U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD

Some Observations on Deep Borehole Disposal of Spent Nuclear Fuel and High-level Nuclear Waste

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General Observations

- Geologic disposal is the most technically viable approach to isolating high-level nuclear wastes and spent nuclear fuel for times approaching perpetuity
- Deep borehole disposal is a technically viable type of geologic disposal

Critical Aspects of Borehole Disposal

- Many potentially suitable lithologies
- Some geologic settings are more suitable than others for safe and reliable borehole disposal
- Engineered elements must function in harmony with natural system characteristics
- To reduce uncertainty and enhance confidence, sustained testing and analysis of geologic and engineered elements critical to system performance is required

Host Rock Selection

- Host rock selection should be based on rock characteristics (not simply lithology)
- Advantageous rock characteristics include:
  - Low permeability
  - High cation exchange capacity/sorption
  - Predictable fracture occurrence and properties

Geologic Setting

- Geologic setting is extremely important to safe and reliable isolation
- Advantageous geologic setting attributes:
  - No natural resources
  - Low heat flux
  - Stable *in situ* stress regime; geologic stability
  - Reducing geochemical environment
  - Characterized rock and water chemistry

Engineered Systems

- Boreholes should provide sufficient isolation without requiring engineering enhancements
- Engineered systems must operate in harmony with natural system
- Advantageous engineered system attributes:
  - No deleterious materials
  - Compatible with *in situ* geochemistry
  - Predictable degradation behavior

Uncertainty

- Uncertainty is an inherent attribute of all natural *and engineered* systems
- To reduce uncertainty / enhance confidence:
  - Waste emplacement should not significantly perturb system
  - All critical system elements must be analyzable over geologic time scales; Natural analogs!
  - Testing, analysis and monitoring programs must be developed and implemented through open and transparent dialog and sustained for long times
  - Expect surprises

Summary

- Geologic isolation of nuclear waste and SNF using deep boreholes is technically feasible
- Many lithologies are potentially suitable, and the geologic setting is critical
- Establishing confidence requires that the total borehole system be analyzable and that testing and analysis is open and sustained