

NOTE TO SILBERBERG

MAY 25 1989

MEMORANDUM FOR: Mel Silberberg, Chief  
 Waste Management Branch  
 Division of Engineering, RES

FROM: Ronald Ballard, Chief  
 Geosciences & Systems Performance Branch  
 Division of High-Level Waste Management, NMSS

SUBJECT: SPECIFIC HLW RESEARCH NEEDS

As we discussed on May 23, 1989, staff in the Division of High-Level Waste Management has developed a preliminary list of specific technical concerns (Enclosure 1) to be used, as appropriate, in your current HLW research program activities. The technical concerns are structured in a manner consistent with our current statement of HLWM research needs provided to you by memorandum dated February 13, 1989. We are presently refining the list to establish priorities for the indicated research needs.

We wish to work closely with your staff to assure that planned research support for FY90 and beyond is timely, consistent with specific needs, and integrated with the HLW program in a manner consistent with programmatic priorities. In order to assure a well coordinated research program, I would like for your staff to meet with designated HLWM staff prior to the ACNW briefing on HLW Research in late June, to informally go over relevant portions of your program plan. I suggest that assigned RES Section Leaders contact David Brooks (x23457) as portions of the program evolve, to arrange meetings with their staff and HLWM counterparts. If you have any questions or comments please contact me (X23462).

*RB*

Ronald Ballard, Chief  
 Geosciences & Systems Performance Branch  
 Division of High-Level Waste Management, NMSS

Enclosure:  
 As stated

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## PRELIMINARY ASSESSMENT OF SPECIFIC HLW RESEARCH NEEDS

### A WASTE FORM AND PACKAGING

#### A1 Identification and Assessment of Potential failure Modes for Waste Packages

##### CONCERNS

- Degradation of waste package from the inside.
- Effects of waste type and origin on degradation mechanisms.
- Effects of wetting/drying on degradation mechanisms.
- Effects of welding on the degradation of materials
- Effects of carbon on stress corrosion cracking
- Effects of (surface) inhomogeneities on the degradation of materials
- Effects of coupled interactions
- Corrosion by microbial processes
- Extrapolation of lab and field data
- Model validation

#### A2 Evaluations of Interactions Between Waste Packages and the Repository Environment

##### CONCERNS

- Corrosion by microbial processes.
- Environment created by interaction with cannister, support plate, emplacement dolly, liner, rock bolt material.
- Effects of wetting/drying on interactions and environment.
- Effects of radiation
- Effects of heat
- Release of carbon-14.
- Effects of coupled interactions
- Extrapolation of lab and field data.
- Model validation

#### A3 Assessment of Corrosion Rates

##### CONCERNS

- Effects of wetting and drying
- Environment of corroded area Vs bulk repository environment
- Kinetics of corrosion
- Effects of microbial processes
- Factors that initiate localized corrosion
- Stress corrosion cracking (Intergranular Vs Transgranular)
- Coupled interactions
- Extrapolation of lab and field data.
- Model validation

## A4 Analogs of Leaching and Migration

### CONCERNS

- Comparison of lab sorption, mineral stability, leaching and kinetic data with observations of natural and anthropogenic analogs
- Changes in leaching rates with time
- Vapor/gas phase transport
- Effects of oxidation state on leaching and radionuclide release
- effects of wetting and drying
- Coupled interactions
- Extrapolation of data
- Model validation

## B REPOSITORY DESIGN AND ROCK MECHANICS

### B1 Rock-Mass Sealing

#### CONCERNS

- Effects of wetting and drying
- Free drainage concept
- Seals as a preferential pathway for gas/vapor/water
- Material properties under repository environment
- Sealing damaged area around drilled holes and blasted holes
- Coupled interactions
- Preferential pathway for carbon-14
- Seismic effects on seal performance
- Extrapolation of lab and field data
- Model validation

## EARTH SCIENCES

### C1 Analog Studies of Conditions/Processes/Environments

#### CONCERNS

- Natural and anthropogenic analogs for extrapolation of lab and field experimental sorption and mineral stability data
- Natural and anthropogenic analogs for extrapolation of experimental approaches/methods
- Air flow in unsaturated rock
- How effective is gas flow at depth.
- Quaternary volcanic-hydrothermal systems
- Approaches for mapping underground facilities.
- Quaternary age determinations
- Extrapolation of data
- Model validation

## C2 Groundwater Chemistry

### CONCERNS

- Concentration of solutes in groundwater due to evaporation
- Redox activity
- Evolution of groundwater chemistry (organic/inorganic/microbial)
- Representative sampling of Cl-36, Tc-99, and I-129 in vadose zone
- Zeolites as indicators of water composition
- Gas phase control of pH and oxidation state of groundwater
- The effect of climatic changes on groundwater chemistry
- Age determinations
- Nonequilibrium conditions
- Extrapolation of lab and field data
- Model validation

## C3 Radionuclide Transport

### CONCERNS

- The effects of inaccurate thermodynamic properties of key solid phases (zeolites) on modeling sorption
- Colloids as a transport mechanism
- Use of Kds to model sorption
- Source term
- Movement of carbon-14
- Vapor/gas phase transport
- Coupling of vapor/gas/liquid phase transport
- Presence of H-3, Tc-99, I-129, and Cl-36 as indicator of transport potential at site
- Coupled interactions
- The use of linear differential equations to model nonlinear transport chemistry
- Extrapolation of lab and field data
- Model validation

## C4 Mineralogy

### CONCERNS

- Stability of zeolites
- Dissolution of minerals causing increasing permeabilities
- Kinetics
- Age determinations
- Extrapolation of lab and field data
- Model validation

## C5 Response of Groundwater Levels and Underground Openings to Strong Ground Motion

### CONCERNS

- Impact of rock mineral stability on seismic response of openings
- Impact of ground motion on rock stability and its effect on waste package
- Groundwater response to seismic and or fault activities
- Extrapolation of lab and field data
- Model validation

## C6 Groundwater Flow and Radionuclide Transport

### CONCERNS

- Effects of excavation and waste emplacement on groundwater flow
- Effects of shaft and tunnels on air and moisture movement through rock
- The reliability of pneumatic tests in determining hydraulic parameters
- Accuracy of surface Vs subsurface based determinations of flux
- What constitutes a representative elementary volume for unsaturated fractured rock like that found at Yucca Mt.
- Geologic variations that effect flow and transport
- Source term
- Air/vapor/gas movement through Yucca Mt.
- Movement of carbon-14
- Mobile Vs immobile water
- Coupled interactions
- The use of linear approximations to evaluate and couple nonlinear flow and transport behavior
- Extrapolation of lab and field data
- Model validation

## C7 Uncertainty in Probabilistic Seismic Hazard Assessment

### CONCERNS

- The uncertainty created by the random occurrence of seismic events
- Effects of rock movement on waste packages
- Extrapolation of lab and field data (earthquakes to 10,000 yrs)
- Model validation

## **C8 Climate Changes and Effects on Unsaturated Flow Conditions**

### **CONCERNS**

- Effects of increased rainfall on unsaturated flow
- Effects of groundwater withdrawal
- Extrapolation of lab and field data
- Model validation

## **C9 Coupled Interactions of Thermal-Mechanical-Hydrologic Systems**

### **CONCERNS (ALSO SEE A1-4, B1, C3, and C6)**

- Effects of coupled interactions on retrievability
- Uncertainties of linear modeling of nonlinear processes and events
- Extrapolation of lab and field data
- Model validation

## **D SYSTEMS PERFORMANCE**

### **D1 Independent Systems Assessment Methodology for Evaluation of Total System Performance**

#### **CONCERNS**

- The use of linear approximations to model non linear systems
- Source term
- Evaluation of human factors
- Extrapolation of lab and field data
- Model validation

### **D2 HLW Preclosure Safety Systems Analysis**

#### **CONCERNS**

- Source term
- Evaluation of human factors
- Extrapolation of lab and field data
- Model validation