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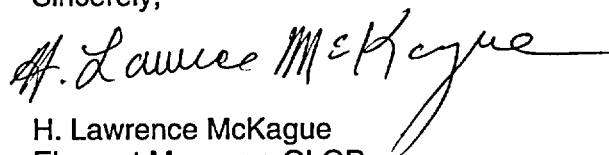
U.S. Nuclear Regulatory Commission
ATTN: Dr. John S. Trapp
Office of Nuclear Material Safety and Safeguards
Two White Flint North, Mail Stop 7 D13
Washington, DC 20555-0001

Subject: Completion of Intermediate Milestone—NRC Review of DOE Documents Pertaining to Igneous Activity Key Technical Issue Agreement Item 2.03 (IM 01402.461.276)

Dear Dr. Trapp:

Attached is IM 01402.461.276, entitled "NRC Review of DOE Documents Pertaining to Igneous Activity Key Technical Issue Agreement Item 2.03." This review provides a basis for not accepting the DOE response to staff questions regarding how tephra volumes used in DOE performance assessments are appropriate for representing Yucca Mountain region volcanic eruptions. No new information has been provided by the DOE to address this agreement, and the cited lack of sensitivity between eruption volume and risk requires additional explanation by the DOE. If you have any questions, please contact Dr. Brittain Hill at 210-522-6087 or me at 210-522-5183.

Sincerely,


H. Lawrence McKague
Element Manager, GLGP

HLM:rae

Attachment

cc:	J. Linehan	J. Schlueter	W. Patrick
	W. Reamer	S. Wastler	B. Sagar
	D. DeMarco	C. Trotter	CNWRA Directors (letter only)
	D. Riffle	K. Stablein	CNWRA Element Managers (letter only)
	B. Meehan	R. Codell	B. Hill
	L. Campbell	J. Anderson	R. Benke
	J. Greeves		T. Nagy (SwRI Contracts)

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NRC Review of DOE Documents Pertaining to Igneous Activity
Key Technical Issue Agreement Item 2.03

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 its 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 attachment addresses one agreement between the NRC and DOE made during the Igneous Activity (IA) Technical Exchange and Management Meeting (see letter,¹ which summarized the meeting). By letter,² DOE submitted information to address IA Agreement 2.03. The information submitted for this agreement is discussed below.

Igneous Activity Key Technical Issue Agreement Item 2.03

Summary

IA KTI Agreement 2.03 is for the DOE to document how tephra volumes used in performance assessments are appropriate for representing Yucca Mountain region volcanic eruptions. The DOE submitted a Letter Report entitled "Range of Tephra Volumes." The DOE continues to use the total volume of existing basaltic volcanoes in the Yucca Mountain region, and some information from analog volcanoes, to define the range of possible tephra volumes. No new information has been provided to document how tephra volumes used in performance assessments are appropriate for representing Yucca Mountain region volcanic eruptions. In addition, the apparent lack of sensitivity for this parameter in DOE performance calculations is not explained, and does not appear an adequate basis to meet this agreement. Staff conclude that the DOE has provided insufficient information to adequately document how tephra volumes used in DOE performance assessments are appropriate for representing Yucca Mountain region volcanic eruptions.

Wording of the Agreement

"Document how the tephra volumes from analog volcanos represent the likely range of tephra volumes from Yucca Mountain Region (YMR) volcanoes. (Eruptive AC-1) DOE agreed and will document the basis for determining the range of tephra volumes that is likely from possible future volcanoes in the YMR in the Eruptive Processes AMR (ANL-MGR-GS-000002). This will be available to the NRC in FY2002."

¹Schlueter, J.R. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Igneous Activity (August 29-31, 2000)." Letter (October 23) to S. Brocoum, DOE. Washington, DC: NRC. 2000.

²Ziegler, J.D. "Transmittal of Report Addressing Igneous Activity (IA) Key Technical Issue (KTI) Agreement Items 2.02 and 2.09." Letter (June 27) to J.R. Schlueter, NRC. Las Vegas, Nevada: DOE. 2002.

Review

During most basaltic volcanic eruptions, magma is erupted as lava flows, scoria cones, and tephra falls. The dispersal of tephra is calculated using the ASHPPLUME model (e.g., Jarzempa, 1997), which relates tephra mass-flow rates to column heights and dispersal distance. In addition, the volume of tephra determines the concentration of high-level waste in the eruption plume. Thus, tephra volume is an important parameter (i.e., NRC, 1998a) in performance calculations for potential volcanic disruption scenarios.

Tephra deposits at basaltic volcanoes in the Yucca Mountain region are highly eroded. Tephra volumes for past basaltic volcanic eruptions in the Yucca Mountain region thus cannot be calculated from field measurements. Based on comparison with analog volcanic eruptions, NRC (1998b) estimated these tephra volumes from cone-to-lava ratios preserved at Yucca Mountain region volcanoes. Analog volcanoes have tephra volumes that range from 0.012–0.44 km³ [0.003–0.11 mi³] (NRC, 1998b). In comparison, estimated tephra volumes for individual Yucca Mountain region basaltic volcanoes range from 0.004–0.05 km³ [0.001–0.012 mi³] (NRC, 1998b).

In CRWMS M&O (2000a), the DOE used a range of tephra volumes from 0.002–0.44 km³ [0.0005–0.11 mi³] to represent a potential repository-intersecting volcanic event. This range is derived (CRWMS M&O, 2000b) from DOE estimated preserved deposit volumes for Yucca Mountain region basaltic volcanoes (CRWMS M&O, 2000c) and analog volcano information in NRC (1999). Preserved deposit volumes (CRWMS M&O, 2000c) are an inappropriate basis for definition of realistic tephra volumes, as only some fraction of the total magma volume should erupt as tephra. The 0.002 km³ [0.0005 mi³] volume for Little Cones (CRWMS M&O, 2000c) also does not account for buried lava flows, which would increase the porosity-corrected volume estimate to 0.024 km³ [0.006 mi³] (NRC, 1998b).

In addition to the inappropriate use of preserved deposit volumes as a realistic range of tephra volumes, the DOE has not provided a technical basis to support the use of historically active basaltic volcanoes as analogs for future eruptions in the Yucca Mountain region (e.g., Connor, 1993). Although support for these analogs is provided in NRC (1998b, 1999), the DOE has not documented the basis for use of the cited volcanoes as analogs for future eruptions in the Yucca Mountain region basaltic magmatic system. Thus, the DOE has not established an independent technical basis to support the use of 0.002–0.44 km³ [0.0005–0.11 mi³] for tephra volumes in performance calculations.

The DOE Range of Tephra Volumes Letter Report cites calculations CRWMS M&O (2000a) that show a lack of sensitivity in probability-weighted dose to changes in tephra volume from 0.0026 km³ [0.0006 mi³] to 0.336 km³ [0.081 mi³] (i.e., changes in eruption column height from 2 km [1.2 mi] to 5 km [3.1 mi] above ground level). This result is unexpected, as simple volumetric relationships indicate a greater than two order-of-magnitude increase in tephra volume should result in an associated dilution in the concentration of incorporated high-level radioactive waste. The DOE should explain why these large variations in tephra volume do not affect dose calculations significantly. In addition, independent calculations using the NRC Total System Performance Assessment code show that the smallest conditional doses result from large-volume eruptions with low wind velocities. Thus, a range of tephra volumes that is biased towards larger volume eruptions will likely bias results towards lower average conditional doses.

No new information was provided in the Range of Tephra Volumes Letter Report to support the DOE tephra volumes used in performance calculations (e.g., CRWMS M&O, 2000a). In addition, DOE

acknowledges that it intends to document the range of tephra volumes and the basis for that range in a future modification to CRWMS M&O (2000c). As providing this needed information was the basis to complete Igneous Activity Key Technical Issue Agreement Item 2.03, staff conclude that DOE has provided inadequate information to meet this agreement. The DOE will need to document how the tephra volumes used in DOE performance calculations represent the likely range of tephra volumes from Yucca Mountain Region (YMR) volcanoes.

Status of Agreement

Staff conclude that the DOE has not acceptably addressed staff questions in Igneous Activity Key Technical Issue Agreement Item 2.03 regarding the use of appropriate tephra volumes in DOE performance calculations. The DOE will need to provide additional information on how the tephra volumes used in DOE performance calculations represent the likely range of tephra volumes from Yucca Mountain Region (YMR) volcanoes. The DOE plans to provide this information in a future modification to CRWMS M&O (2000c), which currently has an unspecified completion date.

References

Connor, C.B. "Technical and Regulatory Basis for the Study of Recently Active Cinder Cones." IM-20-5704-141-001. San Antonio, Texas: CNWRA. 1993.

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.

CRWMS M&O. "Characterize Framework for Igneous Activity at Yucca Mountain, Nevada." ANL-MGR-GS-000001. Revision 00 ICN 01. North Las Vegas, Nevada: DOE, Yucca Mountain Site Characterization Office. 2000c.

Jarzemba, M.S. "Stochastic Radionuclide Distributions After a Basaltic Eruption for Performance Assessments of Yucca Mountain." *Nuclear Technology*, Vol. 118, No. 2. pp. 132-141. 1997.

NRC. "NRC Sensitivity of Uncertainty Analyses for a Proposed High-Level Waste Repository at Yucca Mountain, Nevada Using TPA 3.1—Volume II: Results and Conclusions." NUREG-1668. Washington, DC: NRC. 1998a.

NRC. "Issue Resolution Status Report, Key Technical Issue: Igneous Activity." Revision 1. Washington, DC: NRC. 1998b.

NRC. "Issue Resolution Status Report, Key Technical Issue: Igneous Activity." Revision 2. Washington, DC: NRC. 1999.