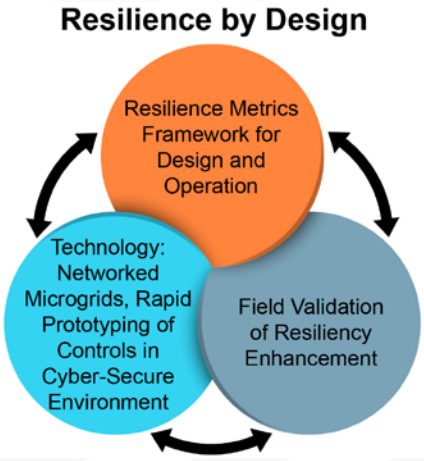
Resilient Alaskan Distribution System Improvements using Automation, Network analysis, Control, and Energy storage (RADIANCE)

CHALLENGE

To enable resiliency in distribution grids, microgrids—or standalone electric grids—are vital, especially in remote geographic areas that are not connected to the transmission system. Microgrids are also gaining attention as more organizations and cities look for ways to generate their own power in emergencies, such as extreme weather or other disruptions. New technology integration, upgrades, new approaches, and complex system interactions necessary for resiliency must be tested and validated before field deployment.



The resilience-by-design approach will be implemented to operate the Cordova, Alaska grid as multiple networked microgrids. Lessons learned from this approach will be made available to more than 800 U.S. electric cooperatives, thus improving the resilience of the nation's electricity delivery systems.

Cordova, Alaska, a town of 2,600 customers, relies on a microgrid served primarily by two hydroelectric plants and diesel power plant. A megawatt-capacity battery for energy storage will be commissioned in 2019.

Energy efficiency and conservation projects have reduced Cordova's use of costly diesel fuel and the associated environmental impact. However, like many microgrids, Cordova's microgrid lacks any advanced sensing, smart reconfiguration, or energy storage with the capability to operate as multiple networked microgrids. This makes the city's power supply vulnerable under conditions of harsh weather, dynamic seasonal loads—and, as with all communities—the increasing threat of cyberattacks.

Resiliency-enhanced operation is necessary for modernizing Cordova's microgrid and for accelerating the adoption of cyber-resilient microgrids in other locations.

At-A-Glance

PROJECT LEAD

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LAB COLLABORATORS

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PARTNERS

- City of Cordova
- Cordova Electric Cooperative
- University of Alaska – Alaska Center for Energy and Power
- Washington State University
- Florida State University
- New Mexico State University
- Siemens Corporation
- Alaska Village Electric Cooperative
- National Rural Electric Cooperative Association

BUDGET

DOE: $6.2M

Industry: $1.6M

DURATION

October 2017 – September 2020

TECHNICAL AREA

System Operations, Power Flow, and Control

Lead: Jeff Dagle

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APPROACH

The project team will put in place a system of resilient, networked microgrids in Cordova. This project introduces the concept of resilience by design, meaning incorporating a cyber-secure resilience framework with real-time sensing and controls at the design stage. The project will provide upgrades and modifications through multiple networked microgrids, micro-phasor-measurement-unit (PMU)-based sensing, and coordinated energy storage.

A zonal approach for operation will be used, with networked microgrids for smart healing and survivability in case of disruption. An energy storage system with controls and requirements from sub-seconds to hours will be designed and optimized as part of the grid architecture. Advanced sensors such as microPMUs will support early detection of problems and provide an accurate view of operational status.

The team will first model and test the design and operation of the cyber-resilient microgrid through linked testbeds at the DOE laboratories, using a digital real-time simulation of the existing Cordova microgrid.

After optimizing the testbed activities, the team will iteratively deploy and validate the multiple-networked microgrids at Cordova. Field validation will minimize the deployment risk of modern power and cyber technologies, and field data will provide insights into the practical use of resilience metrics.

EXPECTED OUTCOMES

The city of Cordova will gain a more resilient and secure grid with enhanced energy storage that reduces the need for diesel fuel. The Alaska Village Electric Cooperative will gain important knowledge that will enable it to operate its 58 dispersed village communities as loosely-networked microgrids in coordination with larger utilities in Fairbanks and Anchorage. This will improve planning and resiliency not only in Cordova, but in a wider area of Alaska.

Beyond Alaska, the National Rural Electric Cooperative Association will disseminate the lessons and information from this project to more than 800 electric cooperatives across the United States. The technical experiences and outcomes will become part of standards such as IEEE 2030.7 and 2030.8.

LAB TEAM

INL Idaho National Laboratory

SLAC NATIONAL ACCELERATOR LABORATORY

Pacific Northwest NATIONAL LABORATORY

As part of the U.S. Department of Energy's Grid Modernization Initiative, the GMLC is a strategic partnership between DOE Headquarters and the national laboratories, bringing together leading experts and resources to collaborate on national grid modernization goals. The GMLC's work is focused in **six technical areas** viewed as essential to modernization efforts:

Devices and Testing | Sensing and Measurements | Systems Operations and Control
Design and Planning | Security and Resilience | Institutional Support