

February 13, 2003

Joseph D. Ziegler, Acting Assistant Manager  
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U.S. Department of Energy  
Office of Civilian Radioactive Waste Management  
Yucca Mountain Site Characterization Office  
P.O. Box 30307  
North Las Vegas, NV 89036-0307

SUBJECT: IGNEOUS ACTIVITY AGREEMENT 2.10

Dear Mr. Ziegler:

In your letter dated July 1, 2002, the U.S. Department of Energy (DOE) submitted a report to the U.S. Nuclear Regulatory Commission (NRC) entitled, "Relative Contributions of Releases From Zones 1 and 2," to provide the information necessary to satisfy Igneous Activity (IA) Agreement Item 2.10. As discussed at the April 15-16, 2002, NRC/DOE Technical Exchange on Key Technical Issues, the information required by NRC to close IA Agreement 2.10 related to the relative release from Zones 1 and 2 would be provided in separate documentation, while the concerns with waste package response would be provided by DOE with information necessary to address IA Agreements 2.18 and 2.19.

In summary, as is discussed in the enclosure to this letter, NRC has reviewed the information provided in the above referenced report and considered it sufficient to complete part 1 of IA Agreement 2.10 related to the relative contribution from Zones 1 and 2. Although DOE used unqualified data in this analysis, the results demonstrate the importance of understanding the degree of damage of the waste packages, and the necessity of completing the work described in IA Agreement Items 2.18 and 2.19. When that work is completed, a better understanding of the risk from both the extrusive and intrusive scenarios will be obtained. As the remaining concerns related to IA Agreement item 2.10 will be provided in response to IA Agreements 2.18 and 2.19, and will be performed under DOE's Quality Assurance Program, we consider that IA Agreement 2.10 is complete.

If there are any questions regarding this letter please contact John S. Trapp at 301-415-8063 or by e-mail at [jst@nrc.gov](mailto:jst@nrc.gov).

Sincerely,

***/RA/***

Janet R. Schlueter, Chief  
High-Level Waste Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: NRC review of DOE letter  
pertaining to Igneous Activity  
Key Technical Agreement 2.10

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**NRC Review of DOE letter Pertaining to  
Igneous Activity Key Technical Issue Agreement 2.10**

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution 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 the NRC staff during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Also, and just as importantly, resolution by the NRC staff during pre-licensing does not prejudice what the NRC staff evaluation of that issue will be after it's licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff has no further questions or comments about how DOE is addressing an issue. Pertinent new information could raise new questions or comments on a previously resolved issue.

This enclosure addresses NRC/DOE Igneous Activity Agreement 2.10 made during the Igneous Activity Technical Exchange and Management Meeting on August 29-31, 2000, as modified during the Igneous Activity Technical Exchange and Management meeting of June 21-22, 2001. By letter dated July 1, 2002, DOE submitted a letter report on "Relative contributions of Releases from Zones 1 and 2" which, together with information which is to be provided in response to IA Agreement Items 2.18 and 2.19 is considered by DOE to be sufficient to close IA Agreement Item 2.10.

The following provides the NRC staff review of this letter report.

**Igneous Activity Agreement 2.10:**

" Document the Interim Change Notices (ICN) to the Igneous Consequences Analysis Model Report (AMR) and the Dike Propagation AMR regarding the calculation of the number of waste packages hit by the intrusion. Include in these or other documents (1) the intermediate results of the releases from Zones 1 and 2, separately, and (2) the evaluation of thermal and mechanical effects, as well as shock, in assessing the degree of waste package damage in Zone 1 and 2.

DOE agreed and will provide ICN 1 of the following AMRs: Igneous Consequences Modeling for TSPA-SR AMR [ANL-WIS-MD-000017]; Dike Propagation Near Drifts [ANL-WIS-MD-000015]; Characterize Framework for Igneous Activity at Yucca Mountain, Nevada [ANL-MGR-GS-000001]; and the calculation Number of Waste Packages Hit by Igneous Intrusion [CAL-WIS-PA-000001]. This will be available to the NRC in January 2001.

DOE will provide the results showing the relative contributions of releases from Zones 1 and 2 in a calculation document. This will be available in FY 2002.

DOE will provide the evaluation of thermal mechanical effects on waste package damage in Zones 1 and 2 in ICN 1 of the Dike Propagation Near Drifts AMR [ANL-WIS-MD-000015]. This will be available to the NRC in January 2001."

**NRC Review:**

In the CRWMS M&O (2000a), groundwater release following an igneous event had a higher risk in 10,000 years than direct release from a volcanic event. Agreement item 2.10 was created to provide staff with additional information on the relative contribution to risk from releases in each damage zone. This information is needed to focus staff review on risk-significant processes related to the definition of individual damage zones.

Analyses presented in Bechtel SAIC Company, LLC. (2001a, b) show the relative contribution to risk from releases in damage Zone 1 and Zone 2. As discussed in Bechtel SAIC Company, LLC. (2001a, b) and the Letter Report, potential releases from damage Zone 1 dominate risk from the igneous intrusion groundwater release pathway for the first 20,000 years. Potential releases from damage Zone 2 contribute less than about 10 percent to the overall risk from the igneous intrusion groundwater release pathway (Bechtel SAIC Company, LLC., 2001a, b).

The minor contribution to risk from Zone 2 appears reasonable based on the limited damage to the engineered barrier system in that zone during an igneous event. Although drip shield and fuel cladding fail during the postulated igneous event, moisture inflow and outflow is restricted in Zone 2 to an end-cap opening that averages only 10 cm<sup>2</sup> [1.6 in<sup>2</sup>] (CRWMS M&O, 1999). In contrast, waste packages in Zone 1 are so extensively damaged that they provide no further restrictions on water flow.

The number of waste packages contained in Zone 1 appears to be a sensitive parameter in DOE performance assessment calculations. Analyses in Bechtel SAIC Company, LLC. (2001a, b) used a median of 197 waste packages in Zone 1, versus a median of 192 waste packages in CRWMS M&O (2000a). Probability-weighted mean annual dose in Bechtel SAIC Company, LLC. (2001a, b), however, increased by up to a factor of two relative to CRWMS M&O (2000a). Part 2 of Igneous Activity Key Technical Issue Agreement item 2.10 is for the DOE "to provide the evaluation of thermal and mechanical effects, as well as shock, in assessing the degree of waste package damage in Zone 1 and 2." Analyses in the DOE Letter Report continue to demonstrate that information needed to address part 2 of agreement item 2.10 affects staff review of risk-significant processes in the DOE performance calculations. While non QA'd data were used by DOE in this analysis, the results are sufficient for the purpose of this portion of Agreement Item 2.10. In order to understand the contribution to risk of the igneous intrusion scenario the analysis required to address Igneous Agreement Items 2.18 and 2.19 are needed, and information related to part 2 of agreement item 2.10 will be addressed by the DOE in Igneous Activity Key Technical Issue Agreement items 2.18 and 2.19, which are expected in FY2003.

Additional Information Needed: None at this time

Status of Agreement:

Staff conclude that the DOE has acceptably addressed staff questions in part 1 of Igneous Activity Key Technical Issue Agreement Item 2.10 regarding the relative contribution to probability-weighted dose from different degrees of assumed waste-package damage during intrusive igneous events. Part 2 of this agreement, regarding the basis for assessing waste package damage during potential igneous events, is superceded by Igneous Activity Key Technical Issue Agreement Items 2.18 and 2.19. Igneous Activity Agreement Item 2.10 is considered complete.

#### References

Bechtel SAIC Company, LLC. "FY01 Supplemental Science and Performance Analyses." Vol. 1: Scientific Bases and Analyses. TDR-MGR-MD-000007. Revision 00 ICN 01. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2001a.

Bechtel SAIC Company, LLC. "FY01 Supplemental Science and Performance Analyses." Vol. 2:

Performance Analyses. TDR–MGR–PA–000001. Revision 00. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2001b.

CRWMS M&O. “Waste Package Behavior in Magma.” CAL–EBS–ME–000000. Revision 00. North Las Vegas, Nevada: TRW Environmental Safety Systems, Inc. 1999.

CRWMS M&O. “Total System Performance Assessment–Site Recommendation.” TDR–WIS–PA–000001. Revision 00 ICN1. North Las Vegas, Nevada: TRW Environmental Safety Systems, Inc. 2000a.

CRWMS M&O. “Igneous Consequence Modeling for Total System Performance Assessment–Site Recommendation.” ANL–WIS–MD–000017. Revision 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000b.

Woods, A.W., S. Sparks, O. Bokhove, A-M. LeJeune, C.B. Connor, and B.E. Hill. “Modeling the Explosive Eruption of Basaltic Magma Into The Proposed High-level Radioactive Waste Repository at Yucca Mountain, Nevada, U.S.A.” *Geophysical Research Letters* 29(13): 19-1–19-4. 2002.