

# Technical Lessons Learned: The Yucca Mountain Experience



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# Technical Advances

- Unsaturated zone testing methods
  - Minimal disturbance to in situ conditions
  - Role of fracture flow in unsaturated zone setting
- Development of suite of process models
  - Improved system model provided feedback
  - Importance of integration between science & engineering
  - Value of objective method for model validation

# Technical Advances (continued)

- Approach for including/excluding features, events & processes in system model
  - International approach refined for Yucca Mountain
- High value of feedback from system model
  - Focus testing on parameters important to results
  - Improve process models with greatest impacts

# Technical Advances (continued)

- Application of NQA-1 controls to site characterization phase of program
- Role of independent peer review/oversight

# Looking Back at Site Characterization

- Undisturbed/ambient geological environment
  - Limited need for site-specific data
    - Understanding of earth materials generally adequate to provide parameters for use in model development
    - Bound long-term climate change impacts
    - Focus data acquisition on testing predictions/building confidence in models
- Disruptive events
  - Site-specific data needed to estimate recurrence intervals
    - Formal expert elicitation played major role as direct measurements not feasible
    - Focus data acquisition on information needed to inform expert judgment

# Looking Back at Site Characterization

(continued)

- Repository-induced environment
  - Major driver for obtaining data to estimate corrosion/material performance
    - Highest confidence in failure modes/rates if environment in emplacement drifts well constrained
  - Future refinements to waste form degradation models (if needed) also informed by improved environmental characterization

# Work to Support Future Repository Program

- Test material behavior for likely range of repository environmental conditions – reduce uncertainty in long term failure modes/rates

# Impact of Changes in Management Approaches

- Impact on geotechnical & geoengineering staffing due to fluctuating annual budgets
  - “Natural deselection”
  - Technical integration more difficult
- Difficult to manage long-lead time procurements for equipment or services
- Challenge to maintain appropriate emphasis on QA controls