

Distributed Energy Resource Management

Mitigating and Managing the Impacts of Solar

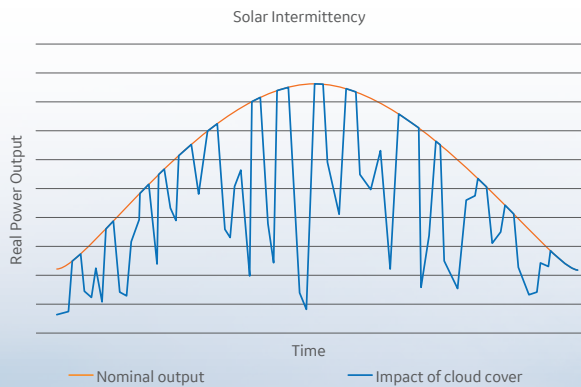
Case Study



The Situation

In recent years energy regulations and advances in technology have driven a significant rise in the volume of distributed energy resources (DERs) across the distribution grid in North America. One of GE's customers, a large American investor-owned utility, was experiencing a substantial increase in the penetration of distributed generation within three of the southern states that it served. Legislation in the first state mandated that 12.5% of retail electricity sales be fulfilled by renewable energy or energy efficiency by 2020¹. This state is the third largest solar producer in the US with 2087 MW of solar electric capacity installed and 223,000 homes powered by solar². The second state's 2014 renewable portfolio standard authorized utilities to develop distributed energy resource programs with the goal of encouraging the development of in-state renewable energy generation capacity³. Though the third state had no renewable portfolio standard and no power purchase agreements in place, it ranked third in the nation for rooftop solar potential⁴. All of these factors led the utility to significantly increase investments in renewables within these three states.

In 2015 the utility launched a \$500 million investment in solar power expansion in the first state, generating 278 MW—128 MW owned and operated by the utility. This investment represented a 60% increase in the amount of solar power for the utility's customers within this state⁵. For the company's customers in the second state it launched a solar rebate program designed to help homeowners and businesses offset upfront costs associated with installing solar on their property⁶. While in the third state the utility announced plans to invest in 500 MW of utility-scale solar by 2024⁷.



Intermittent solar production due to varied cloud cover can result in output swings

The nature of renewable energy is volatile, and the utility realized it had several potential challenges to surmount. During low load periods, feeders with high photovoltaic (PV) penetration could exhibit reverse power flows potentially causing problems with protection systems. Intermittent solar production could also result in voltage swings, increasing the cycling of regulation equipment at feeders and distribution substations. Also a factor was the issue of limited visibility to the impact of solar on the distribution network resulting in challenges related to switching and off-nominal configurations. Lastly, the utility's existing distribution management functions, such as integrated volt-VAR control, automated switching and load shed were not DER-aware.

The Projects

To examine these challenges in depth, the utility collaborated on pilot projects with the U.S. Department of Energy (DOE) and GE Grid Solutions.

In the first pilot, entitled the 'Integrated Smart Distribution RD&D Project', GE worked with the utility and the DOE's Pacific Northwest National Laboratory. The pilot's primary objective was to leverage the intelligence of, and information provided by, sensors, energy boxes and smart meters to integrate DER with the current Distribution Management System (DMS) in order to enhance optimal performance of the emerging distribution system. This built on the DOE's vision of an Intelligent North American Grid by 2030.

In the second pilot, GE is currently wrapping up work with the utility and the DOE's National Renewable Energy Lab (NREL) to identify and mitigate challenges with distributed solar PV using smart inverters and volt-VAR control. The project includes detailed system modeling, combined with Power-Hardware-in-the-Loop verification to compare local vs. centralized management of voltage with utility-scale inverters located in the utility's service territory.



The Results

The end result of the first study was the development of a Distributed Energy Resource Management system (DERM) to manage and mitigate the effects of growing distributed, renewable generation and storage capacity on the electrical system.

The DERM solution delivered:

- DER visualization and modeling tools
- Remote DER monitoring and control functionality
- Power flow directional indicating and alarming
- DERM-enabled study mode feeder reconfiguration
- Dynamic DER scheduling and forecasting
- DER inclusion in integrated volt-var control (IVVC) and fault detection, isolation and restoration (FDIR)
- DERM data export and reporting

In addition, the simulation activity in the smart inverter pilot illustrated that advanced Inverters are important to support distribution operations with PV. There are multiple voltage support options and these devices are currently available in the market. Local advanced inverter controls can help manage PV by providing moderate reductions in regulator operations, improved voltage management and the ability to adapt to reconfiguration of the distribution network.

Conclusion

GE's DERM delivered a user-friendly solution on a next generation user interface, with extensive reporting capabilities, all seamlessly integrated with the utility's DMS. By implementing the DERM solution, the company will be able to mitigate and manage the impacts of solar swing, maintain distribution grid stability, enhance load distribution and forecasting, as well as manage the impact of distributed generation (DG) on transmission.

Endnotes

1. http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_62/GS_62-133.8.html
2. <http://www.seia.org/research-resources/top-10-solar-states>
3. <https://www.eia.gov/state/print.cfm?sid=SC>
4. <http://www.seia.org/state-solar-policy/florida>
5. <https://news.duke-energy.com/releases/duke-energy-commits-500-million-to-north-carolina-solar-power-expansion>
6. <https://news.duke-energy.com/releases/duke-energy-solar-rebate-program-exceeding-expectations-in-south-carolina-one-year-after-launch>
7. <https://www.greentechmedia.com/articles/read/duke-energy-florida-plans-to-add-500mw-of-utility-scale-solar-by-2024>

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