RURAL ENERGY STORAGE DEPLOYMENT PROGRAM (RESDP) CASE STUDY:

Poudre Valley REA Microgrid at Red Feather Lakes

Bringing Resiliency to the Edge of the Grid

RESDP Project

This is the first in a series of case studies on the deployment of battery energy storage systems (BESS) projects at electric cooperatives for NRECA's Rural Energy Storage Deployment Program (RESDP). RESDP's goal is to successfully deploy BESS at rural critical infrastructure served by electric cooperatives to increase resiliency, improve system efficiency, and to collect best practices and lessons learned from these deployments with electric cooperatives across the country. For more information on the project and additional resources, please visit the project landing page at www.cooperative.com/RESDP.

The project profiled in this case study is the Red Feather Lakes Microgrid by Poudre Valley REA, which serves an isolated mountain community to support essential services, such as broadband and shelter, during extended outages.

This material is based upon work supported by the DOE Office of Electricity Stationary Energy Storage Program, directed by Dr. Imre Gyuk.

Project Description and Goals

Red Feather Lakes is a remote community in a rugged area of the Rocky Mountains, northwest of Fort Collins, Colorado served by Poudre Valley Rural Electric Association (PVREA) from a 69 kV radial subtransmission system. The area is subject to short-duration outages caused by vehicular accidents and weather events damaging the radial power lines serving the area. In addition, wildfires and major storms can bring extended outages. The microgrid will be utilized to support essential services for the greater Red Feather Lakes community (which includes several hundred homes and seasonal cabins within a few miles of the unincorporated village center). In the event of an emergency, the microgrid will support 14 metering locations with a combined load of approximately 90 kW. During islanded operation, the

microgrid will power essential services that provide broadband, meeting space, telecommunications, fuel, food, water, general supplies, shelter, and emergency services.

In addition to community resiliency benefits, the project will assess:

- Battery performance, particularly the efficacy of the remote control of the microgrid,
- Effectiveness of the system in outage situations,
- Utilizing the resources for load management based upon distribution, transmission, and generation needs, and
- Optimizing resiliency through enhanced energy efficiency and load management applications.

Elements of the Microgrid

Provided by Poudre Valley REA and/or through RESDP	Provided by Community
140 kW/ 446 kWh battery (Tesla)	20 kW (AC) solar photovoltaic system
Controller (Encorp Egility control platform)	Generac propane generator (130 kW with 1,000 gallons of storage capacity)
Reclosers, switches, line monitoring, transformers, distribution line upgrades and communications systems	

Project Partners	Supporting Partners
Poudre Valley REA, NRECA, Sandia National Laboratories, Pacific Northwest National Laboratory, RFL Community	Tri-State Generation & Transmission Association

Total Project Cost	
$550,000	
Project Partners Cost Share	
DOE	$250,000
Cooperative*	$300,000

*Tri-State G&T is contributing $160,000 to the cost of the project.

Project Milestones and Timeline:

Milestone	Completion Date
Project design	Fall 2020
BESS procurement	Fall 2020
Microgrid controller procurement	Fall 2019
BESS and Controller installed and energized	December 2020
Commissioning commenced	January 2021
Full commissioning and initial operation (grid-parallel)	February 2021
Complete distribution system work	July 2021
Fully operational (island-mode)	July 2021 (estimated)

Answering a Need

In 2018, a community group in Red Feather Lakes won a grant from a family foundation to install a solar PV system at the community library, a building that also serves as the Red Feather Lakes multi-purpose community center. The group of co-op members behind the solar initiative invited Poudre Valley REA staff to discuss ways the community might work with the co-op to maximize the value of the solar installation. When the single power line snaking up the mountains experienced an outage, the co-op dispatched crews from its headquarters 60 miles away, and outages of several hours were not uncommon. The community hoped a microgrid might provide relief.

Josh Noel, PVREA's vice president, technology and energy resources, says that the cooperative saw an opportunity to apply lessons learned from an initial microgrid installation at the PVREA headquarters to meet a community and member need. Discussions continued over the next year, and initial plans focused on utilizing a battery energy system planned as part of the library's solar project as the storage element in the microgrid. PVREA's focus all along, Noel notes, was to develop a solution that could be replicated across their system. "While each microgrid has its own unique characteristics, we are creating a template that can be duplicated in the future to best benefit our members," he says.

Joining the Rural Energy Storage Deployment Project (RESDP)

A variety of scenarios for the microgrid were proposed and evaluated over the next year. In 2019, while it was still anticipated that the project would use a battery tied to the library solar system, Poudre Valley REA set into motion the process to procure a microgrid controller. A request for information (RFI) was issued, and within a few months, the cooperative selected a microgrid controller solution and formed a partnership with Encorp, a global microgrid solutions company headquartered in Fort Collins.

Soon after, changed circumstances led to a decision that a larger battery system should be utilized and that PVREA would be the owner and operator. A new location was selected for the battery system: the Red

Feather Lakes fire station, which is center of the community's emergency services (see Figure 1). It offered other advantages, including:

- a propane-fueled generator, already in use for standby generation,
- the only three-phase service in the community, a level of service required for the microgrid, and
- sufficient space to site a battery energy storage system (BESS).

Figure 1: Aerial view of the Red Feather Lakes commercial center, the heart of the microgrid.
Image courtesy of Poudre Valley REA.

The opportunity to join NRECA's RESDP in 2020 made a significant difference for the Poudre Valley REA microgrid project. The funding made acquiring the battery achievable and provided access to the technical services from Sandia National Laboratories and NRECA. These services included:

- Assistance in an analysis of how battery energy storage and a microgrid might improve reliability and provide new services with a defined economic return,
- Use of Sandia's technical team to collect data and run models to identify the optimal battery size and the proper integration of resources within the microgrid,
- Review of the detailed design of the microgrid, and
- Assistance with the development of Request for Information/Proposals documents, clearly identifying the parameters of the desired solutions.

Procuring the Controller and Battery: Lessons Learned

Poudre Valley REA followed two basic tenets of advice in procuring the battery and microgrid controller:

- Prepare a detailed scope of the expected outcome for the project and provide the technical characteristics that the ideal solution must be able to meet, and
- Ask bidders to propose a solution that can meet the stated needs, while resisting the impulse to narrow options or limit responses to a predetermined technology.

"With technology changing rapidly, we understood we were not the experts and looked to third-party providers to bring creative solutions to fit our needs." says Noel.

The RFI resulted in several quality responses from northern Colorado-based companies, and Poudre Valley REA selected an Egility controller from Encorp.

"The RFI from Poudre Valley was well done, detailed enough, but not to the point of being arduous," says Michael Clark, CEO of Encorp. "Sometimes RFIs are written in a way where it's clear that they don't know what they want, or are written so specifically that you feel it would be challenging to work with the client."

When it later issued a Request for Proposals for a battery system, the cooperative again focused on the general need, though it now had one specific criteria – the technology would need to work seamlessly with the Encorp controller.

Initially, Poudre Valley REA reached out directly to battery manufacturers, before being directed to companies that installed distributed energy projects. Poudre Valley REA eventually purchased a Tesla battery energy system through Namaste Solar, another local Colorado company. Namaste Solar was contracted to deliver and install the battery system.

Design Challenge for the Host Utility

Poudre Valley REA utilized the technical engineering staff at Sandia National Laboratories to estimate the optimal sizes of the components of the Red Feather Lakes microgrid. Models were run to determine the combination of highest efficiency at lowest cost in two applications: stand-alone (island) mode and in grid-connected mode (for reduction of demand during coincident peak periods).

Since two of the three active resources in the microgrid – the PV system at the library and the propane generator at the fire station – are existing resources that are neither owned by the cooperative or covered by RESDP, the key resource decision informed by the Sandia analysis was the power and energy characteristics of the battery energy storage system. The analysis provided parameters of how the microgrid can be expected to operate, in order to maintain safe and efficient use of the equipment while achieving the desired results at the lowest cost.

In island mode, the PV system, when producing, will meet existing demand within the microgrid up to 20 kW, with the BESS picking up additional load from the peak microgrid demand of 90 kW. The battery, which has an expected 3.2 hours of storage under peak loading, will be recharged from the generator. In total, the microgrid should provide at least 12 hours of resiliency during a grid outage. This should provide ample coverage during a "standard" outage in Red Feather Lakes of two to four hours from a

downed tree or a vehicle taking out a co-op utility pole. In grid-connected, demand response mode, the BESS is expected to discharge up to 120 times per year.

Poudre Valley REA's system engineering team took the lead in determining where to locate the microgrid's three-phase service, and to design and build the necessary infrastructure to support it. This included an upgrade of the existing three-phase service at the fire station, which involved installation of new transformers, poles, and primary line (see Figure 2).

Figure 2: Installing the Encorp controller (open cabinet) next to Tesla battery outside the Red Feather Lakes fire station. Image courtesy of Poudre Valley REA.

Troy Richter, the cooperative's engineering director, notes that infrastructure within proximity to the fire station has been augmented to help isolate the microgrid from the rest of the system, including the addition of switches and reclosers. "We're using a common mid-line electronic recloser for monitoring operations and for the control of the isolation point of the microgrid," he says. Primary metering is being installed to provide a continuous monitoring element for the grid until the microgrid is brought into play. "Eventually, the microgrid will isolate itself and become independent when called upon," he adds.

Richter is bullish on the microgrid project, which he says is a great asset for the community and an ideal learning experience for the cooperative and its partners. "We have a lot of expertise with distributed energy resources, but not yet with energy storage," he says. "It's an up and coming area and this project is an opportunity to learn on a smaller scale."

He notes the irony of intentionally creating a microgrid in order to maintain reliable service. "An islanded grid is something we typically try to avoid. Following industry standards, we incorporate distributed energy resources into the grid, so they operate in parallel, all parts working together," he says. "Usually when a resource is not conforming, our job is to isolate it to maintain system reliability and meet our standards for service to our members."

Building and Commissioning the BESS

The original timeline of the project was pushed back several months due to the massive Cameron Peak wildfire in September 2020, which came close enough to Red Feather Lakes to force an evacuation of the community and residences in the surrounding area. Once it was safe to resume work on the microgrid, it was nearly winter, and completion of the final parts of the project was postponed to the spring of 2021.

Poudre Valley REA worked in concert with technical staff from Encorp and Namaste Solar to install and connect the microgrid. The cooperative spent a few weeks on the pre-installation design and engineering work, with less than three days of construction on site. An electrical contractor hired by Encorp installed

the lower voltage conduit, and technicians from Encorp and Namaste Solar worked for about five weeks to install the controller and the battery on a concrete pad outside the fire station.

Since the battery system and the controller were procured separately, there may have been more parties involved in the construction and completion of the microgrid than may have been the case if one prime contractor was hired to deliver the controller and battery as a package. But the different entities worked well together, and the project was executed in an efficient and timely manner with only two factors working against it – the wildfires and the pandemic.

Encorp has installed its controller in microgrid projects of similar size in the U.S. and overseas in South Africa and India, though usually with a commercial customer as the owner. CEO Michael Clark says that working with a cooperative utility was a significant and positive difference. "With their level of expertise, it was easy for the co-op to understand the issues and work hand-in-hand with our people and our electrical contractor," he says. "The staff at Poudre Valley also wish to learn. That's not the case with many of our clients."

Since the hot commissioning of the BESS (just before the onset of below-zero weather after the first of the year), the project was grid-connected and sitting in idle, consuming power in order to maintain a minimum temperature in order to safeguard the battery system. In July 2021, the distribution upgrades were completed at the end of July with the final commissioning process set to finish in early August.

Evaluating the Project

Tri-State G&T Association, Poudre Valley REA's cooperative power supplier, sees the project as an important test of the promise for microgrids as a means of improving resiliency to rural communities. It will also demonstrate how the battery system functions when called upon in demand response mode.

Matt Fitzgibbon, beneficial electrification manager, says that a handful of other Tri-State member systems are discussing battery installations. "Poudre Valley's project is among the most intricate and resiliency focused." Given the changing trends in the industry "our biggest takeaway from the Red Feather Lakes project is that it will be an extensive demonstration of the strengths and the weaknesses of this approach and of the opportunities for other utilities."

The microgrid will be put to its first real time test by the summer of 2021, when it will begin to deliver on its two defined applications of resiliency and demand response.

As to Poudre Valley REA's goal of standardizing microgrid design, as developed, the project shows a degree of promise. The Tesla battery system selected for the project was not custom-built, but an 'off the shelf' product. The controller is supplied by a company that focuses on standardization, though Encorp's CEO Clark takes care to explain that controllers specifically, and microgrids in general, are not 'plug and play.'

The hardware is "80 percent standardized," he says. "The controller platform is the size of a refrigerator and can fit most applications. The software, however, is almost entirely done from the ground up, though it does not require an intense engineering effort. The communications interfaces for each project are designed individually."

Some of the customization comes from having to manage and harmonize disparate elements of varying ages. “A microgrid is never a set of all-new components,” says Clark. “There are always existing pieces of equipment that form the facility, whether is it a generator or a solar system, that may have been in place and operating for years.”

Figure 3: PVREA linemen Kevin Kelly (in bucket) and Thomas Bullock (on ground by truck) upgrading utility service for the microgrid.
Image Courtesy of Poudre Valley REA.

Next Steps

Poudre Valley REA line crews are finished with the distribution work, building around the community to allow for isolation of the microgrid. In August 2021, the project should be ready for both grid-parallel and grid-independent operation.

The microgrid will be controlled by PVREA through its SCADA system at the co-op headquarters in Fort Collins. The co-op will create customized SCADA screens to allow for 24/7 monitoring and will develop a standard operating procedure for the sequence of operations needed to make active use of the microgrid. The cooperative plans to bring Encorp in to provide a training program for its technical staff and operations, and a second training for line crews that will focus on fire safety as well as microgrid manual operations. Richter wants the line crews to “reach a comfort level with the battery, to be able to ask ‘what am I looking at here? What am I going to encounter when we are working around the microgrid?’”

After the microgrid is fully commissioned, the co-op will work on signage for the project, which will be located near the BESS. The co-op also plans to have ribbon cutting ceremony scheduled in the coming months.

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