THE U.S. NUCLEAR REGULATORY COMMISSION OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS REVIEW OF THE U.S. DEPARTMENT OF ENERGY'S KEY TECHNICAL ISSUE AGREEMENT RESPONSES TO THE PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA: TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION 2.01, 2.02, 2.03, 2.04, and 2.07

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) issue resolution goal during this interim pre-licensing period is to assure that the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to accept a License Application for review. Resolution by NRC during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. It is important to note that resolution of an issue by NRC during the pre-licensing period does not prejudge the NRC evaluation during the licensing review. The NRC resolves issues during pre-licensing when the staff has no further questions or comments about how DOE has addressed an issue. Pertinent new information could raise new questions or comments regarding a previously resolved issue.

By letter dated August 18, 2004, DOE submitted a report titled "Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)" (Bechtel SAIC Company, LLC, 2004a) to satisfy the information needs of the referred agreements pertaining to scenario analysis. The NRC requested this information during previous technical exchanges in May and August 2001.

Partial assessment of the Total System Performance Assessment and Integration (TSPAI) 2.02 agreement response was transmitted to DOE by letter dated January 28, 2005 (Kokajko, 2005a). That letter covered Comments 34, 35, 37, 39, 42, 48, 54, 55, 56, 57, 60, 62, 78, 79, and J–1. Comment 37 (related to low temperature creep of titanium alloys) was the only comment that lacked a transparent technical basis. The objective of this agreements response review letter is to evaluate the remaining responses to comments of TSPAI.2.02 [i.e., 3, 4, 11, 12, 19 (Parts 1, 2, and 6), 25, 26, 29, 36, 38, 43, 44, 49, 51, 59, 61, 63, 64, 65, 66, 68, 69, 70, J–2, J–3, J–4, J–7, J–8, J–9, J–10, J–11, J–12, J–13, J–14, J–15, J–17, J–20, J–21, J–22, J–23, J–24, J–25, J–26, and J–27], as well as to assess TSPAI.2.01, 2.03, 2.04, and 2.07 agreement responses.

2.0 AGREEMENTS

The wording of the agreements is as follows:

2.1 Agreement TSPAI.2.01

"Provide clarification of the screening arguments, as summarized in Attachment 2. See Comment # 5, 7, 8, 9, 10, 13, 18, 19 (Part 5), 21, 32, 41, 47, 50, 53, 58, 67, J–5, J–16, and J–18.

DOE will clarify the screening arguments, as summarized in Attachment 2, for the highlighted FEPs. The clarifications will be provided in the referenced FEPs AMR and will be provided to

the NRC in FY03."

2.2 Agreement TSPAI.2.02

"Provide the technical basis for the screening argument, as summarized in Attachment 2. See Comment # 3, 4, 11, 12, 19 (Parts 1, 2, and 6), 25, 26, 29, 34, 35, 36, 37, 38, 39, 42, 43, 44, 48, 49, 51, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 70, 78, 79, J–1, J–2, J–3, J–4, J–7, J–8, J–9, J–10, J–11, J–12, J–13, J–14, J–15, J–17, J–20, J–21, J–22, J–23, J–24, J–25, J–26, and J–27.

DOE will provide the technical basis for the screening argument, as summarized in Attachment 2, for the highlighted FEPs. The technical basis will be provided in the referenced FEPs AMR and will be provided to the NRC in FY03."

2.3 Agreement TSPAI.2.03

"Add the FEPs highlighted in Attachment 2 to the appropriate FEPs AMRs. See Comment 19 (Part 7 and 8), 20, and J–6.

DOE will add the FEPs highlighted in Attachment 2 to the appropriate FEPs AMRs. The FEPs will be added to the appropriate FEPs AMRs and the AMRs will be provided to the NRC in FY03."

2.4 Agreement TSPAI.2.04

"Provide a clarification of the description of the primary FEP. See Comments 24, 31, and 33.

DOE will clarify the description of the primary FEPs, as summarized in Attachment 2, for the highlighted FEPs. The clarifications will be provided in the referenced FEPs AMR and will be provided to the NRC in FY03."

2.5 Agreement TSPAI.2.07

"Provide results of the implementation of the Enhanced FEP Plan (e.g., the revised FEP descriptions, screening arguments, the mapping of FEPs to TSPA keywords, and a searchable index of FEP components), in updates to the FEP AMR documents and the FEP Database.

DOE agrees to provide the results of their implementation of the Enhanced FEP Plan (e.g., the revised FEP descriptions, screening arguments, improved database navigation through, for example, the mapping of FEPs to TSPA keywords, a searchable index of FEP components, etc.), information requested in updates to the FEP documents and the FEP Database (or other suitable documents) in FY03."

3.0 RELEVANCE TO OVERALL PERFORMANCE

The goal of scenario analysis is to ensure that no important aspect of the proposed high-level waste repository is overlooked in the evaluation of its safety. The scenario analysis process

provides the basis for initial development and identification of aspects relevant to waste isolation. Scenario analysis identifies features, events, and processes that could influence, directly or indirectly, dose risk to a reasonably maximally exposed individual from the proposed high-level waste repository. Documentation of the compendium of features, events, and processes facilitates identification of aspects analyzed in the evaluation of repository safety and serves as a road map to the location of analyses and their conclusions. Screening arguments provide rationale for either further considering or not considering features, events, and processes into the total system performance assessment. A well-implemented process for identification of these features, events, and processes helps to ensure relevant aspects of the proposed high-level waste repository and associated implications to the dose risk are evaluated.

Agreements TSPAI.2.01, 2.02, 2.03, and 2.04, are included in the TSPAI subissue for scenario analysis and event probability. These agreements resulted from a staff review of DOE documentation that is consistent with Review Methods 1 and 2 in Section 2.2.1.2 of the Yucca Mountain Review Plan (NRC, 2003). The NRC review of DOE's response for these agreements was also conducted in accordance with the aforementioned review methods. These review methods include evaluating the identification and screening of a list of features, events, and processes. The NRC staff categorized Agreements TSPAI.2.01, 2.03, and 2.04 as low risk-significant. Although TSPAI.2.02 was categorized overall as high risk-significant based on the scope and content of the comments in these agreements, individual comments within TSPAI.2.02 have not been separately categorized within the significance framework. The NRC staff categorized Agreement TSPAI.2.07 as medium risk-significant. This agreement requested documentation on the implementation of the Enhanced Plan for Features, Events, and Processes (FEPs) at Yucca Mountain (Bechtel SAIC Company, LLC, 2002).

4.0 RESULTS OF THE NRC REVIEW

4.1 Agreement TSPAI.2.01

The document "Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)" (Bechtel SAIC Company, LLC, 2004a) addressed Agreement TSPAI.2.01 by directly responding to comments raised during technical exchanges in May and August of 2001. Tracking numbers for these comments are listed in the agreements wording.

Agreement TSPAI.2.01 is deemed of low significance by NRC. Agreement TSPAI.2.01 requested clarifying information on screening arguments for particular features, events, and processes. Details of the NRC review of the comments covered by Agreement TSPAI.2.01 are included in Table 1. Based on the DOE response, the NRC has no further questions at this time.

4.2 Agreement TSPAI.2.02

The document "Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)" (Bechtel SAIC Company, LLC, 2004a) addressed Agreement TSPAI.2.02 by directly responding to comments raised during technical exchanges in May and August of 2001. Tracking numbers for these comments are listed in the agreement wording.

Partial assessment of the TSPAI.2.02 agreement response was transmitted to DOE by letter dated January 12, 2005 (Kokajko, 2005a). That letter covered Comments 34, 35, 37, 39, 42, 48, 54, 55, 56, 57, 60, 62, 78, 79, and J–1 (related to high risk significance agreements). Comment 37 (related to low temperature creep of titanium alloys) was the only comment considered with insufficient technical basis. In this agreement response review letter, remaining responses to comments of TSPAI.2.02 are evaluated [i.e., 3, 4, 11, 12, 19 (Parts 1, 2, and 6), 25, 26, 29, 36, 38, 43, 44, 49, 51, 59, 61, 63, 64, 65, 66, 68, 69, 70, J–2, J–3, J–4, J–7, J–8, J–9, J–10, J–11, J–12, J–13, J–14, J–15, J–17, J–20, J–21, J–22, J–23, J–24, J–25, J–26, and J–27].

Agreement TSPAI.2.02 requested further technical bases for screening arguments for a number of features, events, and processes. In the present review, the following comments were identified as requiring additional technical bases in screening arguments: Comment 59, J–2, J–8, J–14, J–15, and J–20. A minor inconsistency in the documentation was identified in the response to Comment J–21. The January 12, 2005, letter (Kokajko, 2005a) stated that additional technical bases are needed to address Comment 37. It is considered that transparent technical bases have been provided by DOE to address remaining TSPAI.2.02 Comments: 3, 4, 11, 12, 19 (Parts 1, 2, and 6), 25, 26, 29, 36, 38, 43, 44, 49, 51, 61, 63, 64, 65, 66, 68, 69, 70, J–3, J–4, J–7, J–9, J–10, J–11, J–12, J–13, J–17, J–22, J–23, J–24, J–25, J–26, and J–27. Detailed evaluations of responses to these comments are provided in Table 2. The following sections detail additional questions on responses to Comments 59, J–2, J–8, J–14, J–15, J–20, and J–21.

4.2.1 Agreement TSPAI.2.02 Comment 59

The subject comment is worded as, “2.1.08.04.00 (Cold Traps) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001b). Emplacement of waste in the drifts creates thermal gradients within the repository that may result in condensation forming on the roof of the drifts or elsewhere in the engineered barrier system, leading to enhanced dripping on the drip shields, waste packages, or exposed waste material. The DOE Multi-scale Thermohydrologic Model does not account for mass transport along the length of drifts. The only Multi-scale Thermohydrologic Model submodel that includes thermal hydrology (i.e., mass transport) is a cross section of a drift, so it accounts for potential condensation only along the radial axis.”

4.2.1.1 DOE Response to Comment 59

The DOE responded to Comment 59 by splitting the database entry into two entries titled Condensation Forms on Roofs of Drifts (Drift-Scale Cold Traps) and Condensation Forms at Repository Edges (Repository-Scale Cold Traps). The former was considered, and the latter was disregarded in the performance assessment model. According to DOE, additional information supporting screening arguments was presented in the response to Agreement TEF.2.05.

4.2.1.2 NRC Assessment of Response to Comment 59

Agreement TEF.2.05 has been evaluated, and feedback was communicated to DOE in a separate letter (Kokajko, 2005b). While information in that agreement evaluation letter pertinent to Comment 59 states that DOE documents on natural convection processes have not

yet been released, the information that the DOE provided was responsive to the concerns underlying Agreement TEF.2.05, which NRC identified as closed (Kokajko, 2005b). These documents are needed to assess the rationale for condensed water remaining on and in the wallrock. Repository-scale cold traps are excluded because the condensation is stated to occur on drift walls and, therefore, does not contact the engineered barrier system; thus, the possibility of water dripping on drip shield and invert is not considered in screening arguments. Unreleased documents on natural convection (Multiscale Thermohydrologic Model, Revision 02 and In-Drift Natural Convection and Condensation Model) need to be reviewed to evaluate arguments indicating that condensed water resulting from repository-scale cold traps does not contact the drip shield nor the invert. DOE should consider providing information in any potential License Application to support repository-scale cold trap screening arguments.

4.2.2 Agreement TSPAI.2.02 Comment J–2

The subject comment is worded as, "2.1.06.05.00 (Degradation of Invert and Pedestal) has been screened as excluded on the basis of low consequence (CRWMS M&O, 2001b). Rock block impact orientations with the waste package will be affected by degradation of the invert. Comment 2.1.07.01.00 [Rockfall (large block)] stated that angled rock block impacts near the closure lid weld may have undesirable consequences. Furthermore, stability of the waste package during seismic excitation will be affected by a degraded invert foundation. Corrosion of the steel pallet components should be considered when evaluating stability of the waste package on its supporting pallet on a degraded invert foundation."

4.2.2.1 DOE Response to Comment J–2

The DOE responded by splitting the database entry 2.1.06.05.00 (Degradation of Invert and Pedestal) into four entries titled "Mechanical Degradation of Emplacement Pallet, Mechanical Degradation of Invert, Chemical Degradation of Emplacement Pallet, and Chemical Degradation of Invert." All of these processes have been screened as excluded except Mechanical Degradation of Emplacement Pallet. The concern regarding angled rock block impacts due to invert failure is addressed in the response to Comment 79. The DOE concluded that the drip shield provides adequate protection to the waste package from rockfall. The DOE stated that the issues on degradation of the invert and pedestal are addressed by Agreement CLST.2.08.

4.2.2.2 NRC Assessment of Response to Comment J–2

Comment 79 was evaluated in Kokajko (2005a), and staff indicated that DOE will provide information for staff to evaluate the technical basis for DOE screening arguments for drift degradation and seismically induced container failure. The effects of nonuniform settling of the drip shield and the waste package and its pallet, however, have not been analyzed. The invert is expected to incur mechanical damage during seismic events. Thermal stresses may also affect the ability of the invert to maintain the engineered barrier system in a horizontal orientation. The structural integrity of the foundation of the engineered barrier system (i.e., the invert) is also expected to be compromised by corrosion of the structural steel framework of the invert, which is within the scope of the Chemical Degradation of Invert feature, event, and process. Nonuniform settling of these components has the potential to affect the accumulated rockfall load carrying capacity of the drip shield. Moreover, in the event that the drip shield should interact with the waste package under these conditions, the relative interaction angle

can significantly affect the stress incurred by the waste package as a result of the accumulated rockfall load being transmitted. The DOE should consider providing information in any potential License Application to establish the significance to dose risk of this process leading to the contact of the drip shield and waste package.

4.2.3 Agreement TSPAI.2.02 Comment J–8

The subject comment is worded as, "2.2.08.02.00 (Radionuclide Transport Occurs in a Carrier Plume in Geosphere) is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2001c, 2000a). The key assumption (CRWMS M&O, 2001c; Assumption 11) is that results from the near-field thermal-hydrological-chemical coupled processes model (CRWMS M&O, 2000b) can be used to bound the effects of similar coupled processes on far-field flow and transport. This assumption has not yet been verified. Because the screening argument for this item is focused primarily on thermal effects on the chemistry of seepage water entering the emplacement drifts, it does not appear to include other potential effects (colloids, interactions with waste forms, and engineered barrier system materials). Also, 2.1.09.01.00 (Properties of a Carrier Plume in the Engineered Barrier Subsystem) is included in the process model report (CRWMS M&O, 2001b, 2000c), suggesting that radionuclide transport in a carrier plume should be included in transport beyond the engineered barrier system."

4.2.3.1 DOE Response to Comment J–8

The DOE responded to Comment J–8 by redefining the scope of the database entry 2.2.08.02.00 into unsaturated and saturated zone features, events, and processes titled "Chemical Characteristics of Groundwater in the Saturated Zone, Chemical Characteristics of Groundwater in the Unsaturated Zone, Geochemical Interactions and Evolution in the Saturated Zone, and Geochemical Interactions and Evolution in the Unsaturated Zone." According to DOE, technical bases supporting the screening arguments are covered by Agreements Evolution of Near-Field Environment (ENFE).1.04, 4.03, 4.04, and RT.1.05. The DOE argued that groundwater chemical characteristics are implicitly included for both unsaturated and saturated zones because, in devising distributions for the transport parameter K_d, site-specific data were employed to bound the range of potential water chemical compositions. The observed ranges will also account for future variations.

Geochemical interactions and evolution in the unsaturated and saturated zones were excluded on the basis of low consequence. For saturated zone waters, DOE argued that, because current spatial chemical variation captures expected temporal variation, there is no need to explicitly include future interactions and evolution. For the unsaturated zone, DOE discussed results of the thermal-hydrologic-chemical seepage model and concluded that repository-induced changes to seepage water chemistry will be limited in spatial and temporal extent. The mountain-scale thermal-hydrologic-chemical model illustrates a similarly limited effect on unsaturated zone water chemistry.

4.2.3.2 NRC Assessment of Response to Comment J–8

The DOE has provided a technical basis for three of the new database entries: Chemical Characteristics of Groundwater in the Saturated Zone, Chemical Characteristics of Groundwater in the Unsaturated Zone, and Geochemical Interactions and Evolution in the

Saturated Zone. The screening argument for item 2.2.08.03.0B, Geochemical Interactions and Evolution in the Unsaturated Zone, does not appear to be complete. This feature, event, and process superceded, among others, item 2.2.08.02.00, Radionuclide Transport Occurs in a Carrier Plume in Geosphere. The new entry includes the descriptive language, "Groundwater chemistry and other characteristics, including temperature, pH, Eh, ionic strength, and major ionic concentrations, may change through time, as a result of the evolution of the disposal system or from mixing with other waters" (Bechtel SAIC Company, LLC, 2004a, page 6-95). The screening argument focused on changes to transport-relevant characteristics of rock surrounding the drift and of seepage water at the drift wall, but it did not address the transport effects of potential changes to water chemistry (e.g., changes in K_d) below the drift due to interaction of that water with engineered materials in the drift and waste package. In other words, a basis was not clearly provided for neglecting the fact that waters carrying radionuclides from the drift may be chemically quite different from ambient unsaturated zone waters or seepage waters. This plume effect was a component of the original entry 2.2.08.02.00 that was apparently not inherited by 2.2.08.03.0B. The DOE should consider providing information in any potential License Application to establish the potential importance of this process to repository performance.

4.2.4 Agreement TSPAI.2.02 Comment J–14

The subject comment is worded as, "2.2.10.07.00 (Thermal-Chemical Alteration of the Calico Hills Unit) is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2001c). The screening argument is based on the prediction of small changes in aqueous geochemistry and mineralogy in response to coupled thermal-hydrological-chemical processes in the near field (CRWMS M&O, 2000b). Thermal-chemical changes in the far field, including the Calico Hills unit will be even less significant (CRWMS M&O, 2001c; Assumption 11). The screening argument indicates that temperatures in the zeolite-bearing Calico Hills unit, will not be high enough to cause significant zeolite alteration. Final evaluation of this exclusion will depend, in part, on the verification of Assumption 11 that far-field changes to radionuclide transport in the unsaturated zone will be less than the calculated near-field changes (CRWMS M&O, 2001c).

Alteration of the uppermost nonwelded layers below the repository could significantly reduce the fraction of matrix flow below the repository. Nonwelded vitric horizons, either basal Topopah Springs vitrophyre or the uppermost Calico Hills unit, cover nearly half the repository. In the southwestern portion of the repository footprint, the nonwelded, nonaltered tuffs lie as little as 45 m [147.64 ft] below the repository. The screening argument (CRWMS M&O, 2001c) includes the assertion that temperatures in the Calico Hills unit will remain below 70 EC [158 EF], which is not high enough to cause significant zeolite alteration. According to the cited reference, however, it appears temperatures can exceed 70 EC [158 EF] {temperatures up to 85 EC [185 EF] are estimated from figures in the cited section of CRWMS M&O (2000d)} where the nonwelded, nonaltered tuff is closest to the repository."

4.2.4.1 DOE Response to Comment J–14

The DOE responded to Comment J–14 by stating that the process of thermal-chemical alteration of the Calico Hills unit is addressed by responses to Agreements ENFE.4.03, 4.04, 1.04 and RT.1.05. The comment referred to an unverified assumption regarding the

extrapolation of near-field results to the far field. According to DOE, this assumption was no longer required to support screening arguments because of the availability of both drift-scale and mountain-scale thermal-hydrologic-mechanical model results.

4.2.4.2 NRC Assessment of Response to Comment J–14

The DOE referred to agreements related to chemical alteration and radionuclide transport to support screening arguments. Staff considered, however, that the process of thermal-chemical alteration of the Calico Hills unit is within the scope of Agreement ENFE.1.03. Agreement ENFE.1.03 has been evaluated, and feedback to DOE was provided in a separate letter (Kokajko, 2005c). In that letter, NRC indicated that DOE had provided the requested information, and the staff considers the ENFE.1.03 complete. Nonetheless, the staff indicated (Kokajko, 2005c) that DOE had not addressed the effects of uncertainty in the kinetics of mineral alteration, and that DOE had used the implicit assumption that permeability is dependent on porosity alone and is independent of mineralogy. Both of these issues are relevant to technical basis for the screening argument. For example, the screening rationale depends on the assumption that porosity and permeability are correlated. Empirical data (Flint, 1998) from the Calico Hills nonwelded vitric and zeolitic units suggest that permeability is not correlated with porosity; therefore, the screening rationale is not fully consistent with empirical data. Also, the effect of uncertainty in the kinetics of alteration on permeability and porosity does not appear to be addressed in the thermal-chemical model. The DOE should consider providing information in any potential License Application which addresses these assumptions.

4.2.5 Agreement TSPAI.2.02 Comment J–15

The subject comment is worded as, “2.2.10.09.00 (Thermal-Chemical Alteration of the Topopah Spring Basal Vitrophyre) is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2001c, 2000a). The screening argument is based on predicting small changes in aqueous geochemistry and mineralogy in response to coupled thermal-hydrological-chemical processes in the near field (CRWMS M&O, 2000b). Thermal-chemical changes in the far field, including the Topopah Spring basal vitrophyre, are expected to be even less significant (CRWMS M&O, 2001c). Although the assumption that far-field changes are likely to be less than near-field changes (Assumption 11) is reasonable, this assumption has not been verified (CRWMS M&O, 2001c). It is important to note that the near-field analyses (CRWMS M&O, 2000b) focus on seepage chemistry and how it might affect container life, rather than considering thermal effects on radionuclide transport. The technical basis should be further discussed to demonstrate low consequence to radionuclide transport.

Alteration of the uppermost nonwelded layers below the repository could reduce the fraction of matrix flow below the repository. Nonwelded vitric horizons, either basal Topopah Spring vitrophyre or the uppermost Calico Hills unit, cover nearly half the repository. In the southwestern portion of the repository footprint, the nonwelded, nonaltered tuffs lie as little as 45 m [147.64 ft] below the repository. The screening argument for 2.2.10.07.00 (CRWMS M&O, 2001c) includes the assertion that temperatures in the Calico Hills unit will remain below 70 EC [158 EF], which is not high enough to cause significant zeolite alteration. According to the cited reference, however, it appears temperatures can exceed 70 EC [158 EF] {temperatures up to 85 EC [185 EF] are estimated from figures in the cited section of CRWMS M&O (2000d)}

where the nonwelded, nonaltered tuff is closest to the repository. Temperatures would be higher in the overlying Topopah Spring basal vitrophyre than in the Calico Hills unit."

4.2.5.1 DOE Response to Comment J–15

The DOE responded by stating that the process of thermal-chemical alteration of the Topopah Spring basal vitrophyre is addressed by responses to Agreements ENFE.4.03, 4.04, 1.04, and RT.1.05. The comment referred to an unverified assumption regarding the extrapolation of near-field results to the far field. According to DOE, this assumption was no longer required because of the availability of both drift-scale and mountain-scale thermal-hydrologic-mechanical model results.

4.2.5.2 NRC Assessment of Response to Comment J–15

The DOE referred to agreements related to chemical alteration and radionuclide transport to support screening arguments. Staff considered, however, that the process of thermal-chemical alteration of the Topopah Spring basal vitrophyre is within the scope of Agreement ENFE.1.03. Agreement ENFE.1.03 has been evaluated, and feedback to DOE was provided in a separate letter (Kokajko, 2005c). In that letter, NRC indicated that DOE had provided the requested information, and the staff considers the ENFE.1.03 complete. Nonetheless, the staff indicated (Kokajko, 2005c) that DOE had not addressed the effects of uncertainty in the kinetics of mineral alteration, and that DOE had used the implicit assumption that permeability is dependent on porosity alone and is independent of mineralogy. Both of these issues are relevant to technical basis for the screening argument. For example, the screening rationale depends on the assumption that porosity and permeability are correlated. The nonwelded portion of the Topopah Springs basal vitrophyre is considered part of the Calico Hills hydrostratigraphic unit. Empirical data (Flint, 1998) from the Calico Hills nonwelded vitric and zeolitic units suggest that permeability is not correlated with porosity; therefore, the screening rationale is not fully consistent with empirical data. Also, the effect of uncertainty in the kinetics of alteration on permeability and porosity does not appear to be addressed in the thermal-chemical model. The DOE should consider providing information in any potential License Application which addresses these assumptions.

4.2.6 Agreement TSPAI.2.02 Comment J–20

The subject comment is worded as, "2.2.07.05.00 (Flow and Transport in the Unsaturated Zone from Episodic Infiltration). Excluded based on low consequence (CRWMS M&O, 2001c). Screening argument asserts that episodic infiltration is expected to be attenuated by flow in the Paintbrush nonwelded tuff layer such that unsaturated zone flow beneath this layer is effectively steady-state. Analyses to support this assertion, however, have only considered episodic infiltration with an average of 5 mm/yr [0.197 in/yr] infiltration flux. Area-average infiltration flux over the proposed repository horizon at Yucca Mountain is expected to exceed 20 mm/yr [0.787 in/yr] during future wetter climate conditions."

4.2.6.1 DOE Response to Comment J–20

The DOE responded to Comment J–20 by stating that technical basis to support the screening argument is part of Agreement USFIC.4.04. The DOE responded to Comment 20 in Appendix I

of the "Technical Basis Document No. 2: Unsaturated Zone Flow" (Bechtel SAIC Company, LLC, 2004b).

4.2.6.2 NRC Assessment of Response to Comment J–20

The DOE agreement responses provided in Appendixes A–I of Technical Basis Document No. 2 were reviewed by NRC in Kokajko (2005d). Agreement USFIC.4.04 was considered complete. The information provided by DOE, however, does not provide a transparent justification for excluding the effects of transient infiltration below the Paintbrush tuff hydrogeologic unit throughout all portions of the model domain relevant to potential repository performance. Therefore, DOE should consider providing additional technical bases in any potential License Application to address Comment J–20, such as additional analyses of transient flow damping by the Paintbrush tuff unit. These analyses should be based on net infiltration scenarios that are reasonably representative of the higher infiltration rates expected for future wetter climates and also on the thickness of the Paintbrush tuff representative of the area above the majority of the potential repository footprint. Alternatively, DOE could include the effects of transient flow in performance assessment seepage abstractions or provide other lines of evidence to show that transient flow below the Paintbrush tuff layer would not be detrimental to repository performance.

4.2.7 Agreement TSPAI.2.02 Comment J–21

The subject comment is worded as, "2.2.11.02.00 (Gas Pressure Effects) is excluded based on low consequence and low probability (CRWMS M&O, 2001c). Consistency is needed in the screening arguments. Buildup of water vapor pressure within rock matrix blocks from waste heat has not been considered. Gas pressure can build up within matrix blocks that have low permeability. This condition can increase the boiling point and keep water in the liquid phase at higher temperatures. Flashing to vapor as liquid water leaves the matrix block can result in mineral deposition that can later affect flow pathways."

4.2.7.1 DOE Response to Comment J–21

The DOE responded to Comment J–21 by stating that the process is addressed by Agreements ENFE.1.05, 1.07, 4.03 and in the Drift-Scale Coupled Processes (DST and THC Seepage) Models Report (Bechtel SAIC Company, LLC, 2004c).

4.2.7.2 NRC Assessment of Response to Comment J–21

A minor inconsistency exists in documentation. The argument provided to address Comment J–21 (gas pressure effects—buildup of vapor pressure in rock matrix near boiling point of water) appears inconsistent with cited documents. The exclusion argument refers to lack of significant pressure buildup. In the cited document (Bechtel SAIC Company, LLC, 2004c; page 292), however, DOE states that differences in chemistry between Revision 1 and Revision 2 of the document may have resulted from pressure buildup in matrix blocks. Independent staff thermal-hydrological-chemical model results suggest most of the mineral precipitation could occur in the fractures of the reflux zone, with limited precipitation in matrix blocks. Consequently, pressure buildup in the matrix could cause fracture water chemistry to be more diluted; thus, a pressure buildup process is likely of low significance to dose risk. A discussion

of the effect of pressure buildup on flow pathways is lacking, and DOE should consider providing this information in any potential License Application.

4.3 Agreement TSPAI.2.03

The document Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07) (Bechtel SAIC Company, LLC, 2004a) addressed Agreement TSPAI.2.03 by directly responding to comments raised during technical exchanges in May and August of 2001. Tracking numbers for these comments are listed in the agreement wording.

Agreement TSPAI.2.03 is deemed of low significance to waste isolation by NRC. Agreement TSPAI.2.03 requested considering particular features, events, and processes within the scope of particular technical subjects. DOE considered those items within the scope of particular technical subjects as requested in the agreement. Details of the NRC review of comments covered by Agreement TSPAI.2.03 are included in Table 3. The staff has no further questions in this area at this time.

4.4 Agreement TSPAI.2.04

The document Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07) (Bechtel SAIC Company, LLC, 2004a) addressed Agreement TSPAI.2.04 by directly responding to comments raised during technical exchanges in May and August of 2001. Tracking numbers for these comments are listed in the agreement wording.

Agreement TSPAI.2.04 is deemed of low significance to waste isolation by NRC. Agreement TSPAI.2.04 requested clarifying the scope of particular features, events, and processes. The DOE properly clarified the scope of those items. Details of the NRC review of comments covered by Agreement TSPAI.2.04 are included in Table 4. The staff has no further questions in this area at this time.

4.5 Agreement TSPAI.2.07

The document “Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)” (Bechtel SAIC Company, LLC, 2004a) addressed TSPAI agreement 2.07 by referring to a database that is not publicly available. Since agreement completion can be based only on public documents, Agreement TSPAI.2.07 will be considered incomplete until the database of features, events, and processes is made publicly available and the NRC staff subsequently completes its review.

5.0 SUMMARY

The NRC reviewed DOE’s information provided for Agreements TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07. In addition, NRC performed an independent assessment to determine whether the information provided would allow a detailed NRC review of a potential license application for a geologic repository. Notwithstanding new information that could raise new questions or comments, the information provided satisfies the intent of the Agreements TSPAI.2.01, 2.03, and 2.04.

Questions remain on Agreement TSPAI.2.02 [Comments 59, J–2, J–8, J–14, J–15, J–20, J–21, and 37 (Kokajko, 2005a)] and therefore, Agreement TSPAI.2.02 is considered incomplete.

TSPAI.2.07 is considered incomplete until the updated database of FEPs is made publicly available and the NRC staff subsequently completes its review.

6.0 STATUS OF THE AGREEMENTS

Based on the above review, NRC agrees with DOE that the information provided satisfies Agreements TSPAI.2.01, 2.03, and 2.04. The NRC, therefore, considers Agreements TSPAI.2.01, 2.03, and 2.04 to be complete. Questions remain on Agreement TSPAI.2.02 [Comments 59, J–2, J–8, J–14, J–15, J–20, J–21, and 37 (Kokajko, 2005a)], and additional information is needed to address those questions. Agreement TSPAI.2.07 is considered incomplete until the database of FEPs is made publically available and the implementation of the enhanced plan is reviewed. It is up to DOE to decide how, or whether, to respond to staff's feedback noted herein.

7.0 REFERENCES

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Kokajko, L.E. Partial Staff Review of Information Addressing Total System Performance and Integration Agreements TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07. Letter from Lawrence E. Kokajko to Joseph D. Ziegler dated January 28, 2005a.

Kokajko, L.E. Pre-licensing Evaluation of Key Technical Issue Agreements: Thermal Effects on Flow 2.04, 2.05, 2.07; and General 1.01, Comments 5 and 16. Letter from Lawrence E. Kokajko to Joseph D. Ziegler dated April 15, 2005b.

Kokajko, L.E. Pre-licensing Evaluation of "Evolution of the Near-Field Environment" Key Technical Issue Agreements ENFE.1.03, 1.04, 1.05, 1.07, and 4.02. Letter from Lawrence E. Kokajko to Joseph D. Ziegler dated February 4, 2005c.

Kokajko, L.E. Prelicensing Evaluation of Key Technical Issue Agreements, "Evolution of the Near-Field Environment" ENFE.2.03, "Radionuclide Transport" RT.1.01, 3.02, "Unsaturated and Saturated Flow Under Isothermal Conditions" USFIC.4.04, "Total System Performance Assessment and Integration" TSPAI.3.22, 3.24, 3.26, TSPAI.2.02 (Comments 3, 4, 12, J–20, J–23), and "General Agreement" GEN.1.01 (Comments 24, 26, 69, 106). Letter from Lawrence E. Kokajko to Joseph D. Ziegler dated February 9, 2005d.

Winterle, J.R. "Evaluation of Alternative Concepts for Saturated Zone Flow: Effects of Recharge and Water Table Rise on Flow Paths and Travel Times at Yucca Mountain." San Antonio, Texas: CNWRA. 2003.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
5	2.1.09.21.00 (Suspension of Particles Larger Than Colloids). CRWMS M&O (2001a) states these particles will be included and treated as colloids. 2.1.09.21.00 (Suspension of Particles Larger Than Colloids) is not addressed in CRWMS M&O (2001b), however, and is noted as excluded in two other model components in the Yucca Mountain FEP Database (CRWMS M&O, 2001c). It is not clear how the effects of particles are included with colloids. The integration of 2.1.09.21.00 (Suspension of Particles Larger Than Colloids) across the engineered barrier system, unsaturated zone, and saturated zone should be clarified.	The process Suspension of Particles Larger Than Colloids was addressed separately for the engineered barrier system, unsaturated zone, and saturated zone. For all three settings, effects of this process were excluded on the basis of low consequence. The susceptibility of these particles to settling and physical filtration prevents them from effectively transporting radionuclides.	DOE has clarified and strengthened the screening arguments and consistently excluded the process in all settings. Particles larger than colloids are unlikely to be sufficiently mobile to affect radionuclide transport. Therefore, staff considers that DOE has addressed Comment 5 of Agreement TSPAI.2.01.

7	1.4.06.01.00 (Altered Soil or Surface Water Chemistry). This item is excluded on the basis of low probability (CRWMS M&O, 2001b), but is not addressed as part of the scope of document ANL–NBS–MD–000002 (CRWMS M&O, 2001a). The probability argument is not supported by a calculation or an estimate. This item is possibly relevant for the Integrated Subissue Radionuclide Transport in the Saturated Zone because of possible changes in groundwater chemistry.	This process is excluded by regulation to comply with provisions of 10 CFR 63.305(b) that preclude DOE from projecting future changes in human activities in the Yucca Mountain region. Current human activities do not significantly alter soil or surface water chemistry. Aggregate effects in the unsaturated and saturated zones are not considered in the performance assessment model because of this regulatory exclusion.	DOE has provided additional information to clarify the screening argument, which is consistent with the regulation. Therefore, staff considers that DOE has addressed Comment 7 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
8	1.2.04.07.00 (Ash Fall). DOE assumes that ash fall blankets the region between the repository and the compliance boundary (CRWMS M&O, 2000a). Radionuclides associated with ash fall are then assumed to be transported instantaneously into the saturated zone. DOE presented only the case for uniform distribution. Parameter values and models used in the ash fall analysis are unclear. Some parameters used in the model are not well documented, and others, such as the number of waste packages that fail, are not viewed as conservative. DOE should provide additional bases for the choice of models and parameters used to screen this item.	This item was divided into three parts titled Ashfall, Ash Redistribution in Groundwater, and Ash Redistribution via Soil and Sediment Transport. Effects of ash fall are screened as included in disruptive events and biosphere analyses. Ash fall effects in the saturated zone are screened as excluded. The portion of the NRC comment regarding uniform versus nonuniform distribution of ash fall is addressed in Section 6.2.4 of the document Features, Events, and Processes in SZ Flow and Transport (Bechtel SAIC Company, LLC, 2004b).	Staff considers that the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) provides clarifying information that addresses Comment 8 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
9	2.2.10.06.00 [Thermal-Chemical Alteration (Solubility Speciation, Phase Changes, and Precipitation/Dissolution)] [Saturated Zone]: Screened as excluded on the basis of low consequence (CRWMS M&O, 2001a) with reference to the screening argument for 2.2.07.10.00 (Condensation Zone Forms Around Drifts) (CRWMS M&O, 2001b). The argument that repository thermal effects on saturated zone radionuclide transport will be minimal is based on a to-be-verified assumption (CRWMS M&O, 2001b). There is no explicit technical basis presented proving that rock alteration or temperature effects on and processes will negligibly affect saturated zone transport. In addition, it is asserted in CRWMS M&O (2001a) that any such effects would be within the bounds of uncertainty ranges established for transport properties such as K_d. The relevant analysis and model report (CRWMS M&O, 2000b), however, does not provide a clear technical basis that this is the case. DOE should provide additional technical justification for exclusion.	This database entry was split into two new entries, one each for the unsaturated and saturated zones. The DOE response to Comment 9 considered only the saturated zone case. (See Comment J–13 for the unsaturated zone case.) This process was excluded due to low consequence. Screening arguments are no longer based on to-be-verified assumptions. A numerical model of mountain-scale effects of thermal loading on the host rock due to waste emplacement (Bechtel SAIC Company, LLC, 2003, Section 6.5) was used to conclude that there will be insignificant repository-induced calcite precipitation or dissolution at and near the water table.	DOE has provided additional information to clarify the screening argument for alteration effects at the saturated zone. The argument is based on mountain-scale modeling of repository thermal effects. DOE addressed unsaturated zone aspects of this comment separately under its response to Comment J–13 (see Table 2). Therefore, staff considers that DOE has addressed Comment 9 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
9 (continued)	Some comments apply to 2.2.10.08.00 (Thermal-Chemical Alteration of the Saturated Zone). [Unsaturated Zone]: DOE has not provided the technical basis for excluding entrained colloids in the analysis of 2.2.10.06.00 [Thermo-Chemical Alteration (Solubility Speciation, Phase Changes, and Precipitation/Dissolution)] or an alternative database entry (CRWMS M&O, 2001b). DOE has not considered possible entrainment of colloids and particulates in convecting/advecting boiling fluids or by otherwise vigorous water movement in the drift.	This process will not significantly change radiological exposures of releases to the accessible environment.	
10	2.3.11.04.00 (Groundwater Discharge to Surface) is excluded on the basis of low consequence (CRWMS M&O, 2001a). Modeling shows that spring discharge within the 20-km [12.4-mi] radius is not likely, yet past discharges occurred within the 20-km [12.4-mi] radius (e.g., paleospring deposits at 9S and 1S). See discussion of 1.3.07.02.00 (Water Table Rise). Additional technical justification should be provided to fully exclude 2.3.11.04.00 (Groundwater Discharge to Surface).	This surface discharge process is screened as excluded by regulation because the dose to the reasonably maximally exposed individual is not calculated outside the reference biosphere. Groundwater discharges within the reference biosphere, where dose is calculated, are screened as included.	DOE has provided information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 10 in the context of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
13	2.2.10.02.00 (Thermal Convection Cell Develops in Saturated Zone) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001a). DOE indicates that temperatures at the water table are expected to approach 80 EC [176 EF]. DOE further points out the resulting concern is that thermally driven water flow in the upper tuff aquifer could increase groundwater velocities relative to the system without heat sources. Additional justification for exclusion should be provided.	This process is screened as excluded on the basis of low consequence. No significant change in dose is anticipated as a result of thermal convection effects. The screening argument has been clarified by presenting results of thermal modeling that show no generation of convection cells (Bechtel SAIC Company, LLC, 2003).	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 13 of Agreement TSPAI.2.01.
18	The biosphere analysis and model report on features, events, and processes (CRWMS M&O, 2001d) indicates that any future changes in 1.4.07.01.00 (Water Management Activities) can be excluded based on 10 CFR Part 63. This item includes well pumping from an aquifer as a water management activity. The conclusion that changes to water management activities may be excluded is not supported by the regulation. 10 CFR Part 63 indicates the behaviors and characteristics of the farming community are to be consistent with current conditions of the region surrounding the Yucca Mountain site and that climate evolution shall be consistent with the geologic record.	This process is screened as included for both the saturated zone and the biosphere.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 18 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
18 (continued)	As the climate becomes wetter and cooler, the farming community may pump less water out of the aquifer, consistent with sites analogous to the predicted future climate of Yucca Mountain. This reduction in pumping would not be considered a change in the behavior or characteristics of the critical group, because the community would still be raising similar crops using similar farming methods.		
19 (Part 5)	DOE has selected a subset of the full list of features, events, and processes as applicable for biosphere screening in (CRWMS M&O, 2001d). Some entries that are potentially applicable to biosphere dose conversion factor calculations (that should at least be considered for screening) have not been included in the scope of the document ANL–MGR–MD–000011 (CRWMS M&O, 2001d). These include the following: 2.2.08.01.00 (Groundwater chemistry/composition in unsaturated zone and saturated zone) (i.e., chemical species can impact dose coefficient selection).	This process is classified as included in the performance assessment model. The suggested item of groundwater chemistry/composition in unsaturated and saturated zones has been considered in the biosphere model. The screening disposition was clarified by describing recent results of groundwater composition analyses and sorption experiments.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 19 (Part 5) of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
21	2.3.13.01.00 (Biosphere Characteristics) screening argument indicates the Yucca Mountain region lacks permanent surface water (CRWMS M&O, 2001d). It is not clear whether this statement is consistent with the geologic record of past climate change in the area.	This item is classified as included. The previous screening argument for exclusion based on lack of permanent surface water is no longer applicable.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 21 of Agreement TSPAI.2.01.
32	2.1.13.01.00 (Radiolysis) is excluded based on low consequence (CRWMS M&O, 2000c, 2001e). [Waste Package]: Alpha, beta, gamma, and neutron irradiations of air saturated water can cause changes in chemical conditions (Eh, pH, and concentration of reactive radicals) and positive shifts in corrosion potential from the formation of hydrogen peroxide. DOE, on the bases of experimental work, concluded that radiolysis will not lead to localized corrosion of Alloy 22. Additional work, however, is necessary to complete the evaluation of the critical potentials related to localized corrosion of Alloy 22.	The issue of nitric acid formation from radiolysis has been examined and documented in Attachment II of the document In-Package Chemistry for Waste Forms, and Attachment III of the document In Package Chemistry Abstraction. The process of radiolysis is classified as excluded on the basis of low consequence. The dose rate is not high enough to generate high concentrations of HNO_3 (14.2 mol/L) needed to promote the corrosion of zirconium alloy.	Staff considers that the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) provides clarifying information to address Comment 32 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
32 (continued)	[Waste Form Miscellaneous]: The screening argument considers only radiolysis of water to produce hydrogen and oxidants. There is no consideration of the formation of nitric acid resulting from radiolysis in presence of air. Spent nuclear fuel is expected to have higher dissolution rates at lower pH, thus, ignoring nitric acid may underestimate radionuclide release. Potential production of nitric acid from radiolysis of N_2 in air should be considered. DOE should consider potential effect of acid environments on the corrosion of Alloy 22 and titanium.		
41	2.1.02.20.00 (Pressurization from Helium Production Causes Cladding Failure) is included as a process of internal gas pressure buildup that increases the cladding stress contributing to delayed hydride cracking and strain (creep) failures (CRWMS M&O, 2000d). The wording in the text that states helium production from alpha decay is the main source of pressure buildup, could be more precise.	This process has been excluded on the basis of low consequence. No cladding failure from helium production due to alpha decay is anticipated. A more detailed argument describing cladding pressurization from helium production due to alpha decay is included in Section 6.10 of the document titled Clad Degradation–FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004c).	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 41 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
47	2.1.02.17.00 [Localized Corrosion (Crevice Corrosion) of Cladding] is excluded based on low probability of occurrence (CRWMS M&O, 2000d). Experimental evidence is cited to indicate that crevice corrosion has not been observed in zirconium alloys exposed to chloride solutions, including NRC and CNWRA results. There is a need to develop a better understanding of localized corrosion of zirconium alloys before confirming this conclusion, because the data are limited. In the report, Clad Degradation—Local Corrosion of Zirconium and Its Alloys Under Repository Conditions (CRWMS M&O, 2000e) it is noted that crevice corrosion may occur in the presence of fluoride ions.	The screening argument has been clarified by citing additional experimental evidence regarding crevice corrosion in the document Clad Degradation–FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004c, Section 6.7). The issue of corrosion in the presence of fluoride ions was addressed in Section 6.17 of the DOE document (Bechtel SAIC Company, LLC, 2004c, Section 6.17). The issue of corrosion in the presence of fluoride ions will be addressed in revised screening arguments.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 47 of Agreement TSPAI.2.01.
50	2.1.02.13.00 (General Corrosion of Cladding) is excluded based on low probability of occurrence (CRWMS M&O, 2000d). Although general corrosion of cladding could expose large areas of irradiated fuel matrix and produce hydrides, it is argued that this corrosion is a slow process.	The screening argument in Clad Degradation–FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004c, Section 6.3) provides corroborating evidence regarding the corrosion resistance of zirconium at temperatures below 250 EC.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 50 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
50 (continued)	The arguments are based on extrapolation to low temperatures at test data obtained at temperatures above 250 EC [482 EF] and in measurements of oxide thickness from specific fuel rods after reactor operation and exposure to water in reactor pool storage.		
53	2.1.02.22.00 (Hydride Embrittlement of Cladding) is excluded based on low probability of occurrence (CRWMS M&O, 2000d). The DOE screening argument states that the in-package environment and cladding stresses are not conducive to hydride cracking. The NRC staff believe that reorientation of preexisting hydride and embrittlement depends on temperature in addition to the required stresses. Clarification is needed on the cladding temperature and stress distributions used in the analysis. Several of the secondary features, events, and processes related to various processes leading to hydrogen entry into the cladding are listed below. 2.1.02.22.01 [Hydride Embrittlement from Zirconium Corrosion (of Cladding)] is excluded because of low probability of occurrence, low hydrogen pickup as a result of cladding corrosion, low corrosion rate, and relatively small pickup fraction.	An extensive, quantitative screening argument for exclusion of hydride cracking of cladding has been added to Clad Degradation–FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004c, Section 6.12). Hydride cracking and embrittlement of the cladding is excluded on the basis of low consequence. The response provided in Section 6.12 of the document indicates that the stresses in the cladding are not sufficient to fail the cladding at repository temperatures and the in-package environment is not conducive to hydride cracking and embrittlement.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 53 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
53 (continued)	The experimental hydrogen pickup fraction is provided, and it is argued the corrosion rate is low. The conclusion DOE reached regarding failure of cladding as a result of hydrogen pickup from general corrosion is acceptable. The screening arguments, however, can be better justified using quantitative arguments for the corrosion rate during disposal conditions. 2.1.02.22.02 [Hydride Embrittlement from Waste Package Corrosion and Hydrogen Absorption (of Cladding)] is excluded because of the low probability of occurrence. The hydrogen generated by corrosion of waste packages and waste package internals and presented as a molecule in gas or dissolved in water is not directly absorbed by the cladding. It is argued, on the basis of experimental data, that hydrogen absorption occurred through the reaction with water, and not from the dissolved molecular hydrogen. The conclusion DOE reached regarding failure of cladding as a result of absorption of hydrogen gas generated by corrosion of waste package materials is acceptable. The screening arguments, however, could be better organized.		

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
53 (continued)	2.1.02.22.03 (Hydride Embrittlement from Galvanic Corrosion of Waste Package Contacting Cladding) is excluded because of the low probability of occurrence because corrosion of waste package internals will not result in hydriding of cladding. It is argued, using some experimental data as bases, that galvanic coupling to carbon steel will not be conducive to hydrogen charging because corrosion products will interrupt the electrical contact. It is claimed also that the nickel content both in Zircaloy-2 and -4 is not sufficient to induce the necessary hydrogen charging. The conclusion DOE reached regarding failure of cladding as a result of hydrogen entry from galvanic coupling with internal components of the waste packages is, in general, acceptable. The screening arguments, however, could be better supported by more relevant experimental data. 2.1.02.22.04 [Delayed Hydride Cracking (of Cladding)] is excluded because of the low probability of occurrence. The analysis is based on the use of calculated values for the distribution of the stress intensity factor, which is compared with the threshold stress intensity for irradiated Zircaloy-2.		

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
53 (continued)	The DOE analysis of delayed hydride cracking is based on material properties of cladding containing mostly circumferential hydrides. DOE should provide cladding temperatures and stress distributions and demonstrate that they are insufficient to cause hydride reorientation. 2.1.02.22.05 [Hydride Reorientation (of Cladding)] is excluded because of the low probability of occurrence, since tested fuel rods did not exhibit hydride reorientation at stresses higher than those expected at the repository temperatures. It is argued, in addition, that with hydride reorientation, stresses will be insufficient for hydride embrittlement and cladding failure. Therefore, hydride reorientation has not been included in the model abstraction for cladding degradation. DOE agreed to provide updated documentation on the distribution of cladding temperatures and hoop stresses, which are critical parameters needed to evaluate the propensity to hydride reorientation and embrittlement [see 2.1.02.22.00 (Hydride Embrittlement of Cladding)].		

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
53 (continued)	2.1.02.22.06 [Hydride Axial Migration (of Cladding)] is excluded based on low probability. It is unlikely that sufficient hydrogen can be moved to the cooler ends of the fuel rods because of a lack of large temperature gradients in the waste packages. Based on studies for storage up to 90 years, it is concluded that the temperature gradients are not sufficient to induce redistribution of hydrides. The screening arguments, however, should include the combined effects of stress and temperature.		
58	Screening arguments were labeled with the word Preliminary in (CRWMS M&O, 2000a) {FEPs 2.1.07.01.00 [Rockfall (Large Block)]; 1.2.02.01.00 (Fractures); 1.2.02.02.00 (Faulting); 1.2.03.01.00 (Seismic activity); etc}, and in (CRWMS M&O, 2001f). Attachment I of this latter document includes 61 FEPs arguments that are considered preliminary. It is stated that "future modeling and analysis efforts may enhance these considerations, and in this sense they are preliminary." It is necessary to disclose plans to release screening arguments with improved technical bases.	All screening arguments that were considered to be preliminary have been defined, analyzed, and finalized. There are no longer any preliminary screening arguments associated with engineered barrier system features, events, and processes.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 58 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
67	2.2.10.05.00 (Thermal-Mechanical Alteration of Rocks Above and Below the Repository) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001g). Thermal-mechanical compression at the repository produces tension-fracturing in the Paintbrush nonwelded tuff and other units above the repository. These fractures alter unsaturated zone flow between the surface and the repository. Extreme fracturing may propagate to the surface, affecting infiltration. Thermal fracturing in rocks below the repository affects flow and radionuclide transport to the saturated zone.	The screening argument is based on numerical modeling of the effects of thermal loading (Bechtel SAIC Company, LLC, 2003, Section 6.5). Results of the modeling demonstrate quantitatively that thermal-hydrologic-mechanical effects have no significant impact on the vertical percolation flux through the repository horizon; therefore, this process can be excluded.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment 67 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–5	2.1.09.21.00 (Suspensions of Particles Larger than Colloids) is screened as excluded from the engineered barrier system transport and waste form release abstractions (CRWMS M&O, 2000f, 2001b). Exclusion is based on the assumption that although particles may be transported through fractures in the unsaturated zone, low groundwater velocities through the saturated zone would lead to particle settling (CRWMS M&O, 2000f), suggesting inconsistency in the screening analysis. Without quantitative measures of particle size, pore size, groundwater velocity, and chemical variability, however, these qualitative assertions are difficult to evaluate.	The entry 2.1.09.21.00 was divided into three entries titled Transport of Particles Larger than Colloids in Engineered Barrier System; Transport of Particles Larger than Colloids in the Saturated Zone; and Transport of Particles Larger than Colloids in the Unsaturated Zone. Quantitative analyses described in Section 6.2.13 of the document Features, Events, and Processes in SZ Flow and Transport (Bechtel SAIC Company, LLC, 2004b) and Section 6.3.4 of the document	DOE has included an analysis of the maximum particle size that can remain in suspension and used conservative assumptions to simulate particle transport in the engineered barrier system. Staff considers that the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) provides clarifying information to address Comment J–5 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–5 (continued)	Because DOE includes colloid formation features, events, and processes in its screening analysis, and because of the large amounts of iron particles that may be introduced in the engineered barrier system, particle transport through the engineered barrier system into the unsaturated zone is plausible.	Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004d) are used to demonstrate that gravitational settling will render particles larger than colloids immobile. In the saturated zone, the calculated upward vertical component of velocity is shown to be less than the settling velocity, given measured permeabilities and gradients. In Section 6.2.54 of Engineered Barrier System Features, Events, and Processes it is conservatively assumed that no colloid settling or filtration occurs in the engineered barrier system.	
J–16	1.2.07.01.00 (Erosion/Denudation) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001b). The rationale for exclusion from the unsaturated zone on the basis of low consequence is incomplete. DOE should consider the onset and extent of erosion caused by construction and characterization activities at the ground surface and the long-term effects on shallow infiltration.	The screening argument for this item has been expanded to include the effects of construction and characterization activities. DOE concludes that these activities will have a negligible effect because of the planned reclamation of the site ground surface.	DOE has provided additional information to clarify screening arguments. Therefore, staff considers that DOE has addressed Comment J–16 of Agreement TSPAI.2.01.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a)
(References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–18	1.3.04.00.00 (Periglacial Effects) is screened as excluded by low probability (CRWMS M&O, 2001b). Although other periglacial processes will not likely occur at Yucca Mountain, the freeze/thaw process is currently active. Freeze/thaw mechanical erosion, however, will likely increase as the climate cools. The magnitude of erosion will not likely be significant even during the cooler climate condition. The screening argument should be clarified to acknowledge the current freeze/thaw process	Freeze and thaw erosion is recognized in the documents Evaluation of Features, Events, and Processes (FEP) for the Biosphere Model and Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004d). The freeze/thaw process is excluded in both cases due to low consequence.	DOE considered the freeze/thaw process and appropriately excluded it based on a low erosion rate. Therefore, staff considers that DOE has addressed Comment J–18 of Agreement TSPAI.2.01.

References

Bechtel SAIC Company, LLC. "Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)." Rev. 2. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004a.

———. "Features, Events, and Processes in SZ Flow and Transport." ANL-NBS-MD-000002. Rev. 02. Las Vegas, Nevada: Bechtel SAIC Company. 2004b.

———. "Clad Degradation—FEPs Screening Arguments." ANL–WIS–MD–000008. Rev. 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004c.

———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 02. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004d.

———. "Mountain-Scale Coupled Processes (TH/THC/THM)." MDL–NBS–HS–000007. Rev. 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2003.

CRWMS M&O. "Features, Events, and Processes in SZ Flow and Transport." ANL–NBS–MD–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001a.

———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001b.

Table 1. Assessment of Responses to TSPAI.2.01 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response

References (continued)

———. "Yucca Mountain FEP Database." TDR–WIS–MD–000003. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2001c.
———. "Evaluation of the Applicability of Biosphere-Related Features, Events, and Processes (FEP)." ANL–MGR–MD–000011. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001d.
———. "FEPs Screening of Processes and Issues in Drip Shield and Waste Package Degradation." ANL–EBS–PA–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001e.
———. "EBS FEPs/Degradation Modes Abstraction." ANL–WIS–PA–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001f.
———. "FEPs Thermal Hydrology and Coupled Processes." ANL–NBS–MD–000004. Rev. 00 ICN 01. Las Vegas, Nevada:

CRWMS M&O. 2001g.
———. "Features, Events, and Processes: Screening for Disruptive Events." ANL–WIS–MD–000005. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000a.
———. "Unsaturated Zone and Saturated Zone Transport Properties." ANL–NBS–HS–000019. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000b.
———. "Miscellaneous Waste Form FEPs." ANL–WIS–MD–000009. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000c.
———. "Clad Degradation—FEPs Screening Arguments." ANL–WIS–MD–000008. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000d.
———. "Clad Degradation—Local Corrosion of Zirconium and Its Alloys Under Repository Conditions." ANL–EBS–MD–000012. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000e.
———. "Colloid-Associated Concentration Limits: Abstraction and Summary." ANL–WIS–MD–000012. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000f.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
3	2.2.10.03.00 (Natural Geothermal Effects). It is stated that natural geothermal effects are included because the current geothermal gradient is addressed in the saturated zone flow and transport model (CRWMS M&O, 2001a). This discussion, however, does not address the potential for spatial and temporal variations in that gradient, which is part of the description of 2.2.10.03.00 (Natural Geothermal Effects). Resolution of this issue is necessary to address changes in the geothermal gradient in 2.2.10.13.00 [Density-Driven Groundwater Flow (Thermal)].	The current geothermal gradient is implicitly included in flow models. Agreement USFIC.5.13 was completed, providing evidence from fluid inclusions regarding past temperature gradients. The technical basis for item 2.2.10.03.00 has been updated in Bechtel SAIC Company, LLC (2004b,c). The potential for future changes in the geothermal gradient was addressed separately in the response to Agreement ENFE.2.03 (Appendix H of Technical Basis Document No. 2: Unsaturated Zone Flow). Based on combined fluid inclusion, isotopic, and geologic data, DOE concluded that past elevated geothermal gradients resulted from processes no longer active at Yucca Mountain.	DOE has provided a technical basis for the screening argument. Detailed assessment of the response to Comment 3 in Appendix H of the Technical Basis Document No. 2 is provided in Kokajko (2005). Therefore, staff considers that DOE has addressed Comment 3 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a)
(References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
4	1.2.06.00.00 (Hydrothermal Activity). [Saturated Zone]: In CRWMS M&O (2001a), this item is excluded on the basis of low consequence. For saturated zone transport, the adopted K_d distributions account for possible lithologic changes and thermal effects, with reference to CRWMS M&O (2000a). However, the latter document does not provide a clear technical basis that the K_ds were derived in such a fashion. In addition, although the screening argument is based on low consequence, there is a reference at the conclusion of the supplemental discussion to the low probability of hydrothermal activity (CRWMS M&O, 2001a). This also relates to the geothermal gradient in 2.2.10.13.00 [Density-Driven Groundwater Flow (Thermal)]. DOE should provide a stronger technical basis for the assertion that possible hydrothermal effects on K_d values are accounted for in the total system performance assessment.	Agreements RT.1.05 and 2.10 address the technical bases for K_d distributions; however, the DOE screening argument no longer relies on assertions concerning K_d distributions. Silicic volcanism is excluded on the basis of the site geologic history, and hydrothermal effects from basaltic igneous activity would be spatially limited. This comment is also addressed separately in the response to Agreement ENFE.2.03 (Appendix H of Technical Basis Document No. 2: Unsaturated Zone Flow). Based on combined fluid inclusion, isotopic, and geologic data, DOE concluded that past elevated geothermal gradients resulted from processes no longer active at Yucca Mountain.	DOE has provided a technical basis for the screening argument. Detailed assessment of the response to Comment 4 in Appendix H of the Technical Basis Document No. 2 is provided in Kokajko (2005). Therefore, staff considers that DOE has addressed Comment 4 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
4 (continued)	[Unsaturated Zone]: This item is excluded in the unsaturated zone on the basis of low consequence and low probability (CRWMS M&O, 2000b). DOE should provide a sufficient technical basis for models explaining elevated temperatures in the unsaturated zone that adequately address the timing and mode of formation of Type B faults, which record elevated temperatures.		
11	1.3.07.01.00 (Drought/Water Table Decline). According to information in CRWMS M&O (2001a), this item is excluded because of low consequence. DOE states, "ÿ a lower water table could result in less travel through the alluvial aquifer and as a result, less sorption and retardation of the contaminant plume." No evidence, however, is presented that precludes a water table decline. Current flow models assume that groundwater flow through the saturated alluvium is relatively shallow.	Response to Agreements RT.2.08 and USFIC.5.04 were submitted in Technical Basis Document No. 11: Saturated Zone Flow and Transport. Technical bases are provided in the responses to these agreements to exclude water table decline on the basis of low consequence. DOE screens out this process by noting that future climates are expected to have increased precipitation so that a water table decline is not expected.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Document No. 11, DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 11 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
11 (continued)	As water tables decline, how will flow through the alluvium be affected? Is it possible that a larger component of flow will be through the deep carbonate system? Will the upward gradient observed at some locations be affected? Are there distinct pathways that are dependent on elevation of the water table? It is likely that the transport times will stay the same or increase from water table decline; however, the exclusion argument provided seems insufficient. DOE should provide additional technical justification to exclude 1.3.07.01.00 (Drought/Water Table Decline).	DOE also argues that a decline in the water table and lower infiltration rates would enhance the unsaturated zone as a barrier to radionuclide movement (Bechtel, SAIC Company, LLC, 2004a).	
12	2.2.10.13.00 [Density-Driven Groundwater Flow (Thermal)]. The analysis and model report (CRWMS M&O, 2001a) addresses this item in two parts: repository-induced effects (excluded, low consequence) and natural geothermal effects (included). Natural effects are included only to the extent that the natural geothermal gradient is applied in the saturated zone flow and transport model. Changes in thermal gradients, however, are excluded on the basis of low consequence, with reference to 1.2.06.00.00 (Hydrothermal Activity) and 1.2.10.02.00 (Hydrologic Response to Igneous Activity) (CRWMS M&O, 2001a).	The DOE response to Comment 12 focused on the new entry 2.2.10.13.0A (Repository-Induced Thermal Effects on Flow in the Saturated Zone). The entry was excluded on the basis of low consequence. Thermal perturbation at the water table will be minor and localized. Higher water temperature would promote sorption and lateral dispersion; therefore, neglecting high temperatures is conservative.	DOE has provided a technical basis for the screening argument that thermal perturbation of the saturated zone will have low consequences. Detailed assessment of the response to Comment 12 in Appendix H of the Technical Basis Document No. 2 is provided in Kokajko (2005). Therefore, staff considers that DOE has addressed Comment 12 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
12 (continued)	A clear technical basis that all possible changes in thermal gradients will be localized is not provided for these items. The screening argument for 1.2.06.00.00 (Hydrothermal Activity) focuses on geochemical effects (see separate entry), whereas 1.2.10.02.00 (Hydrologic Response to Igneous Activity) is focused on highly localized igneous intrusions. How these arguments apply to 2.2.10.13.00 [Density-Driven Groundwater Flow (Thermal)] is not entirely clear.	Aspects of this comment concerned with natural hydrothermal activity were addressed separately in the response to Agreement ENFE.2.03 (Appendix H of Technical Basis Document No. 2: Unsaturated Zone Flow). Based on combined fluid inclusion, isotopic, and geologic data, DOE concluded that past elevated geothermal gradients resulted from processes no longer active at Yucca Mountain.	
19 (Parts 1, 2, and 6)	DOE has selected a subset of the full list of features, events, and processes as applicable for biosphere screening in (CRWMS M&O, 2001a). Some entries that are potentially applicable to biosphere dose conversion factor calculations (that should at least be considered for screening) have not been included in the scope of the document ANL–MGR–MD–000011 (CRWMS M&O, 2001a).	DOE indicated that processes considered influential to the biosphere system were evaluated. Part 1 was addressed by developing arguments to disregard water table rise processes in a performance assessment model.	DOE has provided technical bases to disregard water table rise (Part 1) processes in a performance assessment model. Distribution and release of radionuclides from the geosphere (Part 6) were included in the performance assessment model. Staff has no further questions at this time.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
19 (Parts 1, 2, and 6) (continued)	These include: Part 1: 1.3.07.02.00 (Water table rise) Part 2: 2.3.11.04.00 (Groundwater discharge to surface) Part 6: 2.2.08.11.00 (Distribution and release of nuclides from the geosphere)	Groundwater discharge to the surface outside the reference biosphere (Part 2) was excluded on the basis of inconsistency with the requirements in 10 CFR 63.113(b). DOE argued that 10 CFR 63 specifies conditions of the reference biosphere; therefore, processes occurring outside the reference biosphere do not need to be considered in a performance assessment model. Distribution and release of radionuclides from the geosphere (Part 6) were included in the performance assessment model.	Regarding the consideration of groundwater discharge points at the surface (Part 2), DOE has stated that spring deposits do not occur at the location of the reasonably maximally exposed individual and are excluded from consideration. Additionally, it does not appear that future surface discharges would likely be a significant risk to the reasonably maximally exposed individual because locations of potential spring discharge points near Yucca Mountain are far enough from projected flow paths that potential discharge of radionuclides to springs is unlikely. Therefore, staff considers that DOE has addressed Comment 19 (Parts 1, 2, and 6) of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
25	2.4.07.00.00 (Dwellings) includes a secondary entry, household cooling, which has an inappropriate screening argument (CRWMS M&O, 2001b). The screening argument indicates that because use of an evaporative cooler would only increase inhalation and direct exposure pathways, and these pathways are only minor contributors to the current dose conversion factors, the use of evaporative coolers can be screened. The direct exposure and inhalation dose from evaporative coolers, however, is the result of significantly different processes than the direct exposure and inhalation dose from radionuclides deposited on soils and, hence, could have a more significant dose impact.	The database entry Dwellings no longer has secondary entries. Household cooling is contained in entry 2.4.07.00.0A, which is screened as included in Evaluation of Features, Events, and Processes (FEP) for the Biosphere Model (Bechtel SAIC Company, LLC, 2003a, 2001a).	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment 25 of Agreement TSPAI.2.02.
26	The analysis and model report (CRWMS M&O, 2001b) states that 3.3.08.00.00 (Radon and Daughter Exposure) is screened as excluded on the basis the parent radionuclide (Th-230) will not reach the critical group in 10,000 years in the basecase scenario (CRWMS M&O, 2001b, 2000c). This rationale, however, does not apply to the direct release scenario, where transport times are much shorter.	This process is screened as included. Exposure to radon and radon decay products is included in the air and inhalation submodels of the biosphere model.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment 26 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
29	2.1.06.07.00 (Effects at Material Interfaces) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001c). The basic chemical processes that occur at phase boundaries (principally liquid/solid) are included in other features, events, and processes. Solid/solid contact occurs or could occur between the drip shield and the invert, backfill, or both, (if included in the Yucca Mountain project design); between the waste package and the invert, backfill, or both (if included in the Yucca Mountain project design); between the pedestal and the waste package, drip shield, or both; and, between the waste form and any other engineered barrier system component materials. Because these materials are all relatively inert, no significant solid/solid interaction mechanisms have been identified relative to the basic seepage water-induced corrosion of the engineered barrier system components and, hence, this feature-event-process is excluded on the basis of low consequence.	Entry 2.1.06.07.00 has been divided into two parts titled Chemical Effects at Engineered Barrier System Component Interfaces, and Mechanical Effects at Engineered Barrier System Component Interfaces. Both of these entries are excluded on the basis of low consequence. No solid interaction mechanisms have been identified that are significant relative to the basic seepage water-induced corrosion of the engineered barrier system components. In addition, no enhanced degradation due to mechanical loading at the engineered barrier system component interfaces is expected. Technical bases supporting screening arguments are provided in Appendix P of Technical Basis Document No. 6: Waste Package and Drip Shield Corrosion.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Document No. 6, DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 29 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
29 (continued)	Interfaces between solid phases in contact with an aqueous phase, however, can accelerate degradation processes such as crevice corrosion of the waste package or galvanic coupling of the drip shield to steel components [see screening arguments 2.1.03.01.00 (Corrosion of Waste Containers) and 2.1.03.04.00 (Hydride Cracking of Waste Containers and Drip Shields)].		
36	2.1.09.03.00 (Volume Increase of Corrosion Products) is screened as excluded on the basis of low consequence (CRWMS M&O, 2001c). The presence of waste package corrosion products with higher molar volume than the uncorroded material that may change the stress state in the material being corroded is excluded in the case of the waste package based on low consequence. These products, however, may have an effect on corrosion processes such as stress corrosion cracking of the outer container, after its initial breaching, that may affect radionuclide release [see 2.1.03.07.00 (Mechanical Impact on the Waste Container and Drip Shield)].	Entry 2.1.09.03.00 was split into three parts titled Volume Increase of Corrosion Products Impacts Cladding; Volume Increase of Corrosion Products Impacts Waste Package; and Volume Increase of Corrosion Products Impacts Other Engineered Barrier System Components. The first one is screened as included (Bechtel SAIC Company, LLC, 2004d, Section 6.19), and the other two are excluded. The effect on waste packages was excluded because there will not be enough corrosion products to produce sufficient pressure to damage the waste package.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 36 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
36 (continued)	The possibility of additional sources of stress arising from the formation of corrosion products should be evaluated in regard to stress corrosion cracking. See comment for 2.1.11.05.00 (Differing Thermal Expansion of Repository Components).	The effect on other engineered barrier system components was excluded because the only affected component is the invert, and the invert would be corroded long before significant waste package corrosion products are produced.	

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
38	2.1.11.05.00 (Differing Thermal Expansion of Repository Components) have been excluded from consideration in the total-system performance assessment code (CRWMS M&O, 2001c,d). The technical basis for excluding differing thermal expansion effects on repository performance is not comprehensive. For example, the screening arguments (CRWMS M&O, 2001c) do not address the limited clearance between the inner and outer barriers of the waste package in the axial direction, which may be as small as 2 mm [0.0787 in] according to design drawings (CRWMS M&O, 2000d). In addition, the differential thermal expansion between various invert components and the drift wall (to which they are attached) was not addressed.	Entry 2.1.11.05.00 has been split into two parts titled Thermal Expansion/Stress of In-Package Engineered Barrier System Components and Thermal Expansion/Stress of In-Drift Engineered Barrier System Components; both are excluded on the basis of low consequence. The waste package and its internals are designed for thermal expansion. Calculations supporting screening arguments are documented in the calculation Waste Package Outer Barrier Stresses Due to Thermal Expansion with Various Barrier Gap Sizes (Bechtel SAIC Company, LLC, 2001b).	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 38 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
38 (continued)	2.1.11.05.00 (Differing Thermal Expansion of Repository Components) is excluded on the basis of low consequence (CRWMS M&O, 2001,c,d). Peak temperature of waste packages with 0.5-m [19.68-in] spacing and 50-year ventilation is 278 EC [532.4 EF] with backfill and 176 EC [348.8 EF] without backfill. The screening argument is that the temperature differential between the inner type 316NG barrier and the outer Alloy 22 barrier is 5 EC [41 EF] with a corresponding strain of $2.15 \times 10^{!5}$. This calculation is performed using the difference between the thermal expansion coefficients for Type 316NG stainless steel and Alloy 22 using the maximum expected temperature difference between the waste package barriers. There will be at least a 1-mm [0.0394-in] gap between the barriers, and no thermal stresses are predicted.		

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
38 (continued)	Calculations should use a temperature of the waste package rather than the difference between waste package barriers. The clearance between the inner Type 316NG barrier and the outer Alloy 22 barrier is 0 to 4 mm [0.1575 in] as specified in the waste package design and fabrication process report (CRWMS M&O, 2000e). It is implicit that this clearance is specified at ambient temperature [i.e., 25 EC (77 EF)] because (i) no temperature is specified and (ii) the Alloy 22 waste package outer barrier will be heated to 371 EC [700 EF] for inner 316NG barrier cylinder installation. Using a temperature of 186 EC [366.8 EF], the calculated strain is 7.99×10^{-4}. For a waste package with clearance gaps of 1 mm [0.0394 in] or less at 25 EC [77 EF], thermal stresses will occur as a result of the differences in thermal expansion.		

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
43	2.1.02.27.00 (Localized corrosion perforation from fluoride). Included because fluoride is present in Yucca Mountain waters and zirconium corrodes in environments containing fluoride (CRWMS M&O, 2000f). It is argued that localized corrosion caused by fluoride is included in the model abstraction for cladding degradation to account for modeling uncertainty of the in-package chemistry since conditions for corrosion induced by fluoride were considered more likely to occur relative to other processes examined.	The screening decision for this process has been changed from included to excluded. The technical basis for this decision is documented in Clad Degradation—FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004d, Section 6.17). The fluoride concentration calculated with the chemistry model was not high enough to cause significant localized corrosion.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 43 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
44	2.1.02.16.00 [Localized corrosion (pitting) of cladding]. Included because localized corrosion by pits could produce penetration of cladding (CRWMS M&O, 2000f). Even though localized corrosion is included in the commercial spent nuclear fuel cladding degradation model abstraction, the effect of chloride ions as pitting promoters is not considered in the analysis of localized corrosion done by DOE. It is stated that pitting corrosion is promoted by concentrated chloride and fluoride solutions at very low pHs and very high oxidation potentials, but these conditions are not predicted to occur in the bulk solution inside waste packages.	The screening decision for this process has been changed from included to excluded. The technical basis for this decision is documented in Clad Degradation—FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004d, Section 6.6). Related information on chloride-induced localized corrosion is treated in the response to Agreement CLST.3.07 in Appendix D of Technical Basis Document No. 7: In-Package Environment	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Document No. 7, DOE has provided technical basis for the screening argument. Staff considers that DOE has addressed Comment 44 of Agreement TSPAI.2.02.
44 (continued)	It is, however, accepted that certain processes such as microbial induced corrosion, galvanic coupling, radiolysis in a humid environment, and evaporation may generate locally concentrated solutions of aggressive species or pH decreases such that a model for localized corrosion is necessary.	and Waste Form Degradation and Solubility. The anticipated chemistry is not expected to cause localized corrosion of zirconium cladding.	

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
49	2.1.02.15.00 (Acid Corrosion of Cladding from Radiolysis). Included as part of the localized corrosion model on the basis that formation of HNO_3 and H_2O_2 ions [sic] by radiolysis can enhance corrosion of cladding (CRWMS M&O, 2000f). It is stated, however, that zirconium has excellent corrosion resistance to HNO_3 and concentrated H_2O_2. The arguments are poorly worded, stating that radiolysis is not expected to occur until waste package failure; then, the gamma dose will be too low to produce sufficient HNO_3 and H_2O_2 to promote general corrosion, however, localized corrosion could be possible.	The screening decision for this process has been changed from included to excluded. The technical basis for this decision is documented in Clad Degradation—FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004d, Section 6.5), where it is shown that no pH values below 3.5 are attained, despite the addition of 10 times the expected amount of radiolysis products.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 49 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
49 (continued)	The argument of local acidic pH such as might result from microbial activity causing localized corrosion of cladding contradicts experimental evidence showing that zirconium alloys are resistant to corrosion in reducing and oxidizing acids. In addition, the argument contradicts other DOE arguments to screen out pitting corrosion by chloride anions {see 2.1.02.16.00 [Localized Corrosion (Pitting) of Cladding]}. In the Basis for Screening, undue consideration is given to alkaline conditions arising from the concrete liner, whereas the possibility of acidic conditions (pH< 2) is not discussed.		

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
51	2.1.02.14.00 (Microbially Induced Corrosion of Cladding). Included as part of localized corrosion model on the basis that microbial activity may induce local pH decreases and the local acidic environment may produce multiple penetrations of cladding (CRWMS M&O, 2000f). It is stated, however, that microbially induced corrosion resulting from sulfide produced by sulfate-reducing bacteria and organic acid-producing bacteria is not expected to occur because of resistance of zirconium to these species. The arguments are poorly worded stating that microbially induced corrosion is not expected to occur (not probable or credible) because microbial	The screening decision for this process has been changed from included to excluded. The technical basis for this decision is documented in Clad Degradation—FEPs Screening Arguments (Bechtel SAIC Company, LLC, 2004d, Section 6.4). There has been no credible observation showing that zirconium was subject to microbially influenced corrosion.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 51 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
51 (continued)	activity is screened at the scale of the repository model as a significant bulk process. The argument of local acidic pH such as might be caused by microbial activity resulting in localized corrosion of cladding contradicts experimental evidence showing that zirconium alloys are resistant to corrosion in reducing and oxidizing acids. In addition, the argument contradicts other DOE arguments to screen out pitting corrosion by chloride anions {see 2.1.02.16.00 [Localized Corrosion (Pitting) of Cladding]}. DOE screening arguments for inclusion or exclusion should be consistent with screening decisions for related entries [see 2.1.02.15.00 (Acid Corrosion of Cladding from Radiolysis)]. A third group of bacteria iron oxidizers should also be considered in the analysis (NRC, 2001).		

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
61	2.2.10.12.00 (Geosphere Dryout Due to Waste Heat). It is necessary to develop a screening argument for this item as part of the scope of the analysis and model report (CRWMS M&O, 2001e). Elevated thermal effects on shallow infiltration from changes in soil water content were not addressed for 2.2.10.12.00 (Geosphere Dryout Due to Waste Heat). The DOE study of a natural thermal gradient on Yucca Mountain addresses this item (CRWMS M&O, 1998). 2.2.10.12.00 (Geosphere Dryout Due to Waste Heat) is screened as included in CRWMS M&O (2001f) for issues related to the near-field environment, but does not address the effects on infiltration.	This process is screened as included for the unsaturated zone. The effects of dryout on surface infiltration are discussed under entry 2.2.10.01.0A titled Repository-Induced Thermal Effects on Flow in the UZ. This process is screened as excluded based on low consequence. This conclusion is supported by thermal-hydrologic modeling at the mountain scale. Climate-induced changes in unsaturated zone flow overwhelm any short-term thermal impacts on soil water content and vegetation, and therefore on net infiltration.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 61 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
63	2.1.09.12.00 [Rind (Altered Zone) Formation in Waste, Engineered Barrier Subsystem, and Adjacent Rock]. The thermal-hydrological-chemical model is screened as included, and the thermal-hydrological model, effects on transport is screened as excluded on the basis of low consequence (CRWMS M&O, 2001f). Thermal-chemical processes alter the rock forming of drift walls mineralogically. These alterations have hydrological, thermal, and mineralogical properties different from the current country rock.	An updated screening argument for this process, based on recent thermal-hydrologic-chemical modeling, is contained in Section 6.8.1 of the document titled Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c). Permeability changes do not adversely affect flow or seepage. Potential changes in sorption have no significant effect on dose because the changes are limited to small fractions of the transport pathway. Related information is presented in the response to Agreement ENFE.1.03 AIN-1 in Appendix F to Technical Basis Document No. 3: Water Seeping into Drifts. The issue of unreacted solute mass trapped in the dryout zone in TOUGHREACT simulations is addressed in the response to Agreement	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Document No. 3, DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 63 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
64	2.2.10.06.00 [Thermal-Chemical Alteration (Solubility Speciation, Phase Changes, and Precipitation/Dissolution)]. [Near-Field Environment]: Screened as excluded on the basis of low consequence (CRWMS M&O, 2001f). Changes in the groundwater temperature in the farfield, if significant, may change the solubility and speciation of certain radionuclides. This change could have the effect of altering radionuclide transport processes. Relevant processes include volume effects associated with silica phase changes, precipitation and dissolution of fracture-filling minerals (including silica and calcite), and alteration of zeolites and other minerals to clays.	An updated screening argument for this process, based on recent modeling and analysis results, is contianed in Section 6.8.13 of the document titled Features, Events, and Processes in UX Flow and Transport (Bechtel SAIC Company, LLC, 2004c). Related information is provided in the response to Agreement ENFE.1.03 AIN-1 in Appendix F to Technical Basis Document No. 3: Water Seeping into Drifts. Changes in solubility limits have no adverse effect on transport. Temperature effects on sorption are negligible or beneficial. Effects on colloid stability are beneficial. Thermal-chemical effects on sorption are limited to a small region and short period after rewetting and are, thus, of low consequence.	Alteration of the Calico Hills Unit and the Topapah Spring Basal Vitrophyre are addressed in Comments J–14 and J–15. NRC assessment of J–14 and J–15 responses are provided in Sections 4.2.5 and 4.2.6. Based on staff review of the summary of the screening argument for other far-field alteration processes (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Document No. 3, DOE has provided technical basis for the screening argument for other far-field alteration processes. Therefore, staff considers that DOE has addressed Comment

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
65	2.1.11.02.00 (Nonuniform Heat Distribution/Edge Effects in Repository). The thermal-hydrological and thermal-hydrological-chemical aspects are screened as included, and the thermal-mechanical effects are screened as excluded on the basis of low consequence (CRWMS M&O, 2001f). Temperature in homogeneities in the repository lead to localized accumulation of moisture. Uneven heating and cooling at repository edges lead to nonuniform thermal effects during both the thermal peak and the cool-down periods.	This process is screened as included.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment 65 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
66	2.2.06.01.00 [Changes in Stress (Due to Thermal, Seismic, or Tectonic Effects), Change Porosity, and Permeability of Rock] is screened as excluded on the basis of low consequence and low probability (for one secondary entry) (CRWMS M&O, 2000g). Even small changes in the fracture openings cause large changes in permeability. The rock deforms according to the rock stress field. Changes in the groundwater flow and in the temperature field will change the stress acting on the rock, which will, in turn, change the groundwater flow. 2.2.06.01.00 [Change in Stress (Due to Thermal, Seismic, or Tectonic Effects), Change Porosity, and Permeability of Rock]	Updated screening arguments for this process, based on recent modeling results, are described in detail in Section 6.2.19 of Features, Events, and Processes: Disruptive Events (Bechtel SAIC Company, LLC, 2004e); Section 6.7.5 of Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c); and Section 6.2.16 of Features, Events, and Processes in SZ Flow and Transport (Bechtel SAIC Company LLC, 2004b). Related information is	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 66 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
66 (continued)	is excluded as having low consequence to dose (CRWMS M&O, 2001f). The DOE analyses used to support the screening argument (CRWMS M&O, 2000h) did not, however, consider water-flux diversion toward a drift from the adjacent pillar caused by increased aperture of subhorizontal fractures in the pillar from thermal-mechanical response. Such flux diversion would cause increased water flow to the drifts.	presented in responses to Agreements RDTME.3.20 and RDTME.3.21. Screening agreements in Bechtel SAIC Company, LLC (2004e) rely on sensitivity analyses and transport simulations to show that accounting for changes in fracture permeability and porosity that may result from seismic activity will have no significant impact on radionuclide transport in the saturated zone. DOE also uses the fact that thermal-hydrological-mechanical simulations, when compared to thermal-hydrological simulation results, show no significant impact on percolation fluxes.	

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
68	1.2.02.01.00 (Fractures) is screened as included for seepage and is screened as excluded on the basis of low consequence for permanent effects (CRWMS M&O, 2001f). Generation of new fractures and reactivation of preexisting fractures may significantly change the flow and transport paths. Newly formed and reactivated fractures typically result from thermal, seismic, or tectonic events. Thermally induced changes in stress may result in permeability changes between drifts that could act to divert flow toward drifts. See also comment on 2.2.06.01.00 [Changes in Stress (Due to Thermal, Seismic, or Tectonic Effects) Change Porosity and Permeability of Rock].	This process is screened as included for both unsaturated and saturated zones.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment 68 of Agreement TSPAI.2.02.
69	2.2.01.01.00 (Excavation and Construction-Related Changes in the Adjacent Host Rock). Initial effects on seepage are screened as included, and permanent thermal-hydrological-chemical and thermal-mechanical effects are screened as excluded on the basis of low consequence (CRWMS M&O, 2001f). Stress relief leading to dilation of joints and fractures is expected in an axial zone of up to one diameter-width surrounding the tunnels.	This process has been split into two, titled Mechanical Effects of Excavation and Construction in the Near Field, and Chemical Effects of Excavation and Construction in the Near Field to distinguish mechanical effects from chemical effects of excavation or construction.	Since the mechanical process in Comment 69 is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment 69 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
69 (continued)		The former process is screened as included, while the latter is excluded due to low consequence. Related information is provided in the response to Agreements RDTME.3.20 and RDTME.3.21.	
70	2.2.10.04.00 (Thermal-Mechanical Alteration of Fractures Near Repository) is screened as excluded on the basis of low consequence (CRWMS M&O, 2000b, 2001f). See discussion in 2.2.06.01.00 [Changes in Stress (Due to Thermal, Seismic, or Tectonic Effects), Change Porosity, and Permeability of Rock]. Heat from the waste causes thermal expansion of the surrounding rock, generating compressive stresses near the drifts and extensional stresses away from them. The zone of compression migrates with time.	Entry 2.2.10.04.00 has been split into two parts titled Thermo-Mechanical Stresses Alter Characteristics of Fractures near Repository, and Thermo-Mechanical Stresses Alter Characteristics of Faults near Repository. Both are screened as excluded due to low consequence. Updated screening arguments are based on recent thermal-hydrologic-mechanical modeling results (Bechtel SAIC Company, LLC, 2004f, 2004g).	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment 70 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
70 (continued)		The compressive stresses near the drift and extensional stresses away from the drift lead to negligible changes in seepage and minor increases in rock saturations around the drift during the thermal period. Related information is presented in the response to Agreements RDTME 3.20 and RDTME 3.21.	
J–3	2.1.06.01.00 (Degradation of Cementitious Materials in Drift). The effects of degradation of cementitious materials on seepage chemistry are excluded on the basis of low consequence (CRWMS M&O, 2001d). DOE gives its bases for its exclusion in 2.1.09.01.00 (Properties of the Potential Carrier Plume in the Waste and Engineered Barrier Subsystem) (CRWMS M&O, 2001d) stating that chemical models show a negligible effect of grout associated with rock bolts.	This process is excluded because of the absence of cementitious materials in the current repository design. Related information on in-drift chemistry is addressed by responses to Agreements ENFE.2.06, ENFE.2.10, and ENFE.2.14 in Appendixes E, G, and J of Technical Basis Document No. 5: In-Drift	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Technical Basis Documents No. 5 and 11, DOE has provided technical basis for the screening argument. Also, the current repository design calls for significantly reduced amounts of cementitious materials.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–3 (continued)	NRC raised questions about these models pertaining to the treatment of evaporation and the chemical divide phenomenon [Evolution of the Near-Field Environment Technical Exchange (Reamer, 2001)]. Concerns about grout chemical effects are related to recent observations of drippings from rock bolt holes in the sealed cross drift test. DOE should provide additional technical bases for screening chemical effects of cementitious materials in the drift. Because degradation products may affect water chemistry, and, therefore, radionuclide sorption behavior, the effect of this database entry on radionuclide transport in the unsaturated zone should also be evaluated. Currently, this entry is not addressed for the unsaturated zone (CRWMS M&O, 2001e). Radionuclide Transport Subissue 1, Agreement 5, Subissue 2, and Agreement 10 concern the technical bases for transport parameter uncertainty distributions.	Chemical Environment. Related information on effects on radionuclide transport is covered by the response to Agreement RT.1.05 in Appendix H to Technical Basis Document No. 11: Saturated Zone Flow and Transport.	Therefore, staff considers that DOE has addressed Comment J–3 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–4	2.1.06.05.00 (Degradation of Invert and Pedestal) has been screened as excluded on the basis of low consequence (CRWMS M&O, 2001d). Invert degradation is excluded on the basis of low consequence (CRWMS M&O, 2001d). The argument that changes to diffusive properties of the invert will be negligible to dose and is not supported by demonstration (by sensitivity analyses) of the significant effect of diffusive release through the invert during the first 20,000 years (CRWMS M&O, 2000i, Volume II, Section 3.3). The sensitivity shown in the Repository Safety Strategy also applies to the first 10,000 years. The screening argument contradicts this information. The screening argument should directly address possible effects of degradation on invert diffusive properties.	The database entry 2.1.06.05.00 (Degradation of Invert and Pedestal) was split into four new entries titled Mechanical Degradation of Emplacement Pallet, Mechanical Degradation of Invert, Chemical Degradation of Emplacement Pallet, and Chemical Degradation of Invert. Instantaneous mechanical pallet degradation is implicit in DOE models, and transport is assumed to take place directly from the waste package to the invert; thus, chemical pallet degradation is inconsequential. Neglect of mechanical invert degradation is conservative, because reduced porosity would tend to inhibit flow. DOE stated that the subject is addressed by Agreement CLST.2.08.	Questions relevant to consequences of degradation of the invert and pedestal were posed under Comment J–2 in Section 4.2.3. Diffusion in the invert is considered in the performance assessment model. Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment J–4 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–7	2.2.08.01.00 (Groundwater Chemistry/Composition in Unsaturated Zone and Saturated Zone) is excluded. DOE included the current ambient groundwater conditions in the Total System Performance Assessment–Site Recommendation abstraction of radionuclide transport in the unsaturated zone, but has excluded future changes (CRWMS M&O, 2000j, 2001e). DOE asserts that thermal effects on chemistry are minimal, but assertion focuses mainly on the effects of dissolution and precipitation on hydrologic properties. The screening argument refers to a model of thermal-chemical effects on seepage water chemistry at the drift wall (CRWMS M&O, 2000k). Because modeled effects fell within the range of variation included in total system performance assessment, it is asserted that effects farther from the drift would be smaller, based on an unverified assumption (CRWMS M&O, 2001e).	Entry 2.2.08.01.00 has been split into two parts titled Chemical Characteristics of Groundwater in the Saturated Zone, and Chemical Characteristics of Groundwater in the Unsaturated Zone. Both are screened as included. The technical basis for radionuclide K_d values was provided separately in response to Agreements RT.1.05 and RT.2.10.	Since this feature is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment J–7 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–7 (continued)	This argument does not address chemical changes below the repository, which are likely to be more significant than changes above, because of interactions with the engineered barrier system and waste materials. Even so, predicted changes in key geochemical parameters (pH and total carbon) in seepage water are large enough to have an effect on sorption coefficients. Without the details on how expert judgment was used to derive the Total System Performance Assessment—Site Recommendation sorption parameters, it is unclear how the effects of changes in the ambient chemistry system are incorporated into the transport calculations.		
J–9	2.2.08.03.00 [Geochemical Interactions in Geosphere (Dissolution, Precipitation, Weathering) and Effects on Radionuclide Transport] is excluded (CRWMS M&O, 2000l, 2001e) from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence.	DOE has developed drift-scale and mountain-scale thermal-hydrologic-chemical models and no longer uses Assumption 11 in its screening arguments. This process was split into two parts titled Geochemical Interactions and Evolution in the Saturated Zone, and Geochemical Interactions and Evolution in	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in Drift-Scale Coupled Processes (DST and THC Seepage) Models (Bechtel SAIC Company, LLC, 2004h), DOE has provided a more detailed technical basis for the screening argument.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–9 (continued)	The key assumption (CRWMS M&O, 2001e; Assumption 11) is that results from the near-field thermal-hydrological-chemical coupled processes model (CRWMS M&O, 2000k) can be used to bound the effects of similar coupled processes on far-field flow and transport. This assumption has not yet been verified. Predicted mineralogical changes (CRWMS M&O, 2000k) in response to the thermal effects of the repository are small (calcite only). Predicted changes in porosity and permeability are also small. Transport through fractures is conservatively modeled in the Total System Performance Assessment—Site Recommendation, assume no retardation. The screening argument, however, only addresses changes in seepage water chemistry. It does not address the possibility of reduced (or enhanced) matrix diffusion through precipitation and dissolution. Diffusion into the matrix and sorption on matrix minerals can be an important retardation mechanism. The effect of small-volume changes on fracture armoring and diffusion into the matrix may be important.	the Unsaturated Zone. Based on model results, both processes are screened as excluded. Relevant information supporting the screening argument is included in the response to Agreement ENFE.2.06 in Appendix E of Technical Basis Document No. 5: In-Drift Chemical Environment. Additional information is provided in the response to Agreements ENFE.1.04, 1.07, and 4.02, and in the document titled Drift-Scale Coupled Processes (DST and THC Seepage) Models (Bechtel SAIC Company, LLC, 2004h).	Potential changes to groundwater chemistry under the influence of a repository are addressed in the assessment of the Comment J–8 response in Section .4.2.3. Assumption 11 is not used in the updated screening argument. Therefore, staff considers that DOE has addressed Comment J–9 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–9 (continued)	The current screening arguments are not sufficient and will depend in part on the verification of Assumption 11 that far-field changes to radionuclide transport in the unsaturated zone will be less than calculated near-field changes (CRWMS M&O, 2001e). Effects on flow are excluded based on low consequence. Problems with modeling of drift-scale coupled processes (CRWMS M&O, 2000k) used to support this screening argument have been raised by NRC. DOE has agreed to provide additional technical bases for the screening argument (Reamer, 2001).		

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–10	2.2.08.06.00 (Complexation in Geosphere) is excluded. DOE included the effects of ambient condition complexation in the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone, but has excluded future changes (CRWMS M&O, 2000j, 2001e). The effects of complexation are "implicitly included in the radionuclide sorption coefficients," but there is no clear technical basis regarding the effects of organics or other ligands provided in establishing the K_d distributions (CRWMS M&O, 2001e). Experimental results, reported in Triay, et al. (1997), that form much of the basis for the sorption coefficient distributions only address the effects of organics on neptunium and plutonium sorption. The analysis and model report (CRWMS M&O, 2000j) does not provide additional information on the effect of organics on other radionuclides. The current process models do not address the effects of complexation on transport parameters, and the exclusion of changes to complex formation does not have sufficient support. In addition, the	This process was split into two parts titled Complexation in the Saturated Zone, and Complexation in the Unsaturated Zone; these are both listed as included. Detailed screening arguments are provided in Section 6.1.31 of Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c). Information relevant to support screening arguments is discussed in the response to Agreements ENFE.4.03 and 4.04 in Appendixes A and C to Technical Basis Document No. 8: Colloids, and in the response to Agreement RT.1.05 in Appendix H to Technical Basis Document No. 11: Saturated Zone Flow and Transport. Related information is provided in the response to Agreement ENFE.1.04.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in the Technical Basis Documents No. 8 and 11, DOE has provided a technical basis for the screening argument. Complexation has been included in the DOE transport abstraction. Therefore, staff considers that DOE has addressed Comment J–10 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–10 (continued)	screening argument refers to modeling results on repository effects on seepage chemistry, which may not be relevant to transport conditions below the repository (CRWMS M&O, 2001e).		
J–11	2.2.08.07.00 (Radionuclide Solubility Limits in the Geosphere) is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2000j, 2001e). The DOE screening argument assumes that radionuclide solubility limits in the geosphere may be different and indicates that radionuclide solubility limits in the geosphere are conservatively ignored with respect to solubility reduction in the far field (CRWMS M&O, 2000l). The possibility of increasing solubility limits, however, should also be considered. Solubility limits in the geosphere will be determined by interaction between the contaminant plume and the host rock.	This process was split into two parts titled Radionuclide Solubility Limits in the Saturated Zone, and Radionuclide Solubility Limits in the Unsaturated Zone. Both solubility constraints are screened as excluded. Arguments are provided in the summary of the screening argument to support the conclusion that disregarding solubility constraints is conservative.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided a technical basis for the conservative approach used in the screening argument. Therefore, staff considers that DOE has addressed Comment J–11 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–12	2.2.10.01.00 (Repository-Induced Thermal Effects in the Geosphere) is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2000l, 2001e). The screening argument is only partially supported by near-field thermal-chemical modeling for a limited number of hydrochemical constituents and minerals (CRWMS M&O, 2000k) and is not directly related to the effects on radionuclide transport. The exclusion of 2.2.10.01.00 (Repository-Induced Thermal Effects in Geosphere) will depend, in part, on the verification of Assumption 11 that far-field changes to radionuclide transport in the unsaturated zone will be less than the calculated near-field changes (CRWMS M&O, 2001e).	This process is screened as excluded based on low consequence because climate-induced changes in unsaturated zone flow overwhelm any short-term thermal impacts. An updated screening argument, based on mountain-scale, thermal-hydrologic modeling results, is contained in Section 6.8.9 of Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c). Information relevant to support the screening argument is discussed in the response to Agreements ENFE.4.03 and 4.04 in Appendixes A and C to Technical Basis Document No. 8: Colloids, and the response to Agreement RT.1.05 in Appendix H to Technical Basis Document No. 11: Saturated Zone Flow and Transport. The response to Agreement	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC 2004a) and information in the Technical Basis Documents No. 8 and 11, DOE has provided a technical basis for the screening argument that repository thermal impacts on unsaturated zone flow are subordinate to climatic changes. Therefore, staff considers that DOE has addressed Comment J–12 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–13	2.2.10.06.00 [Thermal-Chemical Alteration (Solubility, Speciation, Phase Changes, Precipitation/Dissolution)] is excluded from the Total System Performance Assessment—Site Recommendation abstraction of radionuclide transport in the unsaturated zone on the basis of low consequence (CRWMS M&O, 2000l, 2001e). Based on near-field coupled thermal-hydrological-chemical models that indicate the thermal effects of the repository result in only small changes in major hydrochemical constituents and limited changes in mineralogy, thermal effects on chemistry at the mountain scale are expected to be low. Model results in the cited report (CRWMS M&O, 2000k), however, only consider a few components in hydrochemistry important to container life (e.g., pH, total carbon, and calcium). The model is limited to calcite precipitation/dissolution and addresses only seepage water chemistry.	An updated screening argument and technical basis for excluding this process as excluded is contained in Section 6.8.3 of Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c). Information relevant to support the screening argument is discussed in the response to Agreements ENFE.4.03 and 4.04 in Appendixes A and C to Technical Basis Document No. 8: Colloids, and in the response to agreement RT.1.05 in Appendix H to Technical Basis Document No. 11: Saturated Zone Flow and Transport. Additional information is presented in the response to Agreement ENFE.1.04. This comment referred to an unverified	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a) and information in the Technical Basis Documents No. 8 and 11, DOE has provided technical bases for the screening argument. The technical bases include thermal-hydrological-chemical modeling at the mountain scale, as well as geochemical arguments indicating that neglect of this process is conservative. Therefore, staff considers that DOE has addressed Comment J–13 of agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–13 (continued)	Thermal-chemical effects on transport beneath the repository, which could reflect the influence of the engineered barrier system and waste form materials, are not considered. In addition, although the assumption that far-field changes are likely to be less than near-field changes is reasonable, it has not been verified (CRWMS M&O, 2001e). The technical basis should be strengthened to demonstrate low consequence. The evaluation of this exclusion will depend in part on the verification of Assumption 11 that far-field changes to radionuclide transport in the unsaturated zone will be less than the calculated near-field changes (CRWMS M&O, 2001e).	assumption regarding the extrapolation of near-field results to the far field. This assumption was no longer required for the revised screening argument because of the availability of both drift-scale and mountain-scale thermal-hydrologic-mechanical model results. In addition, DOE argued that increased temperatures will increase radionuclide sorption coefficients and neglecting this potential increase is conservative.	

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–17	1.2.10.02.00 (Hydrologic Response to Igneous Activity) is excluded based on low consequence (CRWMS M&O, 2001e). The screening argument to exclude focuses on intrusive events. It should be noted that extrusive events could increase shallow infiltration for the repository in two ways: (i) lava flow would modify or dam a wash overlying the repository and (ii) volcanic fragment and ash layer, which would be highly permeable, may act to trap infiltrating water, shield it from evaporation, and reduce transpiration—all leading to increased shallow infiltration across the repository. There are no data to support or exclude the temporal extent of increased shallow infiltration, though this could be bounded from decades to thousands of years.	This process is screened as excluded. Updated screening arguments and technical bases for exclusion are contained in Features, Events and Processes: Disruptive Events (Bechtel SAIC Company, LLC, 2004e), Features, Events, and Processes in SZ Flow and Transport (Bechtel SAIC Company, LLC, 2004b), and Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c). The latter contains the screening argument relevant to Comment J–17. Extrusive event could lead to ash covering the potential repository footprint or lava blocking (damming) the east-trending washes. DOE suggests that the permeability of the ash would be much larger than that of the soils or bedrock; therefore, little effect is expected on net infiltration.	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided an updated technical basis for the screening argument. Although an ash layer may lead to increases in infiltration and reduction in evapotranspiration for some length of time, the effects on repository performance appear to be small for this probability condition. Therefore, staff considers that DOE has addressed Comment J–17 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–17 (continued)		DOE suggests that the expected type of lava, clinker or aa, would not be able to block (restrain) water from exiting down the wash.	
J–22	1.2.04.02.00 (Igneous Activity Causes Changes to Rock Properties) is screened as excluded from the radionuclide transport in the unsaturated zone abstraction on the basis of low consequence (CRWMS M&O, 2000l, 2001e). Natural analogs (CRWMS M&O, 2000m) suggest alteration time scales of thousands of years (Ratcliff, et al., 1994) and alteration scales of tens of meters. Furthermore, modeling studies of the effects of silica redistribution on fracture porosity and permeability (CRWMS M&O, 2000m) have yielded conflicting results (Matyskiela, 1997). Additional clarification should be provided. Probability may also be an aspect to use in developing screening arguments for 1.2.04.02.00 (Igneous Activity Causes Changes to Rock Properties), provided probability is consistent with the probabilities used for the igneous disruptive scenario.	This process is screened as excluded based on low consequence because of the small scale of hydrologic property changes associated with basalitic igneous activity. An updated screening argument and technical basis are contained in Features, Events, and Processes: Disruptive Events (Bechtel SAIC Company, LLC, 2004e), Features, Events, and Processes in SZ Flow and Transport (Bechtel SAIC Company, LLC, 2004b), and Features, Events, and Processes in UZ Flow and Transport (Bechtel SAIC Company, LLC, 2004c).	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided an updated technical basis for the screening argument. Therefore, staff considers that DOE has addressed Comment J–22 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–22 (continued)		Also, information relevant to support the screening argument is discussed in the response to Agreements ENFE.4.03 and 4.04 in Appendixes A and C to Technical Basis Document No. 8: Colloids, and in the response to Agreement intrusive events is addressed in more detail in Section 6.3.2 of Characterize Framework for Igneous Activity at Yucca Mountain, Nevada (Bechtel SAIC Company, LLC, 2003b), where the results of the Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada (CRWMS M&O, 1996), including the derivation of a probability distribution for aggregate dike length, are described.	

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No.	**Comment**	**DOE Response**	**NRC Assessment of Response**
J–23	1.2.06.00.00 (Hydrothermal Activity) is excluded on the basis of low consequence for basaltic magmatism and low probability for silicic magmatism (CRWMS M&O, 2001e). A consistent approach for the screening arguments is needed. The screening argument is considered incomplete because (i) past hydrothermal activity in the Yucca Mountain region is not clearly related to basaltic igneous activity and (ii) probability screening arguments in CRWMS M&O (2001e) are incomplete with respect to silicic magmatism. In addition, DOE cites unpublished studies by the U.S. Geological Survey and the University of Nevada, Las Vegas that reportedly demonstrate that hydrothermal activity was a site characteristic until about 2 million years ago. Additional unpublished work by Dublyanski and others, however, does not support this conclusion. None of the unpublished work has supported the conclusion that the likelihood of hydrothermal activity at Yucca Mountain during the next 10,000 years is clearly <1:10,000.	This process is screened as excluded on the basis of low consequence. This comment is addressed in the response to Agreement ENFE.2.03 in Appendix H of Technical Basis Document No. 2: Unsaturated Zone Flow. Available evidence is best fit by a conceptual model in which hydrothermal processes are no longer active in the Yucca Mountain area.	DOE has provided technical basis for the screening argument. Detailed assessment of response to Comment J–23 in Appendix H of the Technical Basis Document No. 2 is provided in Kokajko (2005a). Therefore, staff considers that DOE has addressed Comment J–23 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–23 (continued)	A clear linkage to the consequences of basaltic igneous activity or a demonstrated technical basis for probability values below 1 in 10,000 in 10,000 years is missing. DOE should provide additional technical basis to screen 1.2.06.00.00 (Hydrothermal Activity) from further consideration.		
J–24	1.2.04.07.00 (Ash Fall). The screening argument in CRWMS M&O (2000n) for ash fall impacting the saturated zone [i.e., secondary 1.2.04.07.01 (Soil Leaching Following Ash Fall)] includes a three order-of-magnitude error in calculation of the concentration of radionuclides in the well water. Although conservative assumptions are used in the analysis, the error found in Table 6-1 would cause the calculated dose to be 0.161 Sv [16.1 rem], instead of 1.61×10^{-2} [1.61×10^{-4}], and would not support a low-consequence screening argument.	Entry 1.2.04.07.00 is split into Ashfall, Ash Redistribution via Soil and Sediment Transport, and Ash Redistribution in Groundwater, of which only the latter is relevant to Comment J–24. Effects of potential ash deposits on groundwater risk are excluded because contribution to probability-weighted dose would be negligible even if highly conservative assumptions are used in the risk calculation (Bechtel SAIC Company, LLC, 2004a).	Based on staff review of the summary of the screening argument (Bechtel SAIC Company, LLC, 2004a), DOE has provided technical basis for the screening argument. Errors identified in Comment J–24 have been corrected. Therefore, staff considers that DOE has addressed Comment J–24 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–25	1.2.02.02.00 (Faulting). Changes of fault characteristics have been screened as excluded on the basis of low consequence (CRWMS M&O, 2000g); information of new faults has been excluded on the basis of low probability.1.2.02.03.00 (Fault Movement Shears Waste Container) has been excluded on the basis of low probability. 1.2.03.02.00 (Seismic Vibration Causes Container Failure) has been excluded on the basis of low consequence (CRWMS M&O, 2000g). In these items, the DOE screening argument relies, in large part, on the median values of fault displacements and ground motions for postclosure (less than $10^{!6}$/year), rather than the mean values. Staff consider that the mean more reliably incorporates uncertainty and is a more reasonable and prudent statistical measure than the median. DOE should provide additional technical bases for this approach. DOE agreed to address this concern in a forthcoming Request for Additional Information.	This process is screened as included for both unsaturated and saturated zones. The issue of using mean values versus median values for fault displacements and ground motions was addressed in the DOE response to completed Agreements SDS.1.02 and 2.03.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment J–25 of Agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–26	The screening argument for 1.2.02.03.00 (Fault Movement Shears Waste Container) is based, in part, on specific setback distances that will be used by DOE in the repository design (CRWMS M&O, 2000g). The setback distances are a function of fault displacement magnitudes. Thus, the setback values used in the design may need to be reassessed after the displacement issue is resolved.	This process is screened as included. The question of fault displacement magnitudes and setback distances is addressed in Features, Events, and Processes: Disruptive Events (CRWMS M&O, 2000n). A related Agreement, SDS.1.02, is considered complete.	Since the process is screened as included, no additional assessment is needed in the context of scenario analysis. Therefore, staff considers that DOE has addressed Comment J–26 of Agreement TSPAI.2.02.
J–27	1.2.03.01.00 (Seismic Activity) was screened as excluded on the basis of low consequence of effects on such components as the drip shield and waste package and included with regard to effects on cladding (CRWMS M&O, 2000g.) The distributions for ground-motion parameters were developed using the Probabilistic Seismic Hazard Assessment Expert Elicitation. Additional technical bases on the use of expert judgment should be provided.	This entry has been deleted due to redundancy with other database entries. The issue raised in the comment regarding the Probabilistic Seismic Hazard Assessment Expert Elicitation was addressed in the response to Agreement SDS.2.01 AIN-1 in Appendix C of Technical Basis Document No. 14: Low Probability Seismic Events.	Assessment of DOE's response to Agreement SDS.2.01 AIN-1 was previously provided to DOE (Kokajko, 2005b), in which staff indicated that Agreement SDS.2.01 AIN-1 was closed. Therefore, staff considers that DOE has addressed Comment J–27 of agreement TSPAI.2.02.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a)
(References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response

References

Bechtel SAIC Company, LLC. "Key Technical Issue Letter Report (Response to TSPAI.2.01, 2.02, 2.03, 2.04, and 2.07)." Rev. 2. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004a.

———. "Features, Events, and Processes in SZ Flow and Transport." ANL–NBS–MD–000002. Rev. 02. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004b.

———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 02. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004c.

———. "Clad Degradation—FEPs Screening Arguments." ANL–WIS–MD–000008. Rev 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004d.

———. "Features, Events, and Processes: Disruptive Events." ANL–WIS–MD–000005. Rev. 001, with errata. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004e.

———. "Drift Scale THM Model." MDL–NBS–HS–000017. Rev. 00 ICN 01, with errata. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004f.

———. "Abstraction of Drift Seepage." MDL–NBS–HS–000019. Rev. 00 ICN 01, with errata. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004g.

———. "Drift-Scale Coupled Processes (DST and THC Seepage) Models." MDL–NBS–HS–000001. Rev. 02, with errata. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004h.

———. "Evaluation of Features, Events, and Processes (FEP) for the Biosphere Model." ANL–MGR–MD–000011. Rev. 03. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2003a.

———. "Characterize Framework for Igneous Activity at Yucca Mountain, Nevada." ANL–MGR–GS–000001. Rev. 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2003b.

———. "Evaluation of the Applicability of Biosphere-Related Features, Events, and Processes (FEP)." ANL–MGR–MD–000011. Rev. 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2001a.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response

References (continued)

———. "Waste Package Outer Barrier Stress Due to Thermal Expansion with Various Barrier Gap Sizes." CAL–EBS–ME–000011. Rev. 00. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2001b.

CRWMS M&O. "Features, Events, and Processes in SZ Flow and Transport." ANL–NBS–MD–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001a.
———. "Evaluation of the Applicability of Biosphere-Related Features, Events, and Processes (FEP)." ANL–MGR–MD–000011. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001b.
———. "FEPs Screening of Processes and Issues in Drip Shield and Waste Package Degradation." ANL–EBS–PA–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001c.
———. "Engineered Barrier System Features, Events, and Processes." ANL–WIS–PA–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001d.
———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001e.
———. "FEPs in Thermal Hydrology and Coupled Processes." ANL–NBS–MD–000004. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2001f.
———. "Uncertainty Distribution for Stochastic Parameters." ANL–NBS–MD–000011. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000a.
———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000b.
———. "Disruptive Event Biosphere Dose Conversion Factor Analysis." ANL–MGR–MD–000003. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000c.
———. "Design Analysis for the Ex-Container Components." ANL–XCS–ME–000001. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000d.
———. "Waste Package Operations Fabrication Process Report." TDR–EBS–NED–000003. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2000e.
———. "Clad Degradation—FEPs Screening Arguments." ANL–WIS–MD–000008. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000f.

Table 2. Assessment of Responses to TSPAI.2.02 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response

References (continued)

———. "Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada." BA0000000–01717–2200–00082. Rev 0. Las Vegas, Nevada: CRWMS M&O. 1996.

Kokajko, L. E. Prelicensing Evaluation of Key Technical Issue Agreements. "Evolution Of The Near-Field Environment" ENFE.2.03, "Radionuclide Transport" RT.1.01, 3.02, "Unsaturated And Saturated Flow Under Isothermal Conditions" USFIC.4.04, "Total System Performance Assessment And Integration" TSPAI.3.22, 3.24, 3.26, TSPAI.2.02, Comments 3, 4, 12, J–20, J–23, and General Agreement GEN.1.01, Comments 24, 26, 69, 106. Letter from Lawrence E. Kokajko to Joseph D. Ziegler dated February 9, 2005a.

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Table 3. Assessment of Responses to TSPAI.2.03 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table)

Comment No.	Comment	DOE Response	NRC Assessment of Response

19 (Parts 7 and 8)	DOE has selected a subset of the full list of features, events, and processes as applicable for biosphere screening in CRWMS M&O (2001a). Some entries that are potentially applicable to biosphere dose conversion factor calculations (that should at least be considered for screening) have not been included in the scope of the document ANL–MGR–MD–000011 (CRWMS M&O, 2001a). These include 3.1.01.01.00 (Radioactive decay and ingrowth) and 1.2.04.07.00 (Ashfall).	Per the comment, this process was added to the scope of the document Evaluation of Features, Events, and Processes (FEP) for the Biosphere Model (Bechtel SAIC Company, LLC, 2003).	Relevant processes are considered in the scope of biosphere analyses. Staff considers that DOE has addressed Comment 19 (Parts 7 and 8) of Agreement TSPAI.2.03.
20	The Yucca Mountain Project Database (CRWMS, 2001b) does not indicate that 2.2.08.07.00 (Radionuclide Solubility Limits in the Geosphere) is relevant to the biosphere. This item is relevant for limiting the quantity of radioactive material that can leach radionuclides out of the soil or tephra deposit in the biosphere compared with the quantity of radionuclides that would be predicted to leach out of the deposit using only leach rate limits.	Entry 2.2.08.07.00 has been split into two parts titled Radionuclide Solubility Limits in the SZ, and Radionuclide Solubility Limits in the UZ. Per the NRC comment, these entries will also be incorporated into the next revision of Evaluation of the Features, Events, and Processes (FEP) for the Biosphere Model (Bechtel SAIC Company, LLC, 2003).	Based on the DOE statement that the relevant processes will be considered in the scope of biosphere analyses, staff considers that DOE has addressed Comment 20 of Agreement TSPAI.2.03.

Table 3. Assessment of Responses to TSPAI.2.03 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No.	Comment	DOE Response	NRC Assessment of Response
J–6	2.2.07.15.00 (Advection and Dispersion). As defined, this item does not apply to the unsaturated zone and is not discussed in CRWMS M&O (2001c). Given that advection and dispersion are key components of the DOE radionuclide transport in the unsaturated zone model abstraction, the definition of 2.2.07.15.00 (Advection and Dispersion) should be extended to include these aspects (advection and dispersion) in the unsaturated zone.	Entry 2.2.07.15.00 has been split into two parts titled Advection and Dispersion in the Saturated Zone, and Advection and Dispersion in the Unsaturated Zone. These entries have been added to the collection of features, events, and processes pertaining to the unsaturated zone.	Relevant processes were considered in the scope of unsaturated zone analyses. With the inclusion of these processes, staff considers that DOE has addressed Comment J–6 of Agreement TSPAI.2.03.

References

Bechtel SAIC Company, LLC. "Evaluation of Features, Events, and Processes (FEP) for the Biosphere Model." ANL–MGR–MD–000011. Rev. 03. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2003.

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———. "Features, Events, and Processes in UZ Flow and Transport." ANL–NBS–MD–000001. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001c.

Table 4. Assessment of Responses to TSPAI.2.04 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table)			
Comment No	**Comment**	**DOE Response**	**NRC Assessment of Response**
24	2.3.13.02.00 (Biosphere Transport) contains only two secondary entries related to surface water, gas, and biogeochemical transport processes (CRWMS M&O, 2001a). The Yucca Mountain Project feature, event, and process description and the originator description are different and question whether the focus is transport processes, alterations during transport, or both.	There are no longer secondary entries associated with features, events, and processes. Entry 2.3.13.02.00 has been redefined as Radionuclide Alteration During Biosphere Transport. The revised description of this entry is: "Once in the biosphere, radionuclides may be transported and transferred through and between different compartments of the biosphere. Temporally and spatially dependent physical and chemical environments in the biosphere may lead to alteration of both the physical and chemical properties of the radionuclides as they move through or between the different compartments of the biosphere. These alterations could consequently control exposure to the human population." Issues related to biosphere transport are addressed by other features, events, and processes.	Clarification on the scope of the feature, event, and process has been provided. Therefore, staff considers that DOE has addressed Comment 24 of Agreement TSPAI.2.04.

Table 4. Assessment of Responses to TSPAI.2.04 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No	Comment	DOE Response	NRC Assessment of Response
31	There is no database entry addressing the response of the drip shield to static loads and seismic excitation. It is necessary to account for the degradation of the capability of the drip shield to avoid water infiltration due to the interaction of seismic excitation with dead loads (such as those caused by rock fall or naturally occurring backfill) on the drip shield, and it is recommended to add a new feature, event, and process to the database. 1.2.03.02.00 (Seismic Vibration Causes Container Failure) assesses the effect of ground motion on the waste package and drip shield, without consideration of possible pre-existing static loads. The screening argument for 2.1.06.06.00 (Effects and degradation of drip shield) in CRWMS M&O (2001b) states that, "... seismic activity will not induce SCC of the waste packages or drip shields, regardless of magnitude, since a sustained tensile stress is required for SCC and an earthquake is only temporary in nature (CRWMS M&O, 2000, Section 5, Assumption 1)."	Entry 1.2.03.02.00 has been split into four parts titled Seismic Ground Motion Damages Engineered Barrier System Components; Seismic Induced Rockfall Damages Engineered Barrier System Components; Seismic Induced Drift Collapse Damages Engineered Barrier System Components; and Seismic Induced Drift Collapse Alters In-Drift Thermohydrology. The first three entries deal with damage to engineered barrier system components from ground motion, rockfall, and drift collapse, and the last entry covers in-drift thermal-hydrology changes due to drift collapse. Only the third entry, Seismic Induced Drift Collapse Damages Engineered Barrier System Components, has been screened as excluded. Descriptions for the scopes of the four entries are provided.	Clarification on the scopes of the features, events, and processes has been provided. Therefore, staff considers that DOE has addressed Comment 31 of Agreement TSPAI.2.04.

Table 4. Assessment of Responses to TSPAI.2.04 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)			
Comment No	**Comment**	**DOE Response**	**NRC Assessment of Response**
33	Features, events, and processes related to the effect of trace metal cations on Alloy-22 and titanium corrosion and stress corrosion should be added to database, given results recently reported by Barkatt and Gorman (2000).	The project has reviewed the results reported by Barkatt and Gorman (2000) and has concluded that the testing conditions used were not relevant to Yucca Mountain. Agreements CLST.1.01, 1.10, and 6.01, however, are intended to evaluate the effects of introduced materials on water chemistry and deleterious trace element concentrations on the corrosion behavior of titanium, similar to the electrochemically based studies on Alloy 22. Response to Agreement CLST.1.01 is in Appendix A of Technical Basis Document No. 5: In-Drift Chemical Environment. Responses to Agreements CLST 1.10 and CLST 6.01 are presented in Appendixes O and P of Technical Basis Document No. 6: Waste Package and Drip Shield Corrosion. The scope of various features, events, and processes addresses trace metals.	Clarification on the scopes of the features, events, and processes has been provided. Therefore, staff considers that DOE has addressed Comment 33 of Agreement TSPAI.2.04.

Table 4. Assessment of Responses to TSPAI.2.04 Comments in Bechtel SAIC Company, LLC (2004a) (References in Table are Listed at the End of the Table) (continued)

Comment No	Comment	DOE Response	NRC Assessment of Response

References:

Barkatt, A. and J.A. Gorman. "Tests to Explore Specific Aspects of the Corrosion Resistance of C-22." Presentation to the Nuclear Waste Technical Review Board, August 1, 2000. Carson City, Nevada. 2000. <www.nwtrb.gov/meetings/000801.pdf>

CRWMS M&O. "Evaluation of the Applicability of Biosphere-Related Features, Events, and Processes (FEP)." ANL–MGR–MD–000011. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001a.

———. "FEPs Screening of Processes and Issues in Drip Shield and Waste Package Degradation." ANL–EBS–PA–000002. Rev. 01. Las Vegas, Nevada: CRWMS M&O. 2001b.

———. "Stress Corrosion Cracking of the Drip Shield, the Waste Package Outer Barrier, and the Stainless Steel Structural Material." ANL–EBS–MD–000005. Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000.