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Account No. 20.01402.461

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

Subject: Completion of Intermediate Milestone—NRC Review of DOE Documents Pertaining to Igneous Activity Key Technical Issue Agreement Item 2.02 (IM 01402.461.273)

Dear Dr. Trapp:

Attached is IM 01402.461.273, entitled "NRC Review of DOE Documents Pertaining to Igneous Activity Key Technical Issue Agreement Item 2.02." This review provides a basis for accepting the DOE response to staff concerns regarding the potential effects of high-level waste particle size used in volcanic disruption scenarios. Staff conclude that the information provided by the DOE adequately documents that differences between NRC and DOE high-level waste particle-size distributions are not significant in performance calculations of volcanic events. 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	D. Riffle	J. Schlueter	R. Codell	CNWRA Dirs/EMs (letter only)
	W. Reamer	B. Meehan	S. Wastler	J. Anderson	B. Hill
	B. Leslie	L. Campbell	T. Essig	W. Patrick	R. Benke
	D. DeMarco	J. Greeves	K. Stablein	L. McKague	T. Nagy (SwRI Contracts)

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NRC Review of DOE Documents Pertaining to Igneous Activity
Key Technical Issue Agreement Item 2.02

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 prejudge 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 2.02. The information submitted for this agreement is discussed below:

1) Igneous Activity Key Technical Issue Agreement Item 2.02

Summary: A Letter Report entitled "Particle Size Sensitivity" was submitted by the U.S. Department of Energy (DOE) to fulfill Igneous Activity Key Technical Issue Agreement item 2.02. This agreement is for the DOE to provide a sensitivity analysis documenting that differences between NRC and DOE high-level waste particle-size distributions are not significant in DOE performance calculations of volcanic events. Based on staff review of the Letter Report and other available information, the information contained in this Letter Report appears adequate to satisfy Igneous Activity Key Technical Issue Agreement item 2.02. Staff conclude that the information provided in the Letter Report adequately documents that differences between NRC and DOE high-level waste particle-size distributions are not significant in DOE performance calculations of volcanic events.

Wording of the Agreement: "Document results of sensitivity studies for particle size, consistent with (1) [i.e., IA 2.01] above (Eruptive AC-4). DOE agreed and will document the waste particle size sensitivity study in a calculation document. This will be available to the NRC in FY2002."

Review: In the conceptual model for volcanic disruption, a subvolcanic conduit localizes along the trace of an igneous dike and intersects one to several drifts. Waste packages directly intersected by this volcanic conduit are modeled as wholly disrupted due to intense thermal and mechanical loads associated with an erupting volcano (e.g., NRC, 1999). High-level waste within these disrupted package with be subjected to a range of thermal, chemical, and mechanical stress. Although these stresses have not been evaluated explicitly, NRC (NRC, 1999) and DOE (CRWMS M&O, 2000a) agree that these stresses would likely reduce the waste particle size. Available waste particles are assumed to incorporate or adhere to magma particles based on an incorporation ratio between waste

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[1]Schlueter, 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

[2]Ziegler, 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.

and magma particle sizes. The amount of high-density waste incorporated into a tephra particle can affect the resulting transport distance, due to potential increases in particle settling velocity from the modeled eruption plume. NRC and DOE conceptual models use log-triangular distributions for waste and magma particle sizes. The NRC particle-size distribution used an estimated minimum of 0.001 mm [0.0000394 in], a mode of 0.01 mm [0.000394 in], and a maximum of 0.1 mm [0.00394 in] (NRC, 1999). In contrast, the DOE used a minimum of 0.001 mm [0.0000394 in], a mode of 0.02 mm [0.000787 in], and a maximum of 0.5 mm [0.019685 in] in the TSPA-SR (CRWMS M&O, 2000b). Because waste particle size is a potentially significant parameter in airborne transport models (e.g., CRWMS M&O, 2000c), DOE agreed to conduct a sensitivity analysis on the differences between the NRC and DOE particle-size distribution.

In the Supplemental Science and Performance Analysis Report (Bechtel SAIC Company, LLC, 2001a, b), the DOE conducted sensitivity analyses for a range of waste particle-size distribution that exceeded the differences between the NRC (1999) and CRWMS M&O (2000b) values. Particle sizes evaluated in Bechtel SAIC Company, LLC (2001a, b) ranged from minimums of 0.0005–0.001 mm [0.00002–0.0000394 in], modes from 0.002–0.2 mm [0.000787–0.0787 in], and maximums from 0.05–1 mm [0.001969–0.03937 in]. Using seven different particle-size distributions from these ranges, probability-weighted annual doses varied by a factor of 1.3 or less relative to analyses in CRWMS M&O (2000b). Thus, a factor of ten decrease in waste particle size, which should enhance transport distance, had a less than a 30 percent change in probability-weighted annual dose. As the values used by NRC represent only a factor of two decrease from those used by DOE, staff expect a less than 10 percent change in probability-weighted annual dose. This scale of potential change is not viewed as risk-significant, relative to other uncertainties associated with modeling possible volcanic disruption of a proposed repository site.

The results of the sensitivity study appear reasonable, as the modeled amounts of high-level waste are small compared to the modeled amounts of appropriately-sized tephra particles available for waste incorporation. For example, assume that five waste packages (66 MTU) are disrupted in the volcanic conduit. Using a high-level waste density of 1×10^4 kg/m^3 [624.2 lbm/ft^3] results in 33 m^3 [1,165 ft^3] of waste available to create particles of 0.1 mm [0.00394 in] or less. An average tephra volume for the Yucca Mountain region, however, is of order 10^7 m^3 [3.532×10^8 ft^3] when corrected to vesicle-free (NRC, 1999). Assuming only 1 percent of the deposit consists of particles 0.1 mm [0.00394 in] or smaller (e.g., NRC, 1996) results in a particle volume of order 10^5 m^3 [3.532×10^6 ft^3] available to potentially incorporate 33 m^3 [1,165 ft^3] of waste. Thus, for incorporation ratios of 0.1–1 (NRC, 1999; CRWMS M&O, 2000c), the amount of available tephra particles exceeds by several orders of magnitude the amount of available waste particles. Even if the waste-particle diameter is increased by an order of magnitude, there is still an abundance of magma particles having sufficient size to incorporate the waste.

Staff conclude that there are no risk-significant differences between NRC and DOE values used to describe particle-size distributions for high-level waste during basaltic volcanic events. Analyses presented in the DOE Letter Report on Particle Size, which repeats information in Bechtel SAIC Company, LLC (2001a, b), are sufficient to document the expected effects of reasonable variations in high-level waste particle size as modeled in the current DOE performance assessment (e.g., CRWMS M&O, 2000c).

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.

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CRWMS M&O. "Miscellaneous Waste-Form Features, Events, and Processes." ANL–WIS–MD–000009. Revision 00. Las Vegas, Nevada: CRWMS M&O. 2000a.

———. "Total System Performance Assessment–Site Recommendation." TDR–WIS–PA–000001. Revision 00 ICN1. North Las Vegas, Nevada: TRW Environmental Safety Systems, Inc. 2000b.

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