Grid Modernization Program and Intern Opportunities

Sandia National Laboratories

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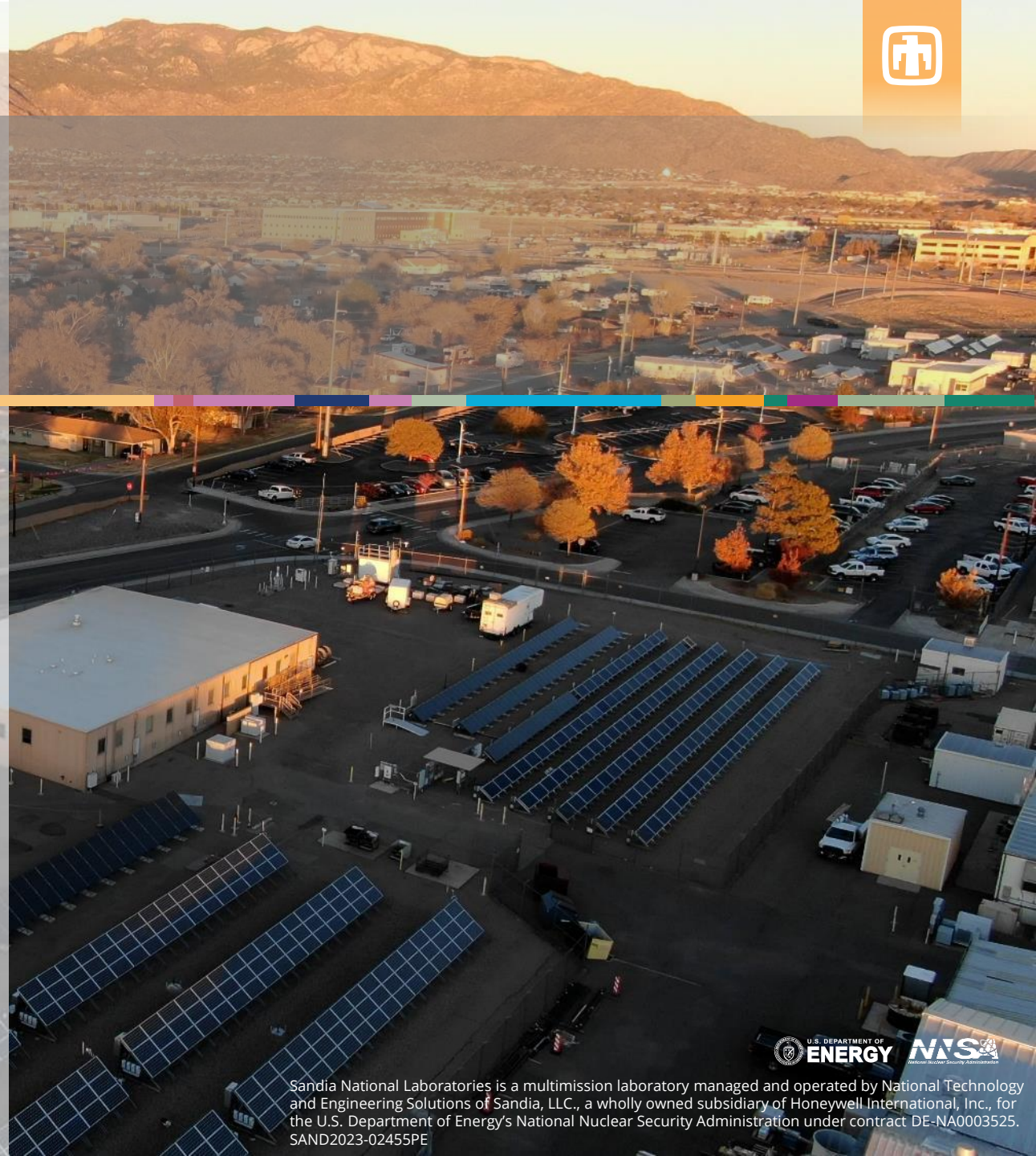
April 2023



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SAND2023-02455PE

SANDIA HAS FIVE MAJOR PROGRAM PORTFOLIOS

SANDIA HAS ~16,000 EMPLOYEES

HISTORY OF GRID MODERNIZATION AT SANDIA

1980s

- Distributed Energy Technology Laboratory (DETL) opens
- Sandia designs first battery test facility hosted by PSE&G in NJ

1990s/2000s

- Sandia starts interconnected PV systems work
- DOE designates Sandia as US Rep to IEC TC57, (standards for information exchange for power systems)

2003/04

- Sandia publishes DOE/EPRI Electricity Storage Handbook
- National SCADA Test Bed (NSTB) established

2009

- R&D 100: SiCPower Module
- DETL modernized to enable high penetration experimentation on distributed generation
- Energy Surety Microgrid (ESM™) Methodology

2010

- Energy Storage Test Pad established as the first facility to test 1MW class storage systems at a national lab
- Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS) established
- R&D100: Micro Power Source

2011

- R&D100 Award Winners: Ultra-high-voltage Silicon Carbide Thyristor
- R&D100 Award Winners: The Demand Response Inverter
- Secure, Scalable Microgrids Grand Challenge and Hardware Testbed Facility Initiated

2013

- Sandia develops the DOE/SNL Global Energy Storage Database

2014

- Grid Modernization Laboratory Consortium established & Sandia participates in 29 GMLC projects

2015

- Smart Grid International Research Facility Network (SIRFN) established
- R&D 100: Sandia and United Silicon Carbide, Inc. create new high voltage switch

2016

- Resilience Node Cluster Analysis Tool (ReNCAT) developed
- Control and Optimization of Networked Energy Technologies (CONET) Laboratory established
- First version of WNTR – Water Network Tool for Resilience

2017

- R&D 100: Control System for Active Damping of Inter-area Oscillations

2018

- QuESt, an open source energy storage simulation and analysis suite, publicly released
- Energy Storage Controls and Analytics Laboratory (ESCAL) created

2019

- Sandia-developed Grid Damping Control Strategy at CONET

2020

- Advanced Power Electronics Conversion Systems (APEX) Laboratory established

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 Emulytics 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 – Charlie Hanley

Energy Storage Technologies and Systems
Ray Byrne

Advanced Grid Modeling
Brian Pierre

Renewable & Distributed Systems Integration
Summer Ferreira

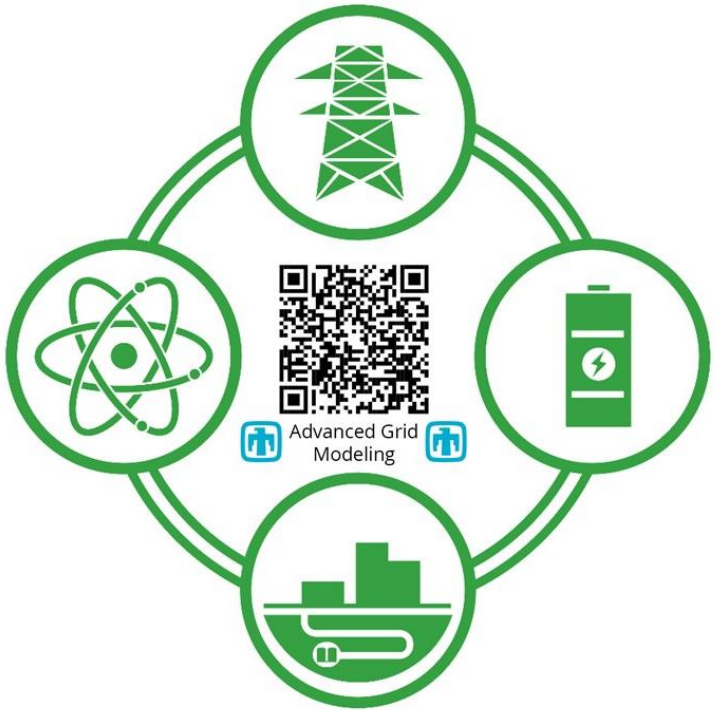
Power Conversion Devices and Systems
Valerio De Angelis

Grid Security
Craig Lawton

Defense and EMP
Steve Glover

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

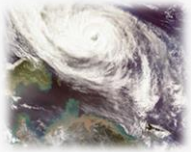
- Power system modeling,
- power system dynamics,
- grid stability,
- power system planning and operations,
- power system protection,
- renewable energy integration,
- threat modeling,
- grid reliability and resilience,
- power systems controls,
- grid optimization and electricity markets,
- grid applied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

Examples of Threats

ELECTROMAGNETIC PULSE (EMP)

CYBER SECURITY

PHYSICAL THREATS



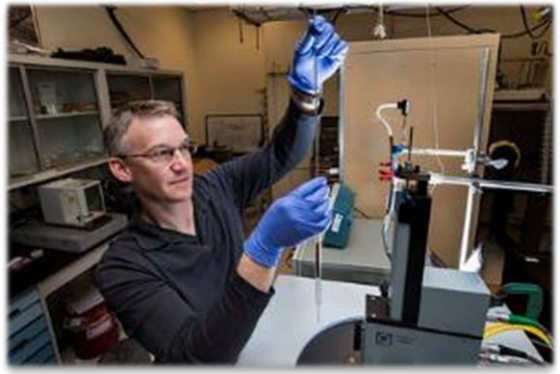
EXTREME WEATHER

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

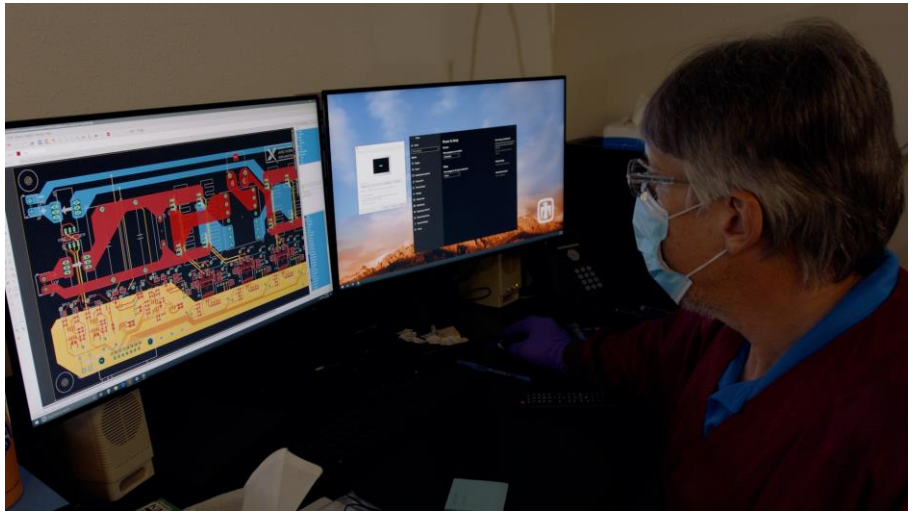


Energy Storage

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

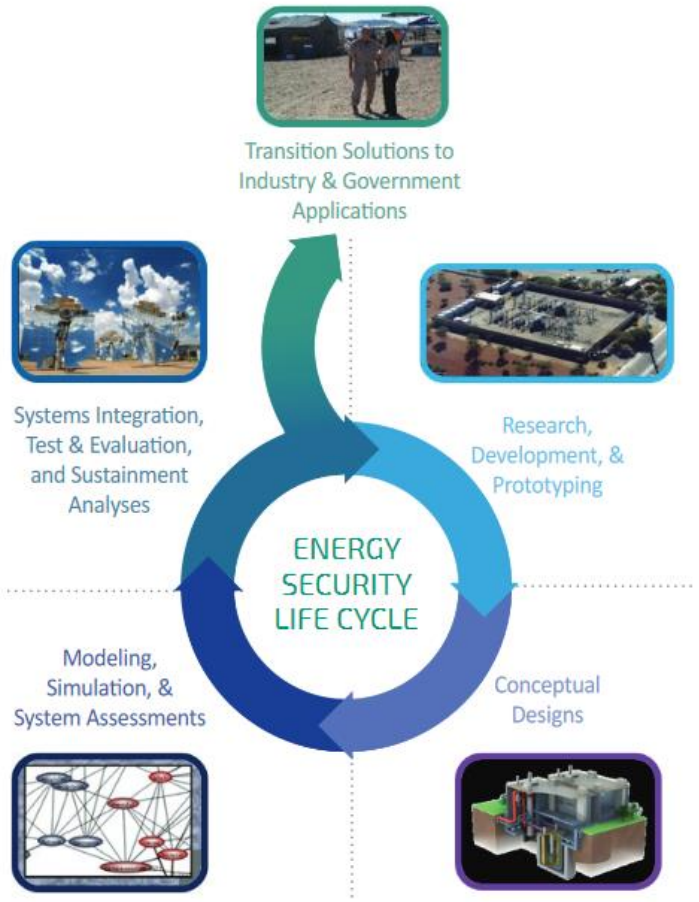
Advanced Modeling and Simulation

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

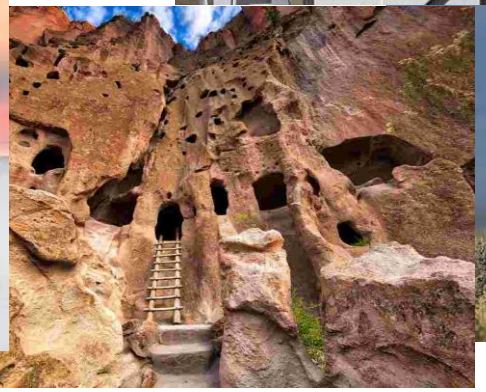
INFRASTRUCTURE DEPENDENCIES

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	92°F	89°F	83°F
57°F	67°F	77°F	79°F	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

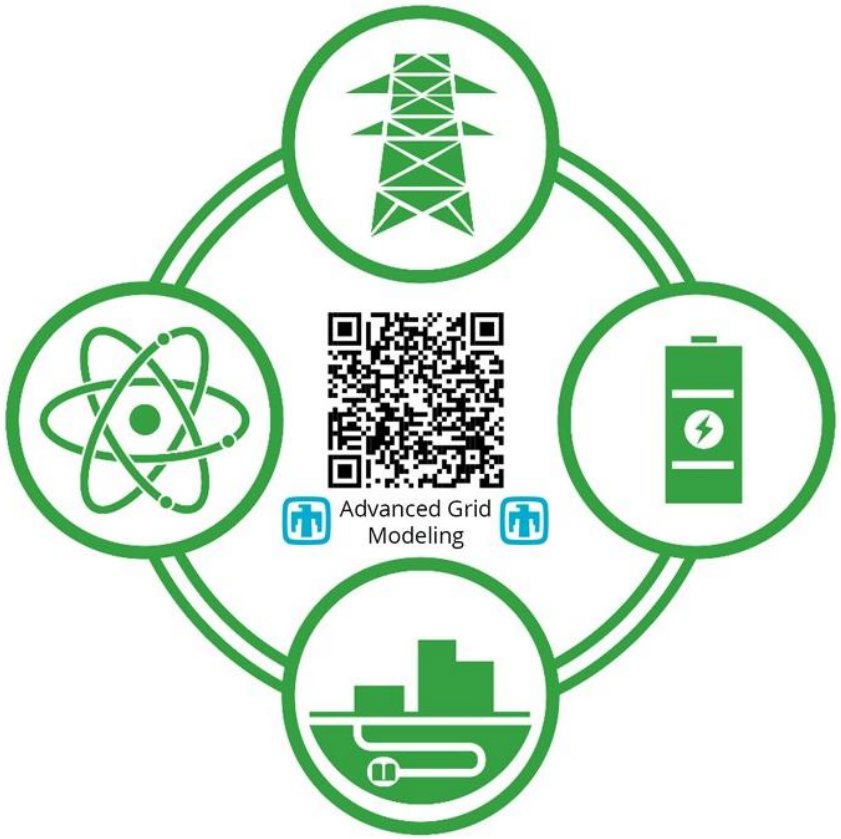
Engage with a diverse team of researchers and mentors

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.



Email resumes to:

Brian J. Pierre

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Join our intern programs:

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