U.S. Department of Energy

Office of Electricity Delivery & Energy Reliability

Electric Distribution Transformation Program

Overview

The Electric Distribution Transformation Program supports the development of technologies and standards that enable the integration of DER (distributed generation, storage, and demand/load management) and advanced power electronics into electric systems. The Program develops standards for interconnection and system architecture; researches advanced technologies in sensing, communications, control, and power electronics; demonstrates integrated electric and market operations; and supports development of regulations that properly value electric services and DER.

Program Areas

System Architecture & Standards

The Program develops an architectural reference guide for integration of communications, information, control, and market systems. This guide will serve as the backbone for the interoperation of electric delivery services with market operations, providing value streams for consumers, suppliers, and service providers.

Distribution Interconnection Standards & Technologies

The Program supports the development of national and international standards for DER interconnection, testing, applications, safety, and control/monitoring, and develops modular plug-and-play interconnection and control technologies to seamlessly integrate DER with electric power systems and local loads.

Distributed Sensing, Intelligence, & Control Technologies

The Program develops distributed intelligent agents to diagnose local faults and coordinate with power electronics and existing, conventional protection schemes to provide autonomous control and protection at the local level. This helps users and system operators optimize control of a large, complex network of DER systems and will provide remote detection, protection, control, and contingency measures for distribution systems. Additionally, research and development is conducted on new power distribution concepts and advanced power electronics.

Distribution System Simulation & Analysis

The Program develops tools to support simulation and analyses of complex interactions of DER, controls, alternative delivery concepts, and policy/institutional influences. This work will provide a virtual test bed to develop technologies and applications; establish technology targets; quantify benefits; and provide viable business models for DER and advanced distribution system implementation.

Test Beds & Field Demonstration

The Program operates the National Renewable Energy Laboratory (NREL) DER Test Facility, which demonstrates advanced interconnection hardware and validates interconnection standards. The Program also conducts phased demonstration of DER system integration, progressing from the packaged system level to facility, utility, and smart utility levels. This work provides real performance data on the grid penetration effects of DER, demonstrating acceptable levels of risks to gain acceptance of DER aggregation.

Stakeholder & Institutional Adoption

The Program promotes adoption of uniform interconnection standards; supports regulatory reform to remove DER rate, tariff, and other barriers; collaboratively develops innovative regulatory approaches to integrate DER in state and regional systems; and supports development of streamlined state/local siting and permitting. This work helps gain stakeholder acceptance and remove barriers impeding the modernization of the electric distribution infrastructure.

Mission

Transforming today's electric distribution infrastructure for increased affordability, security, resilience, and reliability through integration of advanced communications, information analysis and management, sensors and controls, power electronics, and distributed energy resources (DER).

Program Areas

The program works in six areas to better integrate DER with the electric distribution system. See the box to left to read more.

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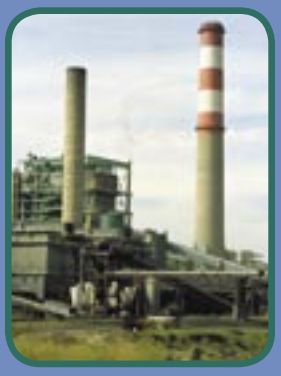

A U.S. Power Plant

Success Stories

Connecticut Demand Response Deployment Project

The Electric Distribution Transformation Program is partnering with Connecticut's Energy Office and Department of Public Utility Control, Northeast Utilities, and Nxegen, Inc., to demonstrate the use of innovative "demand response" technologies in southwest Connecticut to improve electric reliability, reduce consumer prices and market volatility, reduce power plant emissions, save money, and improve domestic security.

Under the project, up to 1,000 customers (representing 25 to 50 MW of managed load) will have the ability to curtail their real time electricity purchases in response to market prices and during periods of highly volatile wholesale prices. Curtailing 50 MW of load during times of relatively high energy prices would provide substantial savings for the 1,000 customers and significantly reduce congestion for the remainder of the regional market. The project is expected to relieve an electricity crisis in southwest Connecticut, a load pocket identified as one of the top reliability risks on the nation's electric grid.

The Connecticut project will provide a national model for other regions and help reach a Program goal of peak load reduction through broad implementation of improved demand management practices. The project has the following stages:

- *Install Nxegen's devices—an innovative, two-way, real-time wireless electricity data and communications system and end use control technology—for up to 1,000 commercial, retail, municipal, and industrial electricity customers in southwest Connecticut;*
- *Operate demand response and load conservation activities with the target customers;*
- *Manage system peak demand to reduce wholesale electric commodity prices through demand-side participation in the wholesale markets;*
- *Measure and validate the energy, economic, and environmental benefits of the demand response demonstration;*
- *Develop a detailed model that quantifies the impact of demand resources in the wholesale electric commodity and transmission resource planning markets.*

National Interconnection Standard IEEE 1547

The Electric Distribution Transformation Program is leading the efforts within the Institute of Electrical and Electronics Engineers (IEEE) to develop standards for the interconnection of DER with the electric power system. In June 2003, IEEE 1547, Standard for Interconnecting Distributed Resources with Electric Power Systems, was approved by the IEEE Standards Board. This standard establishes the long-awaited technical foundation to allow interconnection of all distributed generation technologies to the electric grid. Approval of this standard will have a significant impact on how the energy industry does business and will influence how the electrical distribution system will operate with distributed generators and two-way flow of electricity. This national standard has the potential of being used in federal legislation and rulemaking, in state public utility commission (PUC) deliberations, and by more than 3,000 utilities in formulating technical requirements for interconnection agreements for distributed generators with the electric grid.