

# SIRFN Capability Summary

## Sandia National Laboratories, Albuquerque, NM, USA

### Introduction

Sandia National Laboratories has extensive laboratory facilities to conduct applied research and development on a wide range of Smart Grid applications. The key research areas are listed below:

- **Renewable Energy and DER Integration R&D** focuses on optimal integration of solar generation with other DER. The primary test facility is the Distributed Energy Technologies Laboratory (DETL). Active research activities involve grid compatibility, controls, security, safety, performance, reliability and interoperability.
- **SCADA and Cyber Security R&D** involves cryptographic security and integration of autonomous agent systems. Testing is conducted primarily at the National SCADA Lab, Advanced Information Research Lab, and DETL. Together, these laboratory facilities offer communication and control infrastructure coupled with controllable resources (load and generation).
- **Energy storage R&D** focuses performance and safety of energy storage for stationary and mobile (EV) applications. Testing activities take place at the Battery Abuse Test Lab (BATlab) and the Large-Scale Energy Storage Testpad (LSEST).
- **Power Electronics and Controls R&D** is conducted at several Sandia test facilities. It supports the development of power conditioning units (PCUs) for energy storage and renewable energy applications, with emphasis on lower cost, increased reliability, efficiency and performance, and improved packaging and manufacturing.

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.

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URL: <http://energy.sandia.gov/>

# Renewable Energy and DER Integration

## Desired Level of SIRFN Participation: 3

- 1 = Low 2 = Med 3 = High

## Description of Activities

Sandia conducts a wide range of research to support the development and commercialization of emerging technologies that facilitate grid integration of renewable energy (RE) and other distribution-connected energy resources (DER). This work involves hardware, controls, communications, and related standards at the component and system-level. Related laboratory testing activities include:

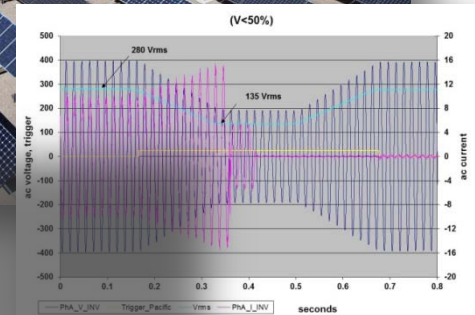
- Evaluation of PV and DER performance with respect to efficiency, grid compatibility and reliability
- Evaluation of DER interoperability and security with respect to utility communications and controls systems
- Specialized performance tests (e.g., radio-frequency emissions, “non-islanding inverter,” interactions of multiple sources on a common microgrid, surge tolerance)
- Evaluation of DER integration, including energy storage, PV/wind generators, and demand response

Testing activities are conducted at Sandia’s Distributed Energy Technologies Laboratory (DETL). DETL is a reconfigurable testbed that can simulate a wide variety of real-world RE and DER integration scenarios. Sandia is a member of the DERlab network.

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# Buildings Automation

## Desired Level of SIRFN Participation: **1**

- 1 = Low 2 = Med 3 = High

## Description of Activities

- Insert text here

## SIRFN Site Focus Area Lead(s):

Name

E-mail: xxx

Phone: xxx

Name

E-mail: xxx

Phone: xxx

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# PEV Integration

## Desired Level of SIRFN Participation: **1**

- 1 = Low 2 = Med 3 = High

## Description of Activities

- Insert text here

## SIRFN Site Focus Area Lead(s):

Name

E-mail: xxx

Phone: xxx

Name

E-mail: xxx

Phone: xxx

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# Microgrids

## Desired Level of SIRFN Participation: 3

- 1 = Low 2 = Med 3 = High

## Description of Activities

Sandia maintains a large portfolio of research, development and demonstration projects in the area of microgrids. Current activities include the following:

- Testing of decentralized controls of DER in grid-tied or off-grid applications including intelligent agent systems
- Testing of decentralized voltage and frequency support and protection systems for microgrid applications
- Detailed monitoring and performance evaluation of fielded full-scale microgrids in military and island applications
- Pre-commercial / pre-deployment testing of microgrid components and systems for conformance to application requirements

The laboratory testing and demonstration activities described above are supported by research related to materials, controls design, hardware integration, and analytics. Sandia microgrid testing activities are conducted primarily at DETL. Sandia also collaborates with partners such as the Consortium for Energy Reliability Technologies Solutions (CERTS).

## SIRFN Site Focus Area Lead(s):

Michael Hightower

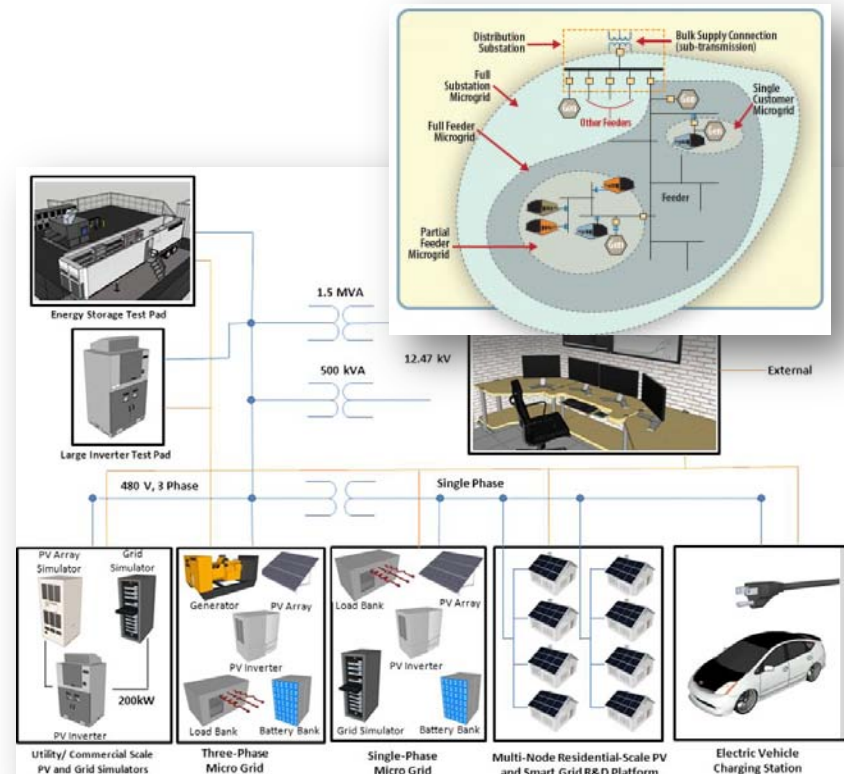
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# Distribution Automation

## Desired Level of SIRFN Participation: **1**

- 1 = Low 2 = Med 3 = High

## Description of Activities

- Insert text here

## SIRFN Site Focus Area Lead(s):

Name

E-mail: xxx

Phone: xxx

Name

E-mail: xxx

Phone: xxx

# Cyber Security

## Desired Level of SIRFN Participation: 3

- 1 = Low 2 = Med 3 = High

## Description of Activities

Sandia's research in the cybersecurity area focus on maintaining the integrity and availability of critical cyber infrastructure, including SCADA (supervisory control and data acquisition) systems, which are required to operate the grid. Future Smart Grid applications will rely more and more heavily on these communications and control systems. Sandia conducts laboratory testing and evaluations in the following areas:

- Laboratory evaluation of SCADA vulnerability and threat mechanisms (components and systems)
- Performance assessment of physical and cryptographic security strategies with respect to established cybersecurity models (e.g., CobiT, SysTrust, ISO/IEC 17799, SSE-CMM and other proprietary models)

Testing activities are conducted at the National SCADA Test Bed (NSTB), which Sandia manages in collaboration with Idaho National Engineering and Environmental Laboratory (INEEL). Sandia also conducts cyber-security evaluations in the field, through the IDART program.

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URL: [http://energy.sandia.gov/?page\\_id=859](http://energy.sandia.gov/?page_id=859)

# Summary of Capabilities: Equipment and Technology

## AC and DC sources:

- 150 kW PV system, fully reconfigurable up to 600Voc
- 30kW gas microturbine
- 180 kW diesel genset with grid interface module
- 200 kW programmable ac grid simulator, up to 480V 3 ph
- 180 kW programmable DC (IV curve) simulator, up to 1kV



AC/DC simulators



Single-phase microgrid

## Programmable loads:

- 500 kVA or fully programmable resistive, inductive, capacitive and motor loads that can be isolated to single-phase (124/240V) and three-phase (208/480V)
- Programmable 1 MVA in conjunction with Energy Storage Test Pad

## Energy Storage:

- 500 kWh lead-acid battery bank
- Several smaller battery banks (12V to 128V)
- Ability to evaluate and characterize MW-scale grid-connected storage systems (Energy Storage Test Pad)



10-node Reconfigurable Testbed

## Application to Subtasks:

- 2.1 DER and RE Integration: High
- 2.2 Building Automation: Low
- 2.3 PEV Integration: Low
- 2.4 Microgrids: High
- 2.5 Distribution Automation: Low
- 2.6 Cyber Security: High



# Summary of Capabilities: Data Acquisition and Analysis

## Data Acquisition:

- PI Historian
- PMUs
- External Data Exchange Facilities

## Laboratory Standards and Certifications:

## Test Configurations:

- 500kVA, 480V, three-phase test node with 6 bays; connected to grid, or isolated to genset or ac simulator; access to programmable loads and energy storage.
- 50kVA, 120/240V, single-phase test node with 10 bays; connected to grid or ac simulator; access to lumped or distributed programmable load and energy storage.
- SCADA simulator with DNP-3 and Modbus over RS232 or Ethernet



AC/DC simulators



Single-phase microgrid



10-node Reconfigurable Testbed

## Application to Subtasks:

- 2.1 DER and RE Integration: High
- 2.2 Building Automation: Low
- 2.3 PEV Integration: Low
- 2.4 Microgrids: High
- 2.5 Distribution Automation: Low
- 2.6 Cyber Security: High