



## DISTRIBUTED ENERGY TECHNOLOGY LABORATORY

*Sandia's Distributed Energy Technology Laboratory (DETL) is a multipurpose research facility designed to integrate emerging energy technologies into new and existing electricity infrastructure to accommodate the nation's increasing demands for clean, secure, and reliable energy.*

### DETL RESEARCH

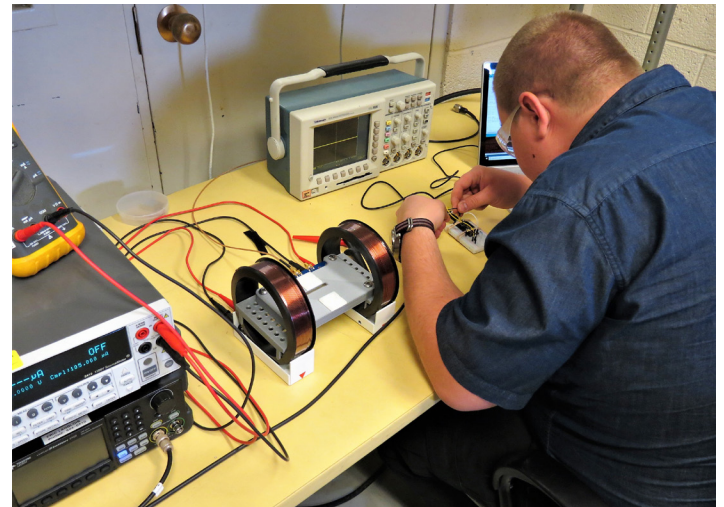
Researchers at Sandia's DETL—located in Albuquerque, NM—perform advanced research on generation, storage, and load management technologies at component through system levels. DETL researchers examine advanced materials, controls, and communications to enable safe and resilient distributed and renewable power systems infrastructure. DETL is a highly configurable platform that allows researchers to evaluate energy resources and controllers such as inverters and other power electronics equipment under a wide range of conditions, including the following:

- Irradiance variability
- AC/DC protection schemes
- High and low temperatures
- Power levels
- Voltage and frequency regulation functionality in both grid-connected and microgrid configurations

### ADVANCED R&D EXPERTISE AND PARTNERSHIPS

DETL's capabilities enable staff and researchers to partner with manufacturers, energy providers, universities, system integrators, state energy agencies, defense institutions, other national laboratories, and international collaborators.

Partnerships enable the investigation of new systems approaches to electric grid issues associated with the high penetration of renewable-based distributed energy resources (DERs).



*Advanced-material, low-cost sensor development*



*Control room and cybersecurity test bed*



*OPAL-RT power hardware-in-the-loop real-time simulation system*



## DETL APPLICATION AREAS

### Advanced R&D for a Clean, Intelligent Electric Grid

DETL enables high penetration of photovoltaics (PV) and other renewable technologies into the electric grid.

### Advanced Power Electronics

Researchers at DETL develop innovative energy management systems for the nation's new energy future, including high-fidelity inverter model development and validation, as well as component performance and reliability evaluations.

### Technology Solutions for Communications and Security

The team conducts adversary-based cybersecurity assessments on live, virtualized DER communications networks by using co-simulation environments that represent power systems, DERs, and communication networks. This capability enables the design of cybersecure DER communication networks, intrusion detection systems, and dynamic defense technologies.

### Solar Technology & Grid-Related Standards and Codes

Sandia supports the PV industry through investigations of high-penetration PV integration and increased hosting capacities. The DETL team works with standards development organizations to inform national and international interconnection, interoperability, and compliance standards.

### DC Microgrid Pilot Project Partnership

Partnering with industry to advance R&D, DETL has established electrical and communication connections to a functioning DC microgrid, enabling enhanced efficiency, load control, cybersecurity, and specialized testing analysis for intentional islanding and surge tolerance.

## DETL EQUIPMENT AND CAPABILITIES

DETL has the capability to conduct tests on utility-scale equipment by using utility and surge simulators, high-power waveform analyzers, and related test equipment that includes the following:

- 180 kVA Ametek AC grid simulator RS180
- 200 kW Ametek TerraSAS PV simulator with up to 20 individual outputs
- 100 kW high-voltage NH Research battery simulator
- 48 kW low-voltage NH Research battery simulator
- 280 kVA/225 kW diesel generator with grid-interconnection controller
- OPAL-RT power hardware-in-the-loop system
- Motor control center-based microgrid
- 100 kVA, 30 kVA grid-forming inverters
- 320 VA microinverter test bed
- High-fidelity inverter model development and validation
- Wind turbine physical motor-generator
- IP-based communications emulator



Solar PV array outside DETL

## DETL SUBJECT-MATTER EXPERTISE

- Hosting capacity research and development
- DER and power systems performance analysis
- Microgrid and adaptive protection systems
- Hardware and standards compliance and development
- Partnerships with the solar PV industry
- Grid cybersecurity

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