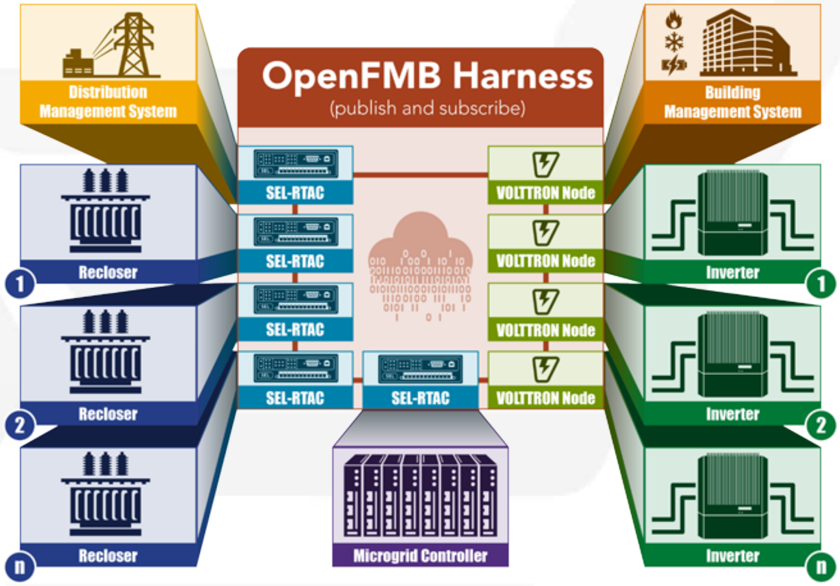
Increasing Distribution Resiliency Using Flexible DER and Microgrid Assets Enabled by OpenFMB

CHALLENGE

The existing electricity infrastructure connects large central power sources to end-use customers through regional transmission networks and local distribution systems. At the local distribution level electricity flows in a single direction, from the substation to the end-use load, typically along a single radial path—with limited redundancy. As a result, any interruption between the substation and the end-use customer results in a loss of service. Consumers can be without power until repairs are completed, with human and economic consequences.

The increasing use of microgrids and distributed energy resources (DERs) has the potential to increase the resilience of end-use loads by limiting the impact of these hazards. However, because legacy infrastructure often lacks flexibility, the integration of high penetrations of DERs, including microgrids, poses a number of operational challenges. Distribution systems need a more flexible operating strategy to take advantage of the decentralized assets to improve resiliency, and such a strategy must be tested and validated.



A segmented, self-healing distribution system uses decentralized assets and forms microgrids to isolate disruptions and minimize outages. It uses distributed energy resources such as solar inverters, smart loads such as building management systems, utility switching devices such as reclosers, and distribution management systems, all controlled locally by a microgrid controller through the open FMB harness.

At-A-Glance

PROJECT LEAD

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PARTNERS

- Duke Energy
- GE Grid Solutions
- University of North Carolina Charlotte
- University of Tennessee
- Smart Electric Power Alliance

INDUSTRY ADVISORY BOARD

- Avista Utilities
- Arizona Public Service (APS)
- Entergy
- North America Energy Standards Board (NAESB)

BUDGET

DOE: $6M
Industry: $1.2M

DURATION

October 2017 – October 2020

TECHNICAL AREA

Devices and Integrated Systems Testing

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Rev. 0, August 2018 | PNNL-SA-137684

APPROACH

Through a collaboration of national laboratory, university, and industry partners, this project is developing and testing a flexible architecture that coordinates decentralized and centralized assets within a central distribution management system. The team will use an open-source reference platform, called OpenFMB, for security and interoperability.

The new operating strategy will

- Treat DERs and microgrids as active elements with distributed controls in the system.
- Incorporate a segment-based, self-healing distribution system that reconfigures based on local and central controls during an unexpected disruption.
- Allow leveraging of end-use loads as a resource.

In addition, the team will research how an individual grid segment can become a microgrid in the absence of other sources. If the transmission system goes down, the microgrid could still generate power. With all this flexibility planned in the design, disruptions to the grid would be isolated and outages minimized.

Toward the end of the three-year project, the team will validate how the new operational system performs at the Anderson Civic Center in Anderson, South Carolina. Served by four separate distribution circuits, this facility acts as an emergency staging area during extreme events. Duke Energy, the hosting utility, will place a new self-optimizing grid on the circuits and a microgrid at the civic center.

EXPECTED OUTCOMES

The Anderson Civic Center will be served by a more flexible and resilient power grid, and the operating architecture can be used more broadly. Duke Energy can use the developed capabilities across its six-state service territory, and other utilities across the nation can implement them in their own territories. Such flexibility encourages the installment of more DERs, to further improve the grid and its resilience.

LAB TEAM

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