



Grid Modernization Program and Intern Opportunities



Sandia National Laboratories

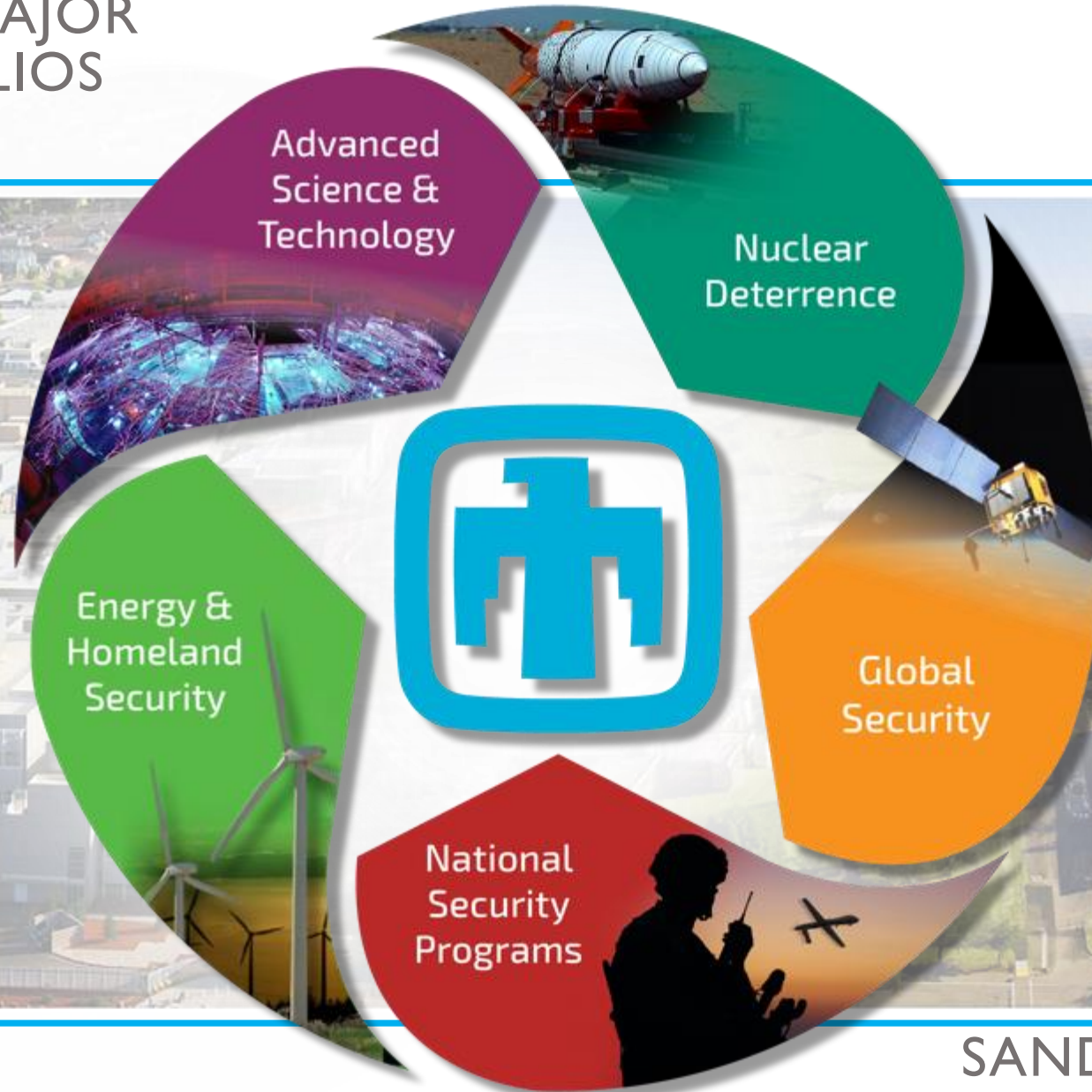
Dr. Brian J. Pierre
Manager – Electric Power Systems Research

April 2023



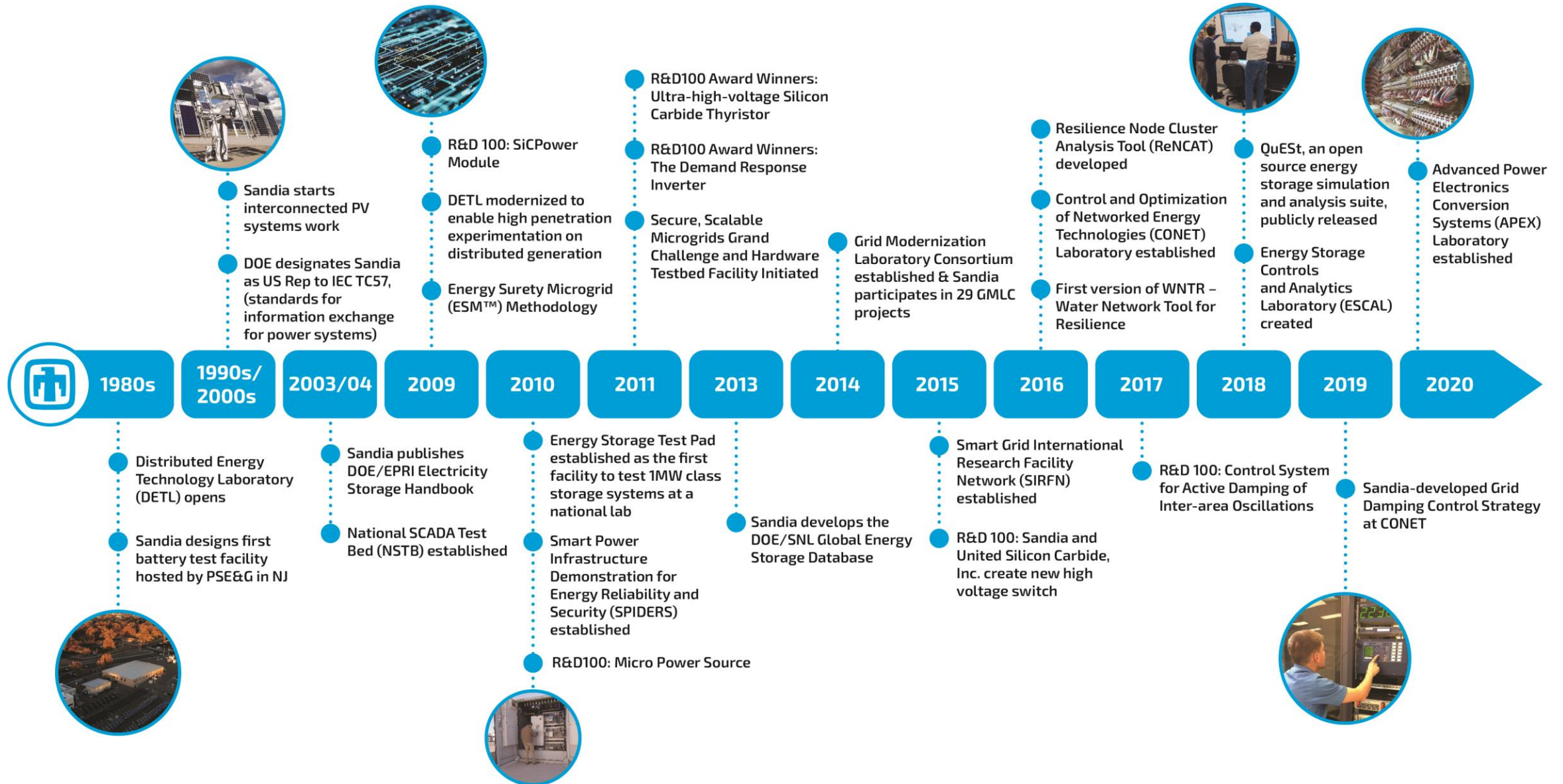
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SANDIA HAS FIVE MAJOR PROGRAM PORTFOLIOS



SANDIA HAS ~16,000
EMPLOYEES

HISTORY OF GRID MODERNIZATION AT SANDIA



FACILITIES



APEX

Advanced Power Electronic Conversion Systems supports the development of advanced power conversion topologies and intelligent control strategies.



CONET

Control and Optimization of Networked Energy Technologies Laboratory conducts research, development, and testing of coordinating networked and distributed systems.



ESCAL

Energy Storage Controls and Analytics Laboratory

dedicated to the development of next-generation energy storage control systems to increase battery performance and lifetime.



DETL

Distributed Energy Technologies Laboratory designed to integrate emerging energy technologies into new and existing electricity infrastructure



ESTP

Energy Storage Test Pad

provides long-term testing and validation for electrical energy storage systems.

SANDIA FACILITIES WE LEVERAGE

- Advanced Materials Laboratory
- Battery Abuse Testing Laboratory
- Battery Test Facility
- Brayton Cycle Lab
- Burn Facility
- Center for Integrated Nanotechnologies
- Cyber Emulitics Laboratory
- MESAFab
- National Infrastructure Simulation & Analysis Center
- National Solar Thermal Test Facility
- Photovoltaic Systems Engineering Laboratory
- Sandia Wave Energy Power-Takeoff Facility
- Secure Scalable Microgrid
- Scaled Wind Farm Technology Facility
- Thermal Test Complex





PROGRAM LEADERSHIP – Charles Hanley



Energy Storage Technologies and Systems

Ray Byrne



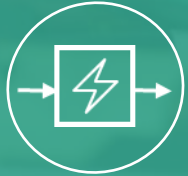
Advanced Grid Modeling

Brian Pierre



Renewable & Distributed Systems Integration

Summer Ferreira



Power Conversion Devices and Systems

Valerio De Angelis



Grid Security

Lon Dawson

Defense and EMP

Steve Glover



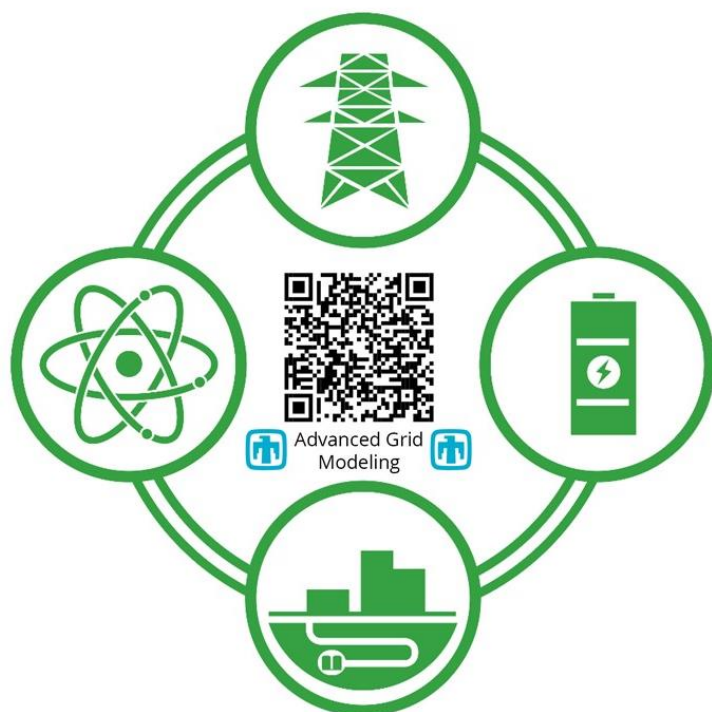
Energy-Water Systems Integration

Stephanie Kuzio



Advanced Grid Modeling

Developing models, algorithms, and tools to improve the resilience, security, equity, and decarbonization of the evolving electric power grid through advanced planning and operational tools and algorithms that can be adopted by utilities and other practitioners.



CAPABILITIES

- Power system modeling,
- power system dynamics,
- grid stability,
- power system planning and operations,
- power system protection,
- renewable energy integration,
- threat modeling,
- grid reliability and resilience,
- power systems controls,
- grid optimization and electricity markets,
- grid applied artificial intelligence and machine learning,
- data analytics applied to the electric grid.

Examples
of Threats



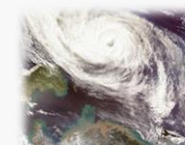
ELECTROMAGNETIC
PULSE (EMP)



CYBER
SECURITY



PHYSICAL
THREATS



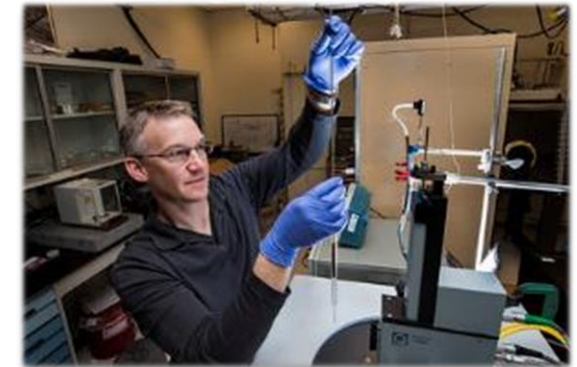
EXTREME
WEATHER

Energy Storage Technologies

Multi-disciplinary R&D to drive the development of low-cost energy storage technologies and integration of energy storage systems across the grid infrastructure.

CAPABILITIES

- Materials Research
- Power electronics and Power Converters
- Energy Storage Safety and system reliability
- Technology Development and Transition
- Pilot Scale Demonstrations
- Grid Energy Storage analytics and controls
- Policy Evaluation
- Industry Outreach

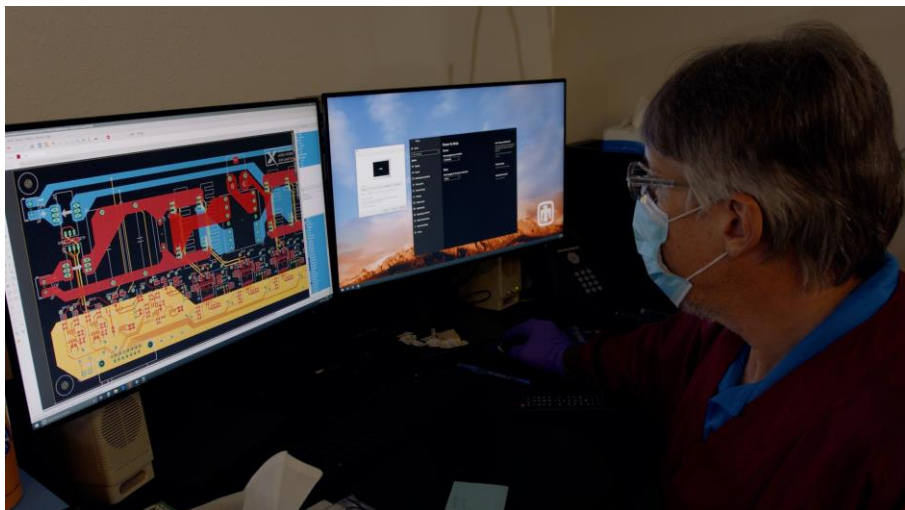


Energy Storage

Efforts that range from basic research and development to large scale demonstrations and deployments. We utilize state-of-the-art capabilities and world-class expertise with a focus of making energy storage cost effective through R&D innovations of battery technologies

Power Electronics and Conversion Systems

Enabling the digital, solid state grid of the future with power conversion at the medium and low voltage levels.



AREAS OF TECHNOLOGY DEVELOPMENT

- Solid-state transformers, protection devices, and multi-stage power converters.
- Advanced Grid Sensors and Data Acquisition Systems
- Power Hardware-in-the-Loop Simulation Advances

Advanced Power Electronic Conversion Systems (APEX) Laboratory

The department maintains the APEX laboratory for designing, fabricating, and testing of prototype power electronic devices and systems.



Renewable and Distributed Systems Integration

Multi-disciplinary research and development to enable grid modernization and large-scale deployment of renewable and distributed energy resources.

RESEARCH AREAS



Distributed Energy Resource Technology

Power Electronics and Controls

Electric Vehicle Charging

Standardization

Grid Security

Advanced Modeling and Simulation



CAPABILITIES

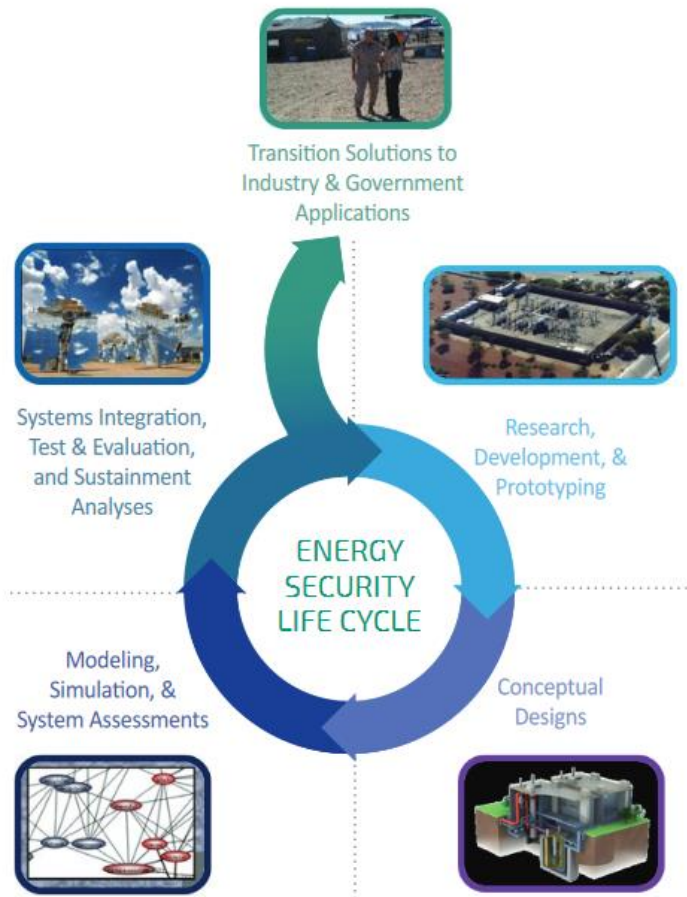
- Advanced modeling and simulation
- Power electronics and controls
- Microgrid design and validation
- Grid performance evaluations and compatibility
- Distributed energy technology validation and demonstration
- Integrated systems optimization, distributed controls, communications, interoperability, and cybersecurity
- Vehicle charging infrastructure grid integration and threat modeling



Defense Energy, Grid Security, and Electromagnetics

World-class technologies, experience, software, and facilities provide support to military customers to address and solve national security energy needs. Development and evaluation of solutions to maintain operations in an adversarial, compromised environment.

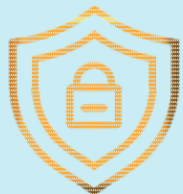
CAPABILITIES



- Electromagnetic Pulse and Geomagnetic Disturbance Resilience
- Novel Controls for Energy Systems
- Unique Research, Development, Test, and Evaluation Facilities
- Advanced Modeling, Simulation, Analytic & Optimization Capabilities and Tools
- Adversarial Red-Teaming
- Monitoring Tools and Techniques
- Forensics and Recovery

INTERN PROGRAM GROWTH, LEARNING, AND NETWORKING

- Participating in research solutions to some of the nation's and world's biggest challenges
- Hands on research and data collection experience
- Mentoring from Sandia National Laboratories staff
- Exposure to the many career/research opportunities at Sandia National Laboratories
- Networking opportunities with peers and staff
- Tours of World class facilities as labs from a wide range of research



SANDIA ENSURES THE U.S. CAN
DEPEND ON A RESILIENT ELECTRIC
GRID AS A FOUNDATION OF ECONOMIC
STABILITY AND NATIONAL SECURITY.

Intern Project Areas



CYBER AND
PHYSICAL THREATS



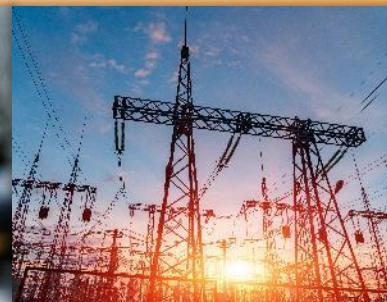
CLIMATE AND
WEATHER



INCREASING NEED
FOR CLEAN,
EQUITABLE ENERGY



INCREASING
ELECTRIFICATION



AGING,
CENTRALIZED
SYSTEM



INFRASTRUCTURE
DEPENDENCIES



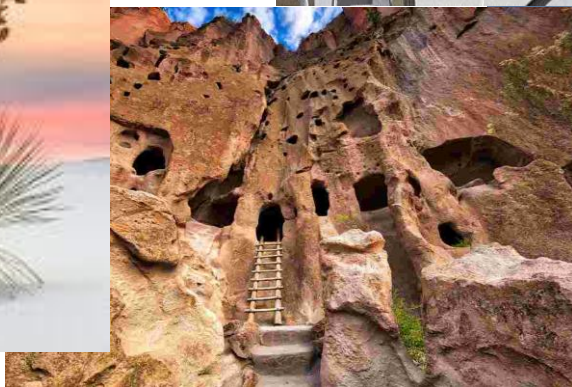
Specific Intern Project Areas

- Design of protection systems for grids with high penetrations of renewable energy
- Develop new optimization algorithms to improve the resilience of the electric power to natural and man-made threats
- Develop new control algorithms to improve grid stability with high penetrations of renewable energy
- Analyze electricity market data to identify potential value streams for energy storage
- Investigate behind-the-meter applications for energy storage and contribute to energy storage case studies
- Design power electronics to interface to different energy storage technologies
- Work at the cross section of wildfire modeling, geospatial science, data analytics, and power systems
- Under-frequency load shedding strategies and fast frequency response
- Community/place based work using social science or systems analysis
- Machine Learning or Reinforcement Learning
- Electric Vehicle (EV) planning tool, distribution system planning tool, microgrid design toolkit (MDT), and resilience planning tool (ReNCAT) development
- Grid anomaly detection techniques
- Analysis/estimation of critical loads (especially over time)
- Develop python code for an open source energy storage valuation tool
- Develop new techniques for evaluating transmission planning scenarios that include energy storage and large penetrations of renewable generation
- Power systems modeling using tools such as: Simulink, Power World, PSLF, PSSE, CAPE, ASPEN, OpenDSS, PSCAD, OPAL-RT, CYME
- Hardware expertise with inverters, control systems, relays, hardware-in-the-loop, Arduino, or raspberry pi
- Computer science work with Python, C, Java, MATLAB

Albuquerque, New Mexico



Apr	May	Jun	Jul	Aug	Sep
72°F	81°F	90°F	<u>92°F</u>	89°F	83°F
57°F	67°F	77°F	<u>79°F</u>	76°F	70°F
45°F	54°F	63°F	68°F	66°F	59°F



Intern Opportunities

Join hundreds of other interns

Enjoy tours of Sandia's world class facilities

Engage with a diverse team of researchers and mentors

Delight in warm dry weather and great outdoors

UNSTOPPABLE



JOIN THE LEGACY OF...

...EXCEPTIONAL **SERVICE**.

...A VIBRANT **CULTURE**.

...**SOLVING** NATIONAL
SECURITY CHALLENGES.

...CAREER **DEVELOPMENT**.

...SKILL + **KNOWLEDGE** TRANSFER.

...**PIPELINE** SUCCESS.

...EMPLOYMENT **OPPORTUNITIES**.

...**MISSION** DELIVERY.

...PURSUING **FELLOWSHIPS**.

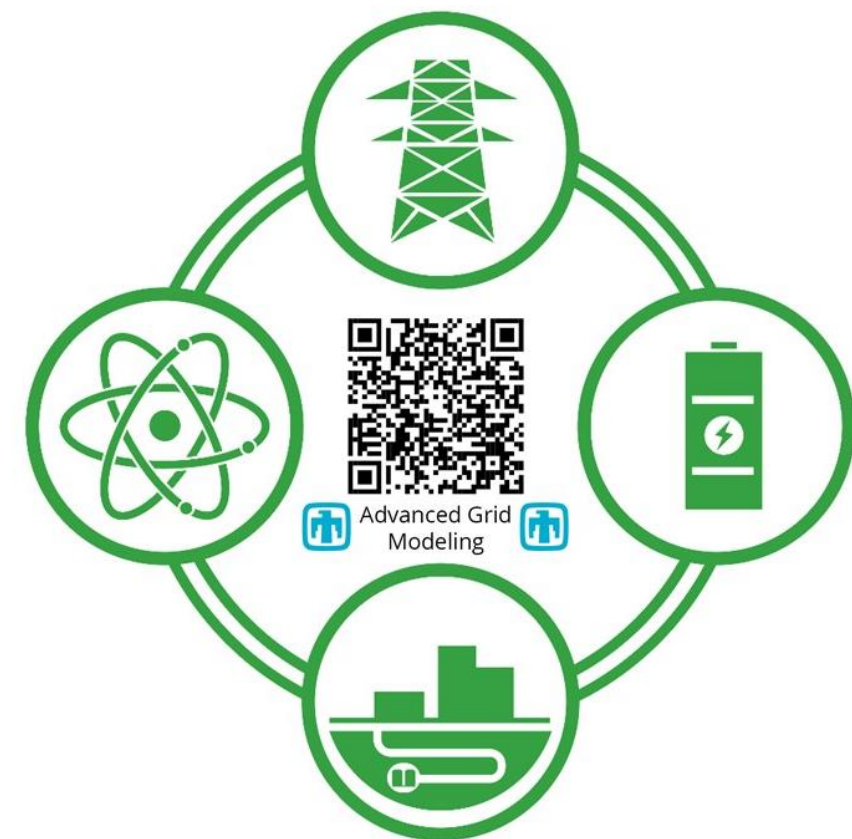
...REAL-WORLD **PROJECTS**.

...**UNSTOPPABLE** SANDIANS.

Student Intern Programs

Intern Central





Email resumes to:

Brian J. Pierre

bjpierr@sandia.gov

Join our intern programs:

Future of Research in Climate, Earth and Energy
(FORCEE)