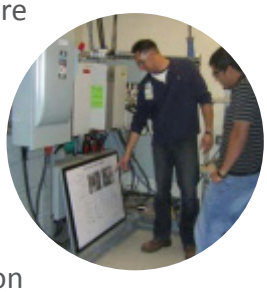
Distributed Energy Technology Laboratory (DETL)

Sandia National Laboratories' DETL conducts research to integrate emerging energy technologies into new and existing electricity infrastructures and accommodate the nation's increasing demands for clean, secure, resilient, and reliable energy.

Sandia's research spans generation, storage, and load management at the component and systems levels and examines advanced materials, controls, and communications to achieve the Labs' vision of a reliable, low-carbon electric infrastructure. DETL research is conducted on behalf of the U.S. Department of Energy, the U.S. Department of Defense, and other customers, often in collaboration with industry and academic partners.

Advanced R&D Expertise & Partnerships



DETL's reconfigurable infrastructure simulates a variety of real-world scenarios, such as island and campus grids, including military installations; remote operations, such as forward operating bases; and scaled portions of utility feeders and the transmission infrastructure. DETL researchers analyze the effects of high penetration of renewable technologies and distributed energy on the grid and resolve issues related to grid interconnectivity, controls, security, safety, performance, reliability and interoperability.

Leveraging Sandia's long history of expertise in fundamental sciences and applications, DETL offers a broad and unique range of R&D capabilities. DETL engineers conduct advanced R&D in areas such as high-penetration photovoltaic (PV) integration, component and system performance and reliability evaluations, model development and validation, cyber-security technology integration, microgrid communications, enhanced efficiency, load control, and specialized tests such as intentional islanding and surge tolerance. Working with industrial and academic partners, DETL engineers also participate in developing industry guidelines, protocols, electric codes, and national and international standards for component and system operations.

At DETL, a designated user facility, staff work side-by-side with partners to conduct investigations and explore new systems approaches to electric grid issues. These partnerships span the spectrum of utilities, manufacturers, system integrators, universities, state energy offices, other national laboratories and defense institutions, and even international collaborators.

DETL Equipment & Capabilities

DETL is located at the Sandia campus in Albuquerque, New Mexico. Generation sources include 130 kW of multiple grid-connected PV arrays, a 30 kW microturbine, a 75 kW diesel genset, fuel cells, and additional interchangeable generators. Storage capabilities include a 500 kWh lead-acid battery bank, along with several additional batteries of smaller size. Over 350 kW of programmable resistive loads are combined with programmable inductive, capacitive, and motor loads. This equipment is available for use on both a three-phase 480 V microgrid and a 240/120 V single-phase microgrid to test various arrangements of distribution grid models and interoperability scenarios.

DETL also offers the ability to conduct tests on numerous utility-scale devices, including utility and surge simulators, high-power waveform analyzers, and other related test equipment. This equipment is used to assess compliance with Underwriter Laboratories, International Electric Code, and other standards, as well as to identify gaps that provide the basis for new standards.

DETL maintains an extensive LabVIEW-based data collection system, with modeling and analysis conducted in a variety of software environments. Communications are supported via an Ethernet-based infrastructure, with wireless and other means, such as power line carrier, also supported.

DETL Application Areas

Advanced R&D for a Clean, Intelligent Electric Grid

Enabling high penetration of PV and other renewable technologies into the electricity grid using

- Scalable distributed control architectures
- Single-phase and three-phase microgrids, with and without storage
- System-level performance and reliability testing
- Component interoperability validation
- Controllable loads for residential, commercial, and combinations of systems
- Utility-connected evaluations of power losses, surge tolerance, and switching of multiple sources on a common grid

Advanced Power Electronics

Developing innovative energy management systems for the nation's new energy future, including

- Solar Energy Grid Integration Systems (SEGIS)
- Controllers for distributed grid equipment based on new and existing standards
- Advances in inverter design, integration, and manufacturing through partnerships with US industry
- Storage-integrated systems development and evaluation
- Long-term inverter performance characterizations

Technology Solutions for Communications and Security

Continuing Sandia's long history of excellence in security research and program design through

- Secure Supervisory Control and Data Acquisition (SCADA) applications
- Technology development and applications capable of supporting multiple communications protocols
- System-level performance and reliability testing
- Proven capabilities in security-based solutions for private and public stakeholders
- Ongoing expansion of capabilities to support cyber security protocols

Solar Technology & Grid-Related Standards and Codes

Supporting PV industry growth through

- Development of new procedures for performance and reliability testing
- Assuring accountability, applicability, and metrics of new standards development
- Analysis of distributed energy components and configurations to comply with new and existing codes and standards

Sandia's Distributed Energy Technologies Laboratory includes configurable microgrids to explore interconnections of various generation, storage, load control, and communications support.

For more information please contact:
Abraham Ellis, Grid Integration Project Manager
E-mail: aellis@sandia.gov
Phone: (505) 844-7717

Sigifredo Gonzalez, DETL Facility Manager
E-mail: sgonza@sandia.gov
Phone: (505) 845-8942
Website: energy.sandia.gov

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