REQUEST FOR ADDITIONAL INFORMATION (RAI)
Volume 3—Postclosure Chapter 2.2.1.1—System Description and Demonstration of Multiple Barriers—Set 1 (RAIs 1 through 7)
(DEPARTMENT OF ENERGY'S SAFETY ANALYSIS REPORT SECTION 2.1)

RAI #1: Table 2.1-1 should be expanded by adding appropriate columns to provide the following information:

1) For each feature or component identified in Table 2.1-1, provide a brief qualitative description of how the stated barrier function is attained (e.g., capillary forces at the wall of the emplacement drift limit ingress of water; general corrosion of waste package is very slow, etc.). Ensure that the processes that affect barrier capability (e.g., sorption to stationary corrosion products) are linked to the specific features or components whose capabilities they affect (e.g., corrosion of waste package internal components, etc.).

2) For each feature or component identified in Table 2.1-1, provide a brief quantitative evaluation of the barrier capability (e.g.; approximately 10% of infiltration enters the drifts as seepage under nominal conditions; the likelihood of waste package failure by general corrosion within 1 million years is less than 15%; packages failed by general corrosion retain the ability to divert up to 50% of the seepage water for up to 100,000 years following the initial breach; etc.). Demonstrate that the evaluation is based on quantitative information from the performance assessment (figures, tables, TSPA intermediate results, TSPA inputs, etc.).

3) Provide references to portions of the license application (subsections of the SAR, figures and tables) that provide the basis for the information presented in items 1 and 2 or update the SAR accordingly. Ensure that these references point to specific locations within the license application rather than to entire chapters or sections. These references should indicate the location of discussions regarding:

- detailed evaluations of the barrier component/feature capabilities, including information of the effect of specific events or processes
- the uncertainties and variabilities in the capability of the barrier feature or component
- how the capability changes over time

For features or components designated as not important to waste isolation, provide comparable information that illustrates/demonstrates that the performance assessment does not include any significant capability arising from the feature or component.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). Table 2.1-1 provides information on barrier capability. However, the multiple barrier description provided in the license application is varied in its level of detail. In certain areas, particularly within the discussion of the capability of the engineered barrier system, the discussion does not provide sufficient detail to determine how the component achieves its stated function or how the

capability (or lack of capability) of the features and components identified in Table 2.1-1 are consistent with the performance assessment. The regulation requires consistency between each barrier's capability and its implementation within the performance assessment. The description of barrier capabilities needs to provide sufficient detail to allow for a reasonable comparison of the described capability with the performance assessment model and/or results.

RAI #2: Address the effects of damping episodic infiltration pulses within the Paintbrush Tuff and the impact of this damping on the capability of the unsaturated zone above the repository (upper natural barrier) to prevent, or substantially reduce, seepage into the drift.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). Although there is a discussion of how the episodic infiltration pulses are damped by the Paintbrush Tuff unit, there is no clear description of how this damping affects the barrier capability to prevent or substantially reduce seepage into the drift.

RAI #3: Identify and describe the barrier capability of the emplacement drift. Describe the capability of the emplacement drift, including uncertainties, consistent with the quantitative analyses in the total system performance assessment (e.g., sensitivity and uncertainty analyses or intermediate results). Provide information on the time period over which the emplacement drift performs its intended function.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). Although the emplacement drift is identified as important to waste isolation in Table 2.1-1, there does not appear to be any specific discussion of the barrier capability of the emplacement drift in SAR Section 2.1.2.2.1 or 2.1.2.2.2, nor any quantitative supplementation in SAR Section 2.1.2.2.6. Because the capabilities of the emplacement drift are not clearly identified, there does not appear to be any specific discussion of the time over which the emplacement drift performs its function or of the uncertainty in the capabilities of the emplacement drift, nor is it possible to determine whether any capability is consistent with the performance assessment.

There does not appear to be a clear connection between the processes and characteristics affecting the emplacement drift identified in SAR Section 2.1.2.2 and the specific components that contribute to these processes. It is therefore not clear that the barrier capabilities implied by the discussion of these processes are consistent with the safety classification provided in Table 2.1-1. For example, there is no clear explanation of why some components of the emplacement drift identified in Table 2.1-1 are considered to be important to waste isolation and some are not. Although Table 2.1-1 indicates that the emplacement drift is important to waste isolation by virtue of its ability to prevent or substantially reduce the rate of movement of water and radionuclides, there is no clear discussion of how this capability is achieved. Furthermore, the non-emplacement openings, closure, ground support, and ventilation systems are determined to be not important to waste isolation in Table 2.1-1, but there is no clear discussion of why these components do not contribute to the barrier capability of the emplacement drift.

RAI #4: Address the capability of a waste package breached by general corrosion to divert seepage water. Describe the capability, including uncertainties arising from the corrosion and EBS flow models, consistent with the quantitative analyses in the total system performance assessment (e.g., sensitivity and uncertainty analyses or intermediate results). Provide information on the time period over which waste package diverts seepage water.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). The SAR identifies the ability of a waste package breached by cracks to prevent water from entering the waste package due to the capillary diversion effect (SAR Section 2.1.2.2.6). However, Section 2.1 of the SAR does not describe or provide performance evidence to support the capability of a waste package breached by general corrosion to divert water. In addition, the effect of corrosion and EBS flow model uncertainties on the waste package capability does not appear to be demonstrated in SAR Section 2.1.2.2.6. This information is needed to confirm the postulated barrier capability.

RAI #5: Address the barrier capability of waste form and waste package internal components. Ensure that this description includes performance assessment inputs or intermediate results demonstrating:

- how various degradation rates of waste forms (e.g., CSNF or HLW glass) at different times affects the EBS barrier capability
- how limited waste package breach area affects the EBS barrier capability
- how solubility affects the EBS barrier capability in the different transport model domains
- how sorption to stationary corrosion products affects the EBS barrier capability
- why colloidal processes do not affect the EBS barrier capability in the nominal and igneous intrusive scenarios

Describe the capability of the waste form and waste package internal components, including uncertainties, consistent with the quantitative analyses in the total system performance assessment (e.g., sensitivity and uncertainty analyses or intermediate results). Provide information on the time period over which the waste form and waste package internal components perform their intended function.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). There is very limited information on the effectiveness of individual features, events, and processes on the rate of release of radionuclides. It is not clear which processes control the releases from a failed waste package. For example,

- DOE does not provide a detailed description of the degradation rates of the different types of waste forms at different times
- DOE does not provide an indication of how effective the limited breach area associated with cracks is at retaining radionuclides under diffusive release conditions
- DOE does not demonstrate or provide specific descriptions of the effectiveness of solubility limits at limiting the releases from the waste package
- DOE does not demonstrate or provide specific descriptions of the effectiveness of the stationary corrosion products inside the waste package at retaining radionuclides, and in

particular, how the desorption rate of radionuclides sorbed to stationary corrosion products affects the rate of radionuclide release from the waste package
- DOE does not describe why colloidal processes are ineffective at transporting radionuclides outside the waste package in the nominal and igneous intrusive scenarios.

Finally, there does not appear to be a clear connection between these processes and the specific components that contribute to these processes. It is therefore not clear that the barrier capabilities implied by the discussion of these processes is consistent with the safety classification provided in Table 2.1-1. For example, corrosion product sorption appears to be a process that is significant in controlling the releases from a failed waste package, and corrosion of the internal canisters appears to be a significant source of these stationary corrosion products; consequently, it is not clear why the codisposal waste canisters are not considered important to waste isolation.

RAI #6: Address the relative contribution of advective transport, matrix diffusion, matrix sorption and colloid filtration to the barrier capability of the lower natural barrier components (unsaturated zone below the repository and saturated zone), and how this is related to relative differences in sorption, solubility, and radioactive decay properties among a set of representative radionuclides.

Describe how these processes affect the capability of the unsaturated zone and saturated zone, including uncertainties, consistent with the quantitative analyses in the total system performance assessment (e.g., sensitivity and uncertainty analyses, model inputs, or intermediate results). Provide information on the time period over which these processes perform their intended function.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). To demonstrate the capability of the lower natural barrier for a range of releases, using a limited number of calculations, 12 radionuclides were selected for the barrier performance demonstrations. These radionuclides represent a broad range of radioactive decay properties, geochemical behavior, and transport characteristics listed in Section 2.1.2.2.6 (page 2.1-68) of the Safety Analysis Report. Because of their diverse properties, these radionuclides were intended to provide a means of examining the performance characteristics of the lower natural barrier. TSPA results are presented in terms of percentage activity reduction through the lower natural barrier for the representative radionuclides. However, there is no discussion linking the activity reductions and unique properties of the radionuclides to the capability of the lower natural barrier to prevent or substantially reduce the rate of radionuclide movement.

RAI #7: Address the relative capabilities of the unsaturated zone below the repository and the saturated zone. Include uncertainties, consistent with the quantitative analyses in the total system performance assessment (e.g., sensitivity and uncertainty analyses or intermediate results). Provide information on the time period over which these components perform their intended function.

Basis: Needed for demonstration of compliance with 10 CFR 63.115 (b) and (c). Section 2.1.2.3.6 of the Safety Analysis Report compares activity releases from the engineered barrier system with activity releases to the accessible environment as the means of quantifying the barrier performance of the lower natural barrier. These TSPA-derived activity results combine the capabilities of the two component features of the lower natural barrier features, namely the unsaturated zone below the repository and the saturated zone. Examination of the TSPA GoldSim code indicates that calculations of activity releases from the unsaturated zone to the saturated zone (i.e. though the water table) can be saved from the simulation outputs. However, these intermediate results are not presented nor discussed in support of the capability of the lower natural barrier to prevent or substantially reduce the rate of radionuclide movement.