

# Sandia National Laboratories Program Overview

*Presentation for  
Japan Atomic Energy Agency  
March 26, 2008*

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Erik Webb<sup>3</sup>

<sup>1</sup>Energy, Resources, & System Analysis / Geohydrology

<sup>2</sup>Nuclear Energy & Global Security Technologies / Performance Assessment Integration

<sup>3</sup>Institutional Relationships



# *Topics for Discussion*

**Sandia National Laboratories Overview**

**Nuclear Energy**

**Global Nuclear Energy Partnership**

**Waste Isolation Pilot Plant**

**Yucca Mountain**

**Related Projects**

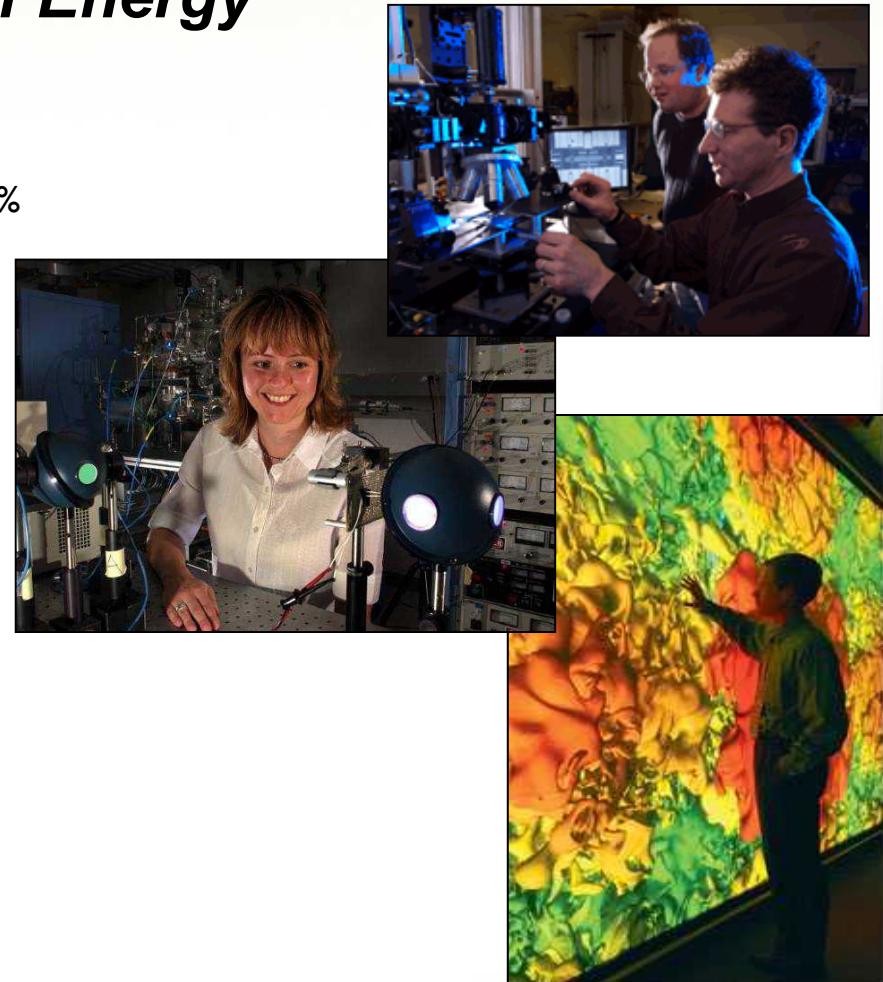
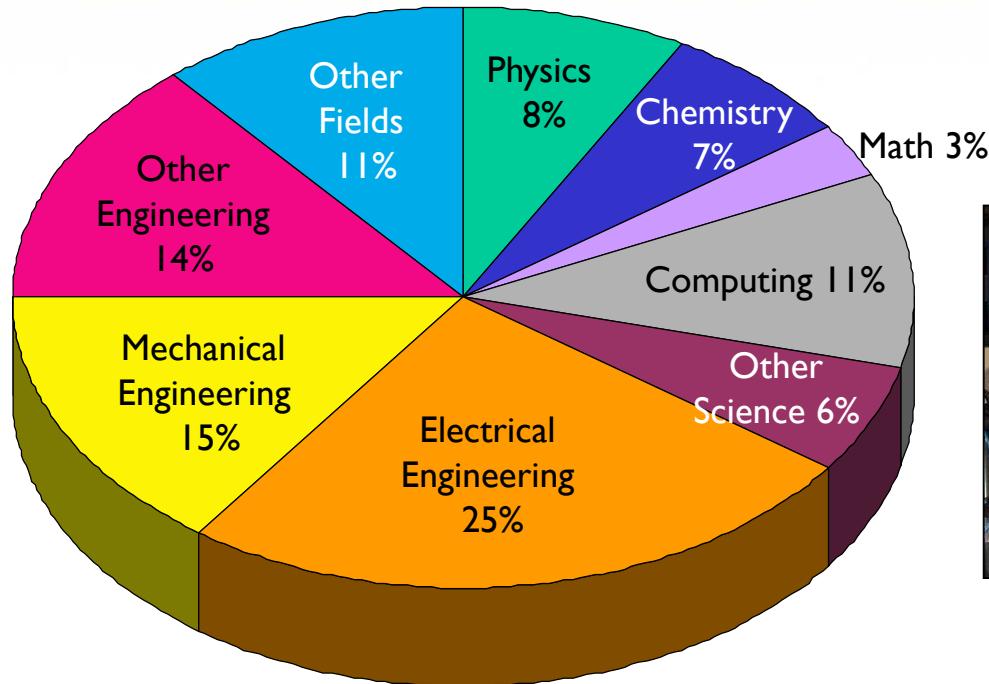


**Sandia  
National  
Laboratories**



***Sandia is a multidisciplinary science and engineering lab dedicated to national and global security***

***US Department of Energy***

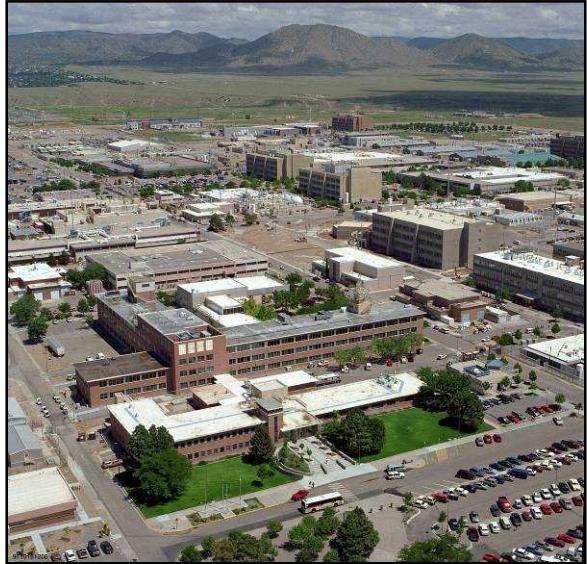


- Over 8,500 full-time employees
- Over 1,500 PhDs
- Over 2,500 MS/M





# Sandia National Laboratories is geographically distributed



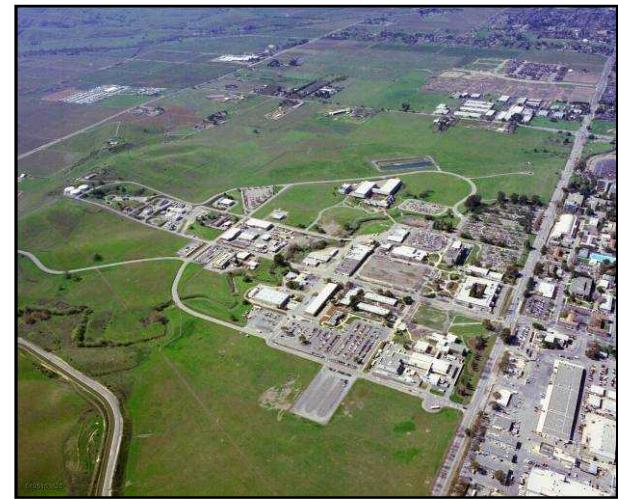
Albuquerque,  
New Mexico



Tonopah Test Range,  
Nevada



Kauai Test Facility  
Hawaii



Livermore, California



Nevada



WIPP, New Mexico



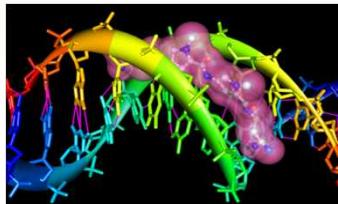
Pantex, Texas





# ***Our work is supported by our science, technology, and engineering capabilities***

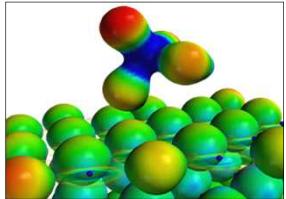
→ ***Sandia Science and Technology Councils***



*Bio Science & Technology*



*Engineering Sciences*



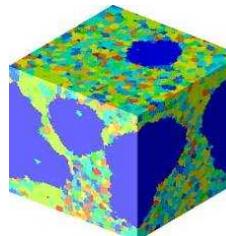
*Chemical & Earth Sciences*



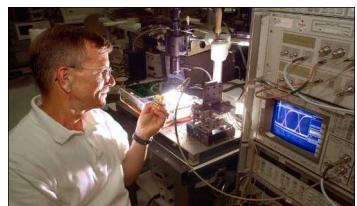
*Manufacturing Sciences*



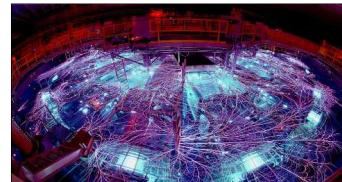
*Computer & Information Science*



*Materials Sciences*



*Electronics*

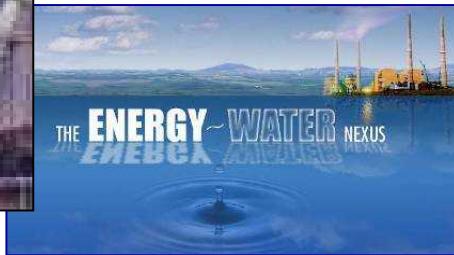


*Pulsed Power Science*



# *Energy, Resources, and Nonproliferation Strategic Management Unit*

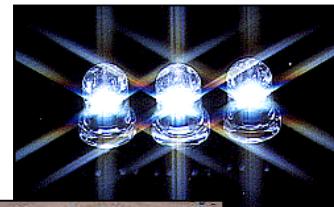
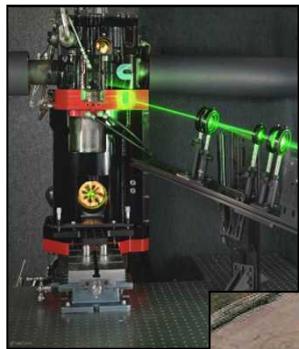
## **Fuel and Water Systems**



## **Nuclear Energy**



*Science Underpins and Enables  
Technology for the Energy, Resource  
and Global Security Missions*



## **Science and Technology**

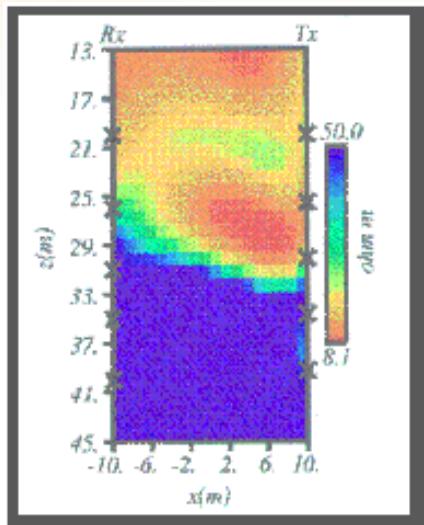


## **Global Security**

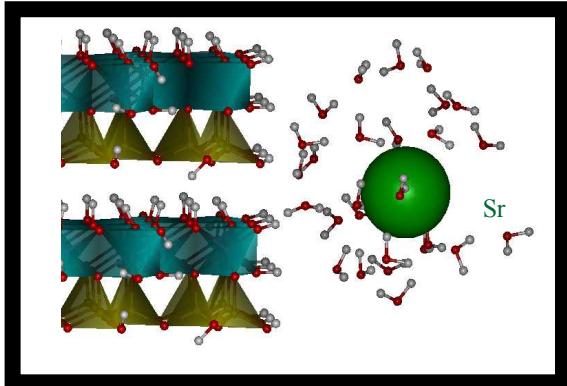


# Mission-Driven Geoscience

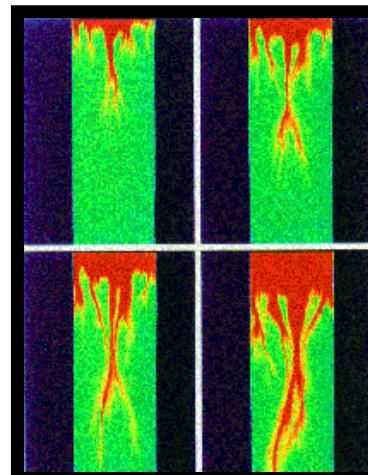
Geoscientists in our Center are advancing the fundamental state of knowledge in their fields, are leaders in the broad technical community, and are enabling a breadth of Sandia programmatic goals.



Geophysics



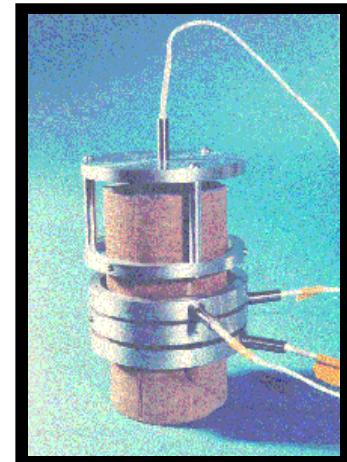
Geochemistry



Geohydrology



Geotechnology



Geomechanics



# Nuclear Applications

We bring a broad suite of Geoscience capabilities to nuclear weapons and non-nuclear military applications.

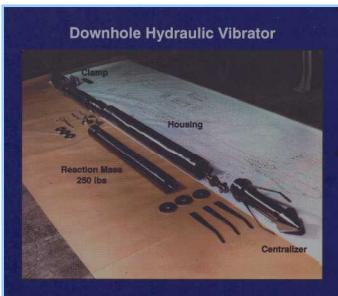
## *Earth Materials Characterization*

- Geomechanical testing
- Geological characterization
- Geochemical remote sensing
- Water purification
- Geophysical methods



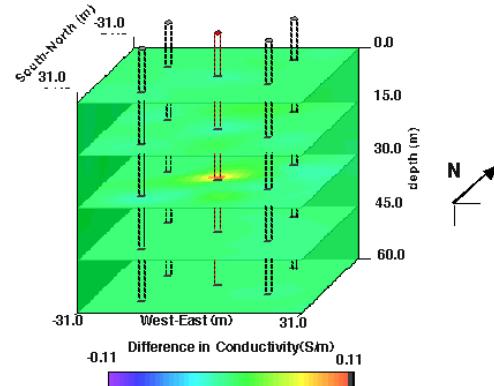
## *Instrumentation*

- Borehole energy sources and receivers
- Downhole communications

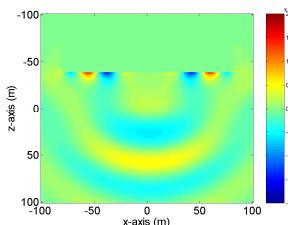


## *Numerical Modeling*

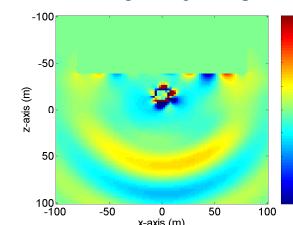
- 3D geophysical wave propagation (seismic, electromagnetic)
- Discrete element modeling of blasting
- Subsurface flow and contaminant transport
- Dynamic structural interactions
- Molecular scale modeling of geomaterials



### No Tunnel

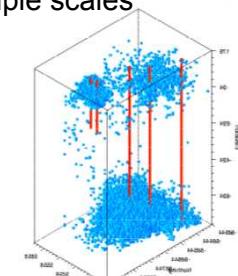
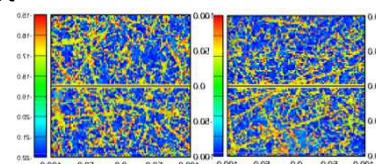


### With Tunnel



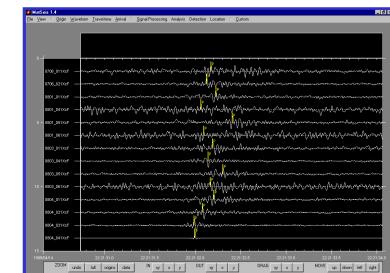
## *Geostatistics*

- Uncertainty propagation
- Estimating spatially varying properties at multiple scales



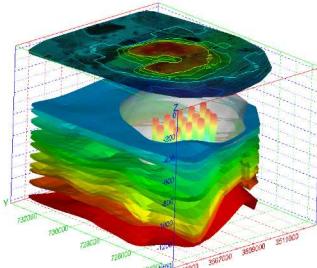
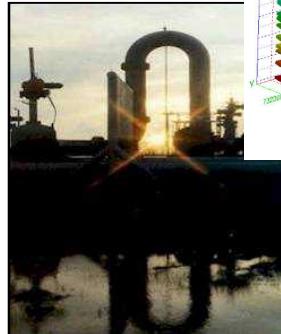
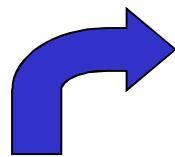
## *Data Analysis and Visualization*

- 3D geologic visualization
- Computational systems for geophysical data analysis (MatSeis)



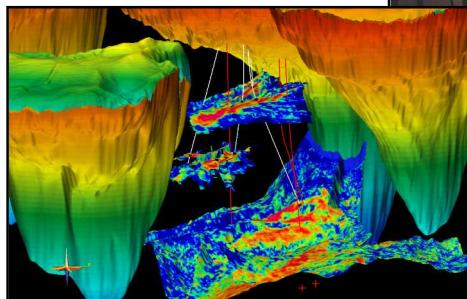
# Energy

We solve subsurface technical challenges to ensure secure, sustainable and environmentally sound energy supplies, efficient and safe energy storage, and effective carbon management.



## Energy Exploration & Generation

- Nuclear
- Fossil
- Renewable



## Waste Management

- Geologic Repositories
- Spent Fuel Transportation
- Environmental Restoration
- Carbon Sequestration



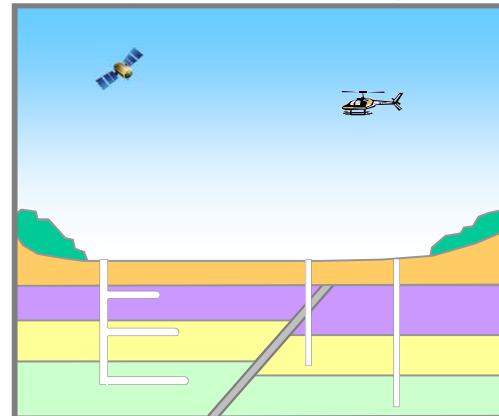
# Repositories & Transportation

We solve key technical issues to enable safe and secure management of hazardous, radioactive, and mixed waste materials

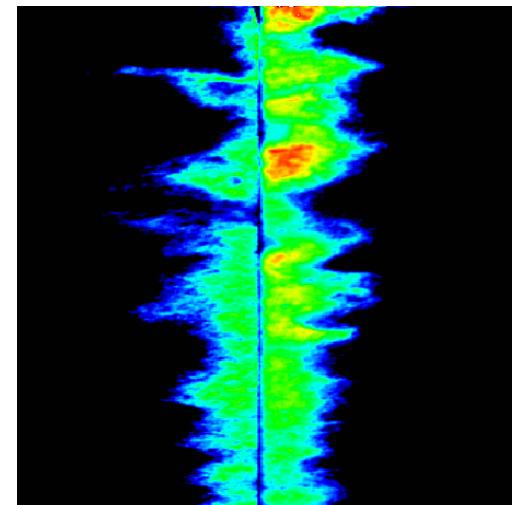
## *Performance Assessment*

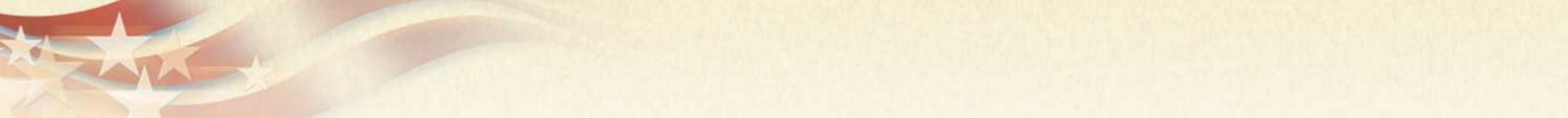


## *Site Characterization and Decision Analysis*



## *Flow and Transport in Fractured Rock*





# Global Nuclear Energy Partnership



**GNEP**  
Ministerial  
Meetings

**“aims to safely and securely expand nuclear power worldwide while responsibly managing nuclear waste and reducing proliferation risks”**

**Established September 16, 2007**

- **16 Original members**
  - USA, Japan, France, China, Russia, Australia, Bulgaria, Ghana, Hungary, Jordan, Kazakhstan, Lithuania, Poland, Romania, Slovenia, Ukraine
- **5 Additional members (as of February 26, 2008)**
  - Italy, Canada, Korea, Senegal, United Kingdom





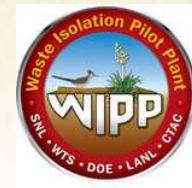
# Sandia's GNEP Involvement

## Planning and Assessment ~\$3.73 mil FY08

- **Fuels**
  - Transient fuel simulation
- **Separations**
  - Monitoring equipment design
  - Regulatory and safety
- **Waste Forms**
  - Geologic repository concept analysis
  - Readiness level assessment
  - Evaluation of testing protocols
  - Salt repository scoping study
  - Long-term waste form S&T
  - Waste form modeling and technology
  - Iodine waste form development
- **Safeguards**
  - Data validation and security
  - Safeguards performance model
- **Reactor**
  - Component testing requirements
  - Severe accident approach
  - Fast reactor
    - Regulatory framework
    - Technology assessment
  - Material, storage, transportation & disposal
- **Systems Analysis**
  - Analysis and integration
  - Economic analysis

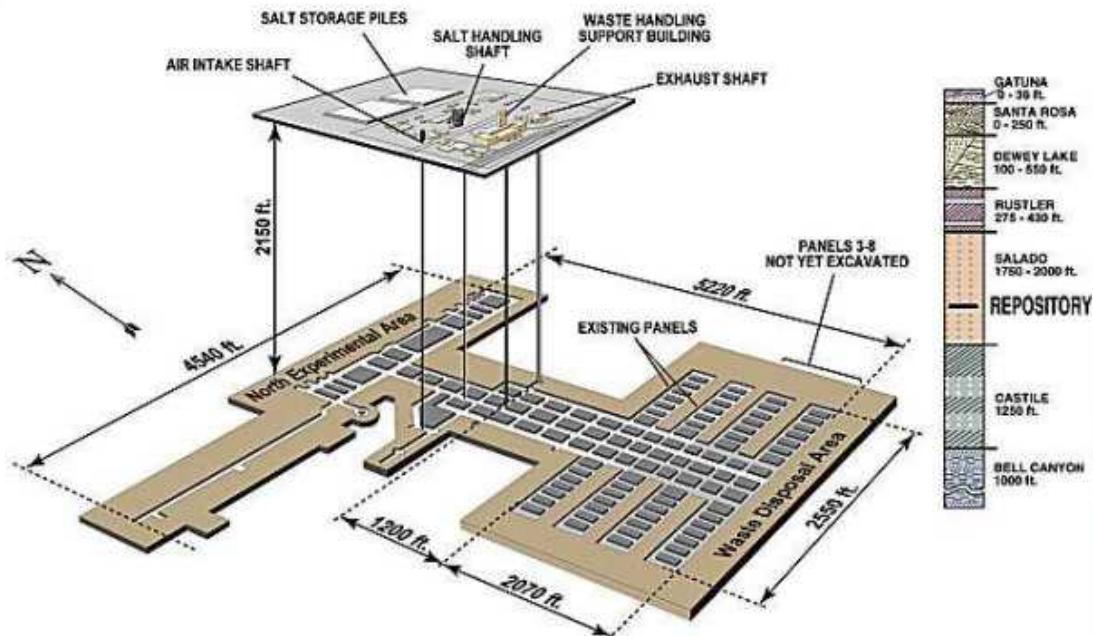


# Waste Isolation Pilot Plant



- Received first shipment of CH-TRU waste on March 26, 1999
- RH-TRU waste was approved October 2006
- As of March 17, 2008, WIPP had received its 100<sup>th</sup> RH shipment, and over 6500 CH shipments (most from Rocky Flats and INL)
- Relicensing in 2009

## WIPP Facility and Stratigraphic Sequence

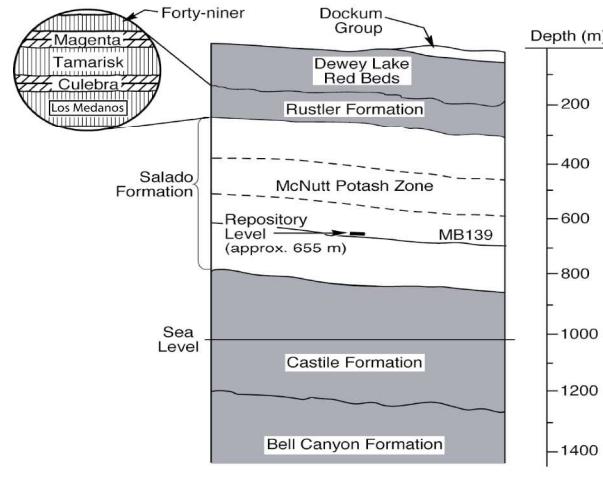


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# Waste Isolation Pilot Plant



- **Sandia is the chief scientific advisor for WIPP to the DOE**
  - Performance, compliance, and impact assessment, sensitivity analysis, scientific investigations and monitoring data analyses, computer modeling, technical review and expert elicitation
- **Key issues for relicense application**
  - Updating all geologic, geophysical, geochemical, hydrologic, and meteorological information
    - Culebra and Magenta aquifers
    - Regional groundwater flow
  - Adding additional monitoring data, analyses and results
  - Identification and justification for activities or assumptions that deviate from the last application
  - Update inventory of waste



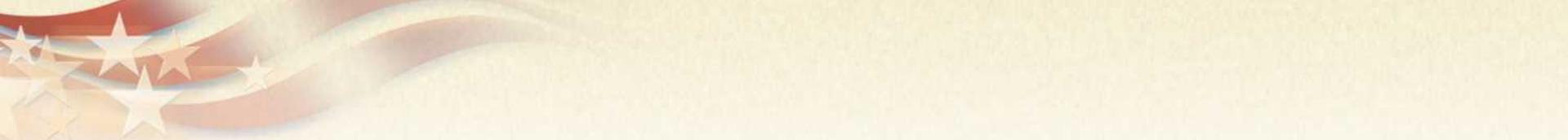
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# Yucca Mountain



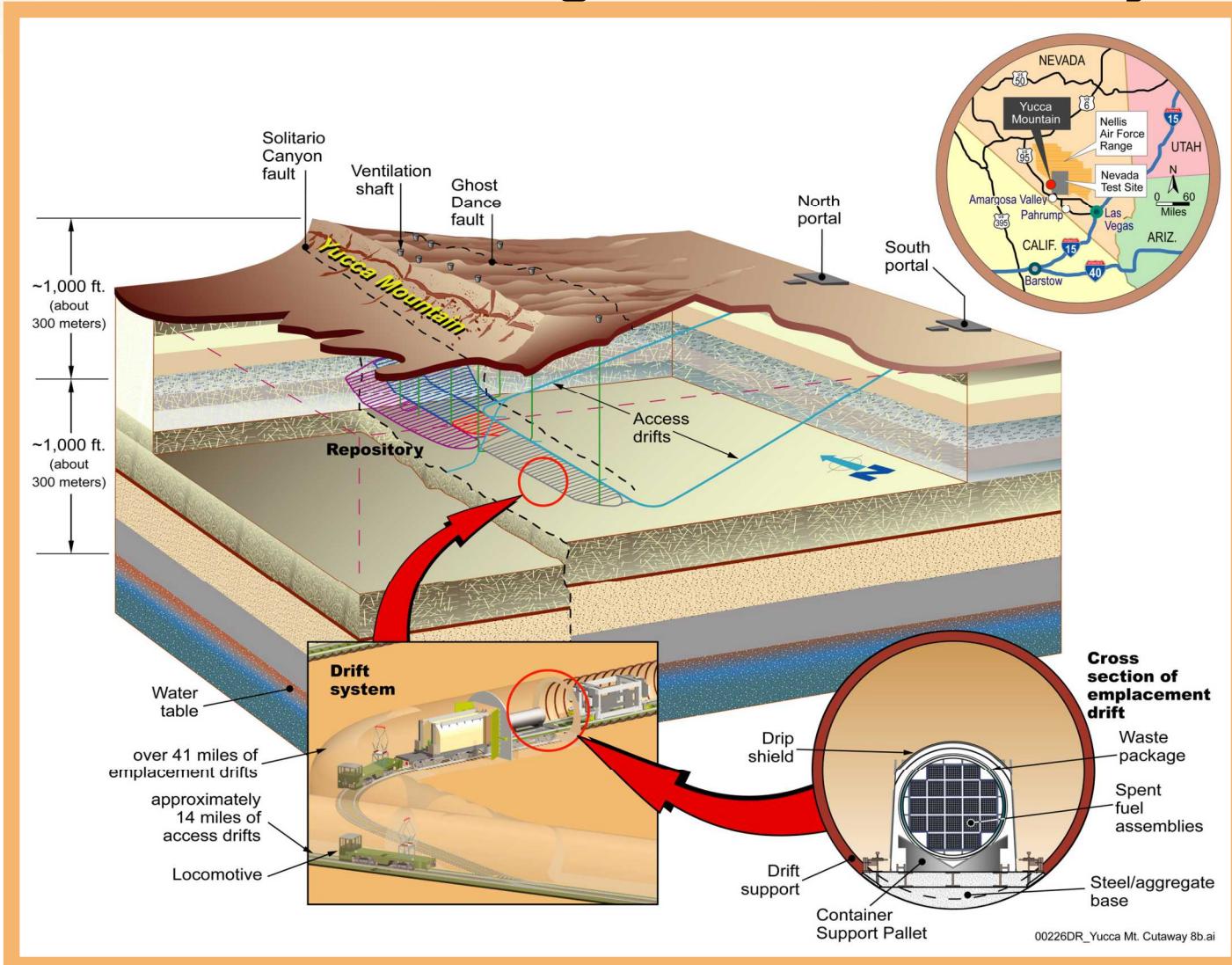


# **Sandia National Laboratories is the OCRWM Lead Laboratory for Repository Systems**

- **Provide Office of Civilian Radioactive Waste Management with strong centralized leadership for its science program**
- **Provide management and integration for all Yucca Mountain scientific programs – includes budget allocation**
- **Increase technical credibility with the scientific community, as well as the project's regulators and stakeholders**
- **Support Office of Civilian Radioactive Waste Management 's license application and its defense in the Nuclear Regulatory Commission's review process**
  - Ensure that the technical and scientific basis for the Yucca Mountain repository is “without question”
  - Define scientific program to support License Application
  - Develop and defend Total System Performance Assessment and underlying technical bases



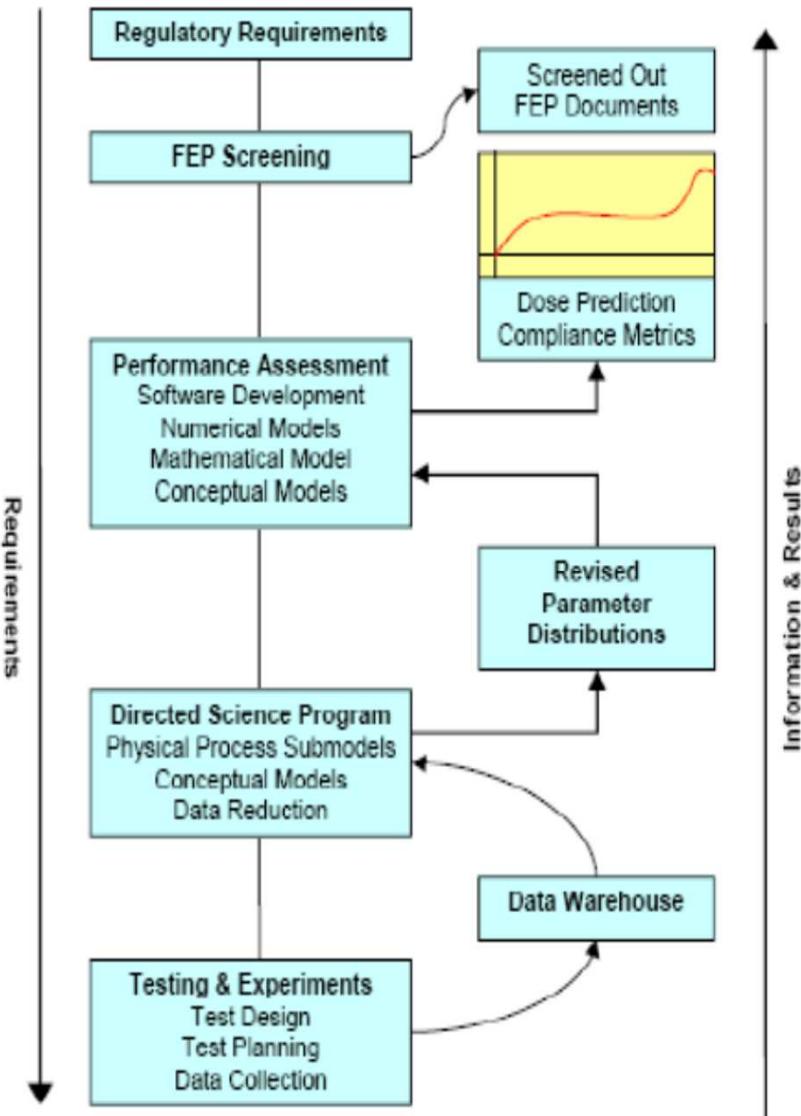
# The Natural and Engineered Barrier System



# Lead Lab Mission Scope (PA Methodology)

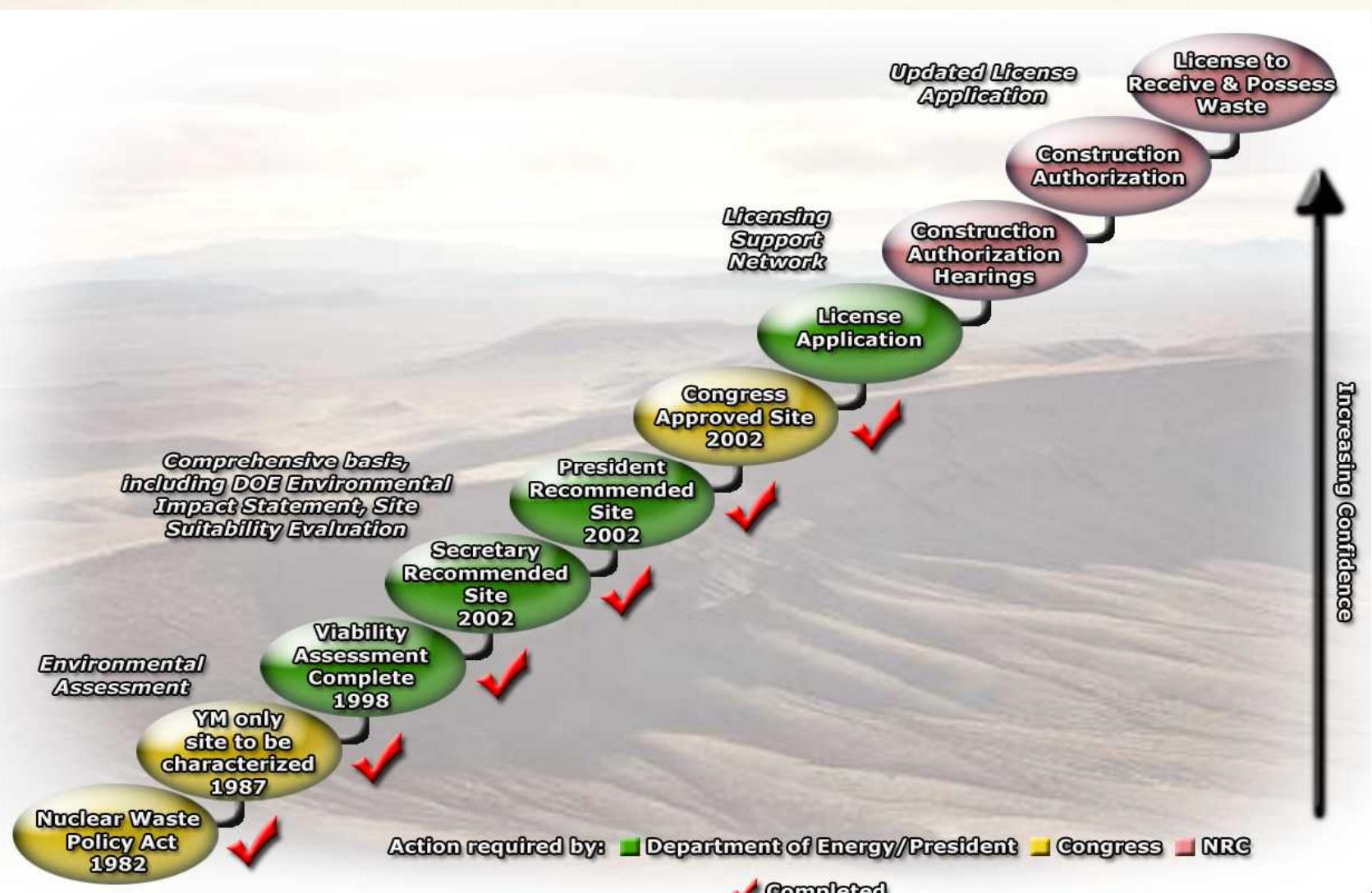
**SNL is responsible for the preparation and defense of all postclosure-related science**

- **Field and lab testing, data generation and data management**
- **Model and software development and configuration management**
- **Analyses and model reports (~120 reports, 10K+ pages)**
- **Performance Assessment (TSPA) compliance calculations**
- **LA Safety Analysis Report sections**
- **License defense**
- **Performance Confirmation**
- **Management and integration of all participants**
  - **Training, planning, resource and workforce management, business operations, QA**



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# Repository Program Steps



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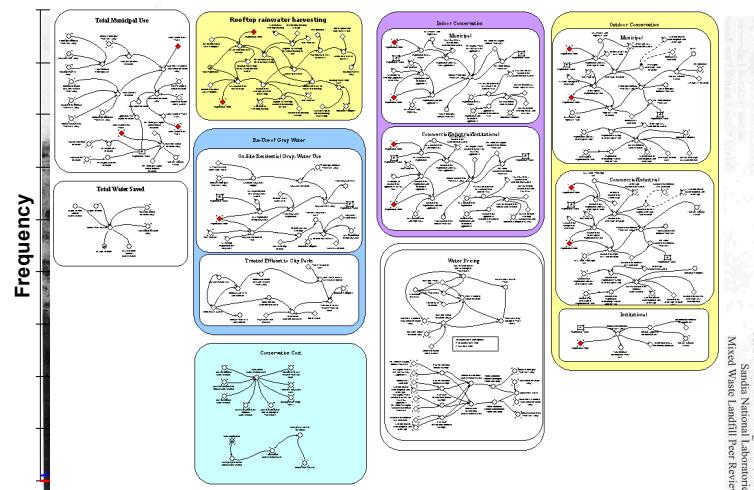
# Yucca Mountain Milestones

- **Draft Supplemental EIS (October 2007)**
  - **(October 12, 2007)**
- **License Application Design complete (November 2007)**
  - **(November 30, 2007)**
- **Licensing Support Network Certification (December 2007)**
  - **(October 19, 2007)**
- **Complete draft License Application (LA) (February 2008)**
  - **(expected April 16, 2008)**
- **Final Supplemental EIS (May 2008)**
- **Submit LA to NRC (June 2008)**
- **Begin Nevada rail construction (October 2009)**
- **NRC authorizes construction (September 2011)**
- **Repository construction continues in stages (September 2011 to early 2022)**
- **Submit updated LA to receive and possess waste (March 2013)**
- **Begin operations (Spring 2017)**



## Related Work

- **Performance assessment technology transfer to the Taiwan Institute of Nuclear Energy Research**
- **Physical protection for the transportation of fissile material (JAEA / Sandia)**
- **Risk-based probabilistic performance assessment of long-term cover systems for waste isolation**
- **Maximum likelihood theory for site characterization**
- **Null-Space Monte Carlo risk assessment**
- **Integrated systems analysis**



reducing model predictive error, *vvater Kesour. Kes.* 41, W05020, doi:10.1029/2004WR003501



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