

**Nuclear Waste Technical Review Board  
International Technical Workshop on Deep  
Borehole Disposal of Radioactive Waste  
Panel 2: Emplacement Mode**

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# Presentation Outline

- Lessons learned from the Spent Fuel Test—Climax
- Specific observations regarding the Deep Borehole Field Test (DBFT)
- Summary and conclusion

# Lessons Learned from the Spent Fuel Test—Climax

- Plan, design, and execute the test consistent with existing or reasonably anticipated legislation
- Plan, design, and execute the test consistent with existing or reasonably anticipated regulations
- Do not “assume away” things that could affect the applicability and/or transferability of the results or conclusions of the test
- Fully integrate the engineering and science objectives; do not allow one to subordinate the other
- Explicitly account for environmental, safety, and quality aspects that could affect actual implementation of what is being demonstrated
- Give preference to using engineered design controls and interlocks; minimize reliance on administrative controls
- Employ management principles that allow for flexibility and adaptation in design, construction, and operations

# Statutory and Regulatory Framing of the Deep Borehole Field Test

- Statutory and regulatory requirements will affect DBD implementation (e.g., retrieval, which can be readily demonstrated)
- None were identified that would discriminate between the two emplacement modes considered, so analysis results are not impacted
- The DBFT should be framed within the context of existing or reasonably anticipated statutes and regulations to assure representativeness and transferability of the results to DBD, should it be deployed as a national strategy

# Integration and Completeness of Objectives

- Operational realism and reasonableness are essential; all possible elements of DBD should be included in the DBFT (many are considered “TBD”)
- Engineering objectives should be on par with science objectives, not subordinate to them
- Options for emplacement fluids other than “muds” should be analyzed; potential for significant impacts on hydrology, geochemistry, sealing, and performance
- DBFT provides opportunity to evaluate potential radiological dose/risk to workers through time-and-motion measurements
- Consideration could be given to simulation of the presence of a radiation field to enhance this aspect of the demonstration

# Completeness of Analyses

- Consideration should be given in the analysis to single boreholes that splay into multiple emplacement segments at depth; this could have operational and performance advantages
- Analyses were not always consistent between wireline and drill string emplacement modes (e.g., the former did not include maintenance, equipment condition/status monitoring, status of emplacement fluid, etc.)
- The analysis did not consider criticality in comparing options; this could be a discriminating factor under canister drop scenarios

# Additional Engineering and Operational Considerations

- Several items are listed for further analysis; these analyses should be completed (e.g., features to prevent gate opening under load, wireline inspection, presence of fluid circulating equipment onsite, etc.)
- Based on high failure probabilities, need to include safety interlocks as an integral part of the DBFT
- Need to include in the DBFT appropriate control systems that will be important to DBD; several are listed as not being necessary for DBFT
- Use of emplacement fluid to “balance” load is sound; given high probability of drop events, consider adding gravity braking to the emplacement equipment

# Conclusions

- The Deep Borehole Field Test Specifications document provides a sound concept, thorough preliminary design analyses, and associated risk, uncertainty, and sensitivity analyses
- The current state of practice and engineering are included in the proposed approach, as are many of the lessons learned from the Spent Fuel Test—Climax demonstration project
- Specific suggestions are made here for consideration as the test design matures and is finalized