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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: MINED GEOLOGIC DISPOSAL SYSTEM THERMAL OPTIONS AND GOALS


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# Outline

- Objectives of Mined Geologic Disposal System (MGDS) thermal design
- Thermal options
- Selecting a thermal design option
- Roll of thermal goals in decision process
- Potential changes required in thermal goals
- Future actions

# Objectives of MGDS Thermal Design

**Develop a system that meets all the requirements imposed on the system including**

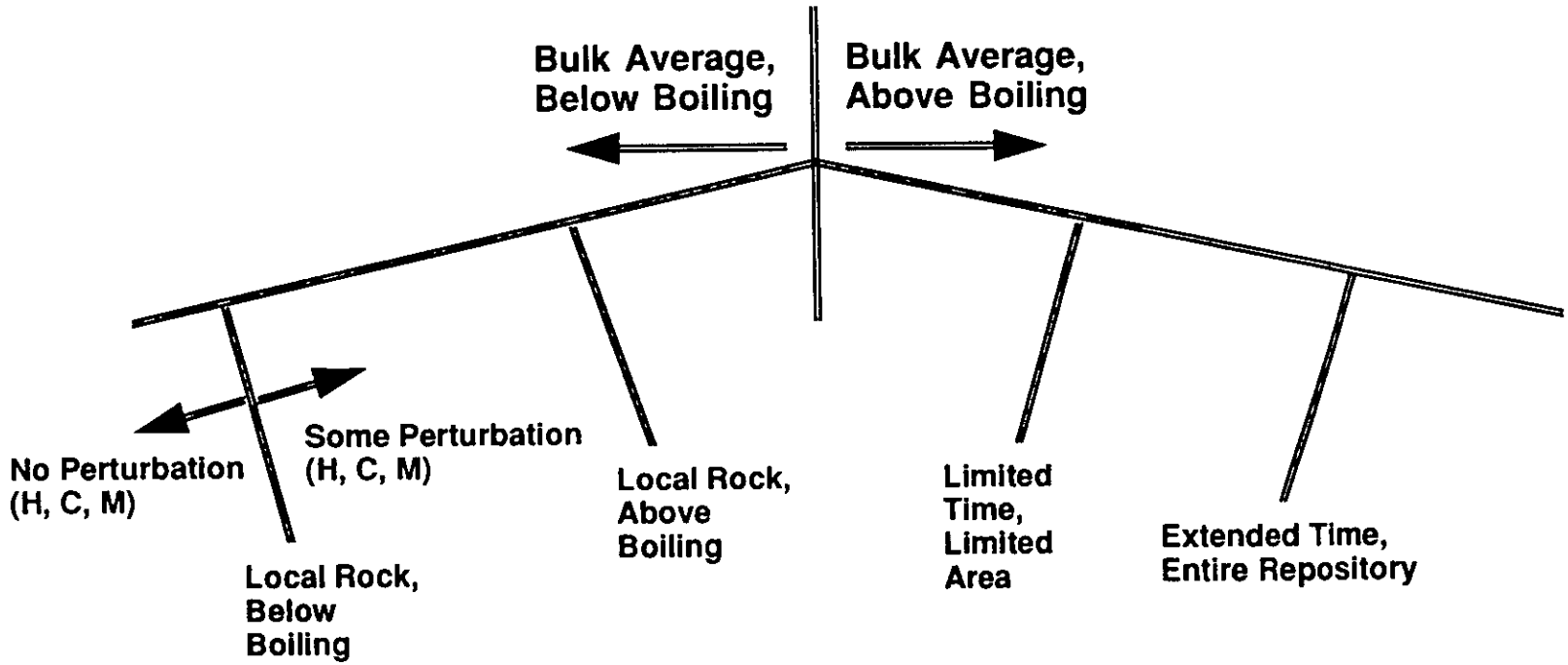
- **Develop a design that achieves waste isolation and containment standards**
- **Develop an engineered barrier that does not exceed the required release rates**
- **Design waste packages that are compatible with the MPC concept that provide substantially complete containment during near-field thermal period**
- **Design the underground facility such that conditions are compatible with preclosure operations and monitoring is achieved**
- **Ability to meet performance must be demonstratable**

# Thermal Loading System Study
# Planned Activities:
# Steps to a Decision

**The thermal systems study provides the technical framework for making a thermal-loading decision and requires the following activities:**

- **Scoping calculations initially to narrow the range of thermal loading - Completed**
- **Parametric analysis to provide recommendations to assist in development of test programs - Initiated**
- **Further analysis with recommendations to narrow thermal loading range through performance evaluations - Planned**
  - **Total system performance assessment, thermal goals (re-evaluated), incorporate data, as available**

# Thermal Design Options



# Selecting a Thermal Design Option

- Systems analysis provides a structured, analytic framework for evaluating a set of alternative concepts and will be used ultimately to select a thermal design option. Systems analysis evaluates the various options using
  - Performance
  - Operability
  - Testability
  - Cost
- Evaluation process ultimately will rely on
  - Analytic models developed to an adequate level of confidence
  - Data
    - Laboratory
    - Surface (drilling, etc.)
    - Subsurface
    - Natural analog

# Thermal Loading Decision

- A thermal design option, with technical backup, ultimately must be selected from the thermal regimes considered
- Timeframe (per program approach)
  - Bounding analysis for early (1998) site suitability determination and Draft Environmental Impact Statement
  - Maximum design basis thermal loading for 2001 License Application {IAW 10CFR60.21(c)(1)(i)(F)}
  - About 2008 License Application to receive waste
  - Amendment for permanent closure after performance confirmation
- How the decision is achieved is answered partly in the attached set of charts

# Aspects of Compliance Impacted by Thermal Loading

- Preclosure safety and retrievability
- Substantially complete containment
- Releases from the engineered barrier system
- Release to the accessible environment

# Development and Use of Thermal Goals

- Thermal goals developed from performance objectives
  - Traceable to regulatory basis
  - Based on licensing strategy and program objectives
  - Based on allocation of performance to certain features
  - Not inviolate and may be coupled
- Thermal goals should help focus the test program
  - An iterative process
  - Data used to validate a goal
- Thermal goals provide guidance for design (CDA)

# Development and Use of Thermal Goals

(Continued)

- Thermal goals also used to evaluate options in addition to
  - Total system performance assessment
  - Other items such as cost, operability, risk
  - Primary requirements, as able to use them
- Following selection of a thermal option, thermal goals may
  - Become technical requirements
  - Be deleted if not necessary

# Revised SCP Thermal Goals

- Based on a top-level strategy of providing multiple barriers
- Oriented primarily toward above-boiling thermal loading
- Utilized only limited data available at that time

# Examples of Current Thermal Goals, Which are Primarily Oriented Toward SCP Above-Boiling Strategy

- Temperature of CHn and TSw3 < 115°C
- Relative displacement at top of TSw1 < 1 m
- Surface uplift < 0.5 cm per year
- Temperature rise at surface < 2°C
- Drift wall temperature < 200°C
- Fuel cladding temperature < 350°C and HLW glass temperature < 500°C
- Maximize time waste package stays above boiling
- Thermal loading that would not degrade PTn barrier

# Examples of Additional Thermal Goals Needed for a Low Thermal Loading*

- Do not alter aqueous flux more that *xx*% from ambient at *Y* meters into the rock
  - Testable on modest time scales (one or two years)
  - Defines disturbed zone
  - Thermally induced percolation flux
- Negligible changes in geochemistry (Eh and pH) of near-field host rock
- Control impact on near-field environments such as
  - Waste package
  - Near-field rock

** Only a few meters of rock around waste package above boiling*

# Future Actions

- Review and revise thermal goals, as needed
  - Consistent with licensing strategy
  - Based on thermal-loading range
  - Integrate into test program
  - Future actions
- Use system study results, as available, to provide recommendations to the testing program
- Use systems analysis to develop technical basis for thermal loading decisions
  - As data become available
  - As modeling capability matures