



U.S. Department of Energy  
Office of Civilian Radioactive Waste Management



# Making the Postclosure Safety Case for the Proposed Yucca Mountain Repository

Presented to:

**NEA/IAEA Symposium: Safety Cases for the Deep Disposal of Radioactive Waste: Where do We Stand**

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# Presentation Outline

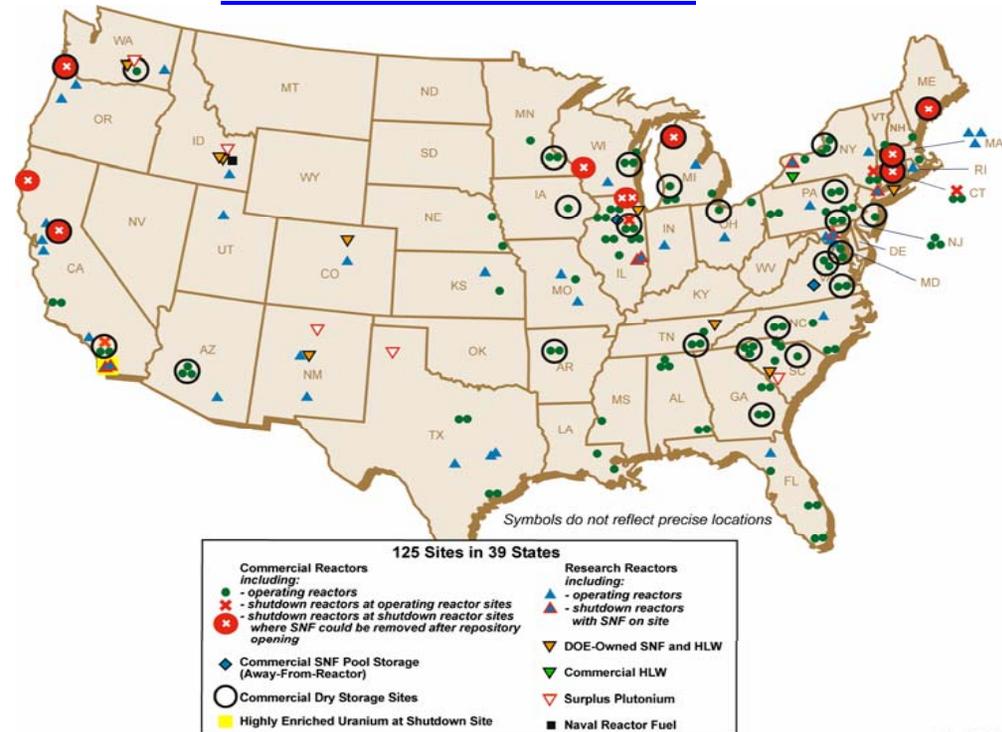
- **Mission and current status of the proposed Yucca Mountain repository**
- **The role of the safety case in licensing**
- **The technical bases for confidence**
- **Institutional bases for confidence**
- **Conclusions**



# The Yucca Mountain Mission

Current locations of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) destined for geologic disposal:

**125 sites in 39 states**



As of July 2004

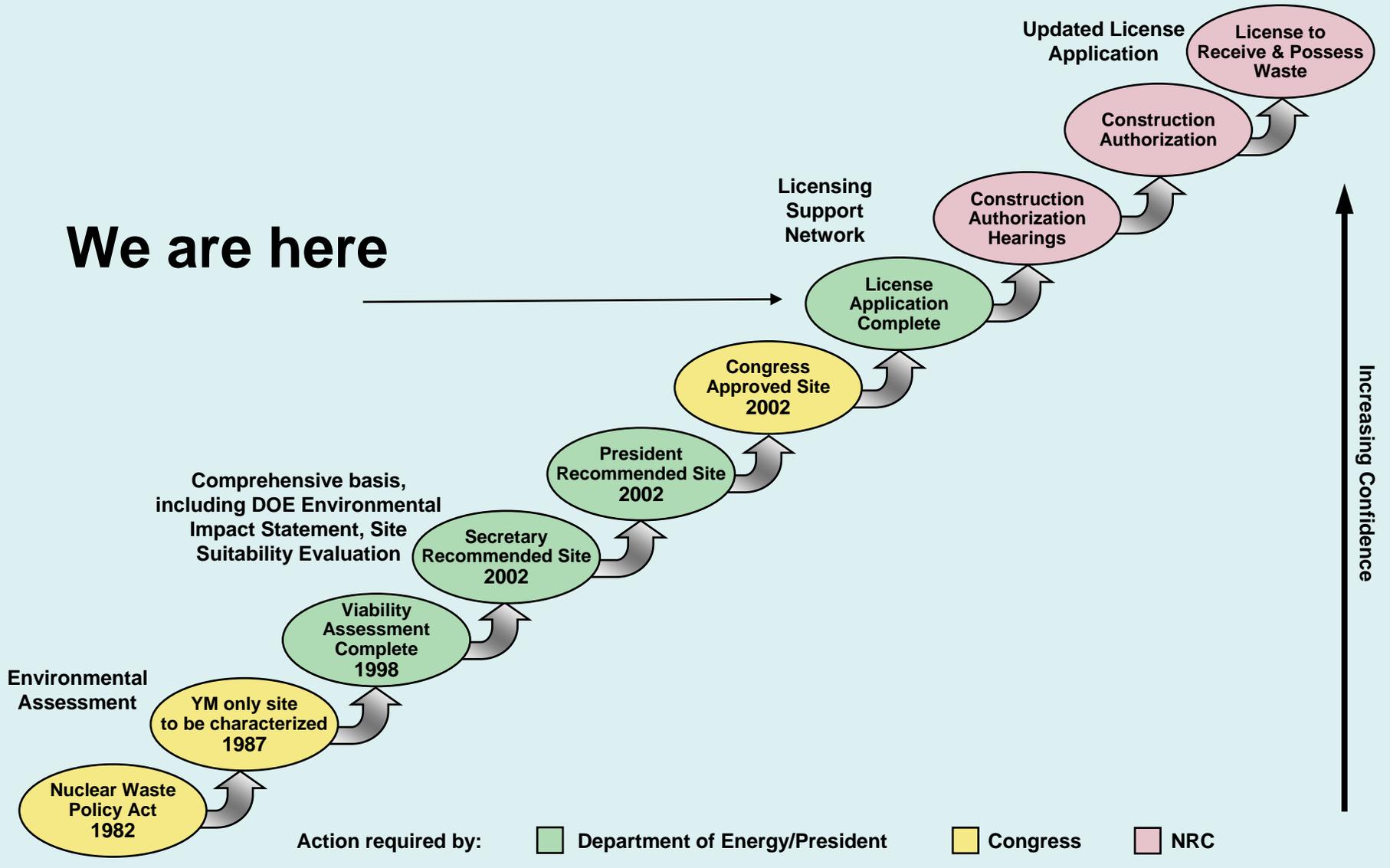
**United States Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM)**

**Mission: to manage and dispose of high-level radioactive waste and spent nuclear fuel in a manner that protects health, safety, and the environment; enhances national and energy security; and merits public confidence.**



# Repository Timeline

**We are here**

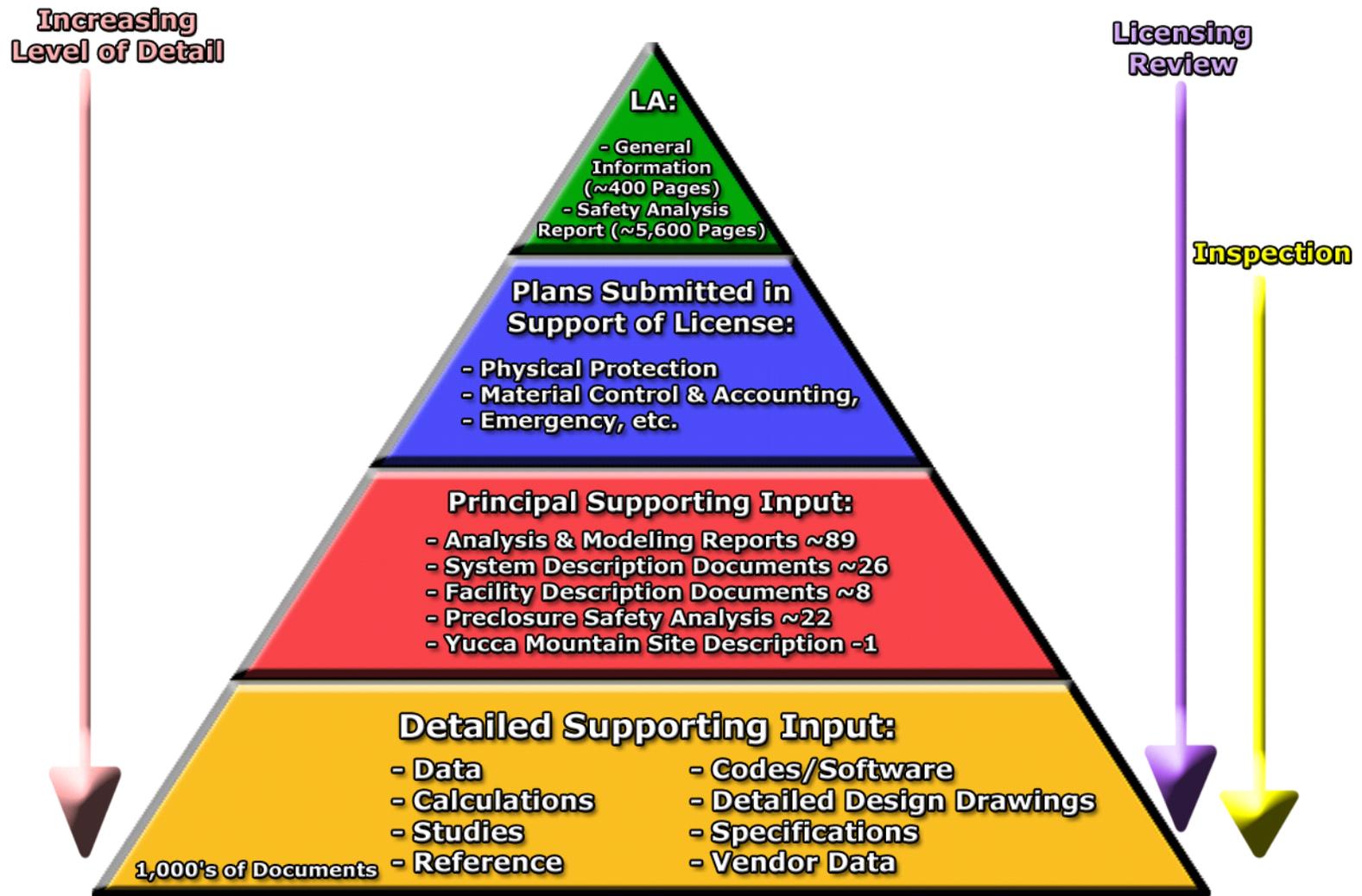


# The Role of the Safety Case in Licensing

- **DOE concurs with the International Atomic Energy Agency (IAEA) definitions for safety assessment and safety case**
- **For Yucca Mountain, the license application is equivalent to the safety case**
  - **The Safety Analysis Report submitted to the Nuclear Regulatory Commission (NRC) will include the safety assessment and comprehensive documentation of the supporting technical basis**
    - ◆ **Systematic analysis of hazards associated with the facility**
    - ◆ **Integration of arguments and evidence that support the finding of safety**
    - ◆ **Evaluation of uncertainties and discussion of the basis for confidence to move forward acknowledging uncertainty**



# Documentation Supporting the License Application



# Outline of the License Application

- **General Information**
  - Site and facility description
  - Proposed schedules for construction, receipt and emplacement of waste
  - Physical protection plan
  - Material control and accounting
  - Site characterization
- **Safety Analysis Report**
  - Repository safety before permanent closure
  - Repository safety after permanent closure
  - Research and development program to resolve safety questions
  - Performance confirmation program
  - Administrative and programmatic requirements

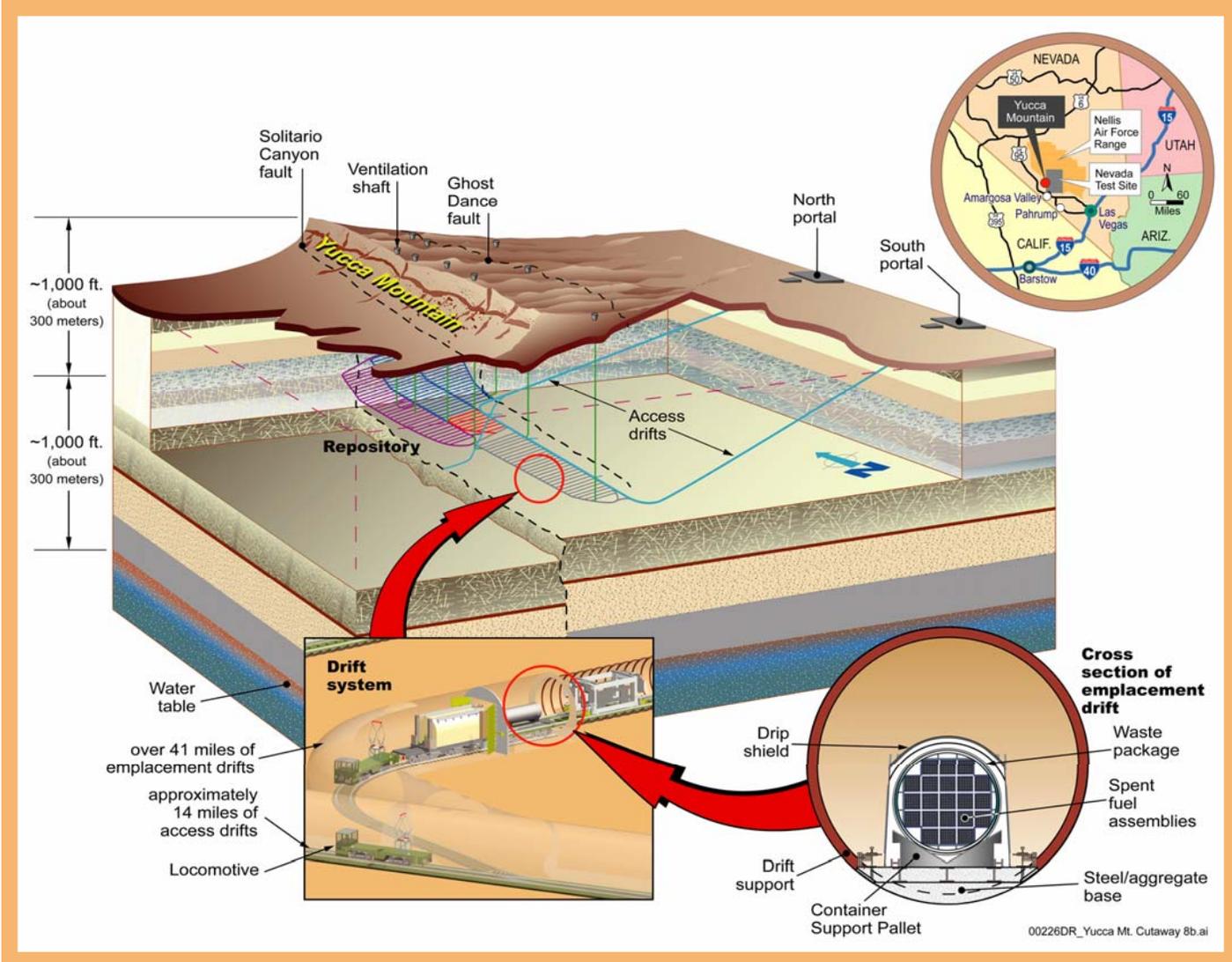


# Technical Basis

- **Multiple barriers provide waste isolation**
  - Robust natural and engineered barriers limit radionuclide release and transport
- **Detailed characterization of natural and engineered systems**
  - Process-level modeling of future performance at the component level
- **System-level safety assessment modeling provides a full acknowledgement of uncertainty**
- **Confidence enhanced by**
  - Peer review
  - Corroboration with analogue information where available



# The Natural and Engineered Barrier System

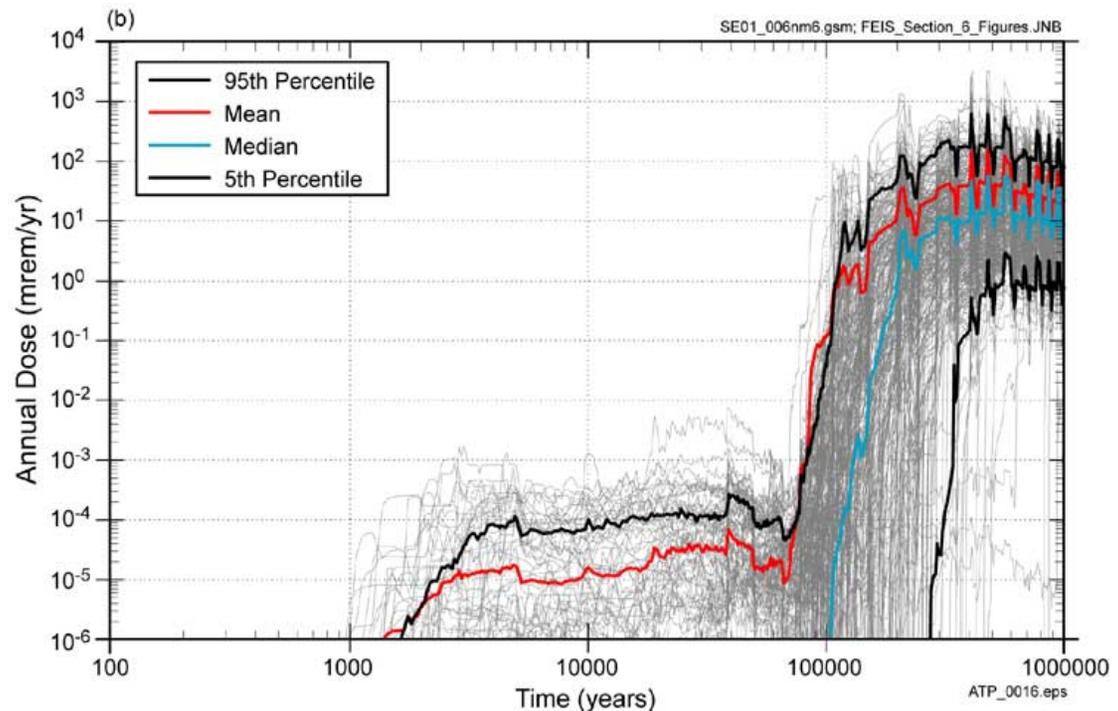


# System-Level Safety Assessment Acknowledging Uncertainty

## Monte Carlo Approach to Uncertainty Analysis

- Each curve is a dose history calculated using a single set of sampled input parameter values
- Summary statistical measures are derived from the distribution of model outcomes
- Stability of the mean (or other summary measure) is related to sample size
- Distribution of model results allows detailed sensitivity and uncertainty analysis of intermediate performance measures

## Example Results from Work Supporting the 2002 Yucca Mountain Site Recommendation



300 Monte Carlo realizations, no disruptive events, ICRP 30 dose model; DOE/RW-0539-1, Figure 4-179; [http://www.ocrwm.doe.gov/documents/ser\\_b/index.htm](http://www.ocrwm.doe.gov/documents/ser_b/index.htm)



# Enhancing Confidence in the Safety Assessment

- **Thorough documentation of internal checking and analysis**
  - **Confirmation of stability of model results**
  - **System and subsystem uncertainty and sensitivity analysis**
  - **Corroboration of system model component results with underlying process models**
- **Peer Review**
  - **External peer reviews of past iterations (1999, 2002)**
- **Comparison to analogue systems where applicable**
  - **E.g., radionuclide mobilization and transport at Peña Blanca, Chihuahua, Mexico**



# Building Confidence through Institutional Actions

- **Performance Confirmation**
  - NRC requires, and the DOE will implement, a testing program throughout the operational period that will challenge data and models underlying the safety assessment
- **Active and passive institutional controls at the site**
  - NRC requires, and the DOE will implement, active controls over the site during preclosure operations, and passive controls, including permanent markers, after closure
- **Quality Assurance**
  - NRC requires, and the DOE is implementing, a rigorous program to ensure the quality of work supporting the technical basis
- **Safety Conscious Work Environment**
  - NRC requires, and the DOE is implementing, a program to ensure an open work environment in which all concerns, safety-related or otherwise, are brought forward by employees without fear of retribution



# Conclusions

- **The Safety Case for Yucca Mountain is based on**
  - A sound geologic site
  - A robust facility design
  - Thorough scientific investigation and analysis
  - A detailed quantitative safety assessment
    - ◆ Confidence enhanced by detailed confirmatory analysis, peer review, and comparison to analogue systems where appropriate
  - Strong institutional commitments and controls
- **The U.S. DOE plans to submit a license application to the U.S. NRC by June 30, 2008**
  - Final evaluations of the safety case will occur through the regulatory process

