SUBJECT: REPOSITORY ADVANCED CONCEPTUAL DESIGN (ACD): SUBSURFACE

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Outline

- FY93 repository design objectives and tasks

- Status of Advanced Conceptual Design (ACD) tasks related to thermal-loading studies including
  - Waste-package handling
  - Subsurface layouts
  - Ventilation concepts
FY93 Repository Subsurface Advanced Conceptual Design (ACD) Objectives

- Support system studies in the areas of thermal loading and emplacement mode
- Support repository/ESF interface development
- Support Multi-Purpose Canister (MPC) design study
- Support site characterization activities
- Perform other ACD tasks to preserve the ACD schedule, to the extent possible
Repository ACD Tasks for FY93

- Management and integration (M&I)
- Requirements and basis for design
- Subsurface waste-package handling equipment concepts
- Shafts and ramps concepts
- Subsurface excavation system
- Underground service system
- Operations/maintenance
Repository Subsurface Design Activities
Supporting System Studies

- Provide subsurface layouts concepts for
  - A range of thermal loading
  - Three emplacement modes
  - A range of waste-package design concepts

- Operability issues including
  - Safety
  - Transportation equipment
  - Retrievability

- Preliminary comparative cost estimate
Subsurface Waste-Package Handling Equipment Concepts

Thermal loading and MPC studies are considering a large range of waste packages, emplacement modes, and areal power densities

To support these studies concepts are being developed for

- Transportation, emplacement, and retrieval equipment for waste packages
  - Containing 2 to 21 (PWR) (SNF) assemblies
  - Weighing from 13 to 164 tonnes (29,000 lbs to 360,000 lbs)

- Emplacement in vertical borehole, horizontal borehole, and in-drift
Concepts for Transportation in Repository

Evaluating in repository transport equipment including

• Wheeled
• Tracked
• Rails
• Monorail
Criteria for Evaluation of Transportation Equipment Concepts

The criteria for evaluation of concepts include

- Gradient of drifts/ramps
- Drift size requirement
- Waste-package size and weight
- Operating environment (radiation, temperature)
- Emission requirement
- Ease of automation
- Power source
- Compatibility with emplacement mode
- Requirement for relocation
- Retrievability requirements
## Concepts for Transportation in Repository

<table>
<thead>
<tr>
<th>Description</th>
<th>Rail</th>
<th>Rubber tired</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power source</strong></td>
<td>diesel, electric, battery</td>
<td>diesel, electric</td>
</tr>
<tr>
<td><strong>Typical operating grade limit</strong></td>
<td>• standard rail  4 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• cog rail  30 %</td>
<td>15 %</td>
</tr>
<tr>
<td></td>
<td>• adhesion rail  10 %</td>
<td></td>
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<tr>
<td><strong>Operating environment</strong></td>
<td>up to 50°C</td>
<td>up to 50°C</td>
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</table>
## Concepts for Transportation in Repository

(Continued)

<table>
<thead>
<tr>
<th>Description</th>
<th>Drift Size*</th>
<th>Drift Size*</th>
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<tbody>
<tr>
<td></td>
<td>Rail</td>
<td>Rubber-Tired</td>
</tr>
<tr>
<td>In-drift emplacement</td>
<td>4.5 m (14 ft)</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Vertical/horizontal emplacement</td>
<td>7 m (23 ft)</td>
<td>7 m (23 ft)</td>
</tr>
</tbody>
</table>

* Approximate
Subsurface Layout Concepts

• Preparing layouts and costs for thermal-loading studies using
  - A range of waste-package sizes (2-21 PWR)
  - Three emplacement modes
  - Range of areal power densities (20 to 114 kW/acre)

• Preparing ESF/interface concepts
Area Requirements at Various Areal Power Densities

(SCP-CD Fuel Age and Burn-up)

<table>
<thead>
<tr>
<th>Areal Power Density (APD) - KW/Acre</th>
<th>Acres</th>
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<tbody>
<tr>
<td>20</td>
<td>4000</td>
</tr>
<tr>
<td>40</td>
<td>2000</td>
</tr>
<tr>
<td>57</td>
<td>1400</td>
</tr>
<tr>
<td>80</td>
<td>1000</td>
</tr>
<tr>
<td>100</td>
<td>800</td>
</tr>
<tr>
<td>120</td>
<td>700</td>
</tr>
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</table>

Primary Subsurface Area Available for Repository Construction (≈ 1850 Acres)

Perimeter SCP-CD Repository Layout
Subsurface Layout Concepts
(Continued)

A repository concept to interface with the current ESF design

- Step-block concepts with no development in Ghost Dance fault
- TBM excavation
- Integrated rail transportation
- Virtually flat emplacement drifts and gradients of less than 3 percent elsewhere
- In-drift emplacement using approximately 4 m diameter emplacement drifts
A Conceptual Single Block Repository
LAPD = 75 kW/acre
(CDR LAPD ~70 kW/acre)
Section A - A'

200 m below surface topography

Proposed location of TS Main Drift

Ghost Dance Fault

Upper Block Emplacement Drift
elev. 3506'

TSw1

TSw2

TSw3

Lower Block Emplacement Drift
elev. 3275'

TSw2

TSw3

Drillhole Wash & Imbricate Faults

Water Table

Note: Plane of section cuts through lowest emplacement drift in step-block layout.
Ventilation Studies

- Evaluating drift lengths from feasibility of temperature control during emplacement or retrieval

- Evaluating ventilation requirements for continuous cooling or cooling as required

- Evaluating concepts for removal of heat from waste packages during pre-closure period

- Evaluating shaft/ramps size, number, location for various ventilation concepts
Ventilation Studies

(Continued)

• Effects of allowing ventilation air to flow continuously through the emplacement drifts
  - Studies suggest that it is feasible to control air temperature by continuous ventilation. May require large number of additional shafts and higher power cost to handle the additional air
  - Ventilation air-flow is capable of removing a significant amount of heat output from emplaced waste packages

• Effects of forced cooling of previously closed drifts for retrieval or maintenance
  - Studies suggest that cooling of emplacement drifts within a period of months is feasible using a relatively large amount of air
Effect of Continuous Ventilation in an Emplacement Drift

In-Drift Emplacement Mode
Areal Power Density 114 kW/Acre
Length of the Drift 900 m
Intake Air Temperature 26.5 C

Source: Danko, G., 1992
Cooling by Ventilation of a Previously Sealed Drift

In-Drift Emplacement Mode
Drift Length 900 m, Sealing Period 50 Years
Areal Power Density 114 kW/Acre
Intake Air Temperature 26.5 °C

Source: Danko, G., 1992
Heat Removal by Ventilation (For Vertical Emplacement)

Source: St. John, C., 1985
(BEST AVAILABLE COPY)
Summary

• FY93 repository ACD tasks include support of system studies including thermal loading

• The repository ACD is considering a range of thermal loading, waste package design, and emplacement mode concepts

• In support of the system studies, preliminary concepts are being developed for
  - Repository layouts
  - Transportation system
  - Ventilation schemes
  - Shafts/ramps design concepts
  - Material handling system
  - Emplacement and retrieval system

• Concepts for ESF/repository interface are being developed in conjunction with the Title II design of ESF