Power grid management system

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For power electronics, technical R& D is needed across advanced components, ...

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The "advanced" elements of an ADMS go beyond traditional distribution management systems by providing next-generation control capabilities. These capabilities include the management of high penetrations of distributed energy resources (DERs), closed-loop interactions with building management systems, and tighter integration with utility tools for meter data management systems, asset data, and billing.

The ADMS Test Bed is a national, vendor-neutral effort funded by the U.S. Department of Energy Office of Electricity"s Grid Controls and Communications division to accelerate industry development and the adoption of ADMS capabilities. The test bed enables utility partners, vendors, and researchers to evaluate existing and future ADMS, distributed energy resource management system (DERMS), and other utility management system applications in a realistic laboratory environment.

The GridAPPS-D platform provides a data rich control environment for researchers to develop futuristic advanced distribution applications, which include the following examples: increased efficiency, reliability, and resilience with real-time DER dispatch; short-term grid forecasting, which has the capacity to pave the way for developing market-based approach to manage distribution assets and flexible resources; and solar forecasting that provides intra-hour forecasted data for DSO to include the impact of solar PV for making operational planning decisions.

This platform can be integrated with the ADMS Test Bed to evaluate the performance of novel advanced distribution management applications.

As part of the Enabling Extreme Real-time Grid Integration of Solar Energy (ENERGISE) program, NREL developed and validated Enhanced Control, Optimization, and Integration of Distributed Energy Applications (ECO-IDEA), a data-enhanced hierarchical control architecture that is a hybrid of centralized and distributed control approaches. The architecture features an ADMS operation, with synergistic ADMS and grid-edge operations, the inclusion of PV fast-regulation capabilities, and comprehensive situational awareness.

The focus of this project was to demonstrate the effectiveness of a data-enhanced hierarchical control architecture to achieve various system-level control and operation objectives using NREL"s ADMS Test Bed. NREL partnered with Xcel Energy, Schneider Electric, the Electric Power Research Institute, and Varentec to demonstrate the novel technology on an Xcel Energy feeder through simulations and field evaluation.

In the architecture, the ADMS, grid-edge management system, and real-time optimal power flow (an NREL-patented technology) control the legacy voltage devices (load tap changer, capacitor banks), grid-edge devices, and PV inverters, respectively. The coordination of the three system-level controls enables improved voltage performance under high penetrations of PV in distribution grids.

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NREL partnered with San Diego Gas & Electric Co. to identify and demonstrate novel methods for leveraging advanced metering infrastructure (AMI)--smart meters--for advanced grid planning and operations. AMI data use is currently limited to customer billing and outage detection. The new methods will reduce the cost of operations for the utility by transforming the AMI meters into a pervasive secondary network measurement platform for monitoring the grid edge.

The current utility architecture has limited field measurements in the form of a few supervisory control and data acquisition points for each feeder. The ADMS Test Bed was used to evaluate the effectiveness of a data-driven voltage control algorithm using AMI data as input, especially in the presence of high penetrations of PV. The algorithm was deployed on GridAPPS-D, an open-source grid operations research platform.