Washington-St. Tammany Case Study

Stress-Testing Designs Before Deployment

FINAL REPORT | MAY 31, 2014

NRECA
A Touchstone Energy® Cooperative
CRN
Cooperative Research Network

NRECA-DOE SMART GRID DEMONSTRATION PROJECT | DE-OE0000222

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The National Rural Electric Cooperative Association

NRECA is the national service organization for more than 900 not-for-profit rural electric cooperatives and public power districts providing retail electric service to more than 42 million consumers in 47 states and whose retail sales account for approximately 12 percent of total electricity sales in the United States.

NRECA's members include consumer-owned local distribution systems — the vast majority — and 66 generation and transmission (G&T) cooperatives that supply wholesale power to their distribution cooperative owner-members. Distribution and G&T cooperatives share an obligation to serve their members by providing safe, reliable and affordable electric service.

About CRN

NRECA's Cooperative Research Network™ (CRN) manages an extensive network of organizations and partners in order to conduct collaborative research for electric cooperatives. CRN is a catalyst for innovative and practical technology solutions for emerging industry issues by leading and facilitating collaborative research with co-ops, industry, universities, labs, and federal agencies.

CRN fosters and communicates technical advances and business improvements to help electric cooperatives control costs, increase productivity, and enhance service to their consumer-members. CRN products, services and technology surveillance address strategic issues in the areas:

- Cyber Security
- Consumer Energy Solutions
- Generation & Environment
- Grid Analytics
- Next Generation Networks
- Renewables
- Resiliency
- Smart Grid

CRN research is directed by member advisors drawn from the more than 900 private, not-for-profit, consumer-owned cooperatives who are members of NRECA.

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FOREWORD

The National Rural Electric Cooperative Association (NRECA) has organized the NRECA-U.S. Department of Energy (DOE) Smart Grid Demonstration Project (DE-OE0000222) to install and study a broad range of advanced Smart Grid technologies in a demonstration that involved 23 electric cooperatives in 12 states. For purposes of evaluation, the technologies deployed have been classified into three major sub-classes, each consisting of four technology types.

Enabling Technologies:	Advanced Metering Infrastructure Meter Data Management Systems Telecommunications Supervisory Control and Data Acquisition
Demand Response:	In-Home Displays & Web Portals Demand Response Over AMI Prepaid Metering Interactive Thermal Storage
Distribution Automation:	Renewables Integration Smart Feeder Switching Advanced Volt/VAR Control Conservation Voltage Reduction

To demonstrate the value of implementing the Smart Grid, NRECA has prepared a series of single-topic studies to evaluate the merits of project activities. The study designs have been developed jointly by NRECA and DOE. This document is the final report on one of those topics.

INTRODUCTION

All Smart Grid installations require design review prior to installation. However, several factors make early and rigorous review of communications designs especially critical:

- Communications is an enabling technology for all other Smart Grid functions and devices.
- Radio, wireless, and cellular communications are subject to environmental conditions that vary with geography.
- Radio, wireless, and cellular communications are subject to environmental conditions that vary over time. (Examples of this include weather, solar activity, and interference from industrial operations.)

It helps to have many sets of eyes on a communication design, and utilities must be open to feedback at each step. Sometimes they must make the difficult decision to change designs after implementation has begun. This was demonstrated when Washington-St. Tammany Electric Cooperative ran into a particularly difficult—and surprising—problem when deploying a communications system intended to connect transmission breakers to its supervisory control and data acquisition (SCADA) system.

The problem was unique to the area Washington-St. Tammany serves. However, the need to thoroughly stress-test communication designs is universal. This case study is meant to illustrate that need and highlight the success of that co-op's deployment in the face of unexpected developments.

ABOUT WASHINGTON-ST. TAMMANY (WST)

Washington-St. Tammany Electric Cooperative (WST) serves the southeastern Louisiana parishes of Washington, St. Tammany, and Tangipahoa, as well as the southern part of Marion County in Mississippi. WST operates 183 miles of transmission lines and more than 4,905 miles of distribution lines, seven transmission substations, two transmission switching stations, and 30 distribution substations.

WST serves more than 50,000 accounts. Its average line density is approximately 9 meters per mile. WST buys its powers from Louisiana Generation (a division of NRG Energy).

ABOUT WST'S SMART GRID DEMONSTRATION PROJECT

WST's goal for the Smart Grid Demonstration Project was to install 24 transmission breakers and connect these to its SCADA system. These breakers then could be controlled from WST's control center. Each breaker could also act autonomously, based on sensor data from its own distribution feeder and information communicated from other breakers. Using these data, breakers could pinpoint and isolate problems, making the feeder "self-healing."

A communication link thus would be required to connect each breaker with the control center. Communications would also be required between breakers, so that they could work in concert.

First Communications Plan: Microwave

WST commissioned a communication study, which was done from topographic maps. That study indicated that the communications needs could be met through a microwave system consisting of seven master sites (hubs) and 27 remote sites. Most towers in the system would need to be approximately 60–80 feet high. A couple of them would need additional height—approximately 100–120 feet. Connections from the hub towers to the control center or monitoring points would be achieved using T-1 lines.

Estimates for the per-tower price were approximately $8,000 for each 60- to 80-foot tower and approximately $12,000 for each 100- to 120-foot tower. Based on this estimate, WST decided to proceed with the microwave option.

Unexpected Difficulty

WST issued a Request for Proposal (RFP) for the construction. However, one of the vendors that responded indicated that the design the co-op had in mind would not work. This concern was based on assumptions about tree height in the areas between service towers.

The longleaf pines native to the area block microwave transmission. Consequently, any microwave communication system would need to have line-of-site, making tree height an important consideration. Tree height was assumed to be 90–100 feet.

However, this did not take into account that the trees in the area had not yet reached their maximum height. Large areas had been cleared at some point in the past (many by Hurricane Katrina). The trees standing there now are the result of replanting. Once it was realized that the trees would continue getting higher, estimates for tower height had to be recalculated.

WST worked with a new contractor on the re-estimate. Line-of-site was determined by positioning two bucket trucks some distance apart. The bucket trucks (owned by WST) could be extended to 60 feet. A mirror was mounted on one truck, and a light source on the other. By shining light from one toward the other, it was determined that line-of-sight did not exist at that height.

With the new data, the tower heights were recalculated. It was determined that, for many towers, the new required height would be 250 feet. This necessitated a switch from a monopole design to a self-supporting tower design. Not only were the structures themselves more expensive, but the larger footprints (relative to monopole structures) meant that real estate became a sizeable expense. Some 250-foot towers would cost approximately $250,000.

Simply by factoring in a better approximation of the average tree height, the cost estimate for the communication network had jumped substantially, making microwave unacceptably expensive.

Second Communications Plan: Fiber Optic

WST then examined other options. This time, the co-op sent out an RFP for a fiber optic system. It was determined that fiber could be strung from existing transmission towers at a cost of about $1,000,000. Under this plan, WST would run 48-count fiber—12 strands would serve the co-op's needs and the remaining 36 strands of "dark fiber" would be leased out, thus helping recoup some of the cost of deployment. In all, WST will deploy more than 100 miles of fiber throughout its system. The co-op expects this deployment to be completed by the end of 2013.

CONCLUSION

WST could have invested hundreds of thousands of dollars in a microwave system, only to find that it did not function as intended and did not meet the needs of its transmission breaker project. Only by being open to feedback about its design at all stages was the co-op able to avoid a misstep.

WST's fiber system will serve its Smart Grid communication needs for the foreseeable future, while also enabling the co-op to lease dark fiber. These leases will provide income to the co-op. In addition, the availability of this broadband resource will be an important resource for WST's service area, enabling economic development in the form of businesses that require broadband connectivity. This win-win scenario is a direct result of re-evaluating and reconsidering the original proposed communication design.