U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
JOINT PANELS ON HYDROGEOLOGY & GEOCHEMISTRY AND STRUCTURAL GEOLOGY & GEOENGINEERING

SUBJECT: OVERALL COMPLIANCE STRATEGY FOR MINED GEOLOGIC DISPOSAL SYSTEM

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Outline

- Program Approach Overview
- Regulatory Strategy
- Thermal Management Strategy
- Expected Thermal Loading Positions

Program Approach Overview

- **Focus characterization initially on tests and analyses most critical to evaluating site suitability and supporting environmental compliance**

- **If site is found suitable, shift focus to data and analyses needed to submit application for construction authorization**
  - **Provide high degree of confidence in safety of repository operations and waste package containment**
  - **Rely on conservative predictions of radionuclide transport that will accommodate a range of possible site conditions**

- **Increase confidence in long-term performance through the performance confirmation program**

Regulatory Strategy

- **Demonstrate compliance with updated information that is reasonably available at each milestone in the regulatory compliance process**

- **Defense-in-depth provided by multiple barriers between the waste form and the accessible environment**

  - **Natural barriers provide defense-in-depth by shifting focus to the timeframe of geologic processes**

  - **Engineered barriers contain the waste and inhibit transport of radionuclides into the geosphere**

Regulatory Strategy

(Continued)

- Reasonable assurance findings rely on
  - Flexible design
  - Conservative analyses
  - Comprehensive plans for performance confirmation

Elements of the Regulatory Strategy

- Demonstrate safe repository operations and ensure retrieval option exists
- Demonstrate ability of the engineered barrier system to contain wastes and inhibit radionuclide mobilization to compensate for uncertainties in natural barrier performance
- Rely on realistically conservative performance assessments to provide reasonable assurance that postclosure performance objectives can be met

Elements of the Regulatory Strategy

(Continued)

Demonstrate safe repository operations and ensure retrieval option exists

- Define design basis events and identify the systems, structures and components (SSCs) important to radiological safety, waste isolation, and retrievability
- Provide appropriate level of design for SSCs important to radiological safety, waste isolation, and retrievability for each licensing milestone
- Provide analyses and control mechanisms to preclude criticality excursions
- Develop quality assurance programs, personnel training programs, emergency plans, and proposed operating procedures

Elements of the Regulatory Strategy

(Continued)

Demonstrate ability of the engineered barrier system to contain wastes and inhibit radionuclide mobilization to compensate for uncertainties in natural barrier performance

- Develop flexible repository design that allows for a range of emplacement strategies
- Evaluate alternatives to the major design features that are important to waste isolation
- Provide robust waste package design that maintains substantially complete containment for at least 1000 years
- Evaluate backfill option to support reasonable assurance finding, if needed

Elements of the Regulatory Strategy

(Continued)

Rely on realistically conservative performance assessments to provide reasonable assurance that postclosure performance objectives can be met

- **Allocate performance to a robust EBS to compensate for uncertainties in the natural system**
- **Provide realistically conservative analyses of natural barriers consistent with available data and reduce conservatism as allowed by data and analyses**
- **Evaluate dilution in the saturated zone for compliance with a dose standard, as appropriate**

Elements of the Regulatory Strategy

(Continued)

- Develop a comprehensive performance confirmation program that may last as long as 100 years
- Identify unresolved safety questions and develop comprehensive plans for resolving them, as appropriate

Thermal Management Strategy

1 Develop a flexible design for the elements of the system (repository, waste package, MPC) that are related to thermal loading

2 Conduct evaluations for technical site suitability evaluation and initial License Application in terms of low thermal loading

3 Evaluate higher thermal loadings to improve cost and performance; select design for License Application update

4 Conduct confirmatory testing of the thermal design

1 Develop Flexible Design

Develop robust design capable of supporting 1998 site suitability evaluation, 2001 License Application, and 2008 License Application update

- Utilize repository design that can encompass a range of areal mass loadings
- Develop robust waste packages, consistent with MPC concept, that can provide containment for at least 1,000 years
- Develop a design for the primary area and use License Application update to address potential use of expansion areas
- Utilize available waste acceptance and storage options to adjust the thermal characteristics of the waste

2 Evaluate Low Thermal Loading for Site Suitability and Initial License Application

- Select low areal mass loading from range encompassed by flexible repository design
- Determine waste acceptance and storage options to produce low thermal loading
- Evaluate early thermal tests for this low loading case
- Use these results in 1998 technical site suitability evaluation
- Expand analysis for 2001 License Application as information permits

3 Evaluate Higher Thermal Loadings to Improve Cost and Performance

- Continue testing and analysis for higher loadings
- Consider waste selection and storage measures to tailor thermal loading
- Determine whether or not higher temperatures are acceptable
- Select thermal design for the License Application update by 2008

4 Confirm Performance of Thermal Design

- Conduct confirmatory testing of thermal effects for emplaced waste packages
- Evaluate performance and rock response during operations to ensure that waste isolation and containment will be achieved and repository operations can be conducted
- Select final thermal loading prior to amendment for permanent closure

Expected Thermal Loading Positions

- Technical Site Suitability Determination - 1998
- Environmental Impact Statement - 2000
- License Application for Construction Authorization - 2001
- Update to Receive and Possess Waste - 2008
- Amendment for Permanent Closure

Expected Thermal Loading Positions

(Continued)

Technical Site Suitability Determination - 1998

- Site suitability evaluation based on reference thermal loading (low range)
  - Characterize pre-existing conditions
  - Evaluate sensitivity to range of thermal loadings under consideration

Environmental Impact Statement - 2000

- Defined in the scoping hearings; this is likely to include extrapolating reference thermal loading to estimate impact of higher thermal loads

Expected Thermal Loading Positions

(Continued)

License Application - 2001

Maximum design basis thermal loading (low range)

- **Support reasonable assurance finding using laboratory tests and short-duration ESF test data**
- **Provide comprehensive plans for performance confirmation during construction and operation**
- **Evaluate impact of higher thermal loads under consideration on EBS and repository performance and compare to design basis**

Expected Thermal Loading Positions

(Continued)

License Application Update to Receive and Possess Waste - ~2008

- **Move toward higher thermal loading depending on results from long-term *in situ* heater tests during construction**

Amendment for Permanent Closure

- **Move toward higher thermal loading depending on results from additional long-term thermal testing during operation**