

NREL + Duke Energy Test Voltage Control for Distributed Solar

CHALLENGE

Integrating high penetrations of utility-scale solar into distribution grids can present voltage regulation challenges for utilities—especially in states with a lot of utility-scale solar capacity like North Carolina. Duke Energy, the primary utility for North Carolina, wanted to compare how the advanced inverters working autonomously or in conjunction with their existing distribution management system (DMS) could help.

SOLUTION

Duke Energy partnered with the National Renewable Energy Laboratory (NREL) and DMS vendor GE Grid Solutions (formerly Alstom Grid) to better understand these voltage interactions through simulation, visualization, and hardware testing.

Duke Energy provided extensive data—including technical network details and one year of power, voltage, and current measurements—for a real-world distribution circuit that includes a 5MW solar photovoltaic (PV) system located 2.1 miles from a substation. Using this data, NREL and partner GE Grid Solutions simulated future operations with the DMS provided by Duke, comparing three operating modes: with conventional inverters; with advanced inverters providing local power control; and with advanced inverters coordinated by the DMS to optimize voltage control.

IMPACT

Results of this research showed that for this circuit and its 5MW solar farm, coordinating voltage control through the DMS provided the best performance. This approach reduced equipment operations, voltage challenges, and cost, compared to local voltage control using advanced inverters alone. This project is one of the first of its kind to explore PV voltage control questions using a commercial DMS as a research tool. By bringing together insights, data, and tools from a utility, a vendor, and a national laboratory, this research informs renewable energy integration across the country.

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NREL, Duke Energy, and GE Grid Solutions partnered to better understand how advanced inverters working autonomously or in coordination with a DMS could help control voltage.

In November 2014 the U.S. Department of Energy launched the GMLC, a strategic partnership between DOE and the national laboratories to bring together leading experts and resources to collaborate on national grid modernization goals.

This integrated effort builds on prior individual projects at the national laboratories to deliver grid-related advancements, such as the **use of distribution management systems for voltage control**.