Overview of Sandia Energy Resilience Methodology and Tools

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Exceptional service in the national interest

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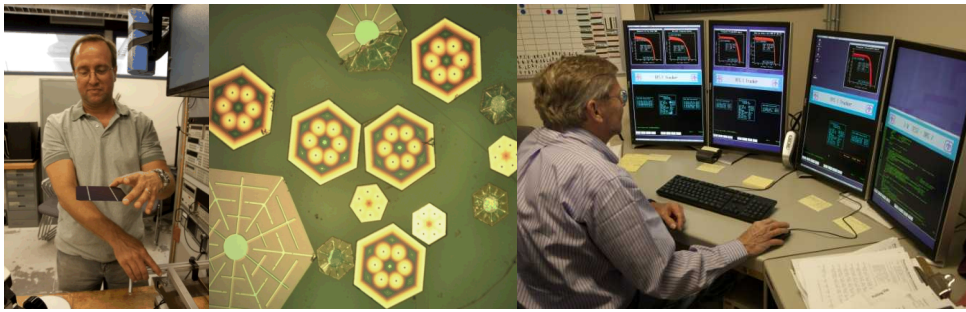

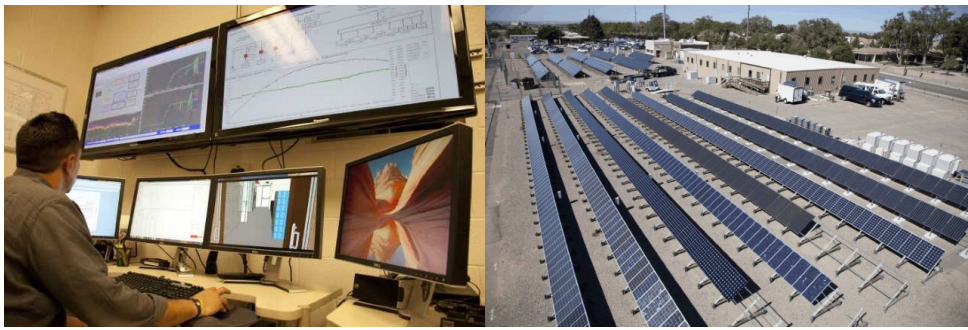

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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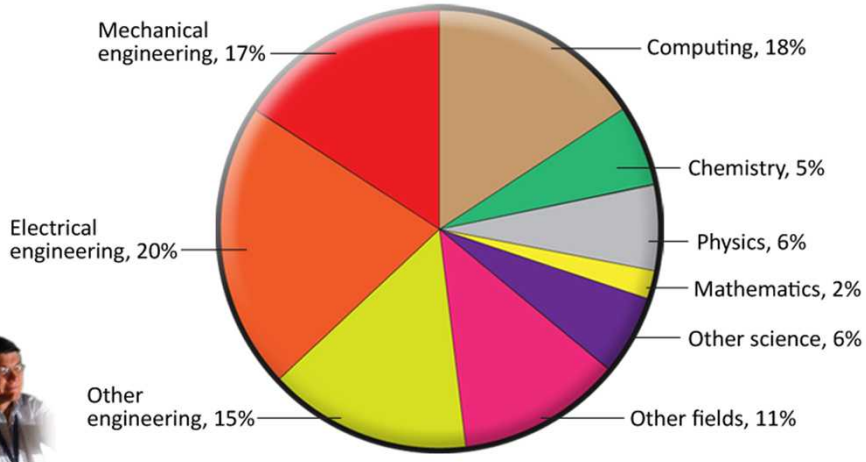
Sandia National Laboratories Highlights

- Operated by Lockheed Martin for DOE/NNSA
- Government-owned, contractor-operated (GOCO)
- Federally funded research and development center (FFRDC)

Sandia Mission Areas

- Nuclear Weapons
- Defense Systems and Assessments
- Energy and Climate
- International, Homeland, and Nuclear Security



~12,000 employees, ~5,000 technical staff

Sandia Operations Sites

Sandia National Laboratories

Albuquerque, New Mexico

Livermore, California

Kauai, Hawaii

Waste Isolation Pilot Plant, Carlsbad, New Mexico

Pantex Plant, Amarillo, Texas

Tonopah, Nevada

Sandia's Energy RD&D Capabilities

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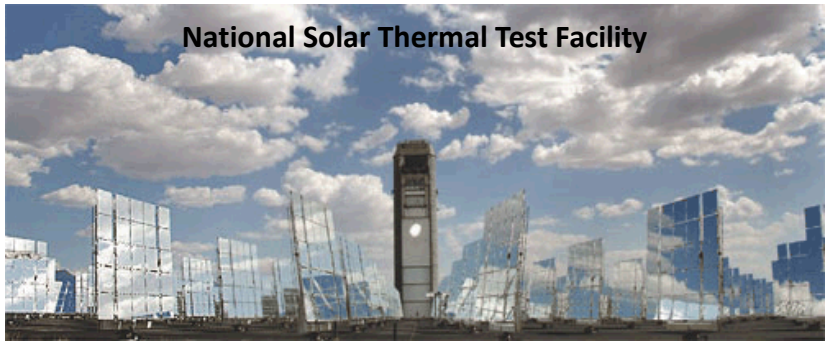
Distributed Energy Technologies Laboratory (DETL)


Supervisory Control & Data Acquisition (SCADA) Test Bed


Combustion Research Facility (CRF)


Joint BioEnergy Institute (JBEI)
(Sandia, LBNL, PNNL, LLNL, UC-Berkley, UC-Davis & Carnegie Inst. for Science)

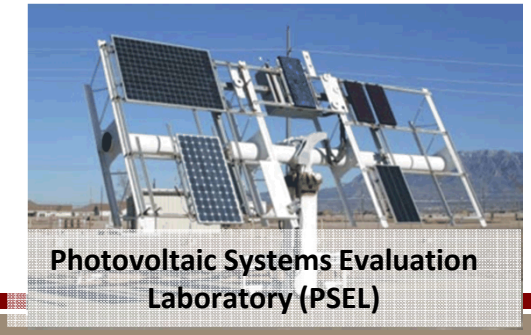

Battery Abuse Testing Laboratory (BATLab)


National Solar Thermal Test Facility


Scaled Wind Farm Technology (SWiFT) Facility


Center for Integrated Nanotechnologies (CINT)
(Sandia and LANL)


National Infrastructure Simulation & Analysis Center (NISAC)
(Sandia & LANL)


Photovoltaic Systems Evaluation Laboratory (PSEL)

Sandia's Energy Surety Approach

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Energy Surety – Safe, secure, and reliable energy supply for sustained system operations and assured system and mission performance

Performance Characteristic	Definition
Safety	Safe supplies of energy to end user
Security	Protection of energy supply infrastructure
Reliability	Can provide energy when and where needed
Sustainability	Can be maintained for long durations with minimal impact on resources
Cost Effective	Provided at affordable cost
Resilience	Ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions

Risk-based Energy Surety Design Methodology

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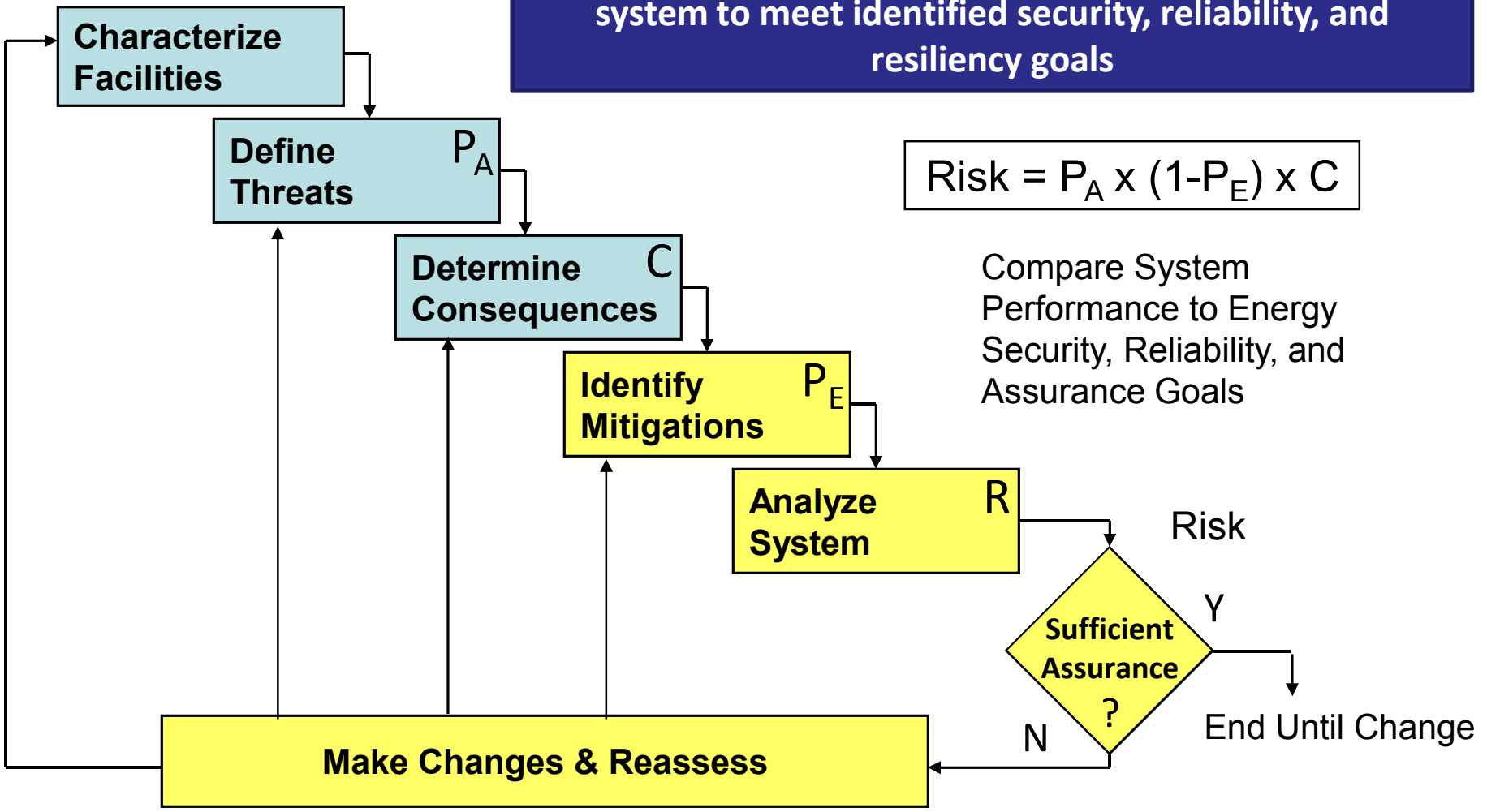
A quantitative approach to assess and design energy system to meet identified security, reliability, and resiliency goals



$$Risk = P_A \times (1-P_E) \times C$$

Compare System Performance to Energy Security, Reliability, and Assurance Goals

Threat Categories

- Natural Disasters
  - Hurricanes, Floods, Tornados, Earthquake, etc.
  - Can have widespread consequences
- Unplanned Events
  - Local or regional service interruption due to equipment failure, equipment malfunction or human error
- Intentional, malevolent
  - Cyber attack
  - Physical attack

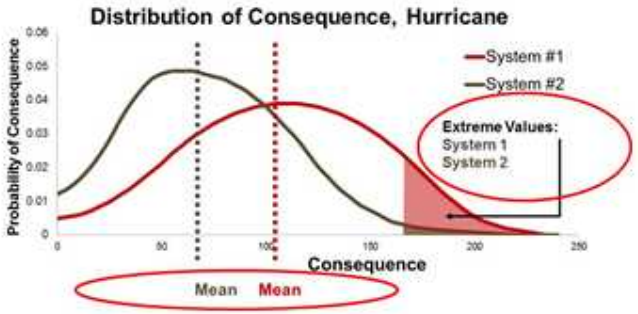
Critical Energy Infrastructure Security Modeling, Simulation and Analysis Capabilities

Military and Civilian Energy Security Assessments

Joint Base Pearl -Hickam

Hoboken

- Systems Performance Modeling and Analysis
- Energy Resilience Quantification
- Complex Inter-dependencies
- System of Systems Assessments
- Optimization & Decision Support



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DCICON Energy Surety Support Plan

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- Phase I – Preliminary Assessment
  - Gain detailed understanding of energy infrastructure to identify critical needs, issues, challenges and constraints
  - Identify performance objectives relative to a threats consequences
  - Apply energy assurance analysis to establish baseline performance and candidate options to enhance system resilience

- Optional Follow-Up
  - Evaluate cost/benefits of options
  - Provide conceptual design to meet identified requirements
  - Support preliminary design with A&E
  - Provide construction, control, and cyber security support and validation

Discussion

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