



## Yucca Mountain Project

### Description

The Yucca Mountain Site in southern Nevada is currently being studied to determine whether it is suitable for the permanent disposal of spent nuclear fuel and higher-level radioactive waste. In 1982, the United States Congress directed the Department of Energy (DOE) to find and characterize a site. If the DOE's characterization studies find the site to be suitable, the Nuclear Regulatory Commission will be responsible for reviewing the license application and making the final decision before the site can be operational.

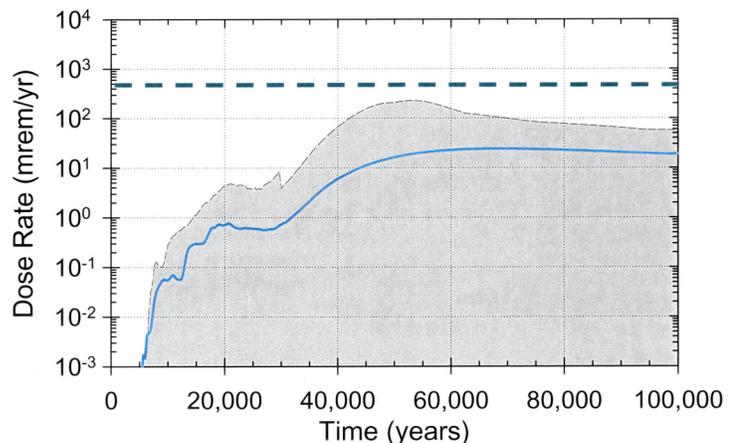
Deep geologic storage was chosen as the concept for waste disposal at Yucca Mountain. This concept exploits the existence of multiple natural and engineered barriers for the containment of waste. Therefore, there are many interacting components that need to be studied including 1) unsaturated and saturated flow and transport, 2) engineered barrier systems [including waste packages and drip shields], 3) the biosphere, and 4) disruptive events [including volcanic and seismic events and human intrusion]. Models representing these components and their associated uncertainties are integrated into total system performance assessment calculations to determine whether the site is suitable for nuclear waste storage.

### Sandia Contributions

Sandia National Laboratories has been a key participant in the Yucca Mountain Project since its inception. Sandia's expertise that has contributed to the Yucca Mountain Project includes performance assessment, numerical modeling, field and laboratory testing, transparency, and quality assurance.

### Performance Assessment

Sandia has established itself as a leader in performance assessment for evaluating nuclear waste repositories. From the beginning of the Yucca Mountain Project, Sandia has conducted or led the critical performance assessment analyses.

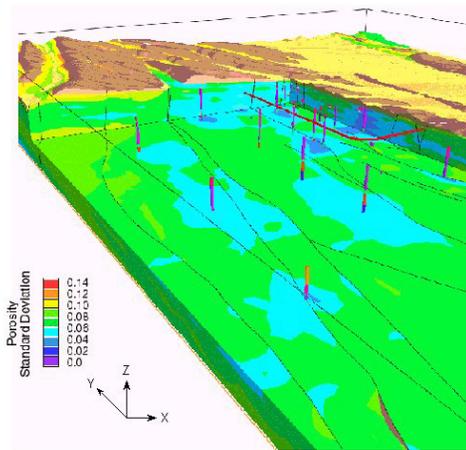


*Hypothetical Example of Total System Performance Assessment Results of Expected 100,000-Year Dose-Rate (Solid Line) with Associated Uncertainty (Gray Area)*



Key capabilities within Sandia essential to performance assessment include:

- Features, Events, and Processes (FEP) screening
- Scenario and conceptual model development
- Process-level modeling
- Integration of site characterization, process-level modeling, and performance assessment modeling activities
- Abstraction methods
- Treatment of uncertainty
- Probabilistic, Monte Carlo simulations
- Analysis and documentation of simulation results



*Uncertainty in the Spatial Prediction of Porosity in the Subsurface of Yucca Mountain with Boreholes Shown as Vertical Lines*

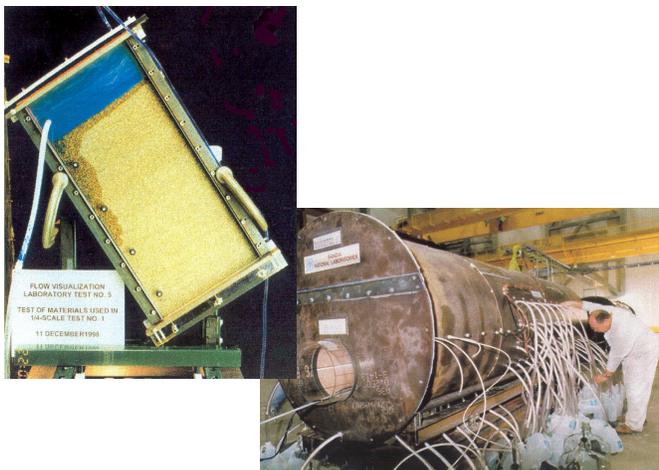
### ***Numerical Modeling***

Numerical modeling at many different scales is an important aspect of the Yucca Mountain Project. Sandia has participated in the modeling of:

- Geostatistical distributions of spatially heterogeneous material properties
- Saturated and unsaturated flow and transport
- Coupled thermal, mechanical, hydraulic, and chemical processes

Modeling has been conducted in support of process-level and performance assessment studies. Modeling has also been conducted in support of laboratory and field testing.

### ***Field and Laboratory Testing***



*Laboratory experiments at the Flow Visualization and Processes Laboratory (left) and Atlas Facility (right)*

Sandia has conducted both field and laboratory tests in support of site characterization and performance assessment of Yucca Mountain. Laboratory tests have been conducted in Sandia's Flow Visualization and Processes Laboratory for the purpose of understanding capillary barriers over canisters as engineered barriers and imbibition into unsaturated tuff. In addition, Sandia has measured thermal capacitance, thermal conductivity, and mechanical strength of the volcanic tuffs. Field tests have included single heater and drift scale thermal tests at the underground Exploratory Studies Facility and tracer tests to study percolation through fractured tuff.

## *Transparency*

Transparency is a key component for characterizing, assessing, licensing, and operating a nuclear waste repository. For a nuclear waste repository program to be transparent, each component of the program must be clear to the regulator, oversight bodies, the general scientific community, and stakeholders. Therefore, interactions with and making information available to these parties is an important component of the Yucca Mountain Project. Sandia has played a key role in interactions with the Nuclear Regulatory Commission and the Nuclear Waste Technical Review Board (the independent, federal oversight group). In addition, Sandia has developed transparency technologies to facilitate the transfer of information. For example, the iMonitor Project, an Internet based remote data acquisition and monitoring system, was created by Sandia and the University of Nevada/Las Vegas to increase transparency and public acceptance of the underground high-level nuclear waste repository projects. The URL for the iMonitor Project is <http://hydrofrac.com/imonitor/>.



*Home Page of the iMonitor Project*

## *Quality Assurance*

Sandia developed and implemented a Quality Assurance program for Yucca Mountain during the earlier stages of the project. Sandia also has instituted data and records management systems that have proven themselves in demonstrating information traceability and retrievability.

## **Contacts**

S. Andrew Orrell  
Yucca Mountain Project Management  
Sandia National Laboratories  
P.O. Box 5800, MS 1399  
Albuquerque, NM 87185-1399  
Phone: (702) 295-5600  
Fax: (702) 295-5672  
Email: [sorrell@sandia.gov](mailto:sorrell@sandia.gov)