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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: SCP THERMAL GOALS REEVALUATION

PRESENTER: DR. STEVEN F. SATERLIE

PRESENTER'S TITLE AND ORGANIZATION: MGDS THERMAL LOADING STUDY MANAGER
M&O/TRW, LAS VEGAS, NEVADA

PRESENTER'S TELEPHONE NUMBER: (702) 794-5376

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Outline

- Introduction
- Objectives and scope of reevalutation effort
- Background and SCP strategy
- SCP thermal goals
- Assessment of the goals
- Recommendations
- Summary

Introduction

- **Why reevaluate the SCP thermal goals?**
  - **Emplacement modes such as in-drift emplacement are being considered as well as vertical and horizontal borehole**
  - **Other concepts are being evaluated, such as extended hot**
  - **Additional data and analysis capability exist now**

- **The SCP thermal goals are surrogates for criteria that is directly derived and which, if met, will provide some confidence that the overall performance objectives will be met**

SCP Thermal Goals

- **Objectives**
  - Provide thermal criteria to support the FY93 Thermal Loading Systems Study
  - Help focus testing and analysis activities
  - Initial steps taken that would lead to changing the baseline, if necessary

- **Scope of effort**
  - Determine the technical rationale for establishing the goal
  - Is the goal still valid?
    - -- Does it apply to all emplacement modes?
    - -- If not completely adequate, should it be deleted or changed?
  - Are there any goals that need to be added?
  - What tests and/or analyses should be done to reduce uncertainties?

SCP Background and Strategy

- **SCP criteria**
  - Used to establish performance of potential repository
  - Established in 1988 based on knowledge existing then
  - Oriented toward performance for SCP design
    - -- Vertical borehole
    - -- Horizontal borehole
  - Performance standards for Yucca Mountain have not been established, so surrogate or derived criteria are needed

- **SCP strategy**
  - Four functions are identified in the regulations; the last one focuses on post-closure performance-design thermal loading
  - Process steps established to describe how the function will be accomplished
  - "Goal" developed that is adequate for the issue to be favorably resolved

Goal Reevaluation

- **Established working groups to perform assessment**
  - Thermal-hydrological
  - Thermal-geochemical
  - Engineered barrier system
  - Operations and safety
  - Regulatory and licensing
  - Performance assessment
- **Duration of effort**
  - Short-term effort initiated by YMPO on March 24, 1993
  - Draft report completed May 31, 1993
- **Evaluated 15 goals**
  - Documented the basis for each of the goals
  - Identified those that remained valid
  - Identified uncertainties associated with goals and the tests that are needed

SCP Thermal Goals Evaluated

Process	Performance Measure	Thermal Goal
Limit temperature changes in selected barriers	Temperature	Limit temperature of CHn to < 115°C Limit temperature of TSw3 to < 115°C *Establish a thermal loading that would not degrade PTn barrier*
Limit deleterious rock movement or preferred pathways	Rock displacement	Relative motion < 1m at the top of TSw1 - No intact rock failure - No continuous joint slip
Limit impact on surface environment	Temperature Surface uplift	Rise in surface temperature ~~< 6°C~~ < 2°C Surface uplift < 0.5 cm/year
~~Vary borehole and drift spacing to control thermal loading and container temperature~~ *Vary the details of the repository configuration and waste package spacing to control thermal loading and waste package container temperature*	Thermal loading Borehole wall temperature Rock mass temperature	Design basis thermal loading less than allowable thermal loading ~~Temperature <275°C~~ *Borehole or emplacement drift 1 m wall temperature < 200°C*
Limit potential for borehole collapse	Stress, deformation, factor safety, and potential rock fall	Boreholes that do not load container beyond limits imposed under issue 1.10.

SCP Thermal Goals Evaluated
(Continued)

Process	Performance Measure	Thermal Goal
Limit corrosiveness of container environment	Time container is above boiling temperature	~~Majority of borehole walls above boiling temperature of water for >300 years~~ ***Maximize the time the waste package container stays above boiling consistant with the thermal strategy developed***
Limit degradation of fuel matrix or cladding	Temperature	Fuel cladding temperature < 350°C High level waste glass temperature < 500°C
Limit access drift temperature	Temperature	Wall temperature in access drift < 50°C for first 50 years
Provide for hydrologic drainage	Temperature	~~Rock temperatures midway between emplacement drifts < 100°C~~
Limit emplacement drift temperature	Temperature	***Wall temperatures in emplacement drift < 50°C for first 50 years for horizontal borehole***

Testing and/or Analysis Recommendations

- Continue to investigate the effects of dehydration/rehydration on zeolytes and the reversibility of such reactions
- Determine hydrologic properties of borehole samples from natural barriers and subject samples to heating and cooling to assess effects
  - Paintbrush Tuff Member (PTn)
  - Topopah Spring Member vitrophyre (TSw3)
  - Calico Hills (CHn)
- Incorporate sample thermal-expansion data being obtained in the analyses and conduct 3-D stress analysis
- Conduct corrosion tests on potential waste-package materials over various temperature ranges
- Examine the reactivity of the water in Yucca Mountain and evaluate the buffering capacity of the host rock
- Conduct and assess the results of studies on zircaloy cladding performance

Summary

- SCP thermal goals have been reevaluated
  - Working group of five teams plus licensing and regulatory and performance assessment performed the review
  - Recommended the goals needing change
  - Recommended testing and/or analysis required to reduce uncertainties
  - Recommended that effort should be revisited in FY94 to incorporate results of testing and analysis
  - To begin reevaluation in middle to late FY94

- Recommend thermal goals be reevaluated at various stages of the development and design
  - As options and focus change
  - As data and analysis mature