This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

SAND2021-9132C

Exceptional service in the national interest

Sandia National Laboratories

Integrating Sandia Capabilities to Create the Grid of the Future

Charles Hanley

Senior Manager, Grid Modernization and Resilient Infrastructures

Sandia National Laboratories

Energy Exchange Conference – August 6, 2021

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

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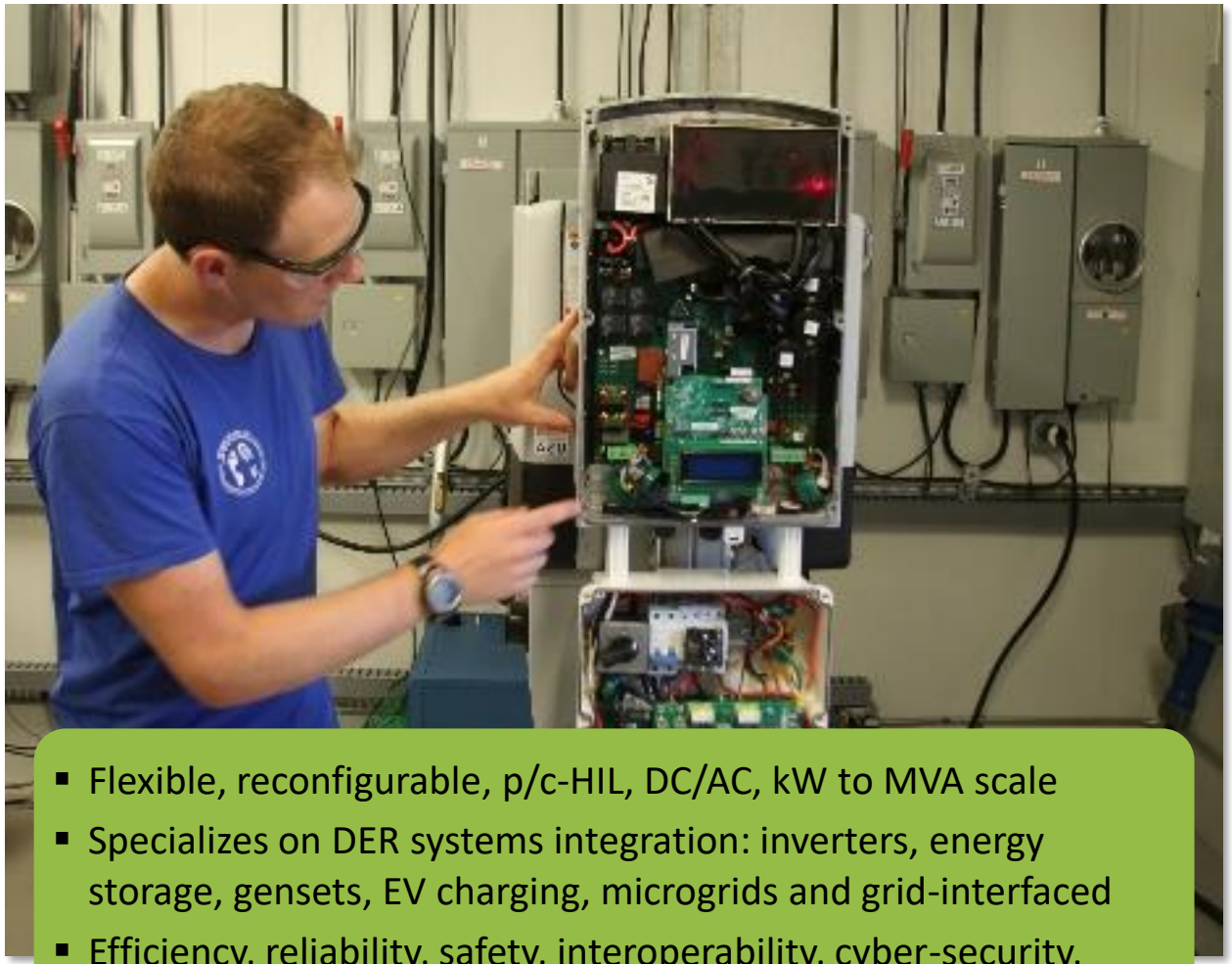
SANDIA SYSTEMS INTEGRATION CAPABILITIES

DISTRIBUTED ENERGY TECHNOLOGIES LAB (DETL)

Sandia National Laboratories

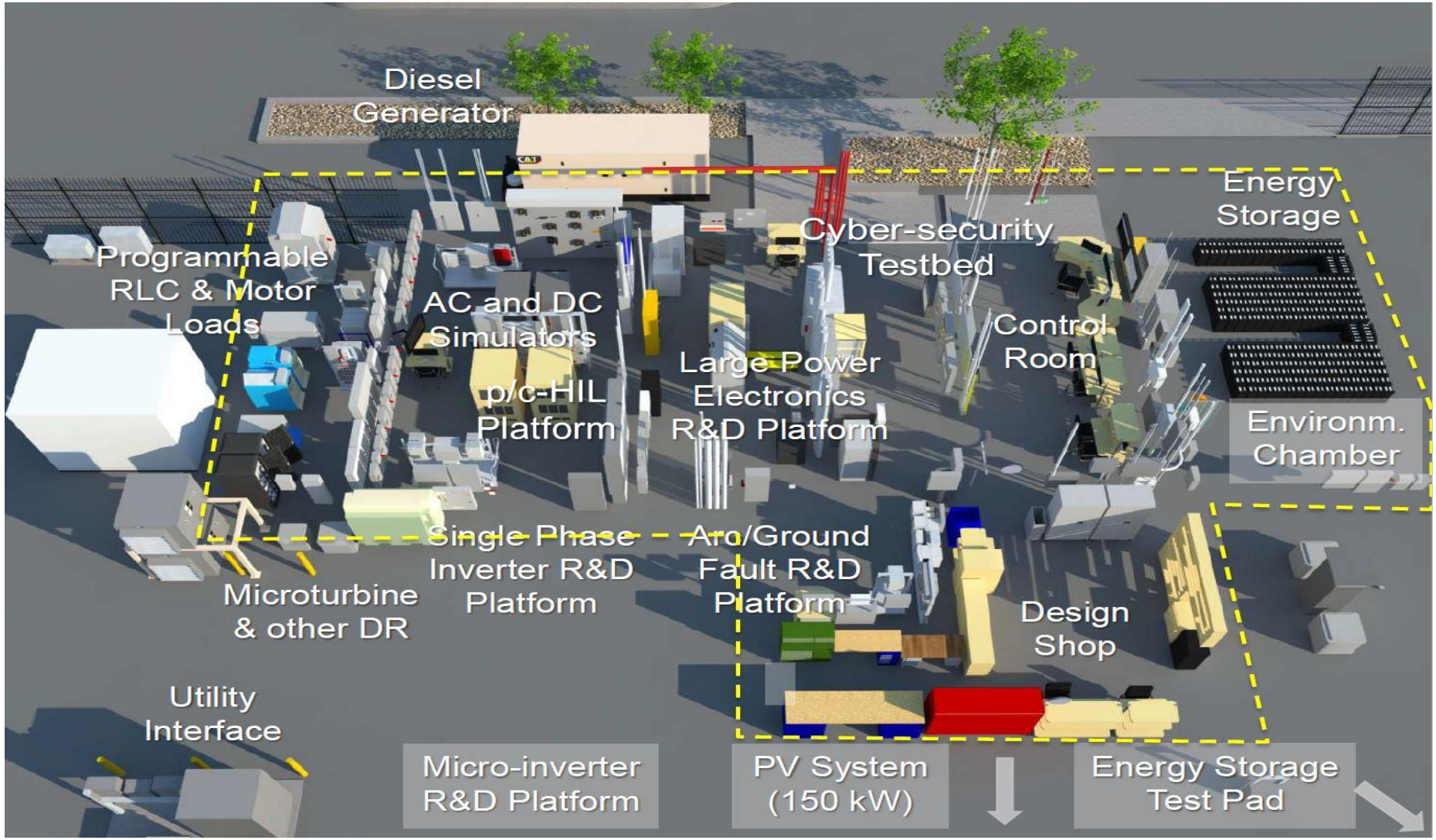


- Flexible, reconfigurable, p/c-HIL, DC/AC, kW to MVA scale
- Specializes on DER systems integration: inverters, energy storage, gensets, EV charging, microgrids and grid-interfaced
- Efficiency, reliability, safety, interoperability, cyber-security, standards conformance

SANDIA SYSTEMS INTEGRATION CAPABILITIES

DISTRIBUTED ENERGY TECHNOLOGIES LABORATORY (DETL)

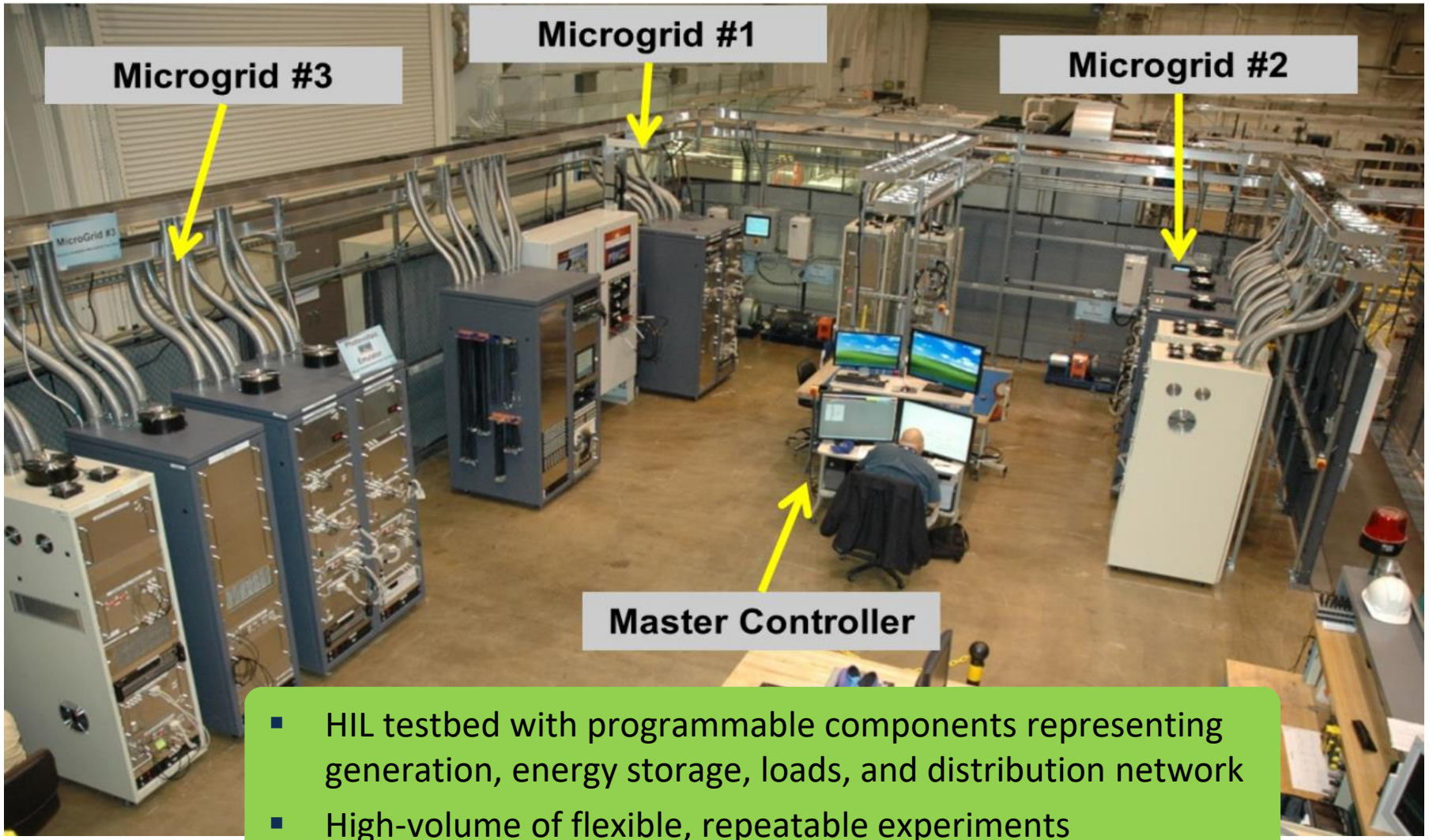
Sandia National Laboratories



SANDIA SYSTEMS INTEGRATION CAPABILITIES

SECURE SCALABLE MICROGRID (SSM) TESTBED

Sandia National Laboratories

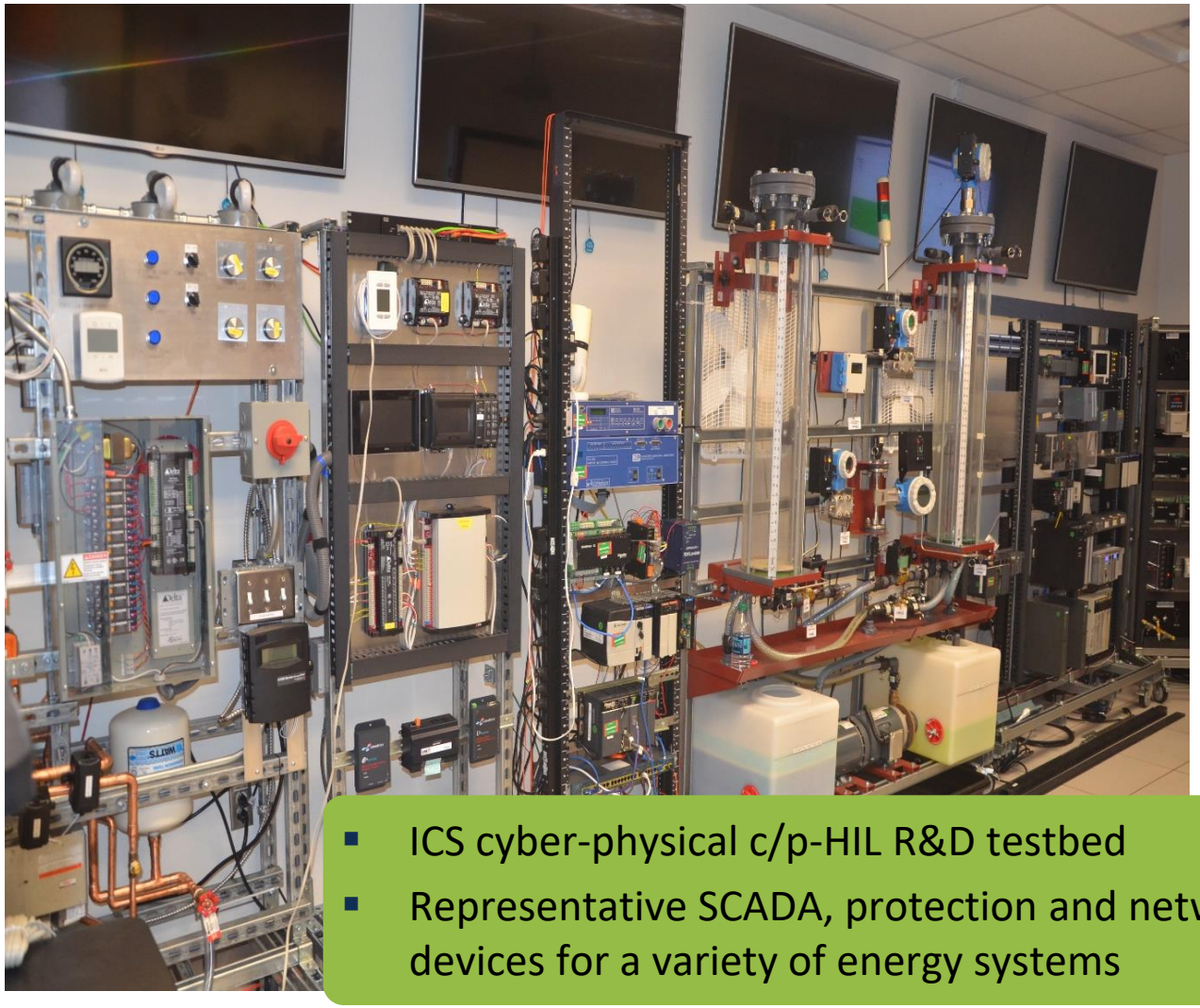


- HIL testbed with programmable components representing generation, energy storage, loads, and distribution network
- High-volume of flexible, repeatable experiments

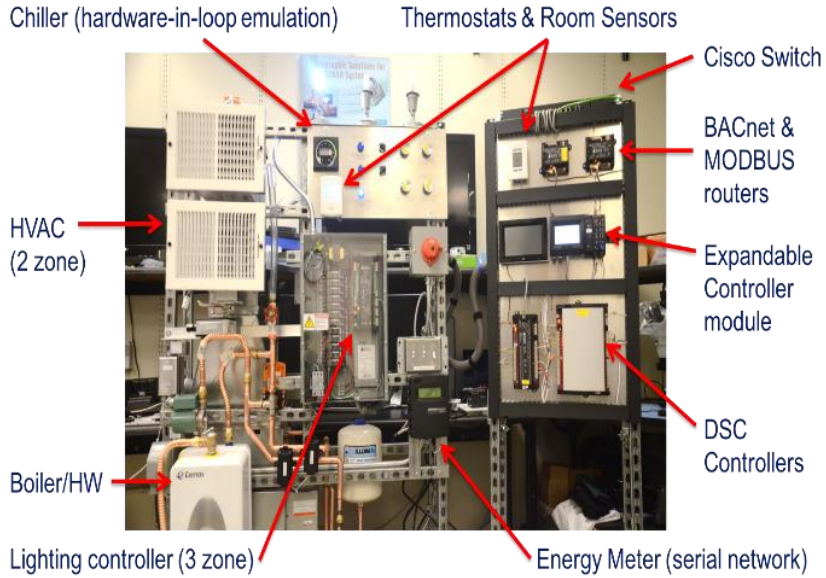
SANDIA SYSTEMS INTEGRATION CAPABILITIES

REPRESENTATIVE ENERGY ICS ENVIRONMENTS (PHYSICAL & VIRTUAL)

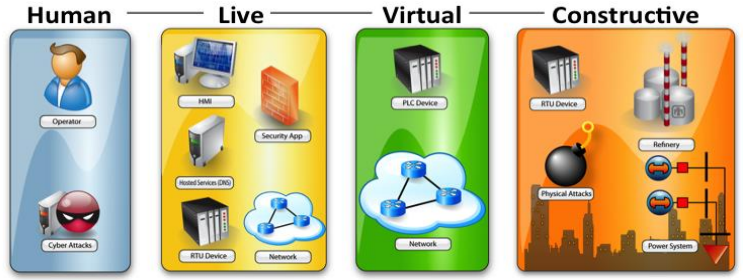
Sandia National Laboratories



- ICS cyber-physical c/p-HIL R&D testbed
- Representative SCADA, protection and network devices for a variety of energy systems



Emulytics™/SCEPTRE

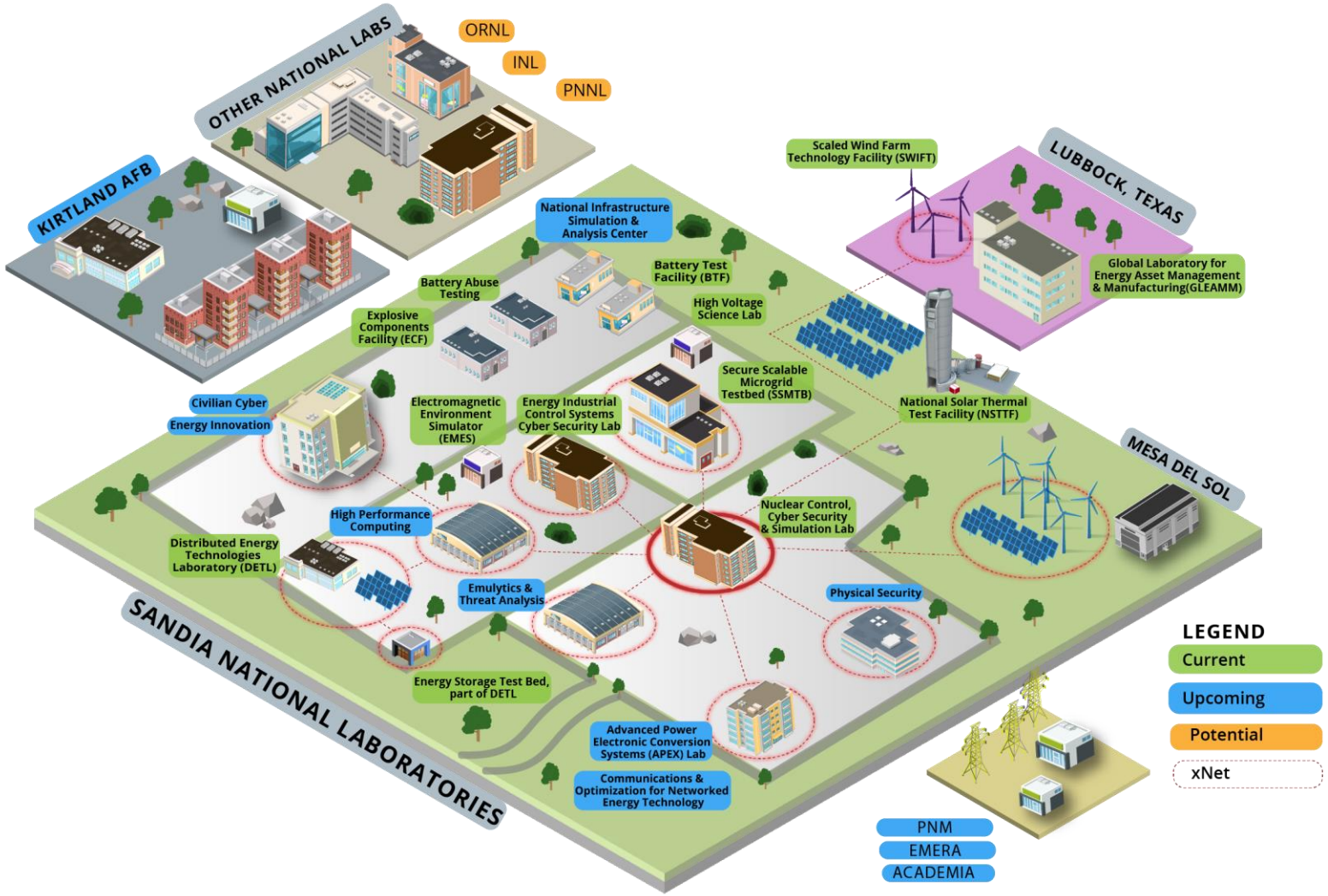


CREATING THE GRID OF THE FUTURE

SANDIA RESILIENT ENERGY SYSTEMS (RES) MISSION CAMPAIGN

Sandia National Laboratories

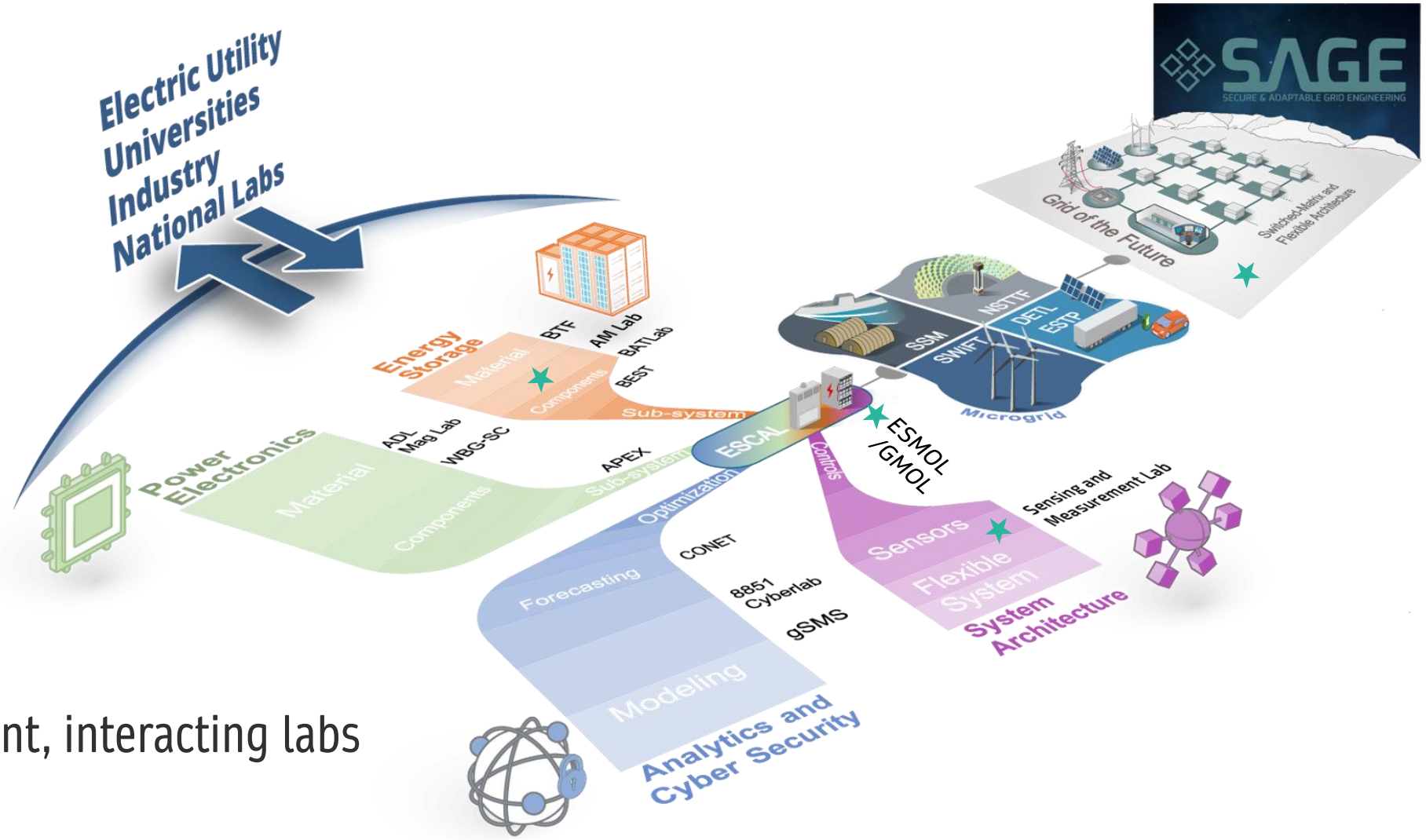
- Internal R&D investment: $40M over 7 years
- Linking several core competencies to resilient energy:
  - Science of vulnerabilities
  - New Materials and Devices
  - Computational Science
- Brings together hardware systems, HIL simulation, and advanced computing



CREATING THE GRID OF THE FUTURE

SANDIA'S GRID LABS OF THE FUTURE ECOSYSTEM

Sandia National Laboratories



Independent, interacting labs

PARTNERING TO INTEGRATE RD&D CAPABILITIES

EMERA TECHNOLOGIES AND KIRTLAND AIR FORCE BASE

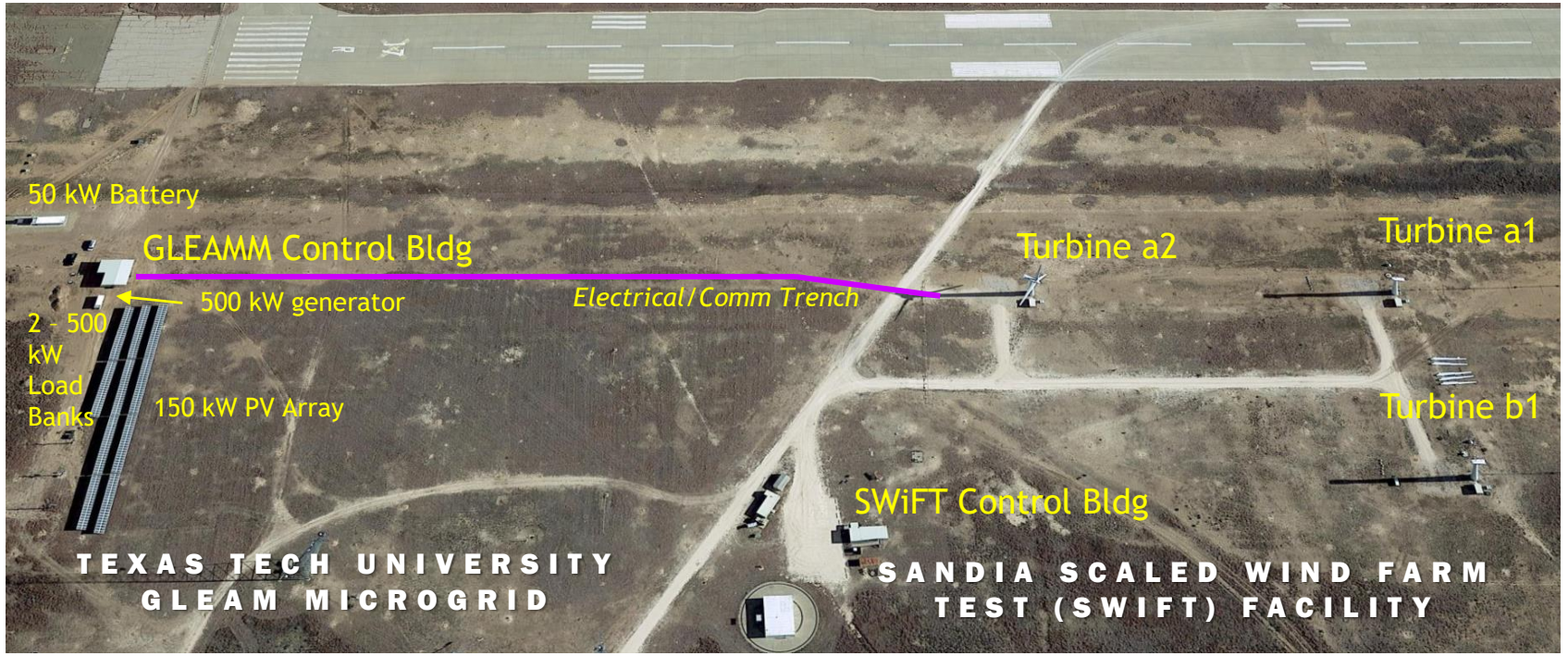
Sandia National Laboratories

- Secure and resilient multi-node DC microgrid demonstration
- Primary service for housing and community center at Kirtland AFB
- Tied to Sandia R&D infrastructure (DETL, PSEL)
- Advanced control, security and safety technologies

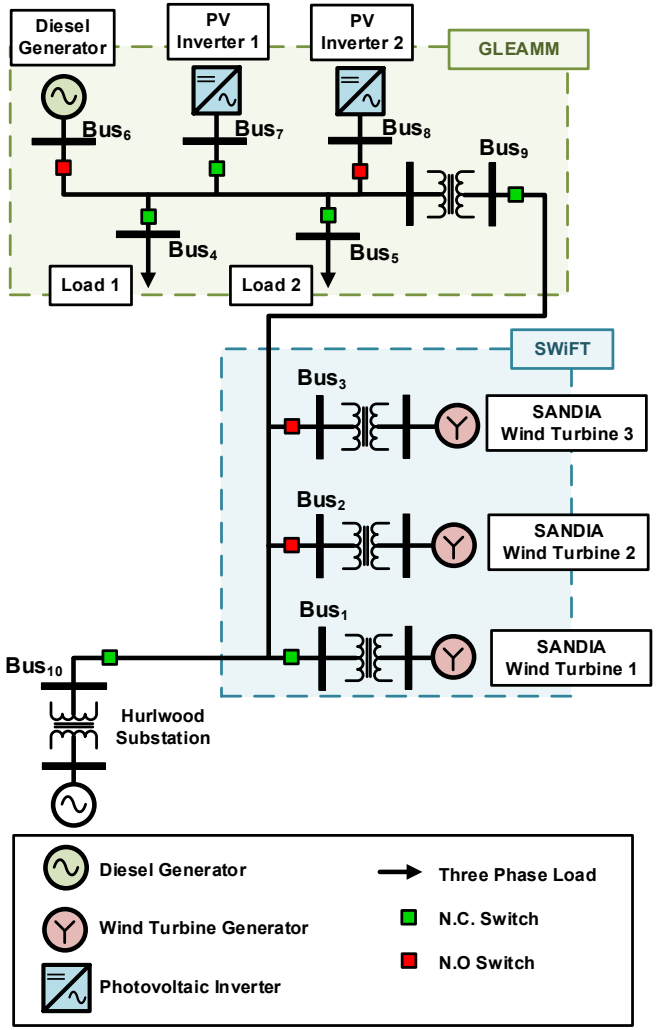
PARTNERING TO INTEGRATE RD&D CAPABILITIES

REESE TECHNOLOGY CENTER – LUBBOCK, TX

Sandia National Laboratories



- Sandia's SWiFT test site uses multiple scaled wind turbines to measure turbine performance and wake interference.
- The TTU *Global Laboratory for Energy Asset Management and Manufacturing* (GLEAMM) manages the recently built co-located microgrid.
- Real-time HIL linkage to Sandia's Distributed Energy Technologies Laboratory.



SWiFT/GLEAMM One-Line Diagram

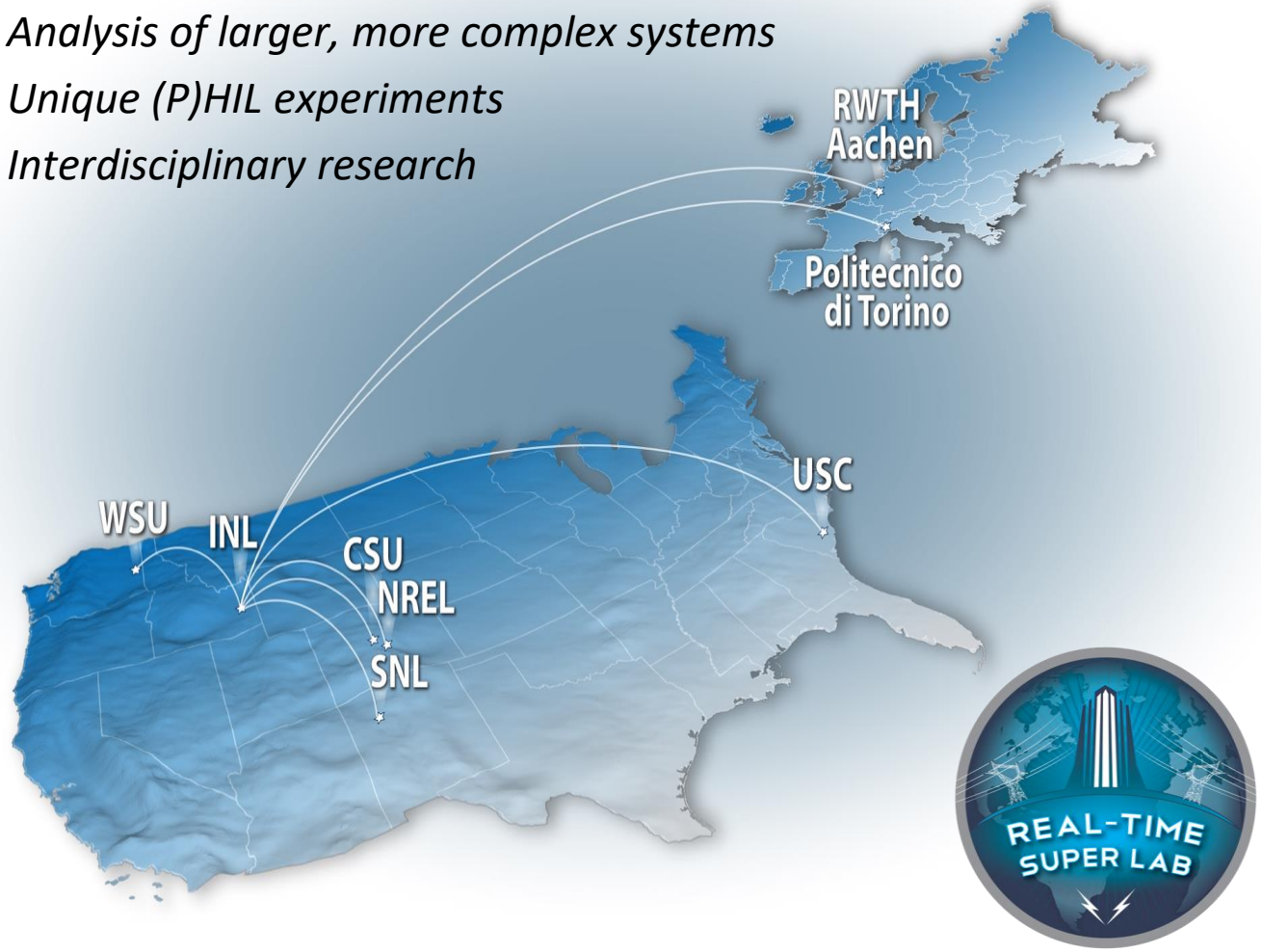
BENEFITS OF CROSS-INSTITUTIONAL INTEGRATION

RT SUPER LAB EXAMPLE

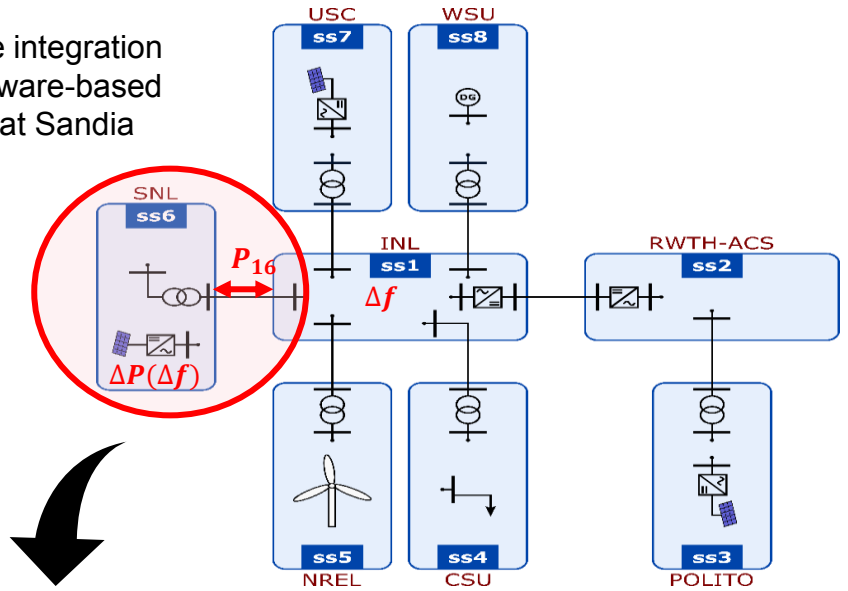
Sandia National Laboratories

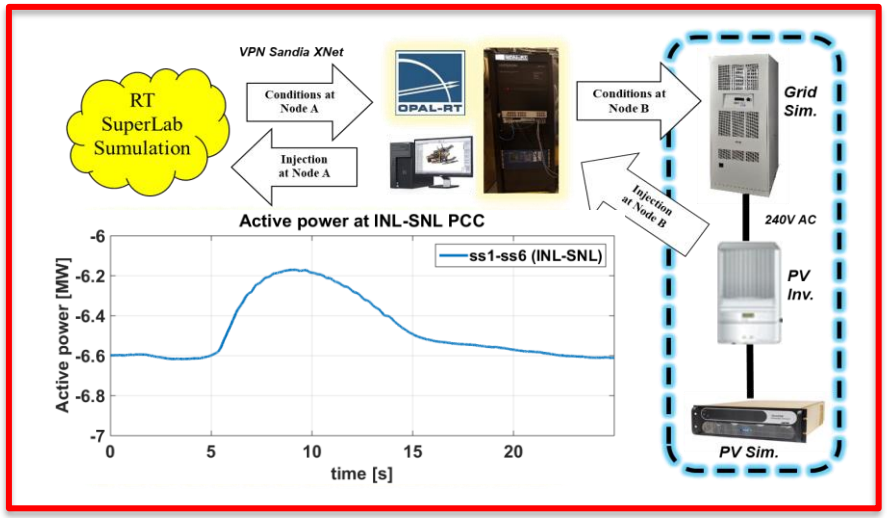
Collaborative research infrastructure enables…

- *Analysis of larger, more complex systems*
- *Unique (P)HIL experiments*
- *Interdisciplinary research*



Real-time integration and hardware-based results at Sandia





BENEFITS OF CROSS-INSTITUTIONAL INTEGRATION

GMLC TESTING NETWORK AND OPEN LIBRARY PROJECT

Sandia National Laboratories

Goal:

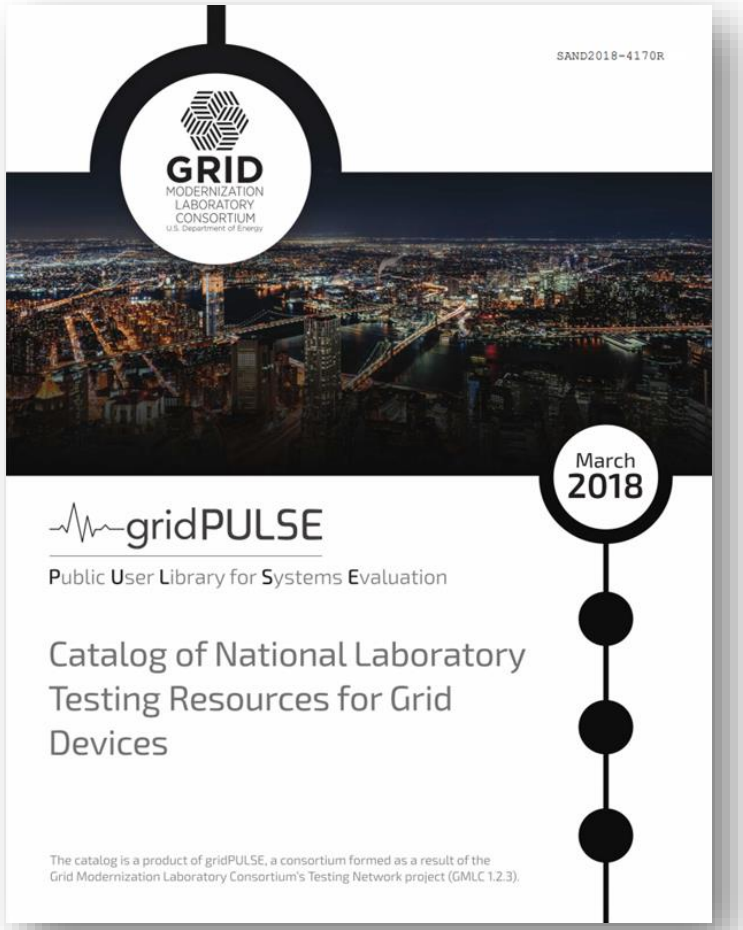
- **Accelerate grid modernization** by enabling better access to the vast grid-related testing infrastructure, models and simulation tools available at national labs and beyond.

Expected Outcomes:

- Directly support development, validation, standardization, adoption and deployment of new grid devices and related technologies
- Improved collaboration among national laboratories, industry and academia

National Laboratory Team:

Sandia National Laboratories, Idaho National Laboratory, Lawrence Livermore National Laboratory, Argonne National Laboratory, Pacific Northwest National Laboratory, Berkeley Lab, NREL National Renewable Energy Laboratory, Oak Ridge National Laboratory, SRNL Savannah River National Laboratory



https://www.osti.gov/servlets/purl/1528814

Sharing models including RT digital twins, testing methods and procedures.