

A Strategy for Conducting a Review of System Description and Demonstration of Multiple Barriers

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ABSTRACT

This document presents a strategy for conducting a review of system description and demonstration of multiple barriers in a potential license application submitted by the U.S. Department of Energy (DOE) for a high-level waste geologic repository at Yucca Mountain, Nevada. A description of tasks and responsibilities, documentation of findings, and a schedule for conducting the review is included. This document is intended to support an integrated risk-informed review of the DOE performance assessment.

ACKNOWLEDGMENTS

This is an independent product of the CNWRA and does not necessarily reflect the views or regulatory positions of the NRC. The NRC staff views expressed here are preliminary and do not represent a final judgment or determination of the matters addressed or of the acceptability of a license application for a geologic repository at Yucca Mountain.

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QUALITY OF DATA, ANALYSES, AND CODE DEVELOPMENT

No data, analyses, or codes are discussed in this document.

1 BACKGROUND

In 10 CFR 63.2, a barrier is defined as any material, structure, or feature that prevents or substantially reduces (i) the rate of movement of water or radionuclides from the Yucca Mountain repository to the accessible environment, or (ii) the rate of release of radionuclides from the waste. A barrier may be a geologic feature, an engineered structure, a containment for the waste, or the waste form itself.

1.1 Basis

As provided in 10 CFR 63.113(a), the geologic repository must include multiple barriers consisting of both natural barriers and an engineered barrier system. Furthermore, the potential DOE license application is required to identify the barriers included, describe the capabilities of each barrier, and provide the technical bases for the capabilities of the barriers in a manner consistent with the technical basis supporting the performance assessment.

The Yucca Mountain Review Plan (NRC, 2003) provides guidance to reviewers on the areas of review, review methods, and acceptance criteria for conducting a risk-informed review of the potential DOE licence application.

Based on requirements in 10 CFR 63.115, the regulatory review will focus on the following aspects of the potential license application

- The barriers identified as important to waste isolation
- The description of the capabilities of the identified barriers
- The discussion of the technical bases for assertions of barrier capability and its consistency with the technical bases for the performance assessment

1.2 Objectives

The goals of this multiple barriers review strategy are to:

- Define the tasks to be accomplished in the review of multiple barriers based on the Yucca Mountain Review Plan (NRC, 2003)
- Assign responsibilities for the defined tasks
- Provide flexibility to allow for potential technical or programmatic changes before and after the submission of the potential license application
- Develop effective integration and participation of the postclosure review teams
- Meet schedule and resource constraints

Accomplishing these goals will lead to a timely, complete, and defensible review of multiple barriers in the potential licence application. It will also support transparent and traceable documentation of findings.

2 AVAILABLE DOCUMENTS

The review of multiple barriers will be based primarily on the documentary materials that will be submitted by DOE in the potential license application, including the Safety Analysis Report. The following documents will be used to support review activities prior to receipt of a potential license application.

- 10 CFR Part 63, in particular Sections 63.2, 63.113, and 63.115
- Yucca Mountain Review Plan (NRC, 2003) (Section 2.2.1.1)
- Integrated Issue Resolution Status Report (NRC, 2005) (Section 5.1.1 and Appendix D)
- NRC and DOE Key Technical Issues Agreements for TSPAI.1.01 and TSPAI.1.02 (Schlueter, 2003)
- Total System Performance Assessment—License Application Methods and Approach (Bechtel SAIC Company, LLC, 2003) (Section 8.3)
- Performance Confirmation Plan (Bechtel SAIC Company, LLC, 2004)

3 TASKS AND RESPONSIBILITIES

The tasks to be conducted in reviewing multiple barriers are grouped into three phases: (i) the period preceding submittal of the potential license application, (ii) the acceptance review period, and (iii) the period during which detailed technical reviews of a license application will be conducted.

3.1 Prior to License Application Submittal

The following tasks will be conducted prior to the receipt of a potential license application from DOE:

- The Multiple Barriers review team will develop understanding and integration of all review teams. This will be done by extracting the requirements of 10 CFR Part 63 and the Yucca Mountain Review Plan (NRC, 2003) relevant to multiple barriers and discuss them with the Model Abstraction review teams to solidify common understanding and interpretation. This task could be aided by mapping potential barriers to integrated subissues risk insights already ranked in the Risk Insights Baseline Report (NRC, 2004).
- Each team involved in reviewing the potential license application will internally resolve any differences of opinion. If the issues cannot be resolved with reasonable effort, the

team will use existing administrative procedures for issue resolution. Differences in opinion that impact importance ranking of barriers should be resolved well in advance of the license application submittal.

- The Multiple Barriers team will consult the documents listed in Section 2 to obtain an initial understanding of the barriers DOE might rely on for waste isolation. This initial study will require in-depth familiarity with the models that comprise the total system performance assessment. It will also indicate the potential significance of the barriers to waste isolation. During the acceptance review and detailed review stages, the indicated barriers, barrier capabilities, and risk rankings will be updated.

3.2 During Acceptance Review

As part of the acceptance review, the Multiple Barriers team will conduct the following:

- List the barriers DOE relies on for waste isolation in the tendered license application and link each barrier to one or more barrier capabilities.
- Prepare a simple spreadsheet with checkboxes to indicate the capability (or capabilities) associated with each barrier. This spreadsheet will be provided to each model abstraction review team to assist in conducting the detailed review.
- Conduct an abbreviated review of the license application documents to come to an initial understanding on the barrier capabilities and their relative importance to waste isolation.
- For the docketing decision, determine whether the description of the capabilities of the barriers provided in the tendered license application is sufficient for NRC to conduct a risk-informed review of postclosure performance.
- If it is determined that the information in the tendered license application is insufficient to understand the capability of the barriers, provide the results of such determination to the Acceptance Review Team, along with any request for additional information necessary to conduct a risk-informed review.
- Based on the information in the tendered license application, assign a significance rank to each barrier as high, medium, or low. If the capability of a barrier cannot be determined, it will be assigned a rank of high until information is provided by DOE in response to a request for additional information. If necessary, this initial determination of significance of barrier capability will be reviewed and updated based on findings of the detailed review or in response to additional information provided by DOE.
- Identify and resolve any significant differences between the NRC risk insights and the derived DOE risk rankings. Where differences exist, the resultant ranking will use the higher of the two rankings. The resultant ranking will be used during the detailed review to determine the focus given to each barrier.

- Update the mapping of DOE barriers to NRC risk rankings and use the updated mapping to identify and document the Model Abstraction team(s) responsible for reviewing each barrier.

3.3 During Detailed Review

The Multiple Barriers team will assess whether the differences between NRC and DOE barrier rankings are logical in light of the differences between the NRC and DOE approaches. This will require frequent interactions with the Model Abstraction teams.

The Model Abstraction teams will conduct the following tasks during the detailed review period:

- Use the comparison of DOE and NRC risk rankings conducted during the acceptance review and the resultant rankings to make staff responsible for reviewing the model abstractions aware of where to focus their reviews. Staff will focus their reviews on the model abstraction(s) linked with barriers ranked high or medium. For barriers ranked low, staff will conduct a simplified review focusing on confirming the main assumptions. Each review team should understand that review focus is not equivalent to review effort. After deciding on the review focus (based on the risk rankings), the effort needed to perform the review will depend on the complexity and state of knowledge about the barriers.
- If necessary, update the spreadsheet developed during the acceptance review of DOE barriers mapped to their capabilities. Verify that (i) the list of barriers includes at least one engineered and one natural barrier, and (ii) DOE analyses link the barriers identified to their respective capabilities.
- Verify that the barrier capabilities are consistent with the definition of a barrier specified at 10 CFR 63.2.
- Verify that DOE has provided adequate information on the time period over which each barrier performs its intended function. This will require a detailed examination of performance assessment results and uncertainty estimates.
- Verify that the barrier capabilities are derived from, and therefore consistent with, the performance assessment results. Use the mapping of barriers to risk insights updated during the acceptance review to identify the relevant performance assessment model outputs.
- Verify that the technical bases provided to support the descriptions of barrier capabilities are (i) consistent with the technical basis for the performance assessment and (ii) commensurate with the importance of each barrier capability.
- Use existing guidance for generation of requests for additional information, if necessary.
- Determine if it would be necessary to update the DOE risk rankings. This will confirm our understanding of the risk insights incorporated in the DOE performance assessment, and form a basis for conducting further postclosure-related regulatory activities in a risk-informed manner.

- Prepare documentation of review findings for inclusion in the Safety Evaluation Report.

4 DOCUMENTATION OF FINDINGS

The review of multiple barriers in the potential license application will directly use the acceptance criteria in the Yucca Mountain Review Plan (Section 2.2.1.1.3). The documentation of findings will constitute the inputs to the Safety Evaluation Report prepared for the potential licence application. The aspects of the documentation that relate to multiple barriers will be based on

- Initial determinations prior to the detailed review
- Receipts from the Model Abstraction teams after completion of the detailed review

Initial determinations will include (i) identifying the barriers and barrier capabilities DOE relies on for waste isolation, (ii) verifying that barriers identified include at least one engineered and one natural barrier, (iii) matching the barrier capabilities with the definition given in 10 CFR 63.2, and (iv) ranking the risk significance of the barriers identified in order to determine the review focus required for each barrier. The spreadsheet prepared by the Multiple Barriers team during the acceptance review should serve as a working document containing these initial determinations. This spreadsheet will be updated by the Model Abstraction teams based on their findings during the detail review of the potential license application.

Receipts from the Model Abstraction teams will include updates to the initial determinations and new determinations made during the detailed review. In particular, the receipts will include (i) the time period over which each barrier performs its intended function, (ii) the performance assessment results that support the waste isolation capability of each barrier (e.g., radionuclide breakthrough curves, fluxes, and doses), (iii) the uncertainties associated with the performance assessment results, and (iv) a statement confirming that the technical basis for the description of barrier capabilities is consistent with the performance assessment.

5 PROPOSED SCHEDULE

Figure 5-1 illustrates the flow of information between the Multiple Barriers team and the Model Abstraction review teams for the periods before and after the detailed review of the tendered license application. Before the detailed review, initial determinations by the Multiple Barriers team will include an update to the review focus based on the barriers DOE relies on for waste isolation and the significance associated with each barrier. After the detailed review, the Model Abstraction teams will return with information to confirm that the technical basis for the description of barrier capabilities is consistent with the performance assessment.

After completion of the acceptance review it is anticipated that there will be a maximum of 108 days for the completion of multiple barriers reviews and submission of draft inputs to the Safety Evaluation Report. The proposed schedule is as follows:

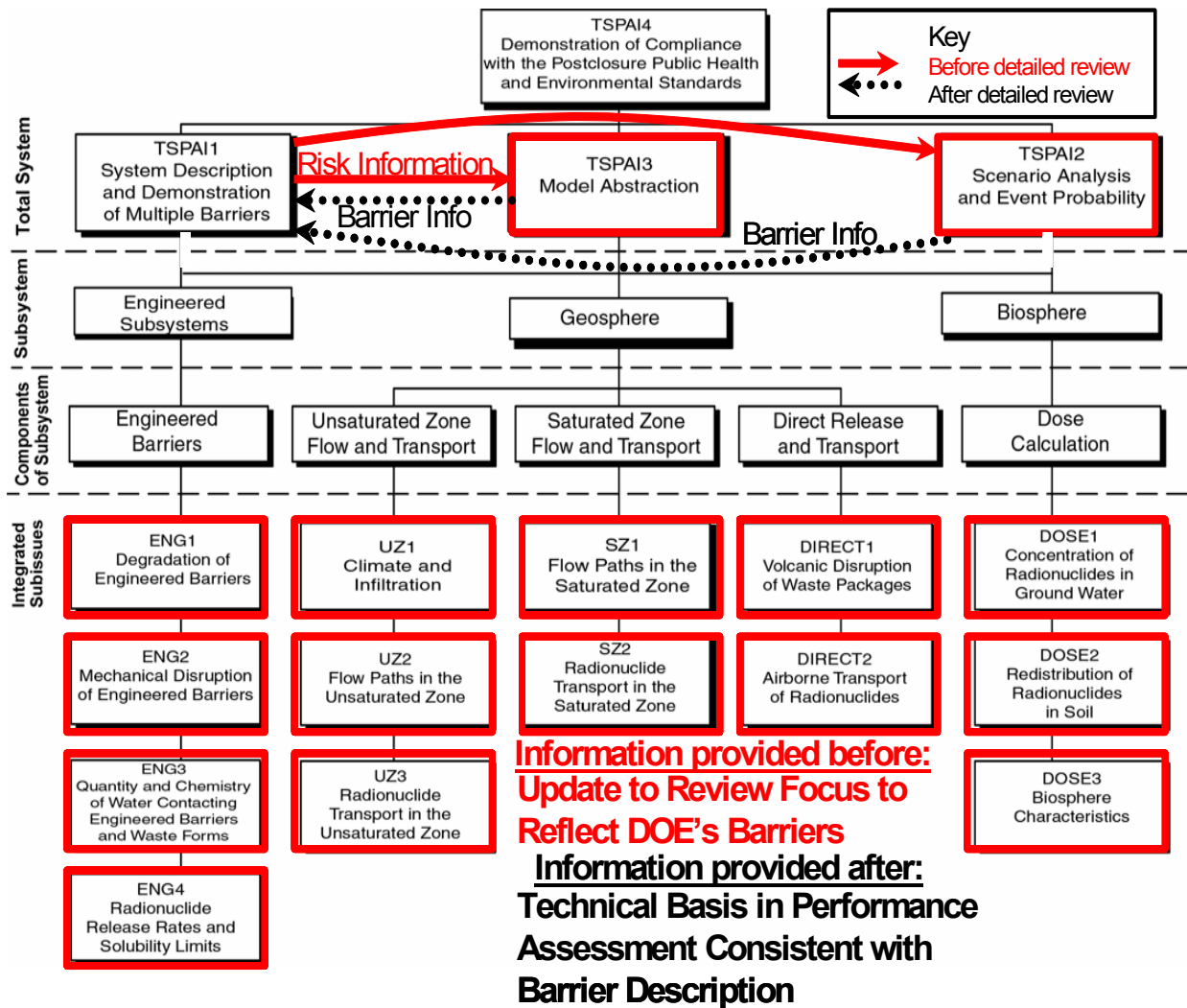


Figure 5-1. Components of Postclosure Performance Assessment Review Indicating the Flow of Information for Review of Multiple Barriers. Risk Information is Provided by the Multiple Barriers Team Before Detailed Review (Solid Arrows). Confirmation of Technical Basis for Barrier Capabilities is Returned to the Multiple Barriers Team After Detailed Review (Dotted Arrows). Red Outlined Integrated Subissues Boxes Comprise the TSPA3 Model Abstraction Teams.

Prior to License Application Submittal (Ongoing Activities)

- Develop integration of review teams
- Resolve differences of opinion
- Review available documents

During Acceptance Review (Activities May Be Conducted Simultaneously Within 25 Days)

- List DOE barriers and capabilities
- Evaluate risk significance of barriers
- Map barrier capabilities to risk significance
- Compare DOE and NRC risk rankings
- Assign barrier reviews to Model Abstraction teams

During Detailed Review

- Determine level of review focus, 5 days
- Update barrier capabilities mapping, 5 days
- Verify compliance with acceptance criteria, 30 days
- Prepare draft inputs to the Safety Evaluation Report, 30 days

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