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OVERNIGHT MAIL

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U.S. DEPARTMENT OF ENERGY (DOE) COMMENTS ON U.S. NUCLEAR REGULATORY COMMISSION (NRC) ISSUE RESOLUTION STATUS REPORTS (IRSR)

Reference: Ltrs, Stablein to Brocoum, dtd 10/29/97, 11/7/97, 11/7/97, 11/12/97, and 11/13/97

The DOE has completed review of the IRSRs transmitted under the letters referenced above. Although we believe the issue resolution process has potential benefits for the development of mutual understanding of important concerns during prelicensing, we have some comments and questions resulting from our technical reviews of the IRSRs; these detailed comments are provided in Enclosures 1-5. In addition, we would like to continue our discussions at a management level on the following items: (1) The use of the IRSRs and acceptance criteria in the licensing process; and (2) the relationship of the issues and subissues to an overall system evaluation.

We believe DOE and NRC continue to make significant progress in achieving informal issue resolution as reflected in these reports. We do not expect formal responses to our comments; we will continue to schedule interactions as necessary to facilitate the resolution of these and other issues. Again, we appreciate the opportunity to comment on the IRSRs and believe they are valuable tools for issue clarification and resolution.

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I look forward to continuing our dialog on this subject. If you or your staff have questions regarding our comments, please contact either me at (702) 794-1359, or April V. Gil at (702) 794-5578.

Stephan Brocoum
Assistant Manager for Licensing

AML:AVG-1264

Enclosures:
1. Key Technical Issue: Repository Design and Thermal-Mechanical Effects Issue Resolution Status Report, 10/29/97
2. Key Technical Issue: Evolution of the Near-Field Environment, Issue Resolution Status Report, 11/7/97
3. Key Technical Issue: Unsaturated and Saturated Flow Under Isothermal Conditions Issue Resolution Status Report, 11/7/97
4. Key Technical Issue: Structural Deformation and Seismicity Issue Resolution Status Report, 11/12/97
5. Key Technical Issue: Thermal Effects on Flow Issue Resolution Status Report, 11/13/97

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Enclosure 1

KEY TECHNICAL ISSUE: REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS ISSUE RESOLUTION STATUS REPORT

The U.S. Department of Energy (DOE) appreciates the progress made in resolving the sub-issue components of this Key Technical Issue (KTI) that relate to the acceptability of the design control process for the Exploratory Studies Facility and the acceptability of the DOE's proposed seismic design methodology. The DOE also appreciates the closure of the following open-items: (1) all open-items associated with the Exploratory Studies Facility design control process that were raised in the U.S. Nuclear Regulatory Commission's (NRC) Site Characterization Analysis, (2) NRC's review of the associated site characterization Study Plans, and (3) NRC-DOE correspondence. We are concerned, however, that the KTI covered by this Issue Resolution Status Report (IRSR) has expanded to four subissues that now encompass ten components, only two of which are considered resolved. This expansion of level of detail could require greater effort by both NRC and DOE to resolve the KTI if each component must be addressed separately.

1. The wording suggests that clarification may be necessary to determine if there are differences between the current Project approach to design and testing, and NRC staff expectations. For example:

   a. Section 3.3.3 identifies several potential influences of thermal-mechanical processes on underground design. Specifically, the IRSR states that, among other things, "the presence or absence of backfill, and the quality and quantity of roof support are some of the parameters that have a potentially profound effect on the long-term performance of the repository." It should be noted that, at this time, repository design does not take credit for the performance of ground support beyond the preclosure period and there is insufficient information to determine whether backfill is needed for long-term stability to enhance performance.

   b. Section 4.1.2 establishes the following as one acceptance criterion for the design control subissue: "If testing is employed for verification of design adequacy, the testing is conducted under the most adverse conditions anticipated." DOE's current plans for Engineered Barrier System testing and evaluation call for a combination of laboratory testing, *in situ* testing, and modeling. Modeling is the most cost-effective way to evaluate the sensitivity of the design to the full range of conditions anticipated. Performance confirmation monitoring will provide information to verify design bases under the range of actual conditions in the repository.

2. The following are stated in the IRSR in a way that implies that they are facts although their validity has not been established:

   a. The statement in Section 3.3.2 that "Backfill would act to more directly transfer load to the waste-packages, thus having a potentially detrimental effect with respect to fault disruption," does not acknowledge the possibility that backfill could result in a more uniform load distribution on waste-packages and thereby minimize concentrated loads and impact loads, which are more problematic in terms of potential performance impacts.

   b. The statement in Section 3.3.2 that "the absence of backfill would tend to mitigate the effects of direct fault displacement" is questionable since backfill would displace and compress with movement of the fault and drift and would thus act to distribute the load and continue to provide some support at the drift side-walls.

   c. The statement in Section 3.3.3 that "thermomechanical effects combined with seismic loads to affect drift stability" potentially overstates the contribution of the seismic component in the underground facility. Based on case histories for underground structures subjected to earthquakes and on the Preclosure Seismic Design Methodology report, (DOE 1997), seismic activity is anticipated to have only minor effects on emplacement drift stability unless the drift is intersected by an active fault on which displacement occurs.

3. One acceptance criterion for the second Topical Report (*Preclosure Seismic Design Methodology for a Geologic Repository at Yucca Mountain*, YMP/TR-003-NP) in Section 4.2.1 is that "The proposed methodology does not contradict established methodologies and principles tested and documented in the license applications for nuclear power plants and independent spent fuel storage installations." The NRC has accepted the methodology proposed by the DOE in this topical report, where design bases are determined based on a probabilistic hazard assessment rather than the deterministic methodologies that have been used in the past in license applications for other facilities. The wording of the criterion appears to be inconsistent with the approach proposed in the topical report and previously accepted by the NRC.

Enclosure 2

KEY TECHNICAL ISSUE: EVOLUTION OF THE NEAR-FIELD ENVIRONMENT ISSUE RESOLUTION STATUS REPORT

1. This Issue Resolution Status Report (IRSR) is a well-presented summary of coupled processes and near-field chemistry issues of potential importance to repository performance. Project staff is cognizant of these issues, and many of them are being addressed in the testing, modeling, and performance assessment activities.

2. The U.S. Nuclear Regulatory Commission (NRC) states in IRSR section 5.2 that the TSPA-1995 waste package results may be non-conservative. However, many conservative assumptions and approaches were used in TSPA-95. Some of them were: (1) high pitting factor ratios were used for the outer barrier; (2) the inner barrier was assumed to be subject to pitting corrosion regardless whether it experiences dripping or not (pitting of corrosion-resistant material in humid-air conditions only is highly unlikely), and; (3) pits were assumed to be able to grow over the entire surface of the inner barrier (pits tend not to grow against the direction of gravity).

3. Total System Performance Assessment (TSPA) 1995 attempted to capture (indirectly) potential effects of aggressive groundwater chemistry and formation of hygroscopic nature of corrosion products and other mineral precipitates on the waste package surface by imposing low critical relative humidity (RH) thresholds for humid-air corrosion initiation (65-75% RH) and aqueous corrosion initiation (85-95% RH) of the outer barrier. It was also assumed that the inner barrier is subject to aqueous pitting corrosion as soon as the outer barrier is penetrated, regardless of whether it is dripped on or not.

4. IRSR section 4.1 lists seven coupled processes that may affect the rate and chemistry of seepage into the repository and requires the U.S. Department of Energy (DOE) to include them in performance analysis. These issues are being addressed in TSPA analysis, as follows:

   Thermal-hydrologic effects on liquid flow: for TSPA Viability Assessment (VA), significant efforts have been devoted to study the liquid and gaseous flows driven by thermal perturbation. Three-dimensional computer simulations in drift scale will yield the flow and temperature distributions as functions of time and space; the results will be abstracted into TSPA calculations. Also, this process is being considered in the Altered-Zone Expert Elicitation.

   Effects of fracture-matrix interaction: In TSPA-VA, seepage into the drift is via the fracture continuum, and the matrix has little effect.

Hydrothermal-chemical effects: In TSPA-VA, changes in groundwater composition caused by evaporation are accounted for by considering mass balance relations starting from J-13 composition. Temperature history and gas fluxes from thermal-hydrological simulations are used for this calculation. Single heater-test results were used to incorporate larger scale processes into the conceptual development of the abstracted models. The feedback to changes in hydraulic properties has not been directly incorporated into current performance assessment models. These coupled processes are being evaluated in the altered zone expert elicitation.

Dehydration of hydrous phases liberating moisture and consuming thermal energy: This process is not considered in current TSPA analysis, and it is viewed as of secondary importance to processes involving movement of free water.

Effects of microbial processes on hydraulic properties: It is not clear how important microbial processes will be on a bulk scale. A model is being developed to help bound the evolution of microbial communities in the drifts by a means of assessing their potential to have major bulk effects, as opposite to representing only local perturbations. In TSPA-VA sensitivity analyses, these effects will be considered in terms of their capacity of change bulk chemistry within drifts.

5. Zeolite dehydration is a significant concern in altered high-zeolite content layers below the repository host rock units, which will exhibit important radionuclide retardation performance. Implementation of existing design criteria will limit temperature in these areas and substantially reduce the potential impact. By contrast, within the repository host rock, the zeolite abundance is generally low, and the evolution of water from dehydration of this material during heating may not be significant.

6. The first paragraph in IRSR section 4.3.2.1 suggests the possibility of localized corrosion (pitting) and stress corrosion cracking (SCC) of Zircaloy fuel. These degradation modes are viewed as highly unlikely because the temperatures and stresses on the cladding will be low by the time the water contacts the waste form. In addition, the availability of chemical species that can cause pitting or SCC in cladding may be impacted by competing corrosion of the waste package internals and containment barrier materials.

7. IRSR section 4.2.2.1, (page 33, 4th paragraph) discusses concerns with Alloy 825. However, as the NRC is aware, Alloy 825 is no longer the reference containment barrier material. Lifetimes of waste packages using Alloy 625 or Alloy C-22 are expected to be significantly longer than those expected for Alloy 825, because these alloys are more resistant to localized corrosion than is Alloy 825.

8. Section 4.2.2.1 (page 32, 3rd paragraph) states that "in mildly alkaline environments [hydrogen ion concentration potential (pH) ranging from 8 to 11], carbon steel can undergo localized rather than uniform corrosion because of a passive film is formed on the metal surface." Research (Marsh et al., 1985) has shown that, in high chloride and high

bicarbonate/carbonate solutions, pitting (localized corrosion) can occur in this pH range. With water dripping and evaporation on a waste package, it is possible that concentrated solutions of chloride and bicarbonate/carbonate could form in the ranges of susceptibility to localized corrosion. However, because of the limited amount of water available and the formation of carbonic acid ($H_2 CO_3$) from the presence of gaseous carbon dioxide, this potential susceptibility is less likely.

9. Sections 3.3.1 (first paragraph) and 3.3.2 (first paragraph) discuss the limitations of the geochemistry module used in TSPA-93 and the geochemistry module used in TSPA-95. Some of the limitations of the TSPA-93 and TSPA-95 geochemistry modules will be addressed in the TSPA-VA. The modules being developed for use in TSPA-VA assess some of the conceptual issues for geochemical variation resulting from both thermal and substance perturbations. These modules will enable use of more realistic values for evaluating the engineered barriers in the drifts (e.g., waste package, waste form, invert materials, etc.). In addition, many of the modules for the engineered barriers are being augmented to account for more compositional effects on their performance.

10. Sections 3.4.2 (last paragraph), 4.3.2.2 (fifth paragraph), 4.4.2.1 (eighth paragraph and colloid transport, stability and filtration sections) discuss concerns with treatment of colloids. Considerable work was initiated this fiscal year (FY-98) to make a realistic bounding (base case) colloid calculation for TSPA-VA. The calculation includes data on colloid formation, and colloid stability (forward and reverse sorption rates, effects of pH and ionic strength). Therefore, the Project is making progress in addressing this IRSR concern.

11. It is unclear how the study of the processes listed in IRSR section 4.4.1 (bullet eight) will lead to a better understanding of coupled thermal-hydrologic-chemical processes because all these natural mineral deposits were deposited and/or formed under ambient conditions.

12. IRSR section 4.4.2.1 (fifth paragraph) discusses neptunium (Np) solubility. The Project is currently doing considerable work on Np solubility and speciation. This work includes determination of the phase controlling Np solubility (NpO_2 or Np_2O_5), as well as oxidation-reduction potential (Eh) and pH stability range of these phases under a variety of expected near field geochemical conditions. In addition, work is in progress to determine the range of the Eh and pH of the local ground waters at Yucca Mountain.

13. IRSR section 4.4.2.2 (second paragraph) discusses effects of organics. Research is ongoing to address the complexing effects of humics on various radionuclides under several near field geochemical conditions. This work will help reduce some of the uncertainty currently associated with the effects of organics on radionuclides in the near-field environment.

14. On page 63 (last paragraph), the NRC comments that issues related to their letter on the DOE's thermal-hydraulic testing modeling program remain to be addressed. DOE Yucca Mountain Site Characterization Office has addressed these comments in their letter dated January 23, 1997 which is currently being reviewed by the NRC staff.

15. The IRSR also states that two of the nine related open-items from the NRC's Site Characterization Analysis are resolved. DOE believes that it should be possible to resolve most, if not all, of these outstanding open-items based on current information and our planned future work.

Enclosure 3

KEY TECHNICAL ISSUE: UNSATURATED AND SATURATED FLOW UNDER ISOTHERMAL CONDITIONS ISSUE RESOLUTION STATUS REPORT

1. Observation on Figure A-1: Flowdown Diagram for Total System Performance Assessment: the figure accurately represents the conceptual flow of information about present-day infiltration into Total System Performance Assessment (TSPA). The U.S. Department of Energy (DOE) is in agreement with the depiction of the flow of information in the figure.

2. The Issue Resolution Status Reports (IRSR) introduces "shallow infiltration," "net infiltration," and "recharge" as virtually synonymous terms but does not provide specific definitions. "Shallow infiltration" usually denotes infiltration from precipitation into the soil zone at the upper atmosphere-soil boundary, "net infiltration" usually denotes the liquid-water flux moving vertically downward below the plant-root zone and below the zone of evapotranspiration, and "recharge" nominally is a saturated-zone concept and refers to the flux of water entering the saturated-zone across the water table from the overlying unsaturated-zone. "Percolation flux," on the other hand, refers to the downward flux of water in the deep unsaturated-zone across a particular horizon or datum plane and is not synonymous with, for example, "net infiltration." Clear and precise definition of these terms, some of which may be subject to more than one standardized interpretation, is needed.

3. Section 3.3 of the IRSR describes the U.S. Nuclear Regulatory Commission (NRC) staff's views regarding the importance to repository performance of the subissue related to the amount and spatial distribution of present-day shallow infiltration. Although DOE agrees that infiltration is an important parameter for estimating potential seepage, there is uncertainty associated with understanding how information on variations in present-day shallow infiltration can be applied to estimate future variations that could result from a foreseeable change to cooler and wetter conditions.

4. Section 3.3 describes "key elements" of the engineered and natural subsystems that represent various abstractions of the subissue related to present-day shallow infiltration. The key elements as described in the IRSR are: (1) quantity and chemistry of water contacting waste forms (includes consideration of shallow infiltration and deep percolation), (2) fracture vs. matrix flow (includes consideration of shallow infiltration) and, (3) spatial and temporal distribution of flow (includes consideration of infiltration). While no technical issues have been identified associated with the key elements as identified in the IRSR, the IRSR does not discuss the basis for identifying and describing the key elements. Hence, the purpose for developing the key elements and the relationship of these elements to resolution of the key technical issues and associated subissues is not clear. Finally, the role of the key elements in the development of an acceptable license application or in supporting compliance arguments

presented in the license application is not clear. The DOE is concerned about the potential for creation of additional items that must be resolved prior to NRC acceptance of the license application or that must be incorporated into the compliance arguments presented in the license application.

5. The first acceptance criterion (Section 4.3.1) specifies that DOE must show that several parameters have been considered in ways that do not underestimate infiltration. The DOE does not plan to collect additional data about these parameters because it views the collection of such information as unnecessary for its performance analysis. Although the NRC has identified potential seepage into repository drifts as an important parameter, long-term potential seepage appears to be related more to changes in climate variables and percolation flux than to variations in present-day shallow infiltration. Hence, there appears to be little justification for continuing work to understand variations in present-day infiltration.

6. The DOE has a minor technical concern related to the description of the use of the Maxey-Eakin method to estimate recharge. The description in IRSR section 4.3.2-1.a, paragraph 2, indicates that the method "is most reasonable on a regional scale and larger and is highly questionable at scales as small as the Yucca Mountain site scale." The DOE believes that the Maxey-Eaken method is applicable at "watershed-scale," but the term "regional scale" as used by the NRC is ambiguous.

7. IRSR Section 4.3.2, bullet 1: "Implications of Net Infiltration Characterization for Repository Performance," indicates that the NRC apparently expects an evaluation of the ability of the system to attenuate episodic wetting pulses to appropriately characterize the behavior of deep percolation. Current DOE plans are to demonstrate that the steady-state model adequately bounds episodic wetting.

8. There is a potential concern with the description of the conceptual model. The concern relates to conclusions that are drawn about data trends such as the one suggested by the precipitation record at weather station 4JA (Appendix B, pages 2-3). Given the apparent variability in annual precipitation data, there may be insufficient data to support extrapolation of data from 35 years to longer periods.

9. The NRC characterized the description of hydrologic environments at Yucca Mountain (Flint and Flint, 1995; Flint et al., 1994 and 1996) as possibly inadequate to account for the west flank of Yucca Crest (See IRSR Appendix B, "Environments to Consider at Yucca Mountain," page 9, paragraph 2). The DOE expects that data from moisture monitoring along a segment of the east-west cross drift, about 200 meters long, will provide sufficient information about infiltration behavior of the crystal-rich and crystal-poor intervals of the Tiva Canyon Tuff on the west side of Yucca Crest to address the NRC's concerns.

10. Appendix D of the IRSR contains an apparent omission in the list of unresolved open-items. The appendix lists Site Characterization Analysis (SCA) Comment 15 as unresolved. (The comment concerns the perceived inadequacy of horizontal borehole testing of the Solitario Canyon fault to address the potential impact of faults on fluid flow). According to our records, SCA Comment 15 was closed by a letter from J. Holonich to R. Milner dated September 15, 1994.

11. The Appendix D description of the open-items associated with TSPA 95 does not reflect the approach the DOE is using for TSPA Viability Assessment (VA) to evaluate infiltration, percolation, and saturated-zone dilution. The TSPA VA approach retains use of a maximum saturation value of 1, which concerned the NRC during its review of TSPA 95. However, the TSPA VA approach restricts fracture-matrix interaction, and the net effect is expected to address the NRC's concerns.

12. There appear to be some inconsistencies between the NRC review strategy presented in the License Application Review Plan (NUREG-1323) and that indicated in the IRSR. For example, it is unclear whether net infiltration will be treated as an entity for license application review purposes (as suggested by the IRSR), or whether components such as average annual precipitation and average annual potential evapotranspiration will be evaluated, as indicated in NUREG-1323, review plan 3.2.4.1. To complicate the matter, the discussion of potential evapotranspiration in Section 4.3.2(1)(b) of the IRSR does not include any references to the methods described in NUREG-1323, Review Plan 3.2.4.1. Because of the lack of references to the methods described in the review plan, it is not clear whether use of the review plan methods would be acceptable to NRC for determining estimates of precipitation and potential evapotranspiration for the purpose of resolving issues identified in the IRSR. It is also not clear whether the evaluations described in the review plan are still necessary for developing the license application, given the development of the IRSR. The same concern applies to the description of precipitation data in the IRSR.

KEY TECHNICAL ISSUE: STRUCTURAL DEFORMATION AND SEISMICITY ISSUE RESOLUTION STATUS REPORT

1. Page 11, Section 4.1.1.2 (Type I Faults): The U.S. Nuclear Regulatory Commission (NRC) staff assumes that relevant and potentially relevant faults, as identified by the U.S. Geological Survey (USGS) 1996), are equivalent to Type I faults. This assumption may not be valid. The USGS study did not evaluate the potential of the identified faults to determine if they may affect the design or performance of structures, systems, and components important to safety, containment, or waste isolation; or if they may provide significant input into models used in the design or in the assessment of the performance of structures, systems, and components important to safety, containment, or waste isolation as called for in NUREG-1451 (McConnell et al., 1992). This may not be a significant issue because the approach the U.S. Department of Energy (DOE) expects to take will consider all of the faults that the NRC would consider under its definition of Type I faults.

2. Page 11, Section 4.1.1.2: The NRC staff reference McKague et al. (1996) to imply that selection of the most conservative ground motion attenuation relation is appropriate for evaluating faults as to their Type. The DOE's position is that ground motion attenuation relations should be evaluated for their applicability to the Yucca Mountain region at different magnitude and distance ranges and a reasonably conservative relation or combination of relations should be selected, not necessarily the most conservative.

3 Page 12, Section 4.1.1.2: As a result of the assumption that relevant and potentially relevant faults are Type I faults, the NRC also assumes that the DOE believes that 84th percentile ground motions are appropriate for evaluating faults as to their type. Although the DOE may eventually agree with this assumption, no official determination has been made by the DOE as to what measure of ground motion is appropriate.

4. Page 13, Section 4.1.1.2: The NRC staff state that DOE has not considered *in situ* stress in its analysis of USGS Type I faults. This comment is based on the NRC assumption that relevant and potentially relevant faults, as identified in USGS (1996), are equivalent to Type I faults. *In situ* stress was not considered because, as was noted in comment 1, the USGS was not carrying out an evaluation of Type I faults.

5. Page 19, Section 5.1.1.1: The NRC staff state, "Because the use of 84th percentile peak acceleration is more conservative than the mean or median values, the DOE terms relevant and potentially relevant generally correspond to NRC's guidelines on Type I faults." The NRC guidance on Type I faults, however, provides no guidelines on the appropriate ground motion attenuation relation to use or on the appropriate ground motion measure (e.g., mean, median, 84th percentile) to use in assessing fault Type. The NRC seems to be stating that it is acceptable to use the 84th percentile from an average of available ground motion

attenuation relations instead of the mean from the most conservative since they come out about the same. For assessment of seismic hazard at Yucca Mountain, the DOE intends to rely upon median ground motion evaluations provided by the results of the Probablistic Seismic Hazard Assessment (PSHA).

6. Page 17, Section 4.4.1.2 (Viable Tectonic Models section): The NRC summarizes the consensus from an Appendix 7 meeting concerning viable tectonic models, concluding that five models should be used to bound the impacts of faulting and seismicity on repository performance. In carrying out its PSHA, however, the DOE has not restricted the range of tectonic models that its teams of experts can consider in providing their interpretations of seismic sources. The NRC goes on to observe that the PSHA expert elicitation process appears to be heading toward considering an appropriate range of tectonic models.

7. Many of the modeling aspects discussed by the NRC in the Viable Tectonic Models will be incorporated into the DOE's abstracted seismic/volcanic disruptive model for Total System Performance Assessment Viability Assessment. We anticipate that NRC's review of these models will result in real progress in this area of concern.

8. The NRC staff indicate in the Issue Resolution Status Report that they intend modeling several parameters: fault slip impacts on dose from faulting scenarios; dose sensitivity to fault-dominated flow in the unsaturated-zone; magma flow sensitivity to structural controls; waste-package failures from seismic motion; and focused fracture flow. Although the DOE is not modeling each of these parameters in the same way, these parameters are included within other models.

Enclosure 5

KEY TECHNICAL ISSUE: THERMAL EFFECTS ON FLOW ISSUE RESOLUTION STATUS REPORT

1. The document appears to place emphasis on the value of most recent conceptual and numerical models of thermal and hydrologic processes without appropriate consideration of attendant confidence in numerical predictions. Parameter uncertainty issues are given limited emphasis in the Issue Resolution Status Report (IRSR). However, the U.S. Department of Energy (DOE) considers parameter uncertainty and sufficiency of data important factors affecting confidence in numerical predictions.

2. The relevance of Appendix B of the IRSR to issue resolution is unclear. The NRC abstracted models REFLUX1and REFLUX2 discussed in Appendix B seem to represent the basis of comments in the IRSR document, but the intent of the use of these models is not discussed in the IRSR.

3. The report includes little discussion in the technical justification sections on important thermal-hydrologic phenomena, such as effects of multi-drift dryout zone coalescence, lateral movement of condensate, modes of drainage in pillars and the "cold trap" effect. The reviewers were concerned that a prioritization process must be established for these phenomena prior to framing the technical basis for thermal-hydrologic modeling issue resolution.

4. Page 5, Section 3.2.1 (Effect of Reflux on Waste Package Integrity): The NRC includes humid air and aqueous corrosion environments in the EBSFAIL module of the Total System Performance Assessment version 3.0. The NRC appears to assume that aqueous corrosion is initiated at 60 percent relative humidity; however, the Project assumes that aqueous corrosion is initiated at 85 percent humidity.

5. Page 14, Section 4.1.1 (Acceptance Criteria for subissue 1): The NRC indicates that one item necessary to meet acceptance criteria for this subissue is for DOE "to determine whether water refluxes back to the heaters during either the heating or cool down phases of the tests." The cool down phase single heater test will be completed in January 1999. The large block test will be completed in July 1999. Both tests are expected to provide data regarding refluxing in time to support the License Application. The drift scale test cool phase is scheduled to be completed in December 2005 and will provide information on refluxing.

6. Page 19, Section 4.3 (Acceptance Criteria for Subissue 3): The NRC indicates that one item necessary to meet acceptance criteria for this subissue is for DOE to evaluate "coupling of thermal processes". Coupling will not be considered in the base case. Preliminary sensitivity analyses may be available for Viability Assessment.

7. Page 22, Section 5.2 (U.S. Nuclear Regulatory Commission Audit Review of U.S. Department of Energy TSPA-95): The NRC identified an item of concern from review of TSPA-95 that relates to heat transfer calculations. This item has been addressed in a recent round of drift-scale calculations.

8. Page 22, Section 5.2 (U.S. Nuclear Regulatory Commission Audit Review of U.S. Department of Energy TSPA-95): The NRC suggests a comparison study be performed between equivalent continuum model (ECM) and alternative conceptual models. The Thermal-hydrologic modeling program conducts analyses with both ECM and alternative conceptual models. As such, the need for comparison studies between models has not been established.

References

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