DOE DER Distributed Power Program

NREL DER Test Facility

……advancing distributed power technology

What are Distributed Energy Resources?
Distributed Energy Resources (DER) are modular electric generation or storage located near the point of use. Distributed power systems include biomass-based generators, combustion turbines, concentrating solar power and photovoltaic systems, fuel cells,wind turbines, microturbines, engines/generator sets, and storage and control technologies. Distributed power systems can either be grid connected or operate independently of the grid. Those connected to the grid are typically interfaced at the distribution system. In contrast to large, central-station power plants, distributed power systems typically range from less than a kilowatt (kW) to tens of megawatts (MW) in size.

When effectively integrated into an electric power system, distributed power systems can be used to provide high-value energy, capacity, and various ancillary services such as voltage regulation, power quality improvement, and emergency power. However, achieving these benefits requires that these systems be carefully integrated with the electric power system. For this to proceed smoothly, questions on how to integrate the growing number of distributed generators into grid networks have to be addressed in a coordinated manner.

NREL DER Test Facility
The Distributed Energy Resources Test Facility (DERTF) is an integral part of NREL's Distributed Energy Resources Center designed to assist the U.S. distributed power industry in developing and testing distributed power systems. Researchers use advanced state-of-the-art laboratories and outdoor test beds to characterize the performance and reliability of Distributed Power Systems, support standards development, and to investigate other emerging complex system integration issues.

Co-located with the Hybrid Power Test Bed at the National Wind Technology Center, the 2,000-square-foot test facility is operational and works closely with the DP community -especially those in industry- to study and evaluate advanced or emerging DP technologies. This work includes:

- Characterization, testing, and evaluating the performance of interconnection systems and controls to make sure they operate properly and meet the interconnection, communication, and other standards.
- Development of protocols and procedures for testing and evaluating systems to ensure that they meet performance, safety, and compatibility standards.
- Testing advanced designs for grid-connected or stand-alone use, microgrids, and hybrid systems.
- Coordination of laboratory and industry testing activities, in particular by defining and providing standard testing and evaluation procedures.

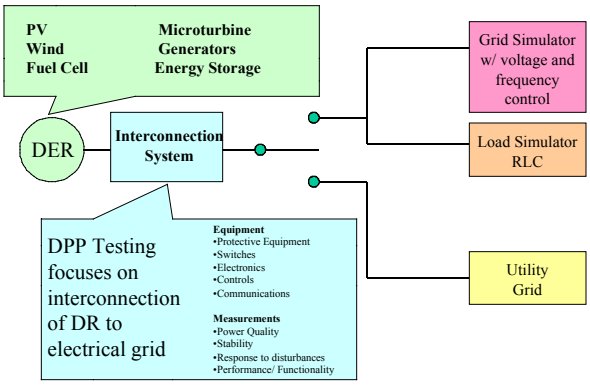

Diagram of Distributed Power Testing

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Test Facility Capabilities
Engineers can evaluate the moment-by-moment dynamics of distributed power systems, gather data on long-term performance, or demonstrate innovative design concepts at the DER Test Facility. High-speed data acquisition equipment monitors power quality, harmonic distortion, and electrical transients. A 200kW grid simulator can emulate a utility and allows for voltage and frequency control. The grid simulator can also reproduce disturbances such as sags, swells, and harmonic problems with the utility.

200kW Grid Simulator

A load simulator located at the DERTF with resistive, inductive, and capacitive elements can create power factors up to 0.37, allowing test engineers to evaluate system operation under severe conditions that may be encountered in real power systems. With this equipment researchers can investigate the power systems dynamic response to sudden load changes and to conditions of phase imbalance or loss of phase.

High Voltage Tester to Simulate Lightning Strikes

Standards and Codes
Researchers at the DERTF also work with industry to develop and validate consensus standards and codes for interconnection and integration of distributed resources with electric power systems. These standards and codes include IEEE, IEC and NEC.

Interconnection Testing
Researchers are helping develop and validate the procedures for IEEE P1547 "Standard for Distributed Resources Interconnected with Electric Power Systems" and IEEE P1589 Interconnection Conformance Test Procedures. The test facility is capable of conducting all of the testing in the standard including tests for voltage and frequency disturbances, islanding conditions, surge withstand (lightning strikes), harmonics, and flicker.

Systems Integration Testing
The test facility also has the ability to test up to three power systems simultaneously and can integrate up 15 power systems components (generation, storage, loads) at any single time. This unique capability allows for research on how distributed power systems interact with each other and the utility.

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11/01