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June 25, 1997

Dr. Stephan J. Brocoum, Assistant Manager  
for Licensing  
Yucca Mountain Site Characterization Office  
Office of Civilian Radioactive Waste Management  
U.S. Department of Energy  
P.O. Box 30307  
North Las Vegas, NV 89036-0307

SUBJECT: VOLCANISM AND THE USE OF EXPERT ELICITATION IN YUCCA MOUNTAIN,  
NEVADA, SITE CHARACTERIZATION PROGRAMS

Dear Dr. Brocoum:

In late 1996, the U.S. Nuclear Regulatory Commission issued its Branch Technical Position, designated NUREG-1563<sup>1</sup>, on the use of expert elicitation in the high-level radioactive waste management program. As the staff was completing this guidance, the U.S. Department of Energy (DOE) published the results of an expert elicitation, the Probabilistic Volcanic Hazards Analysis (PVHA) for Yucca Mountain, Nevada. Since their publication, our respective staffs have discussed these documents, as well as the continuing independent NRC efforts to understand the volcanology of the Yucca Mountain area. Discussions have transpired during an Appendix 7 meeting, a Technical Exchange, two NRC Advisory Committee on Nuclear Waste (ACNW) interactions, and a bi-monthly management meeting. At each discussion, DOE has raised the same two issues. First, DOE states that NRC has not documented the basis of its preferred estimate of the probability of a volcanic event at Yucca Mountain. Second, DOE is concerned that "the NRC staff has not given due weight" or consideration to the conclusions of the PVHA expert elicitation, in particular because of the larger number of the experts DOE elicited as compared to the number of experts available to the staff. Each time these issues have been raised, the staff has provided a response. The purpose of this letter is to document the staff's positions with respect to these two issues.

#### PROBABILITY OF A VOLCANIC EVENT AT YUCCA MOUNTAIN

As part of the development of the staff's independent review capability, NRC directed its technical assistance contractor, the Center for Nuclear Waste Regulatory Analyses (CNWRA), to perform confirmatory analyses related to the probability and consequences of volcanic activity in the Yucca Mountain area. As the results of this work have become available, they have been published as either CNWRA contractor deliverables, NRC products, or as articles in peer-reviewed journals (see Enclosure for the list of publications).

<sup>1</sup> Kotra, J.P., et al., "Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program," U.S. Nuclear Regulatory Commission, NUREG-1563, November 1996.

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This work, along with previously identified Site Characterization Analysis and study plan open items, documents the basis for the staff's current estimate on the probability of a volcanic event at Yucca Mountain.

Subsequent to the completion of the PVHA, DOE and NRC staffs conducted a Technical Exchange (in February 1997) to discuss the status of volcanic studies, with emphasis on the probability of volcanic events. This interaction was followed by an April 1997 briefing by staff to the ACNW at which time additional information was shared with DOE. At both the Technical Exchange and the ACNW briefing, NRC presented its preferred range of probability values for direct extrusive disruption of the repository as between  $10^{-7}$  and  $10^{-8}$  events per year.<sup>2</sup> Documentation of the bases for these numbers is provided in the publications cited in the Enclosure.

Taking into account the conclusions of the PVHA report, the staff's limited confirmatory work, and the State of Nevada's independent analyses, the staff recently advised ACNW, the Commission, and DOE that there is sufficient information to conclude that certain aspects of the volcanic probability subissue can be "closed" with DOE, at the staff level, consistent with the agreement on issue resolution. The aspects of the subissue to be closed, as well as the information presented at these various meetings and published in the scientific literature, will be documented in full in the forthcoming *Issue Resolution Status Report on the Probability of Future Igneous Activity*, currently planned for the Fall of 1997.

#### STAFF VIEWS REGARDING DOE'S EXPERT ELICITATIONS

DOE has stated repeatedly that it believes that the PVHA report provides a defensible basis for characterizing the probability of volcanic events at Yucca Mountain. Moreover, DOE believes that the PVHA was conducted in a manner that is consistent with the guidance in NUREG-1563, which should lend additional credence to the conclusions of that particular elicitation. Both at the March 1997 bi-monthly management meeting and the ACNW briefing, DOE has asserted that the staff has not given due weight to the conclusions of the PVHA, despite its consistency with the NRC guidance. Furthermore, DOE has questioned whether it is appropriate for the staff to take issue with the opinion of 10 experts (in the case of the PVHA) based on the view of a few CNWRA and staff. Both statements suggest that DOE believes the staff should be giving greater weight to DOE analyses (and conclusions) obtained using formal expert judgment than to non-DOE analyses and conclusions.

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<sup>2</sup> As reflected in the April 1997 Technical Exchange, the NRC's preferred range (i.e., between  $10^{-7}$  and  $10^{-8}$  for the probability of direct extrusive disruption) can be compared to the PVHA report's mean probability  $10^{-8}$  (events per year) for both intrusive and extrusive disruptions. One of the agreements resulting from the April 1997 Technical Exchange was that an annual probability of  $10^{-7}$  is a reasonable upper bound for extrusive disruptive events, although there are differing views among the two staffs on the lower bound.

Contrary to DOE's view, the staff believes that due consideration has been accorded to the PVHA report, as it would be to any technical analysis performed by DOE. It is this consideration, along with that of other available information, that has allowed the staff, as noted above, to conclude that certain aspects of the volcanic event probability subissue can now be closed with DOE, at the staff level. That being said, however, the staff is not bound by the conclusions of an elicitation *a priori* solely on the basis of adherence to NUREG-1563 guidance. As noted in NUREG-1563, "...the use of a formal elicitation process, even when conducted in a manner consistent with guidance provided in NUREG-1563, will no way guarantee that specific technical conclusions will be accepted and adopted by the staff, a Licensing Board, the Commission itself, or any other party to a potential HLW licensing proceeding...." Moreover, NUREG-1563 states that "... it is the staff's view that expert judgments obtained through an evidently flawed or poorly documented process will weaken DOE's ability to support demonstrations of compliance...."

Inherent in the responsibilities of NRC as an independent regulator is the need to seek independent corroboration of conclusions and supporting calculations in those areas potentially significant to repository performance. In this regard, the staff will need to satisfy itself that DOE's analyses of the repository system are sufficiently supported, that the limitations of its analyses are well-understood, and that appropriate allowances have been made for the time, hazards, and uncertainties involved. To do this, the staff will selectively probe DOE's assessments for potential weaknesses, based on a familiarity with the methods, site data, and prevailing assumptions used. Inasmuch as the staff believes that the PVHA was conducted in a manner that is generally consistent with the guidance set forth in NUREG-1563 and that, as noted above, supportable estimates on certain aspects of the volcanic probability subissue now exist, the staff's future interests will focus on how these probability estimates will be used in conjunction with consequence analysis for volcanism in a total-system performance assessment (TSPA) for Yucca Mountain.

## CONCLUSIONS

Generally, the staff will continue to monitor DOE's implementation of the guidance found in NUREG-1563. Thus far, NRC observation of the DOE-sponsored elicitation has revealed few, if any, significant deviations between DOE's implementation and NRC's guidance. Although certain elicitation may have potential weaknesses, as first discussed during the September 1996 Appendix 7 meeting<sup>3</sup>, the staff believes such weaknesses do not appear to fundamentally change the conclusion or outcome of any TSPA. However, as the results of these elicitation become available, the staff will consider their conclusions in conjunction with whatever other information the staff has available when reviewing DOE's site characterization activities.

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<sup>3</sup> See Austin to Milner letters dated December 31, 1996, and January 7, 1997.

With regard to DOE's specific use of the PVHA results, DOE, like any potential licensee, can propose to use whatever information it believes appropriate to evaluate the Yucca Mountain site and to develop a repository design. The staff sees no reason to reject the PVHA results. For its part, in reviewing DOE's evaluations and designs based on the PVHA, the staff will review these in light of the caveats it has previously expressed.

Finally, the staff has received your June 4, 1997, letter responding to DOE commitments made at the February 1997 DOE/NRC Technical Exchange on igneous activity. The staff is currently reviewing this letter and will respond to it under separate correspondence.

If you have any questions regarding this letter, please contact Michael P. Lee. He can be reached at (301) 415-6677.

Sincerely,

ORIGINAL SIGNED BY  
MICHAEL J. BELL

Michael J. Bell, Acting Chief  
Performance Assessment and  
High-Level Waste Integration Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: As stated

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Sincerely,

**ORIGINAL SIGNED BY  
MICHAEL J. BELL**

Michael J. Bell, Acting Chief  
Performance Assessment and  
High-Level Waste Integration Branch  
Division of Waste Management  
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DATE	06/19/97		06/24/97						

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Dr. L.H. Barrett

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If you have any questions regarding this letter, please contact King Stablein, the Acting Branch Chief for the Geosciences and Engineering Branch. He can be reached at (301) 415-7252.

Sincerely,

John T. Greeves, Director  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: As stated

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