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 RELATED TO THE POTENTIAL GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA: TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION.3.07 AND GENERAL 1.01 COMMENTS 13 AND 95

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) issue resolution goal during this interim pre-licensing period is to ensure the U.S. Department of Energy (DOE) has assembled sufficient information about a given issue for NRC to accept a License Application for review. Resolution by NRC staff during pre-licensing does not prevent anyone from raising any issue for the NRC staff consideration during the licensing proceedings. It is equally important to note that resolution of an issue by NRC staff during the pre-licensing period does not prejudge the NRC staff evaluation of the issue during the licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff have no further questions or comments about how DOE is addressing an issue. Pertinent new information could raise new questions or comments about a previously resolved issue. The NRC licensing decision will be based on information provided as part of a potential License Application.

By letter dated July 28, 2004, DOE submitted Appendix J (Bechtel SAIC Company, LLC, 2004a) of a report, Technical Basis Document No. 3. Appendix J provides the informational needs of Key Technical Issue (KTI) Agreements Total System Performance Assessment and Integration (TSPAI) 3.07 and General (GEN) 1.01 Comments 13 and 95. This information was requested by NRC during technical exchanges in August 2001 (Reamer, 2001a) and October 2001 (Reamer, 2001b). In its transmittal letter, DOE recommended that Agreements TSPAI.3.07 and GEN.1.01 Comments 13 and 95 be considered closed based on the information provided in Appendix J.

2.0 WORDING OF THE AGREEMENTS

TSPAI.3.07

The agreement reads (Reamer, 2001a): [NOTE: ENG 3.1.1 in this agreement refers to item 3.1of NRC integrated subissue ENG 3 (NRC 2002, Table 1.1-2]

"Provide technical basis for representation of or the neglect of dripping from rock bolts in the ECRB [Enhanced Characterization of the Repository Block] in performance assessment, including the impacts on hydrology, chemistry, and other impacted models. Appropriate consideration will be given to the uncertainties in the source of the moisture and how those uncertainties impact other models (ENG3.1.1) [For ENG 3.1.1, See NRC 2002, Table 1.1-2, Item 3.1]. DOE will provide technical basis for determination of future sources of water in the ECRB, will evaluate the possibility of preferential dripping from engineered materials, and will give appropriate consideration to the uncertainties of the water sources, as well as their potential impact on other models. The work done to date as well as the additional work will be documented in the AMR on *In-Situ* Field Testing Processes (ANL–NBS–HS–000005) or other documents. This AMR will be available to NRC in FY 2003. DOE will evaluate the role of

condensation as a source of water and any impacts of this on hydrologic and chemical conditions in the drift, and DOE will document this work. The effects of condensation will be included in TSPA if found to be potentially important to performance."

GEN.1.01 (Comment 13)

The agreement reads (Reamer, 2001b):

"The SSPA [Site Suitability Performance Assessment] argues that rock bolts will not enhance seepage, contrary to the Seepage Model for PA including Drift Collapse AMR, which indicates increased seepage due to rock bolts."

"Basis: Puddles of water were observed directly under rock bolts in Alcove 5. An explanation provided by DOE for this observation was that water was used for drilling these rock bolts in place. Dripping has been observed from rock bolts in the sealed ECRB. The explanation provided by DOE (so far) for this observation is that this is condensation."

GEN.1.01 (Comment 95) [NOTE: The page and section numbers cited in the agreement refer to Bechtel SAIC Company, LLC (2001)].

The agreement reads (Reamer, 2001b):

"Page 4-31: The explanation of the observed seepage enhancement in the ESF and associated tunnels appears to be speculation that is not supported by any concrete evidence."

3.0 NRC EVALUATION AND COMMENT

3.1 Relevance to Repository Performance

The performances of drip shields and waste packages can be affected directly by the quantity and chemistry of water contacting them. Drift seepage, one of the direct controls for the quantity of water contacting engineered barriers and wasteforms, is potentially affected by the presence of rock bolts in the repository emplacement drifts. While drift seepage is considered to have high significance to waste isolation in the NRC Risk Insights Baseline Report (NRC, 2004), Agreement TSPAI.3.07 is related to the effect of rock bolts on drift seepage, and is considered to be a medium risk significant agreement (Travers, 2003).

Finally, while GEN.1.01 is considered to be of high-risk significance overall (Travers, 2003), the individual comments within GEN.1.01 (e.g. 13 and 95) were not separately categorized within the significance framework. The specific comments of GEN.1.01 are related to other KTI agreements, whose risk significance varies from low-risk to high-risk significance. This review addresses two GEN.1.01 Comments 13 and 95 which are associated with TSPAI Agreement 3.07 (a medium risk significance agreement). Therefore, they are considered to have a "risk significance" that is no higher than "medium."

3.2 Result of the NRC Review

In Appendix J of the technical basis document, DOE provided responses to the four main

issues relevant to Agreements TSPAI.3.07 and GEN.1.01 Comments 13 and 95. These four issues are: (i) impact of rock bolts on hydrology, chemistry, and other applicable models; (ii) seepage enhancement due to rock bolts; (iii) uncertainties regarding whether the source of the observed moisture in the sealed portion of the Enhanced Characterization of the Repository Block Cross-Drift was seepage or condensation; and (iv) future sources of water in the Enhanced Characterization of the Repository Block Cross-Drift, related uncertainties, and potential impact on models.

To evaluate the impact of rock bolts on hydrology and seepage, DOE developed a refined seepage model that includes rock bolts. Results from DOE's hydrologic model, which were summarized in Appendix J, indicated the impact of rock bolts on seepage is negligible. The DOE examined the effects of rock bolts and their corrosion products on the chemistry of water entering the drift. This analysis is provided in Bechtel SAIC Company, LLC (2004b). The result of the analysis, summarized in Appendix J, indicated rock bolts will have a negligible effect on the chemistry of seepage water. With respect to the source of moisture in the sealed portion of the Enhanced Characterization of the Repository Block Cross-Drift, DOE stated two factors [provided in Bechtel SAIC Company, LLC (2003a)] suggest condensate, rather than seepage, contributed to the observed water in the Enhanced Characterization of the Repository Block Cross-Drift: (i) visual observation of droplets on impermeable engineered materials, and (ii) chemical analysis of water. The DOE stated although seepage also may occur in the sealed drift, the available data do not conclusively identify the source of water as seepage water. With respect to future sources of water in the Enhanced Characterization of the Repository Block Cross-Drift, DOE summarized in Appendix J its numerical modeling to predict seepage under ambient and thermal conditions, including related uncertainties. Based on the information provided by DOE, the NRC staff concludes that DOE has been responsive to NRC staff concerns. Therefore, NRC staff considers Agreement TSPAI 3.07, and GEN 1.01 Comments 13 and 95 closed.

While DOE has adequately addressed the intent of these agreements, we recognize that this is an area of on-going data collection and analysis. Consequently, DOE should consider the following in developing a technical basis for screening out the impact of rock bolts on hydrology and seepage:

- For the hydrologic aspects of agreement TSPAI.3.07 and GEN.1.01 Comment 13, Appendix J contains a description of the rock bolt seepage numerical model. As described in Appendix J (Bechtel SAIC Company, LLC, 2004a), an emplaced rock bolt was represented as an open borehole that did not protrude from the drift wall. Integration of information from ongoing field tests (e.g., Passive Test in the cross-drift) with the grouted rock bolt seepage model described in Bechtel SAIC Company, LLC (2003b) could improve the basis for assessing the effect of rock bolts. In the ongoing field tests, preliminary observations suggest the rock bolts, which are in contact with the host rock and protrude from the drift wall, may serve as focal points for water dripping onto the engineered barrier system and invert. Under ambient conditions, enhanced seepage due to rock bolts would be less than during the thermally perturbed period. The rock bolts may serve as preferential flow pathways during the thermally perturbed period. Water buildup in the reflux zone may preferentially flow along rock bolts and drip onto the engineered barrier system and invert.

- For GEN.1.01 Comment 95, information in Appendix J included a summary of available observations from the passive seepage test in the Enhanced Characterization of the Repository Block Cross-Drift pertaining to the evolution of water in the experiment. No conclusive information is available to discern whether the water in the drift resulted directly from seepage or was evaporated and condensed. Observations suggest at least some of the water was condensed at the locations where it was found. Seepage, however, could not be eliminated as a source of some of the water. Although the drift walls were still rewetting (and likely imbibing condensed water) after being dried by ventilation, the source for water condensed on impermeable surfaces had to come from the rock wall, albeit from some other location. This implies that locally, percolation and dripping have sufficiently rewet the drift wall.

The NRC staff believes ongoing measurements and observations in the passive seepage test will help clarify the source of the water.

4.0 SUMMARY AND STATUS OF THE AGREEMENTS

The NRC staff reviewed DOE's KTI agreement responses within Appendix J of the technical basis document to determine whether sufficient information was provided to close the agreements. On the basis of this review, and notwithstanding new information that could raise new questions or comments concerning the preceding agreements, NRC staff considers the information provided in the technical basis document satisfies the intent of Agreements TSPAI.3.07 and GEN.1.01 Comments 13 and 95 and the staff has no further questions at this time. Therefore, NRC staff considers the agreements and comments closed.

5.0 REFERENCES

Bechtel SAIC Company, LLC. "Appendix J: Representation of, or the Neglect of, Dripping from Rock Bolts in the Enhanced Characterization of the Repository Block Cross-Drift [Response to TSPAI 3.07 and GEN 1.01 (Comments 13 and 95)]." Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004a.

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Reamer, C.W. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Total System Performance Assessment and Integration (August 6–10, 2001)." Letter (August 23) to S. Brocoum, DOE. Washington, DC: NRC. 2001a. <www.nrc.gov/waste/hlw-disposal/public-involvement/mtg-archive.html#KTI>

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Travers, W.D. "Final Staff Response to March 19, 2003, Requirements Memorandum on the Waste Arena Briefing–M030303A." Letter (June 5) to Chairman Diaz and Commissioners Dicus, McGaffigan, and Merrifield. Washington, DC: NRC. 2003. <www.nrc.gov/reading-rm/adams.html>