

# Sandia National Laboratories

## Pi Tau Sigma – University of Michigan

**David Lord**  
Principal Member of Technical Staff  
Geotechnology & Engineering Department

March 21, 2012

*Exceptional Service in the National Interest*

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.



# Goals

- Introduce you to Sandia National Laboratories
- Information about Sandia employment
- My pathway from U of M to Sandia
- Brief overview of projects I've worked on at Sandia

# Sandia's Sites

Albuquerque,  
New Mexico



Livermore,  
California



Las Vegas,  
Nevada



Carlsbad,  
New Mexico



Kauai,  
Hawaii



Pantex, Texas



Tonopah, Nevada

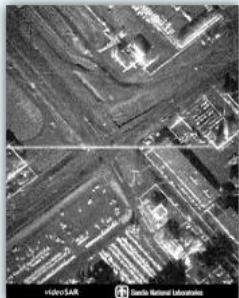


Kodiak, Alaska



# Sandia's Broad National Security Role

## Defense Systems & Assessments



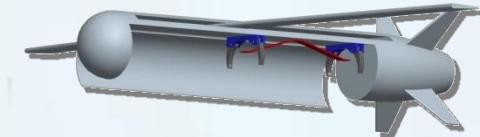
SAR imagery



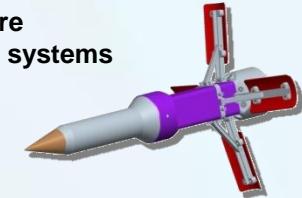
SAR imagery



Missile defense



Ground sensors  
for future  
combat systems



## International, Homeland, and Nuclear Security



Critical Asset Protection

Global Security



Homeland Security

Homeland Defense &  
Force Protection



## Energy, Climate, and Infrastructure Security

Infrastructure

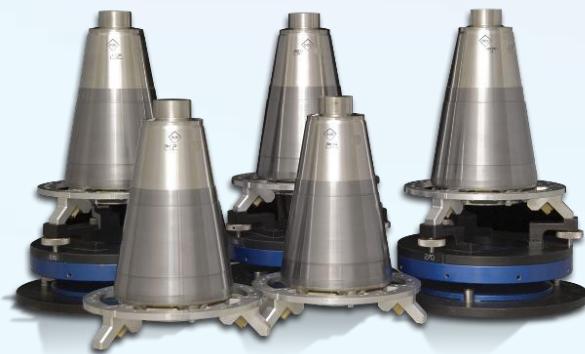


Nonproliferation

Energy  
supply

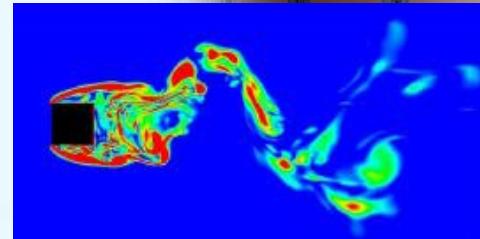


# Sandia's Nuclear Weapons Program

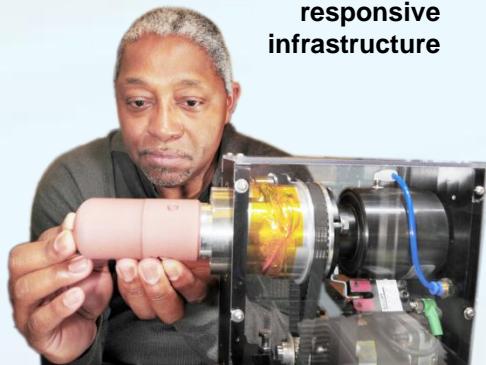


Weapon system  
and component  
engineering

Stockpile  
and complex  
transformation

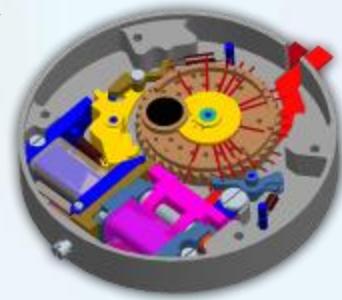


Modeling and simulation

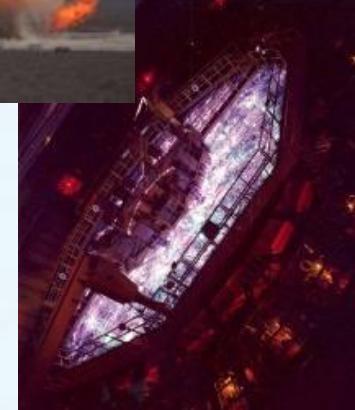


Production and  
responsive  
infrastructure

Enhancing the safety  
of the stockpile



Testing and  
evaluation



Annual Stockpile Assessment



# Emerging National Security Thrusts



Nuclear



Energy



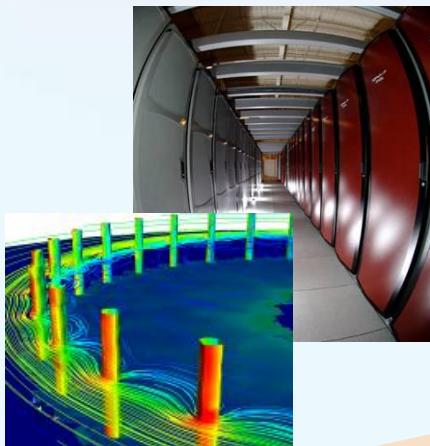
Cyber



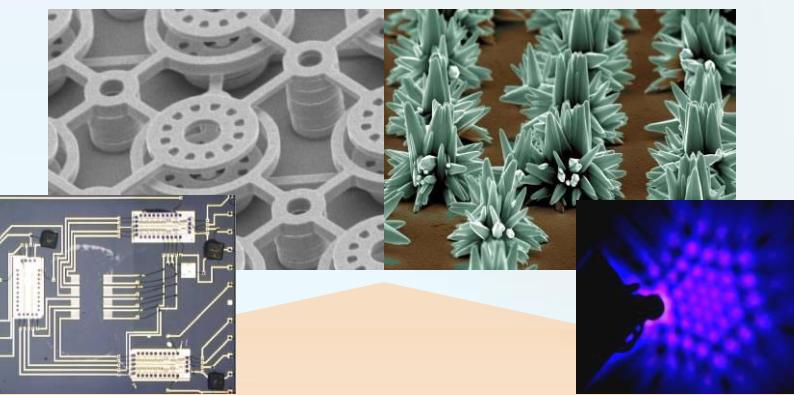
Science & Technology



# Research Disciplines Drive Capabilities



High Performance Computing



Nanotechnologies & Microsystems



Extreme Environments



Computer Science

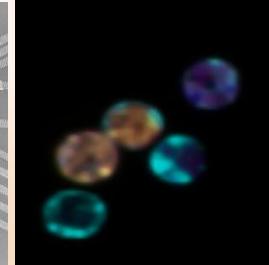
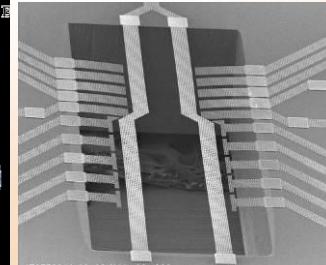
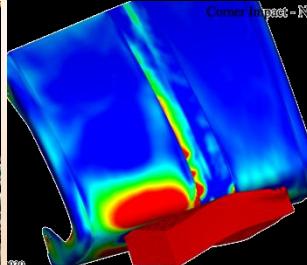
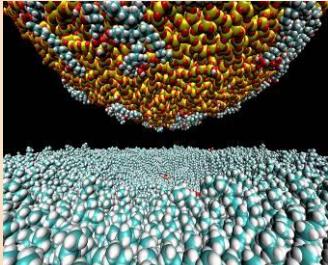
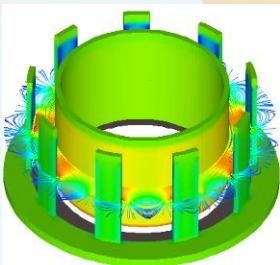
Materials

Engineering Sciences

Micro Electronics

Bioscience

Pulsed Power

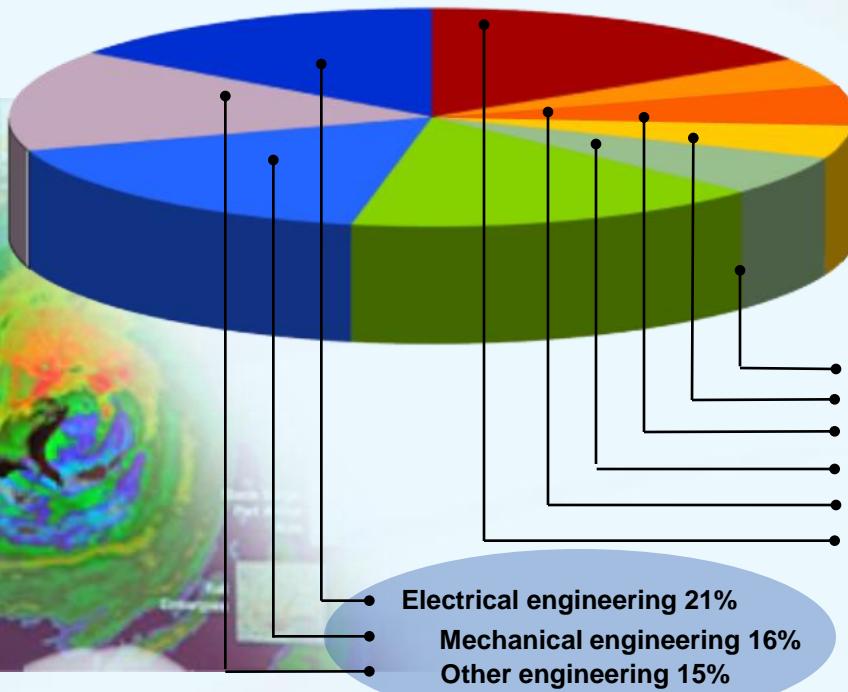


Research Disciplines

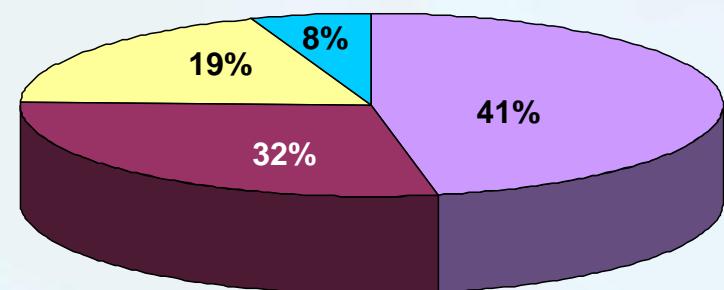
# People and Budget (According to 2009 Annual Report )

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

Technical staff (3,850) by discipline:



FY10 operating revenue  
\$2.4 billion



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





# Partnerships and collaboration accelerate innovation



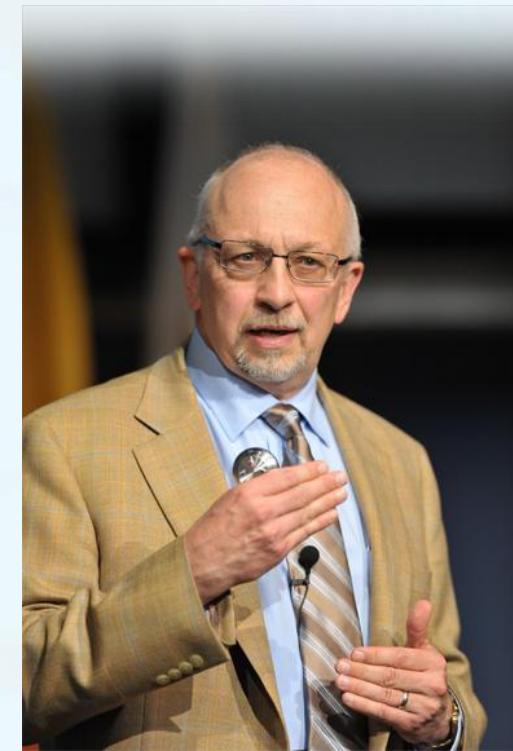
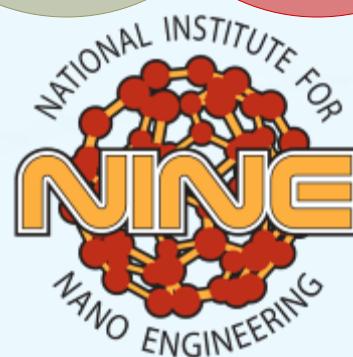
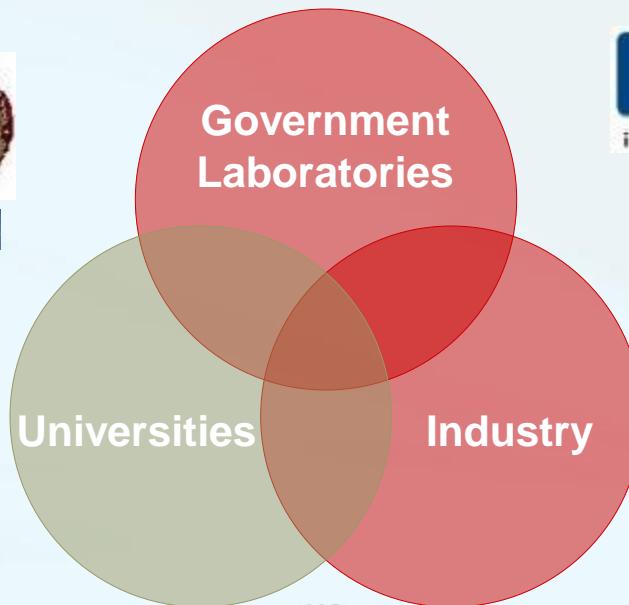
[The University of Texas](#)



The University of New Mexico



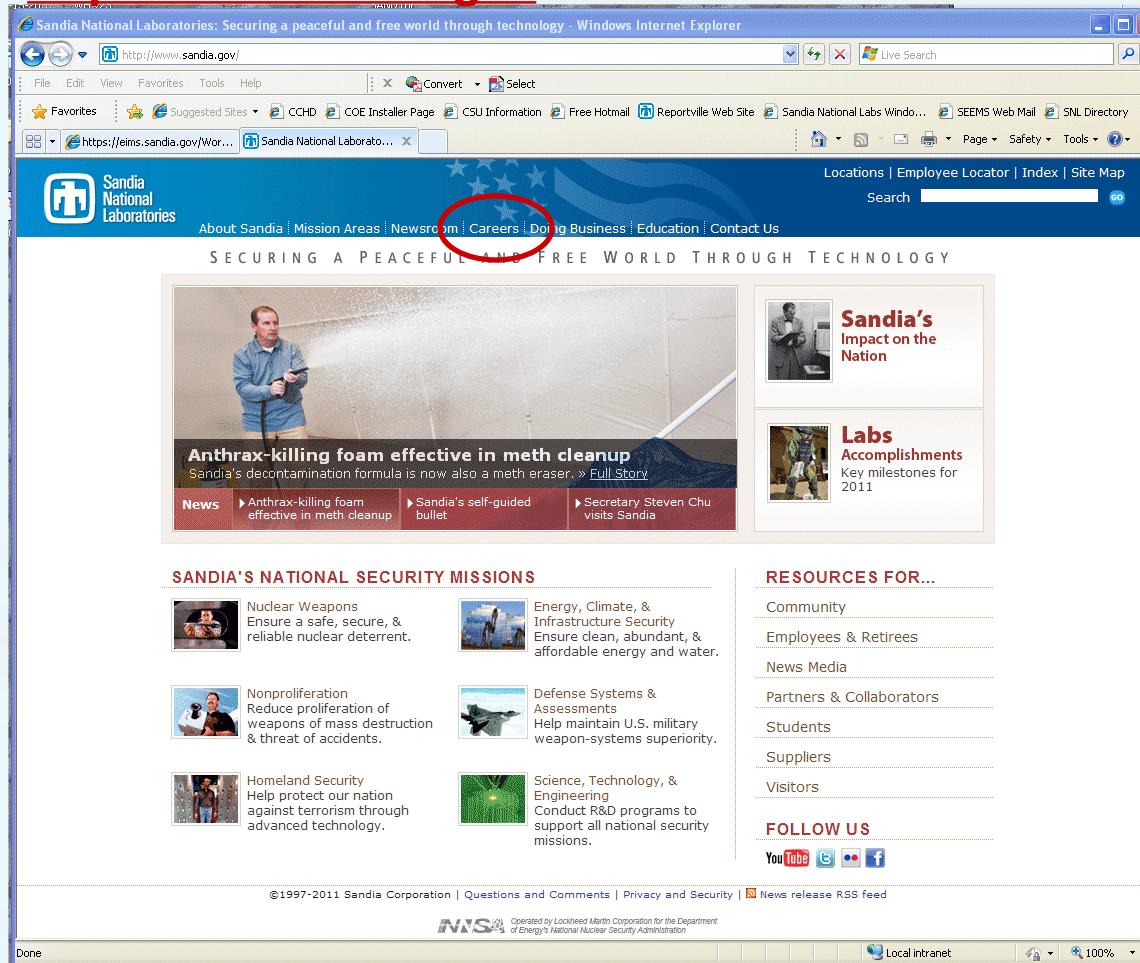
UNIVERSITY OF  
NOTRE DAME





# Careers at Sandia

■ <http://www.sandia.gov>



Sandia National Laboratories: Securing a peaceful and free world through technology - Windows Internet Explorer

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SECURING A PEACEFUL AND FREE WORLD THROUGH TECHNOLOGY

**Anthrax-killing foam effective in meth cleanup**  
Sandia's decontamination formula is now also a meth eraser. > Full Story

**News** ▶ Anthrax-killing foam effective in meth cleanup ▶ Sandia's self-guided bullet ▶ Secretary Steven Chu visits Sandia

**Sandia's Impact on the Nation**

**Labs Accomplishments**  
Key milestones for 2011

**SANDIA'S NATIONAL SECURITY MISSIONS**

**Nuclear Weapons**  
Ensure a safe, secure, & reliable nuclear deterrent.

**Nonproliferation**  
Reduce proliferation of weapons of mass destruction & threat of accidents.

**Homeland Security**  
Help protect our nation against terrorism through advanced technology.

**Energy, Climate, & Infrastructure Security**  
Ensure clean, abundant, & affordable energy and water.

**Defense Systems & Assessments**  
Help maintain U.S. military weapon-systems superiority.

**Science, Technology, & Engineering**  
Conduct R&D programs to support all national security missions.

**RESOURCES FOR...**

Community

Employees & Retirees

News Media

Partners & Collaborators

Students

Suppliers

Visitors

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Local intranet

100%



# Student Internships and Co-ops

- Year-round and summer
- Must be a U.S. citizen with full-time enrollment status
- Minimum cumulative GPA of 3.2/4.0 for undergraduates or 3.5/4.0 for graduate students
- STEM and business disciplines
- Apply online at Sandia's website: [www.sandia.gov](http://www.sandia.gov)

# Fellowship Programs

**National Physical  
Sciences Consortium**  
9

**Master's Fellowship  
Program**  
22

**Truman  
Fellowship**  
6

**GEM**  
5

**Doctoral Studies  
Program**  
19

**Special Master's  
Program**  
7

**Laboratory Directed  
Research & Development**  
30





University of Michigan to Sandia

**MY PATH**



# Education and Work

- **University of Michigan**
  - BS, Mechanical Engineering, 1991
  - MS, Mechanical Engineering, 1992
  - Ph.D., Environmental Engineering, 1999
- **New Mexico Institute of Mining and Technology**
  - Post-doctoral research assistant, 1999-2001
- **Sandia National Laboratories, Albuquerque, NM**
  - Technical staff, 2001-present



**Sandia National Laboratories**

# My role at Sandia

## ■ Principal Member of Technical Staff

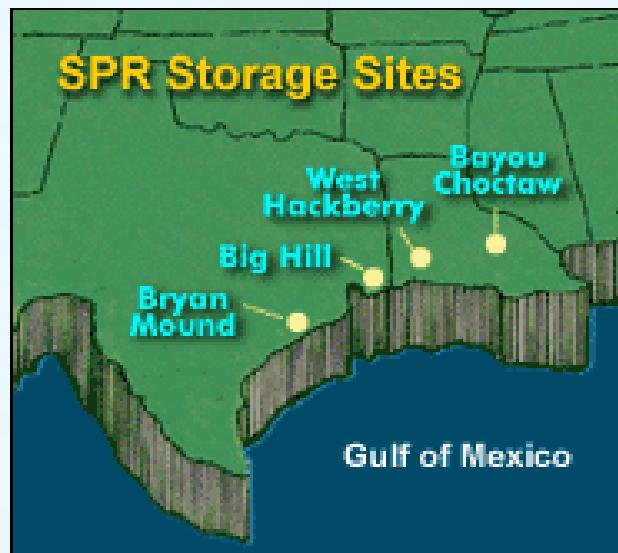
- Direct work of junior Ph.D., MS, BS-level technical staff and contractors
- Perform original engineering analyses
- Interact regularly with external project partners and Department of Energy customers

## ■ Projects

- Nuclear waste management
  - Waste Isolation Pilot Plant (WIPP)
- Crude oil storage in underground salt caverns
  - U.S. Strategic Petroleum Reserve (SPR)

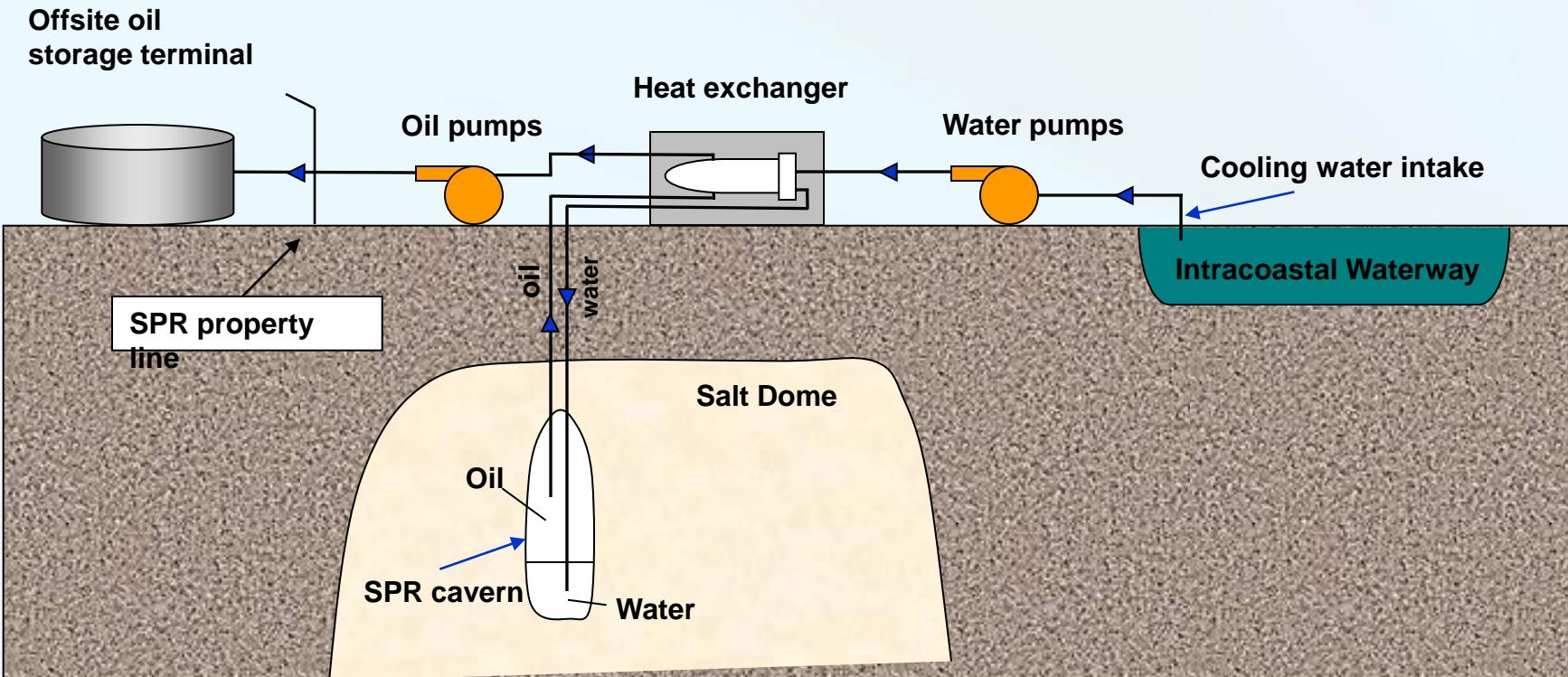
# US Strategic Petroleum Reserve (SPR)

- Strategic stockpile of crude oil stored in underground salt caverns on Gulf Coast
  - Owned and operated by US DOE
- Started in the 1970's under the Ford administration
- Designed to protect against supply interruptions



# Design Concept

- Oil is stored in solution-mined salt cavern
- Oil is displaced with water when needed
- Inexpensive to build (\$/bbl storage) and very secure



# Sandia Role on SPR

- **Sandia is R&D advisor to SPR project**
  - 1.5% SPR annual operating budget goes to Sandia
  - About 9 FTEs in Albuquerque, NM
- **Sandia applies expertise in geology, geomechanics, chemical engineering, and fluid dynamics**
  - Develop field monitoring and laboratory experimental programs
  - Develop models of storage site geology and structural features, dissolution mining to build storage caverns, oil phase behavior, and fluid dynamics



## Artesia, NM Brine Well Collapse



**Implications of inadequate cavern integrity:  
well collapse!**

Artesia brine well collapse, morning, July 20, 2008 at 10:44 am.  
Photo courtesy of National Cave and Karst Research Institute

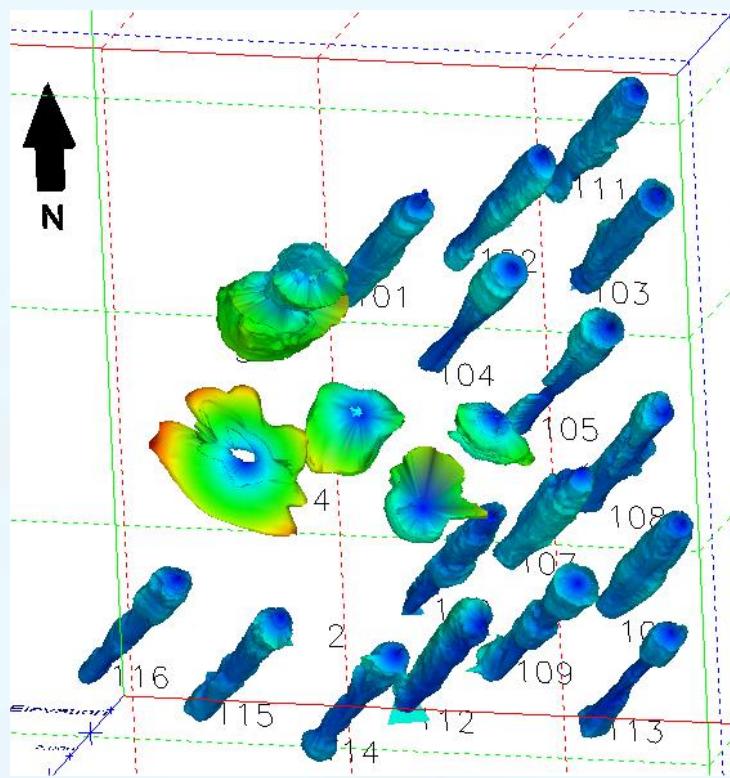
# Mechanical Integrity

- **Assure containment of process fluids**
  - Brine, oil
- **Assure safety of operations**
  - Surface subsidence
  - Pressure controls
- **Apply geomechanical models to evaluate the stress-strain-failure relationships in geologic storage systems**
  - Site planning and maintenance

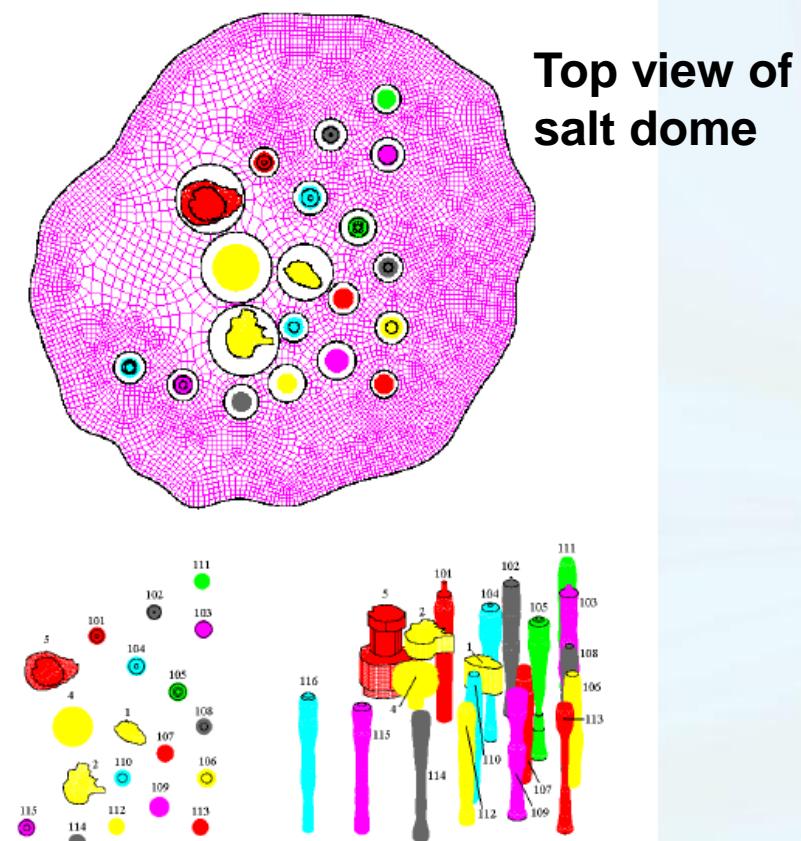


# Geomechanical Model Applications

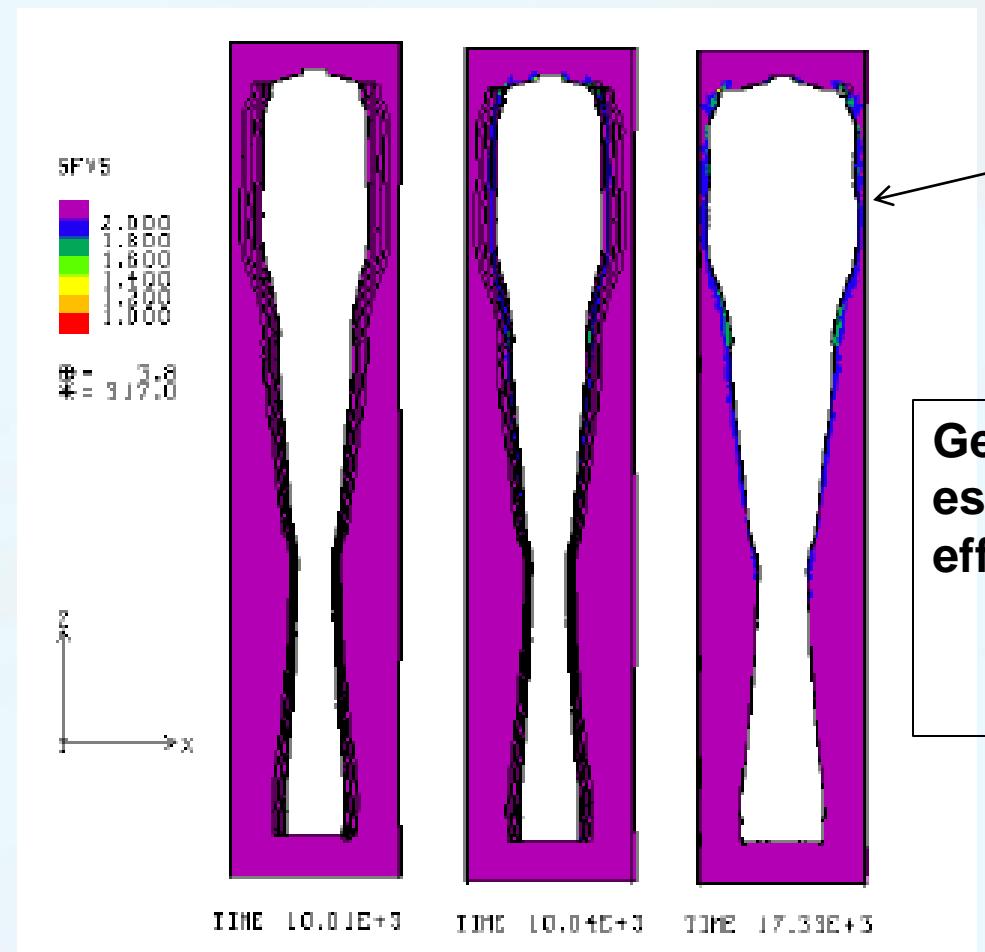
## Visualization of Bryan Mound SPR cavern field from geologic data



## Interpretation for geomechanical modeling



# Geomechanical Model Results



Identifying regions of likely damage during theoretical operations scenario.

Geomechanical analyses help establish guidelines for safe and effective cavern operations.

# Job Search Keys

- **Engage your faculty advisor**
- **Keep in touch with recent graduates in the work force**
- **Look into co-ops and internships**
  - Effective trial period for both parties
  - Often lead to permanent jobs
- **Use ECRC resources**
- **Most applicable to Ph.D.'s**
  - Present your work at professional conferences and market yourself while you are there
  - Contact people in your field about post-docs because many are not advertised

# Post doc job search: What really worked

- **Sent unsolicited e-mails to the top 10 researchers I wanted to work for**
  - Sources for contacts
    - Dissertation bibliography
    - Conference proceedings
  - Polite e-mail saying that I am graduating soon, interested in their work, CV attached with publications list
- **8 responses, 5 interviews, 3 job offers in 2 months**
  - All post-doc positions

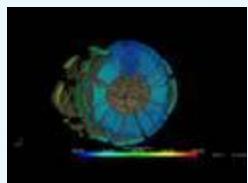


# Stay Connected...



[www.youtube.com/user/SandiaLabs](http://www.youtube.com/user/SandiaLabs)

## Top viewed videos:



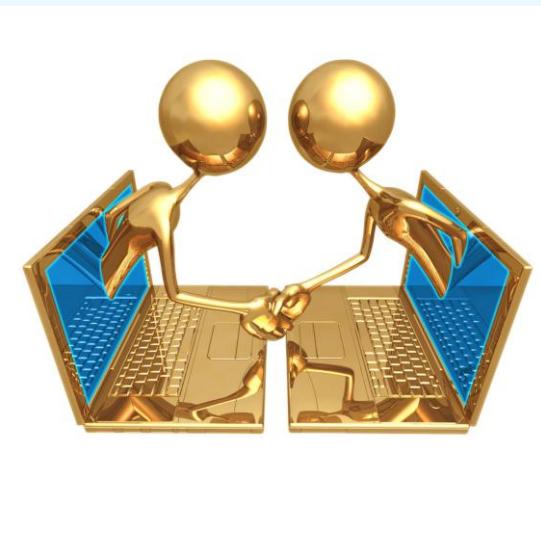
Apophis destruction simulation Z Machine at Sandia Labs  
140,800+ views



Z Machine at Sandia Labs  
64,200+ views



Rocket Powered Train Impact Test  
59,000+ views



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