

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

**NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING**

**SUBJECT: REPOSITORY ENGINEERING
STUDIES**

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Repository Engineering Studies

The Board has requested discussion of the following issues:

- 100-year ground support**
- Recovery from rockfall**
- Backfill**

100-Year Ground Support

100-Year Ground Support

The Repository Controlled Design Assumptions (CDA) document contains the following assumption:

Assumption # DCSS 028:

"Emplacement drifts will be designed to be stable through the retrievability period and will not rely on planned maintenance. Shafts, ramps, and all other drifts will be designed to be stable, but may rely on periodic maintenance."

100-Year Ground Support

- **This assumption will be revised to acknowledge the fact that some degree of post-emplacment drift maintenance is expected**
- **The goal is to minimize the number of times that emplacements drifts would be re-entered because of potential safety concerns and the high cost of post-emplacment drift maintenance**

100-Year Ground Support

(Continued)

A number of FY95 engineering studies have contributed to the issue of long-term stability of emplacement drifts

Some relevant results from these studies:

- **Definition of the potential repository block**
 - **Evaluated available geologic logs, maps, geophysical information, test results, and rock properties information to better define the usable volume within the TSw2 unit and to provide guidance for siting repository drifts within the most stable areas**

100-Year Ground Support

(Continued)

- **Emplacement Mode Evaluation Study**
 - **Evaluated several in-drift and alcove-based emplacement modes for overall feasibility. Ease of retrieval and inherent stability of excavations were major points of comparison. Concluded that in-drift modes were superior to alcove-based modes, but did not differentiate from among several in-drift options.**

100-Year Ground Support

(Continued)

Results

- **Recommended Layout Concepts Report**
 - **Layout design involves development of drift configurations and orientations that are inherently the most stable available using current site information**
- **Thermomechanical Analysis**
 - **This evaluation considered the heating of emplacement drifts and the effect these conditions might have on drift stability. The evaluation did not indicate any general instability in the drifts. It can be concluded that, with ground support, the drifts should remain stable**

100-Year Ground Support

(Continued)

Results

- **Repository Design Data Needs**
 - Identified data needs for ongoing repository design work. Among these were geochemical effects of man-made materials in the waste package environment. (Ground support may constitute one of the largest single sources of permanent man-made materials in the repository)
- **Ground Support Analysis**
 - This evaluation will assess common ground support materials and their applicability to the emplacement environment

100-Year Ground Support

(Continued)

Results

- **Remote Handling/Robotics Scoping Analysis**
 - Early remote/robotics work involves assessment of the expected conditions, the state of technology, and potential applications to repository work
- **Repository Heating and Cooling Scoping Analysis**
 - This analysis concentrated on removal of heat from emplacement drifts via the ventilation system. Both continuous cooling and rapid or "blast" cooling were evaluated for applicability to maintaining or re-establishing access to emplacement drifts. Though not included in this effort, a natural extension of this work will be to perform thermomechanical analyses to assess cool-down stresses in an emplacement drift

100-Year Ground Support Summary

- **While it is a goal of the repository designer to develop emplacement drifts having inherent long-term stability, it will not be assumed that emplacement drifts will never require maintenance**
- **Evaluation of ground control systems for emplacement drifts is in the early stages. By the end of repository ACD, the feasibility of long-term drift stability should be determined**

Recovery from Rockfall

Recovery from Rockfall

- **Rockfall in an emplacement drift is one of many potential events that may be encountered**
- **Development of Design Basis Events (DBE) has not yet been performed for the repository**
- **In general, recovery from an emplacement drift rockfall would require the following activities to be conducted:**
 - **Cooling of the drift to 50°C or less for equipment re-entry**
 - **Removal of unaffected waste packages between the drift entrance and the fall**
 - **Sufficient movement/removal of the fallen rock to allow engagement of the affected waste package**
 - **Withdrawal of the affected waste package**
 - **Withdrawal of the remaining waste packages in the drift**
 - **Remediation or abandonment of the drift**

Emplacement Drift Backfill

Emplacement Drift Backfill

- **Background**
 - **Backfill (if used) is a part of the underground facility (10 CFR 60 definition) and, by extension, part of the engineered barrier system (EBS)**
 - **The EBS shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure (10 CFR 60.133 (h))**
 - **Requirements for backfilling have not yet been established**

Emplacement Drift Backfill

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Potential uses of backfill:

- Enhance waste package longevity by reducing contact between water and the waste package
- Retard release of radionuclides from the near-field environment
- Provide mechanical protection for the waste packages from eventual rockfall
- Prevent/reduce potential for subsidence of the rock mass

Emplacement Drift Backfill

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The need for backfill must be assessed in light of the following factors:

- **The waste package is being designed to perform in a warm, damp environment**
- **The waste package design is structurally robust**
- **Pre-emplacment measures, such as diffusion barriers installed in the emplacement drift floor, may prove to be more effective in improving performance than backfill might be**

Emplacement Drift Backfill

(Continued)

Current Design Assumption (CDA Key Assumption #046):

- **"Means for retarding the escape of radionuclides from the disposal container and/or for the physical protection of the waste package (e.g., backfill) will be evaluated for implementation in waste package and subsurface designs"**

Backfill Systems Study

A systems engineering study is planned for late FY95-early FY96 to evaluate backfill. The output of this study is expected to include

- Recommendation for sensitivity cases for use in TSPA '95**
- A list of potential backfill alternatives**
- An evaluation of the nearfield and TSPA effects of the alternatives**
- Design approaches for backfill emplacement**
- Cost estimates for the options**

Summary

- **The goal is to design and develop emplacement drifts that will be usable for 100+ years with minimal required maintenance**
- **Recovery from emplacement drift rockfall will be required (if rockfall is determined to be a credible DBE)**
- **The need to employ backfill in the emplacement drifts is being evaluated**