SAND2011-0718P

Energy, Climate, & Infrastructure Security (ECIS) Overview

Rick Stulen, ECIS SMU Vice President

ExxonMobil

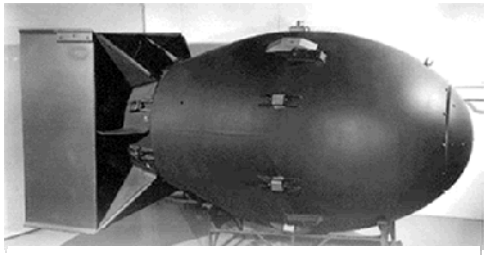
Sandia National Laboratories
January 11, 2010

Sandia National Laboratories is a multi program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sandia National Laboratories

Sandia's History

"Exceptional service in the national interest"



THE WHITE HOUSE
WASHINGTON

May 13, 1949

Dear Mr. Wilson:

I am informed that the Atomic Energy Commission intends to ask that the Bell Telephone Laboratories accept under contract the direction of the Sandia Laboratory at Albuquerque, New Mexico.

This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense, and should have the best possible technical direction.

I hope that after you have heard more in detail from the Atomic Energy Commission, your organization will find it possible to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

I am writing a similar note direct to Dr. C. E. Buckley.

Very sincerely yours,

Harry Truman

Mr. Leroy A. Wilson,
President,
American Telephone and Telegraph Company,
195 Broadway,
New York 7, N. Y.

Sandia National Laboratories

Sandia's Governance Structure

Sandia Corporation

- AT&T: 1949–1993
- Martin Marietta: 1993–1995
- Lockheed Martin: 1995–Present
- Existing contract expires 9/30/12

Government-Owned Contractor-Operated

Federally Funded Research & Development Center (FFRDC)

Sandia's Sites

Livermore, California

Albuquerque, New Mexico

Las Vegas, Nevada

WIPP, New Mexico

Kauai, Hawaii

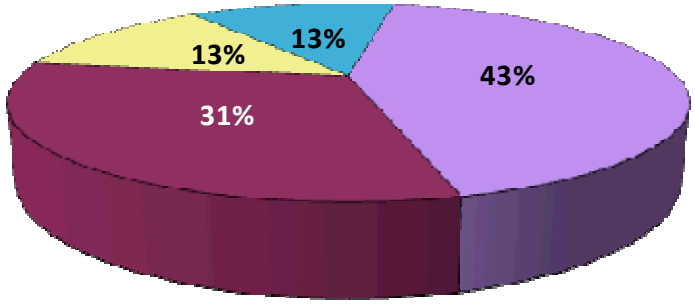
Pantex, Texas

Tonopah, Nevada

People and Budget

- On-site workforce: 11,400
- Regular employees: 8,250
- Gross payroll: ~$900 million

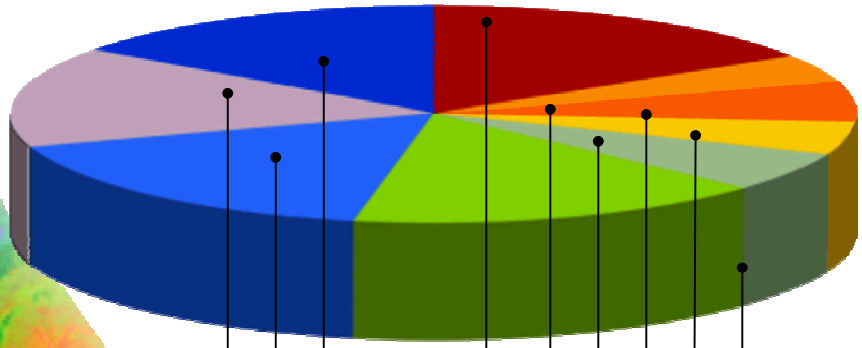
FY10 Operating Revenue
$2.3 billion



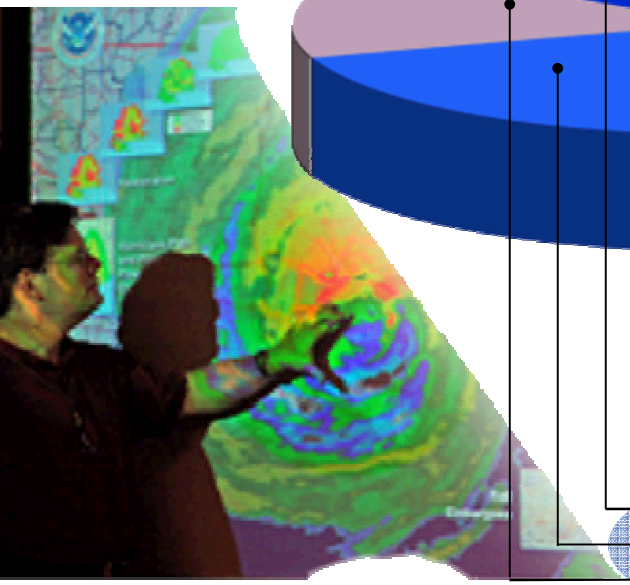
(Operating Budget)

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

Technical staff (3,850) by discipline:



- Computing 16%
- Math 2%
- Chemistry 6%
- Physics 6%
- Other science 6%
- Other fields 12%
- Electrical engineering 21%
- Mechanical engineering 16%
- Other engineering 15%



Sandia National Laboratories

Program structure

Paul Hommert
Laboratories Director

Jerry McDowell
Deputy Lab Director and EVP for National Security Programs

Kim Sawyer
Deputy Lab Director and EVP for Mission Support

Nuclear Weapons

One Strategic Management Unit

- *Nuclear Weapons*

Nuclear Weapons SMU Vice Presidents

Steve Rottler
Weapon Science & Technology (WS&T)

Rick Stulen
CA Laboratory

Mike Hazen
Defense Security Prgm (DSP)

Carolyne Hart
Stockpile and Weapon Product Realization (SWPR)

National Security Programs

Three Strategic Management Units

- *Defense Systems and Assessments*

Michael Vahle
(Acting) Vice President

- *International, Homeland & Nuclear Security*

Jill Hruby
Vice President

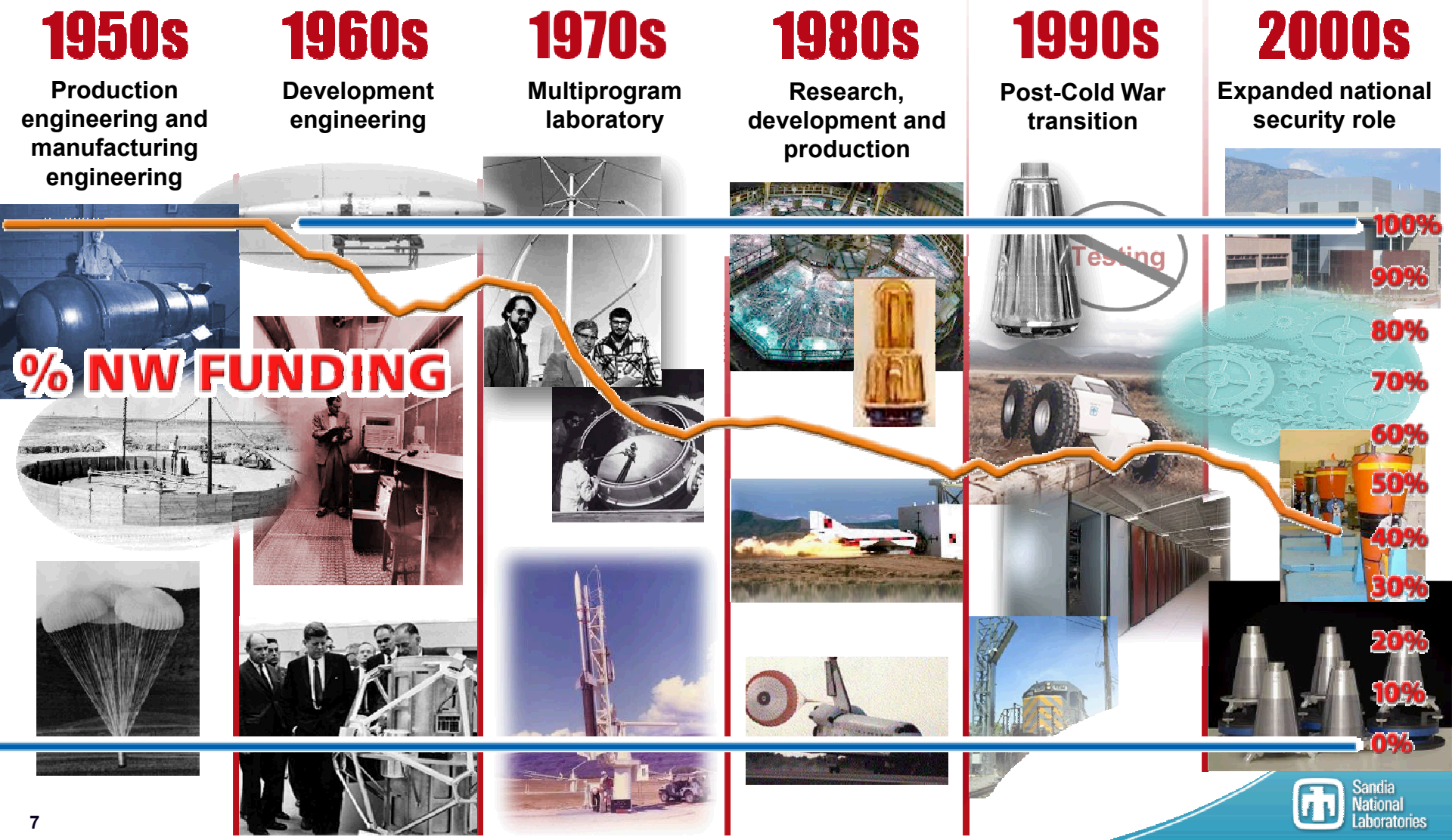
- *Energy, Climate & Infrastructure Security*

Rick Stulen
Vice President

Mission Support

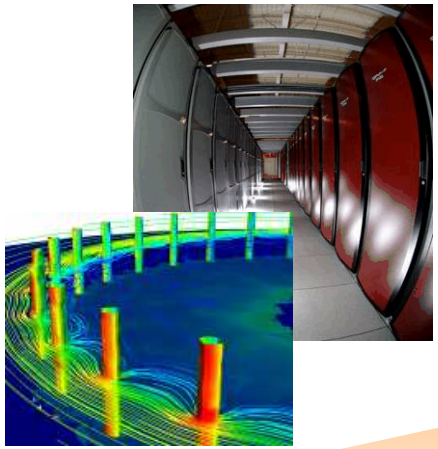
- HR & Communication
- Legal
- IT/CG
- Finance & Business Operations
- INFRAOPS

The Evolution of Our Mission

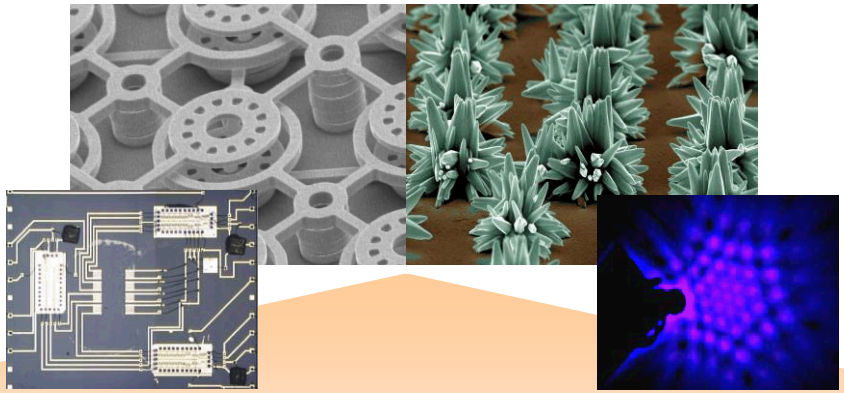


Sandia National Laboratories

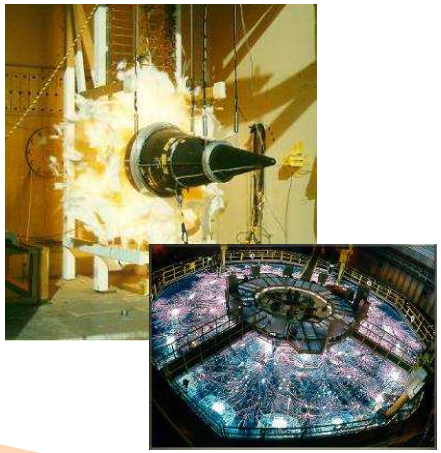
Research Disciplines Drive Capabilities



High Performance Computing

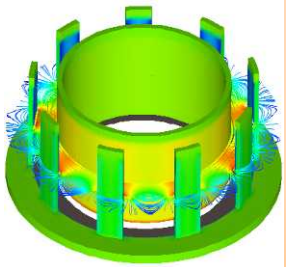


Nanotechnologies & Microsystems

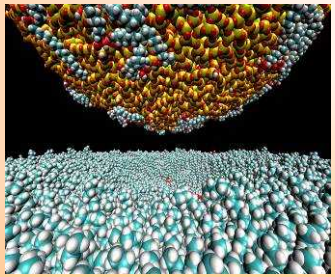


Extreme Environments

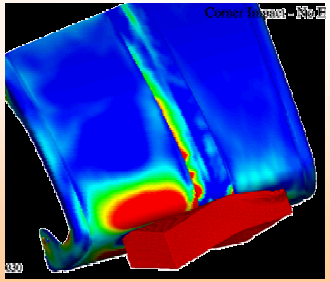
Computer Science



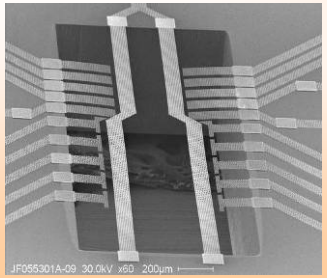
Materials



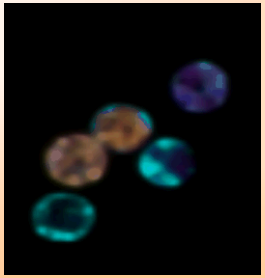
Engineering Sciences



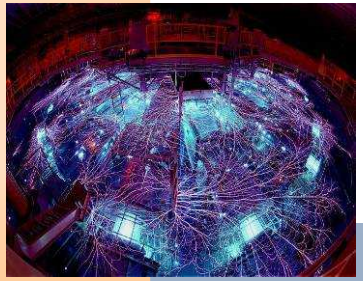
Micro Electronics



Bioscience

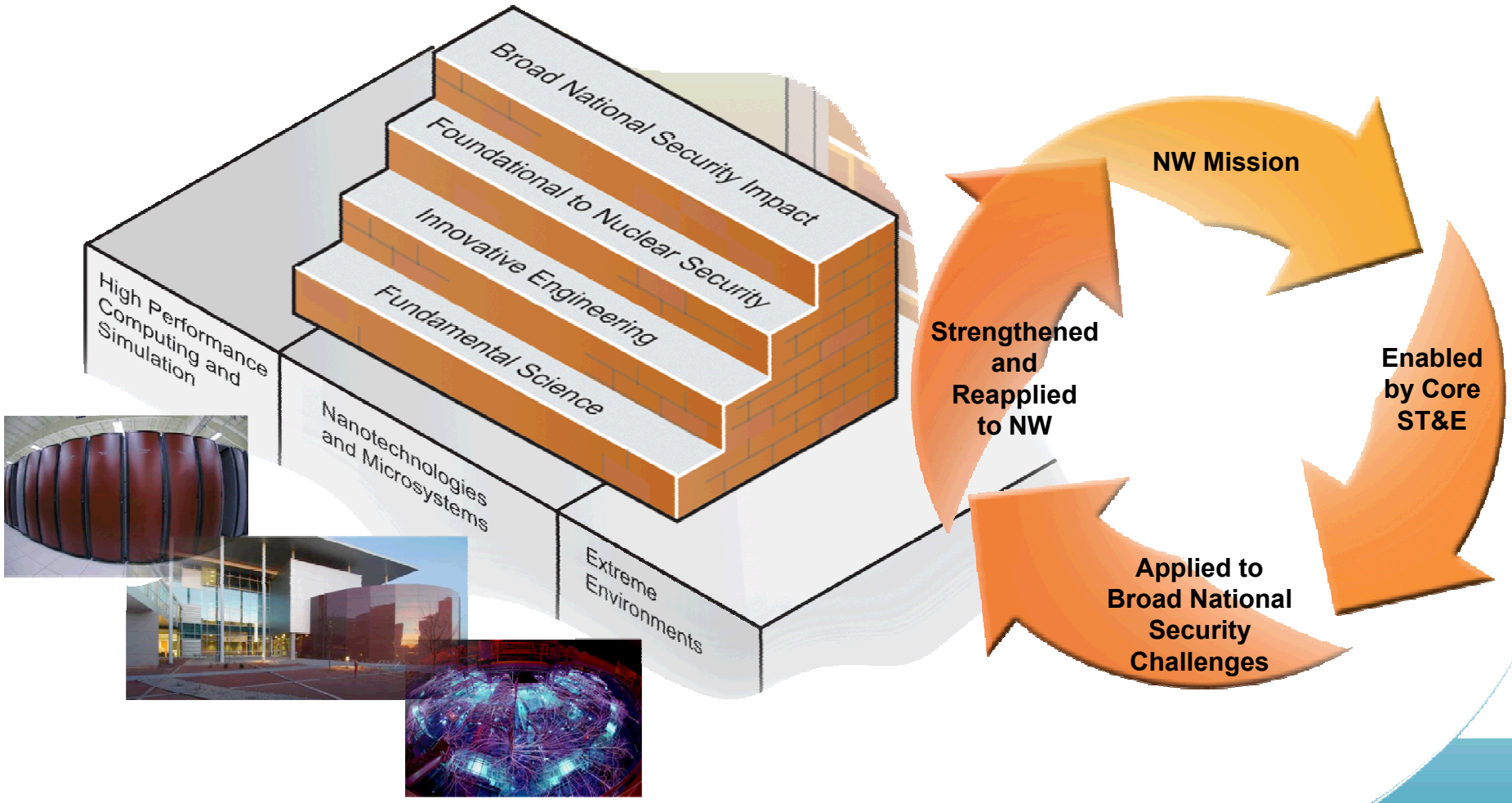


Pulsed Power



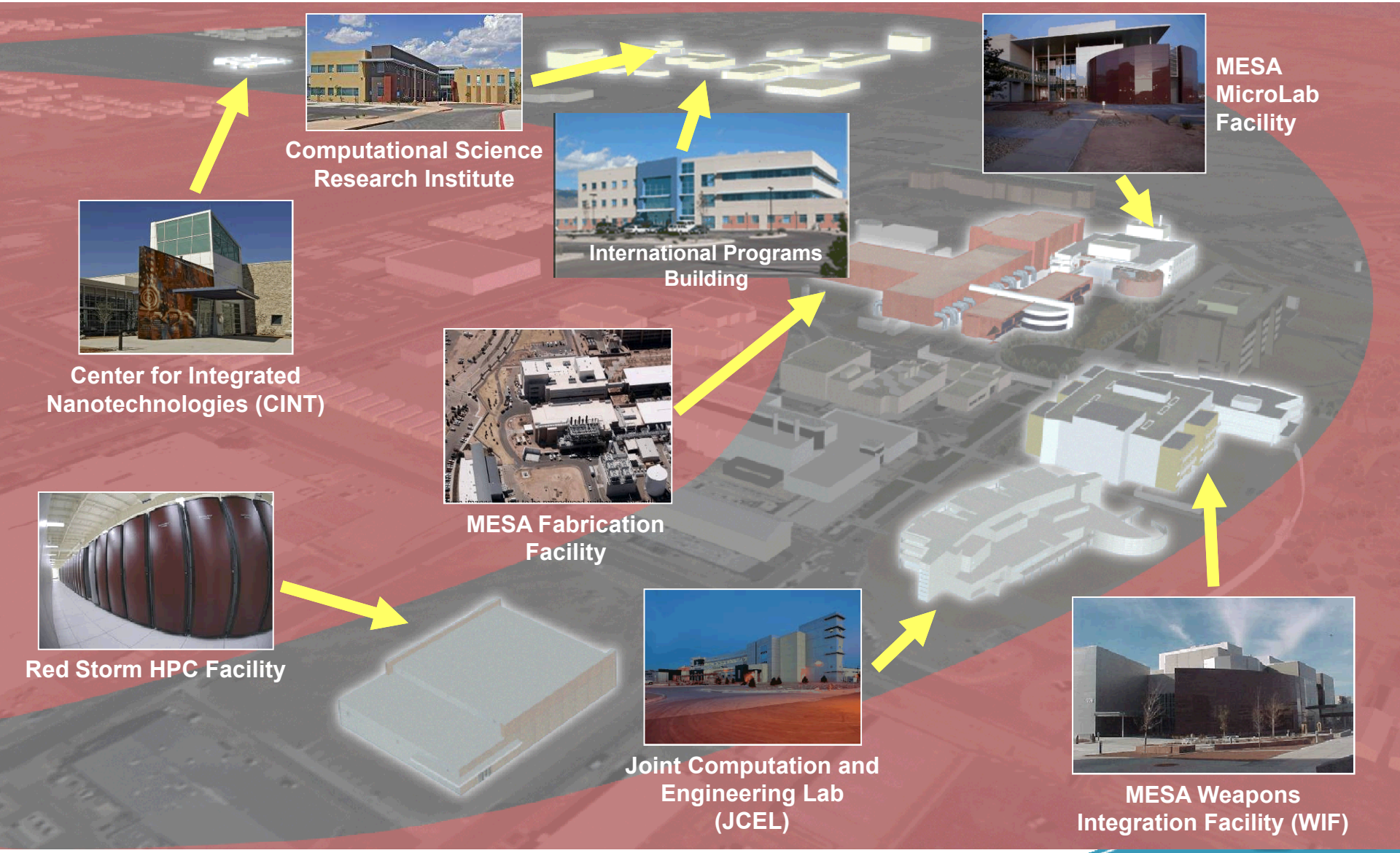
Research Disciplines

From Science to National Security Impact



Sandia National Laboratories

Sandia's Innovation Corridor opens Sandia to greater interactions



Energy, Climate, and Infrastructure Security

SMU OVERVIEW

Global Context

- Energy consumption will continue to grow with development gains and population growth
- Fossil fuels dominate energy picture and will likely continue to, so that we as a nation need to manage GHG emissions to ensure US energy security
- U.S. deeply dependent on foreign supplies of petroleum in the transportation sector
- Energy and climate security are now a clear global priority

Vision

Enhance the nation's security and prosperity through sustainable, transformative approaches to our most challenging energy, climate, and infrastructure problems.

We Have Four Overarching SMU Objectives

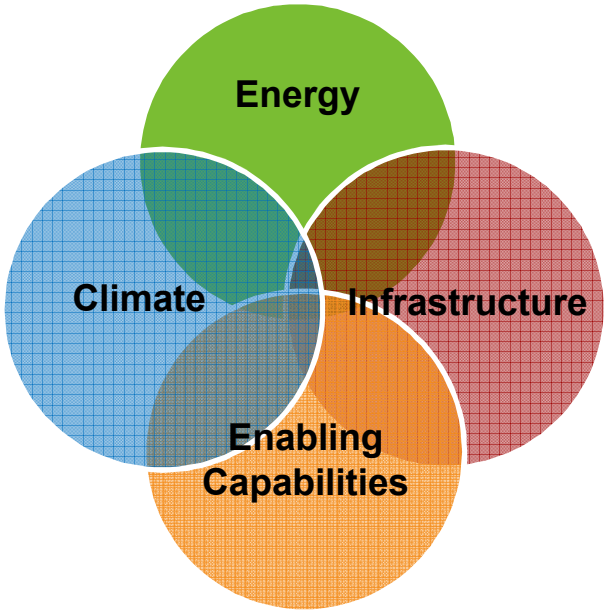
- **Accelerate U.S. industries' innovation, development, and successful deployment of energy solutions** to the nation's most challenging problems.
- **Enable sound government energy policy decisions** by providing timely and objective technology assessments and systems analyses.
- **Steward enduring and relevant science, systems, and security competencies** to support inherently government functions and services.
- **Support U.S. leadership in global energy challenges** through strategic international engagement.

Energy, Climate, and Infrastructure Security SMU Program Areas

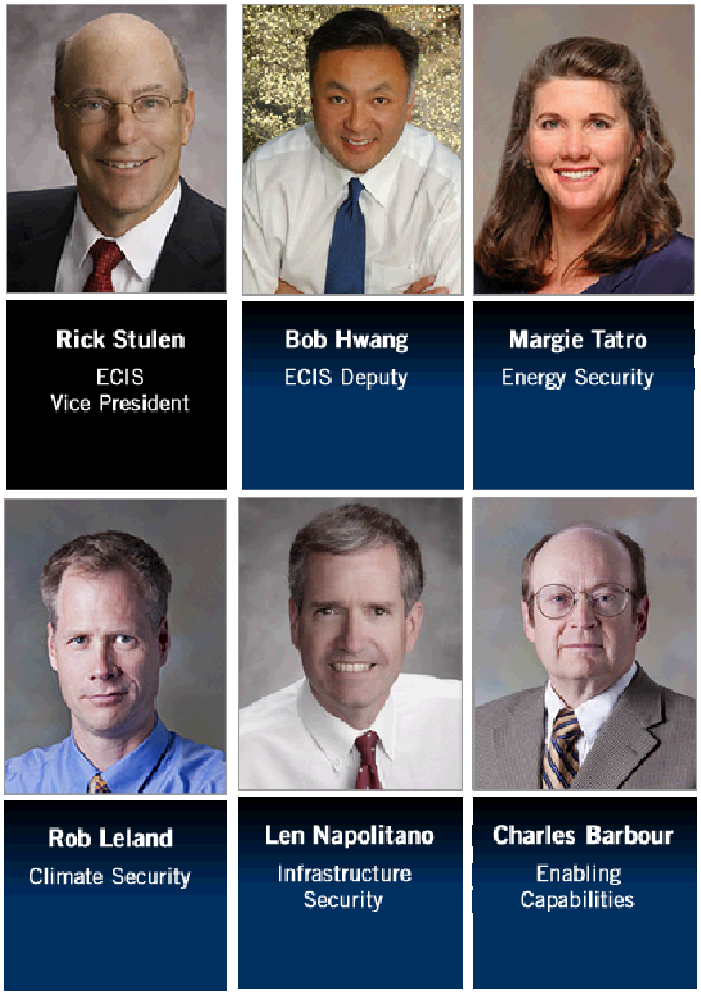
Energy	Climate	Infrastructure	Enabling Capabilities
Renewables	Sensing and Monitoring	Modeling Analysis	Discovery
Nuclear	Modeling and Analysis	Cyber	Systems Analysis
Transportation	Carbon Management	Electricity	Regulations and Policy
Efficiency	Water	Energy Assurance	ARPA-E
		International Assurance	

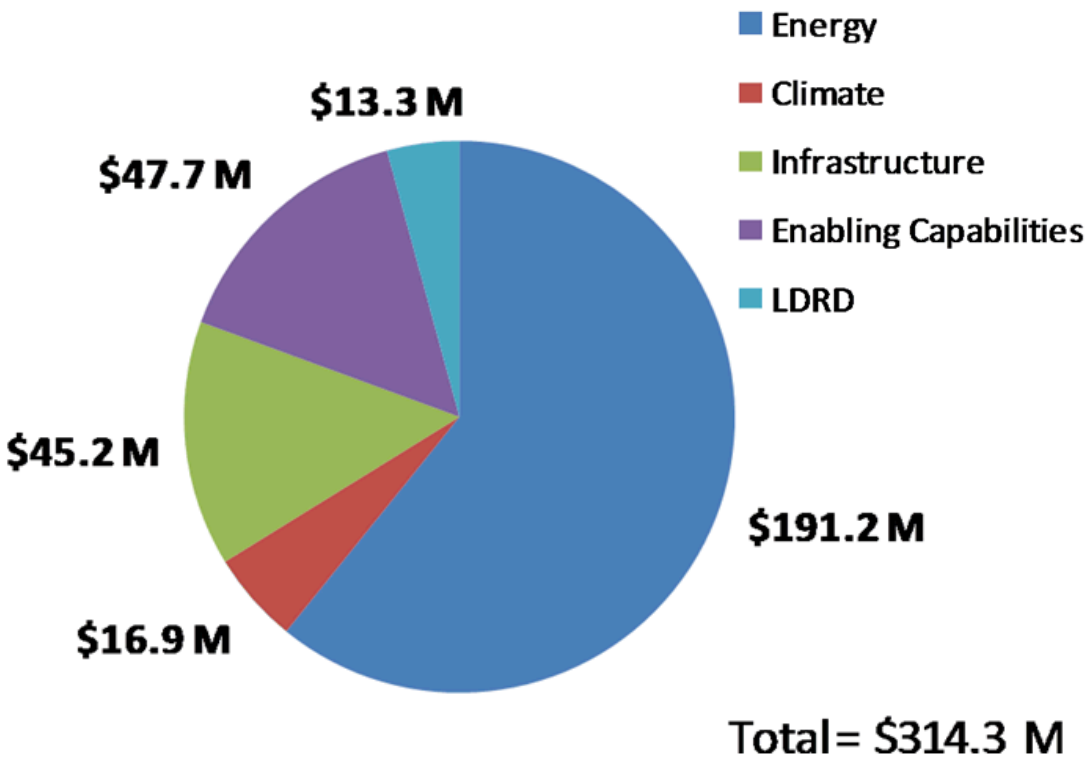
Important National Energy Security Challenges

- Reduce our dependence on foreign oil
- Reduce carbon footprint of power generation
- Provide the foundation for a global climate treaty
- Advance credible carbon management strategies
- Assure water safety, security and sustainability
- Assure energy security for critical installations
- Increase security and resiliency of the electrical grid and energy infrastructure
- Strengthen the nation's S&T base to accelerate industry for energy and climate security
- Advance energy storage technologies



ECIS FY10 Portfolio





Sandia National Laboratories

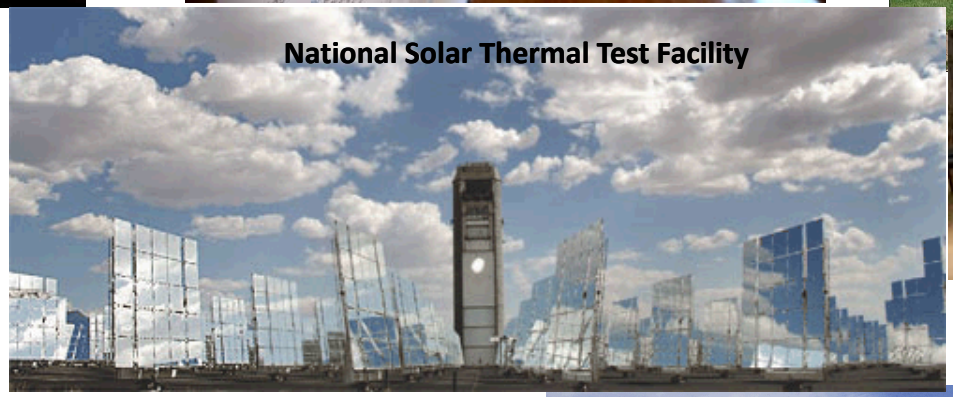
Energy-focused research facilities


Supervisory Control & Data Acquisition (SCADA) Test Bed

Joint BioEnergy Institute (JBEI)

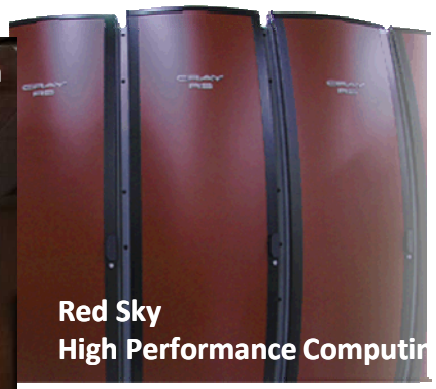

Combustion Research Facility (CRF)


PV panels at the Distributed Energy Technologies Laboratory (DETL)


National Solar Thermal Test Facility


Battery Abuse Testing Laboratory (BATLab)


National Infrastructure Simulation & Analysis Center (NISAC)


Red Sky
High Performance Computir


Center for Integrated Nanotechnologies (CINT)

Sandia National Laboratories

Energy, Climate, and Infrastructure Security

HIGHLIGHTS

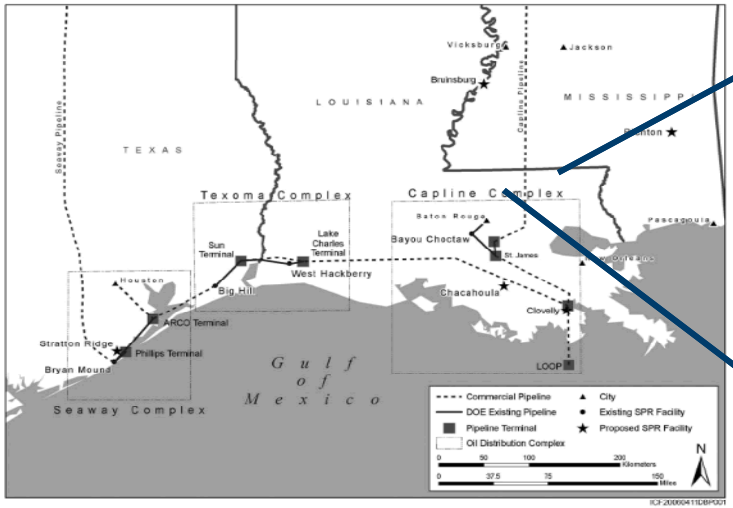
Strategic Petroleum Reserve

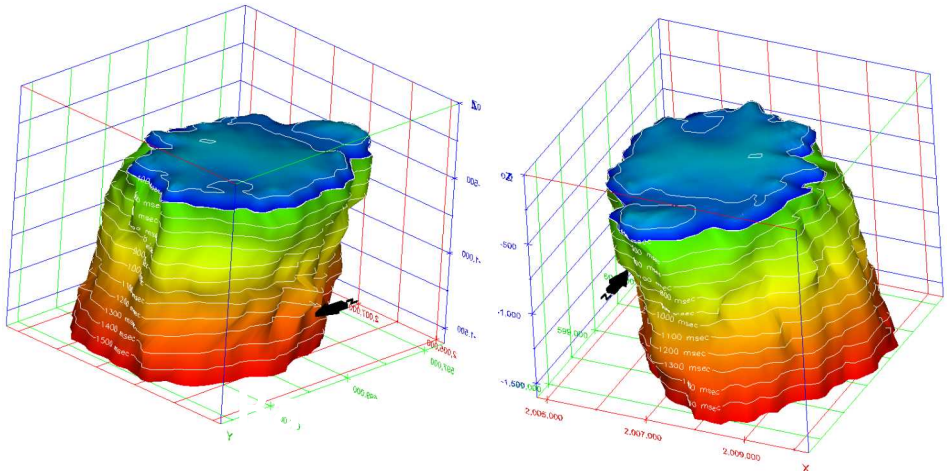
Bayou Choctaw Dome, LA; one of the four SPR storage sites

(red colors indicate that cavern radius exceeds stability criterion based on nearest neighbors)

Caverns within Bayou Choctaw Salt Dome

Figure 2.2.2-1: Existing and Proposed SPR Facility Locations and Crude Oil Distribution Complexes





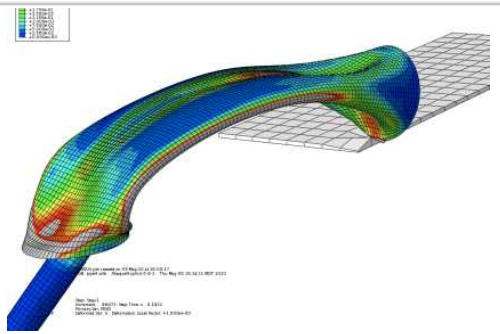
- 62 caverns at four sites holding 727 million barrels of oil
- CAVEMAN tools continuously integrate cavern data, e.g. monitoring well leakage
- CAVEMAN has influenced state regulation in Kansas, Texas and Louisiana

Sandia National Laboratories

BP Oil Spill

Sandia led the tri-lab team in Houston

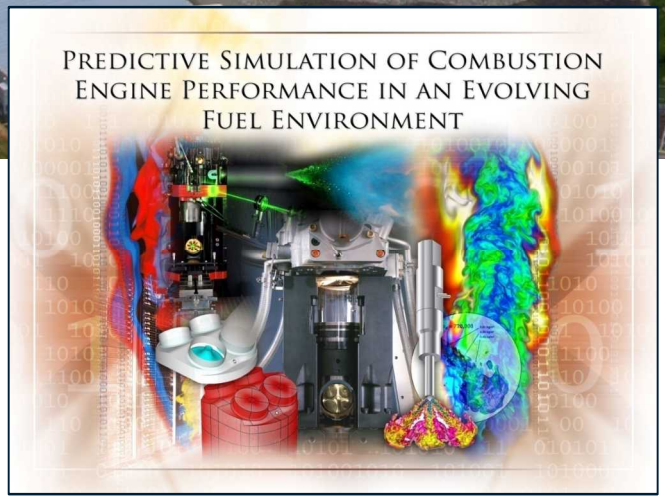
- Sandia, Los Alamos & Lawrence Livermore national laboratories had continuous presence from May 1-Sept. 21
- Funding was provided through an agreement between the US Coast Guard and the DOE.
- Assistance included:
  - Estimating maximum well shut-in pressures
  - Examining annular or central flow indicators
  - Reviewing the mechanical design/integrity of “first of kind” hardware
  - Calculating the structural integrity of the riser
  - Calculating flow and spill volume



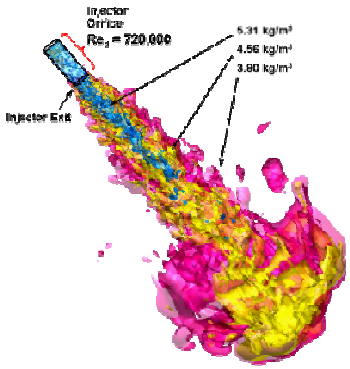
Combustion Research Facility

An Office of Science Collaborative Research Facility

CRF 30 CELEBRATING THIRTY YEARS 1980–2010



Reynolds-averaged Navier-Stokes calculation of fuel injector captures mean behavior

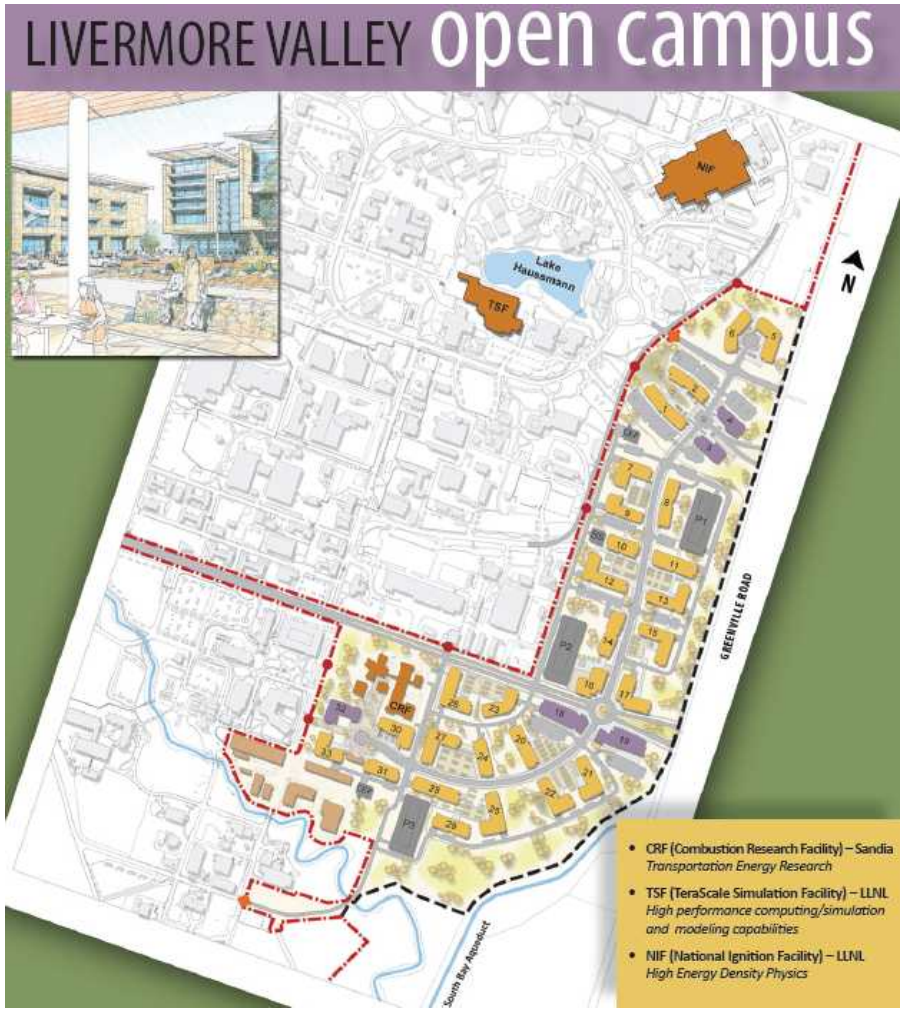


Large-eddy simulation of fuel injector captures greater range of physical scales

Sandia National Laboratories

Livermore Valley Open Campus (LVOC)

- An open, national security research and development space



- LVOC will be modeled after research and development campuses found at major industrial research parks and other U.S. Department of Energy laboratories
- Devised to enhance and accelerate international scientific collaboration and partnerships with U.S. industry and academia
- LVOC Objectives:
  - *Enhance the two laboratories' national security missions by substantially increasing engagement with the private sector and academic community*
  - *Stay at the forefront of the science, technology and engineering fields*
  - *Ensure a quality future workforce by expanding opportunities for open engagement of the broader scientific community*

Sandia National Laboratories | National Nuclear Security Administration | Lawrence Livermore National Laboratory

Sandia National Laboratories

The Joint BioEnergy Institute (JBEI)

jbei
Joint BioEnergy Institute

U.S. DEPARTMENT OF ENERGY Office of Science

Located in Emeryville, California

Unified Research & Operations:

- $134M, 5-year DOE OBER program
- Highly focused research agenda
- Single operation and facility

Six Partners:

- Three DOE National Laboratories
- Two Universities
- One Foundation

Four Science Divisions:

- Feedstocks
- Deconstruction
- Fuels Synthesis
- Cross-cutting Technologies

Industry Partnership Program:

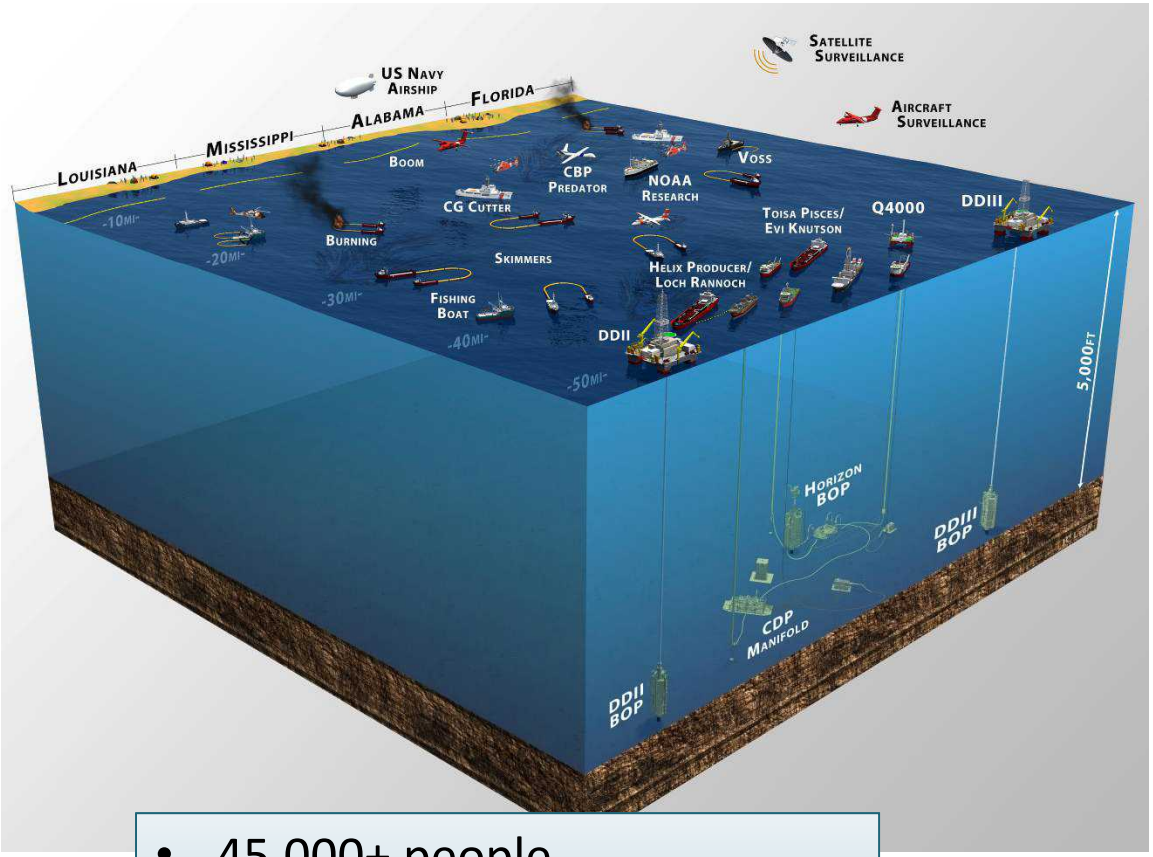
- Underpin growth of biofuels industry
- Ensure technology transfer to the developing biofuels industry

Berkeley Lab | Sandia National Laboratories | Lawrence Livermore National Laboratory | UC DAVIS University of California | Carnegie Institution for Science | Sandia National Laboratories

Energy, Climate, and Infrastructure Security

DISCUSSION TOPICS

Deepwater Horizon



- 45,000+ people
- Over 7,000 sea vessels, 150 airplanes,6 deepwater drilling rigs,

High Performance Computing

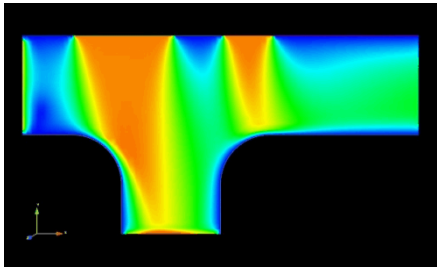
- DOE mission imperatives require simulation and analysis for policy and decision making
  - •*Energy*: Reducing U.S. reliance on foreign energy sources and reducing the carbon footprint of energy production and use
  - •*Climate*: Understanding, mitigating and adapting to the effects of global warming
  - •*National Nuclear Security*: Maintaining a safe, secure and reliable nuclear stockpile

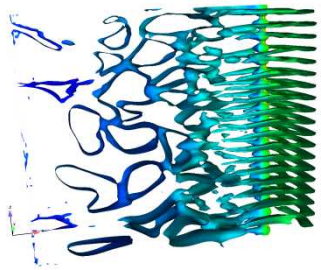
•Multidisciplinary Research is key to HPC Success

Trilinos

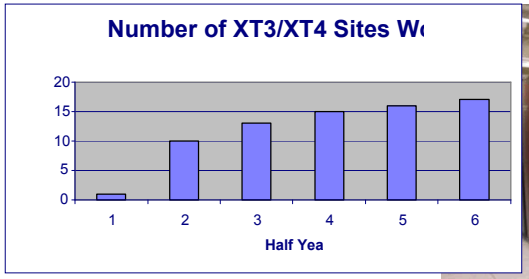
DAKOTA

Leading Edge Algorithms and Enabling Technologies





State-of-Art Computational Science Applications



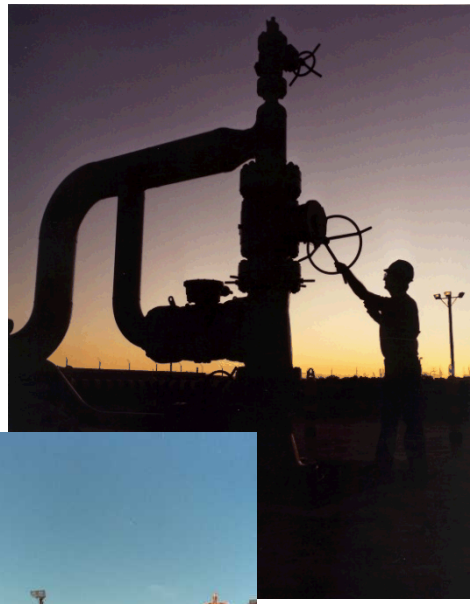
Scalable HPC Architectures and Systems

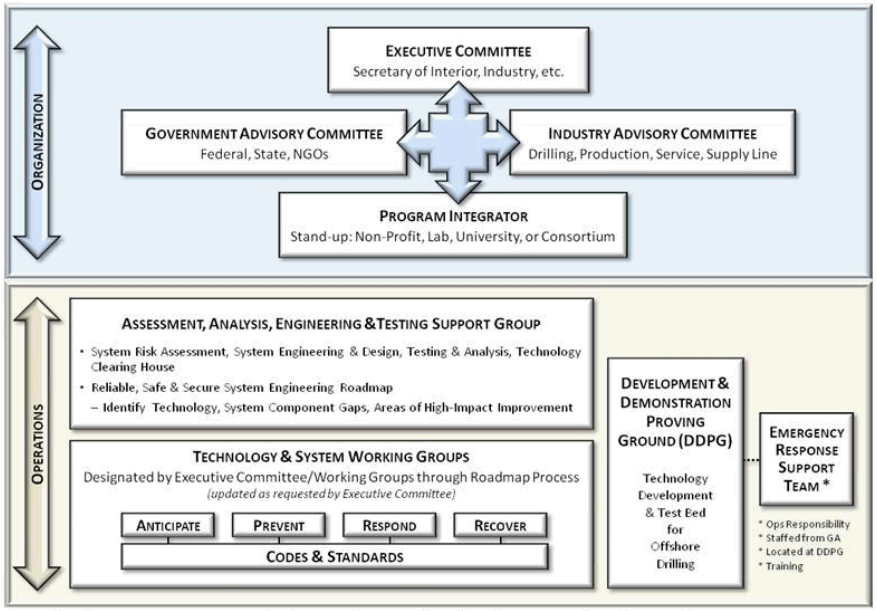
Sandia National Laboratories

Drilling Strategy

- Joint Venture for Safe and Secure Offshore Petroleum Research and Development

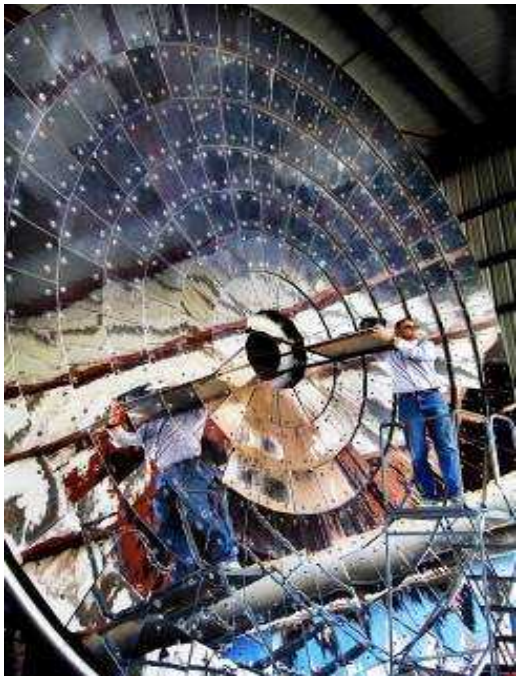
- Idea based on Sematech semiconductor partnership

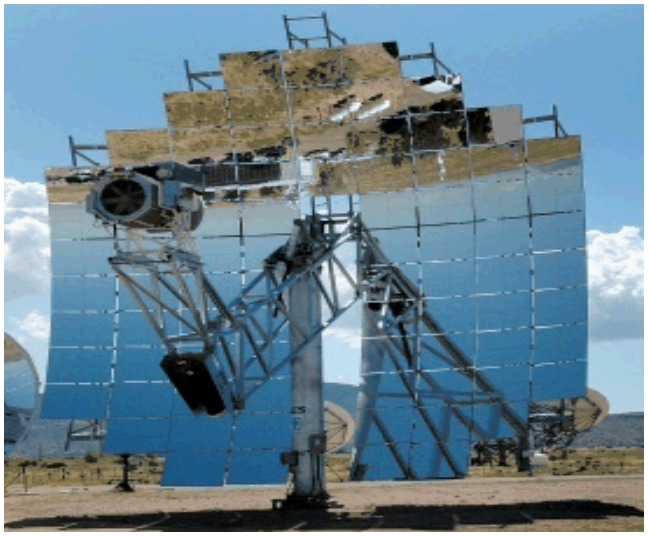


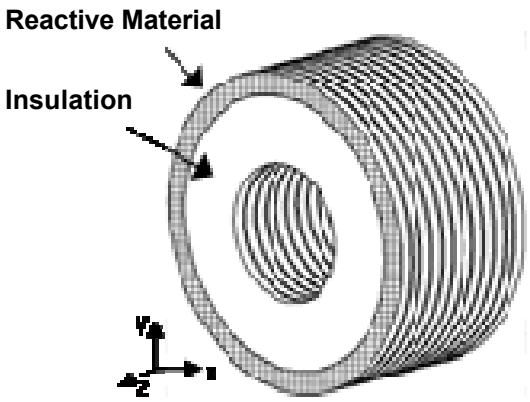


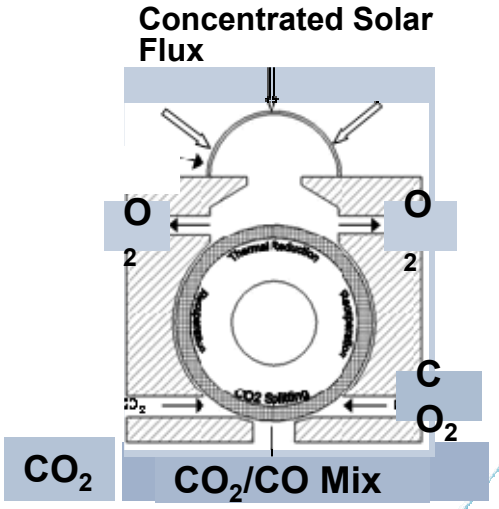
An industry-government partnership for supporting research and development, regulatory issues, and emergency response

"Sunshine to Petrol" uses the sun to break apart CO_2 and store energy in hydrocarbons









Counter-Rotating-Ring Receiver/Reactor/Recuperator