due to our inability to track specific cost reductions. Among these are:

- Better identification of over or under voltage situations which will reduce equipment damage. We have tracked the number of transformers identified, but cannot determine the reduction in equipment failure or damage.
- Reduction in insurance claims filed by the homeowner due to our ability to identify and repair electrical outages when the member is not home.
- Routine account changeovers through meter reading – When a member changed electric service from one name to another, we previously had to roll a truck to obtain the meter reading in order to close out the old account and start the new account. This is now performed from the office and the number of changeovers has not been tracked.
- Better service due to the eliminated estimated meter reads which reduces member complaints and associated labor to address these grievances.
- Reduce the number of field visits for false outages reported by the member. There have been numerous instances in which we have been able to ping the meter and determine the account was off due to a main breaker thrown, thus avoiding a service run.
- Improve member service by allowing usage data to be accessed through our MDM system. This reduces high bill complaints and the number of field visits by SKRECC member service personnel.
- Reduced fuel consumption through reduction of truck rolls.
- Longer life span of vehicles through reduced mileage and truck rolls.
- Reduced overtime charges for reconnecting delinquent accounts after hours. We dispatch two line technicians for each after hours reconnect. The disconnect collars will reduce the need to roll a truck in approximately 96% – 98% of these after hour reconnects.
- Through load monitoring, we can avoid the overloading of transformers, and have a larger sized transformer installed before the increased load causes the current transformer to fail. We have found a few of these but have not been tracking this number.

Future Development and Concerns

The completion of the installation of our AMI system is not the end of the project, but the beginning of a sustained effort to build a smart grid infrastructure with installation to continue in multiple phases over many years, as each project becomes economically feasible. We will be performing a cost/benefit analysis of each new technology to verify that its deployment and ongoing operational costs result in savings for our members. Among the items to be investigated and concerns to be addressed are:

- Distribution Automation – We hope to investigate down line recloser and voltage regulator control through our AMI system as technological advances allow. This will help with outage restoration times and possible voltage reduction for future savings.
- Two-way Communicating Capacitor Control Switch – Capacitor control is currently available through TWACS. We will be investigating the use of more switched capacitors for power factor correction and energy savings.
- Controllable/Addressable Thermostat – Another technology to investigate is an AMI controlled thermostat which would allow for a significant increase in load control capabilities.
- SKRECC would like to utilize the “smart grid” connection to schools we serve to assist in educating students of all ages regarding the energy savings capabilities now available with the AMI system.
- Investigate and implement time-of-use rates to give our members additional options in controlling the time of their energy usage and the corresponding costs.
- Implement a Pre-Paid Meter Tariff which will allow our members to avoid deposits and better allocate their money throughout the month by paying in smaller increments and better managing their cash flow.

Other Project Benefits

The lack of information and communication available to the end user has been a factor in preventing SKRECC from assisting our members in their desire to reduce their electric usage and in reducing our corresponding system electrical demand. Members can now monitor their electrical usage and see the corresponding savings from new technologies such as remote control of appliances.

In addition to member benefits there are societal and environmental benefits from an AMI system through the reduced CO2 emissions from power plants through the reduction in electric usage and in addition there is also a reduction in vehicle emissions from the elimination of manually reading meters and manually connecting and disconnecting accounts.

There could also be an added benefit of moderated demand growth for both the distribution cooperative and the generation and transmission cooperative which could lengthen the life of electrical facilities.

Member Acceptance

As an electric cooperative, SKRECC does not view our rate payers as customers but as member owners. Throughout our history SKRECC has been involved in the communities we serve through our employee's volunteering for various community service organizations and actively representing SKRECC as a company in community events. Through the years our employees have been active members of many organizations including:

- Local Volunteer Fire Departments
- PRIDE (Environmental Organization)
- Local Chambers of Commerce
- American Legion
- Local Development and Industrial Foundations
- Lion's Club
- Blue Star Mothers
- Bethany House Abuse Center
- Master Musicians Festival
- Regional Hazardous Materials Team
- Local Historical Societies
- Humane Society
- Lake Cumberland Red Cross
- Kiwanis International
- Somerset Rotary Club
- Habitat for Humanity
- United Way
- 4-H Clubs
- Parent Teacher Associations
- God's Food Pantry
- Friend's of Lake Cumberland
- Local Rescue Squads
- Coaches of Local Youth Sports Teams
- Plus many other organizations

SKRECC employees are respected participants in the communities we serve and this member relationship has been beneficial in obtaining 100% participation in the AMI project. While other utilities have offered an opt-out option on their AMI systems, SKRECC has not given this option to our members.

SKRECC has been a participant in the American Customer Satisfaction Index (ACSI). ACSI is one of the most recognized customer satisfaction indices in the United States. Member satisfaction data is collected quarterly by a residential member satisfaction phone survey. SKRECC has historically received high marks in this satisfaction survey. The last survey was performed in 2012 and SKRECC had an overall ACSI Score of 80. This is lower than in previous years but 80% satisfaction rate is still higher than many industries and most other electric utilities. SKRECC ranks very high on Quality of Customer Service (89%), reliability of electric service (87%) and image of your electric provider in your community (86%).

We have had limited concerns and no opposition to the installation of the AMI system and we attribute this to our community involvement and excellent customer satisfaction level.

Recommendations

- Obtain feedback from all departments within the organization prior to installation. By allowing each department to voice their concerns and respond appropriately, there will be reduced problems with the deployment and greater acceptance of the system.
- Train employees about all of the benefits of the AMI project so they can be well informed of AMI issues and benefits when assisting members.
- Have regular update meetings for the project team so progress can be evaluated and issues addressed.
- Provide status reports for the management team, CEO and board of directors so they can better understand the progress made and issues being encountered.
- Monitor various communications sites including on-line and print media for any issues or concerns that members may have including; Twitter, Facebook, newspapers and local talk radio.
- Respond quickly to all member inquires and concerns and do not discount the reason for the complaint. Some of the issues that arise may seem insignificant and irrational but if it is a concern to your member or customer then the issue needs to be addressed to resolve their apprehensions.
- When discussing the AMI system with members emphasize the benefits they will receive from the AMI system as an individual and not the benefits obtained by SKRECC.
- Inform the members of the project and its progress through continual communications. This can be achieved by issuing press releases, attending public meetings, publishing regular articles in the local newspapers or magazines, and provide updates on your website and through bill inserts.
- If available, utilizing your automated calling system to notify customers when you will be in their area changing meters. If the automated calling system is not available, look for other ways of notification. Field visits by employees were much better received when advance notice was given to our members.
- Be proactive in reminding members of cold and/or hot weather events. Weather related increases in electric bills following the installation of smart meters can lead members to attribute the increase to the smart meter even though there is no correlation.