

REVIEW BY THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
OF THE DEPARTMENT OF ENERGY'S AGREEMENT RESPONSE RELATED TO
THE PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA
"IGNEOUS ACTIVITY" KEY TECHNICAL ISSUE AGREEMENT 1.02
[PROJECT NO. WM-00011]

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC) issue resolution goal during the precicensing period is to assure the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to begin a detailed technical review of a License Application (LA), if submitted. Resolution by the NRC staff during precicensing does not prevent anyone from raising any issue for NRC consideration during licensing proceedings. Also, and just as important, resolution of an issue by NRC during precicensing does not prejudice the NRC staff evaluation of the issue during the licensing review. Issues are resolved by the NRC staff during precicensing 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.

By letter dated November 5, 2003, DOE submitted a response to the NRC staff's request for additional information of December 19, 2002, regarding Igneous Activity (IA) Key Technical Issue (KTI) Agreement 1.02. The NRC staff's request indicated that the DOE letter, dated September 26, 2002, did not provide an adequate technical basis to evaluate the likely effects of credible interpretations of new aeromagnetic and ground magnetic data on DOE probability models.

2.0 WORDING OF THE AGREEMENT

IA KTI Agreement 1.02 requests that DOE:

Examine new aeromagnetic data for potential buried igneous features (see U.S. Geological Survey, Open-File Report 00-188, Online Version 1.0), and evaluate the effect on the probability estimate. If the data survey specifications are not adequate for this use, this action is not required. DOE agreed and will document the results of the evaluation in an update to the AMR, Characterize Framework for IA at Yucca Mountain, Nevada (ANL-MGR-GS-000001), expected to be available in Fiscal Year (FY) 2003.

3.0 TECHNICAL INFORMATION PROVIDED IN DOE AGREEMENT RESPONSE

This enclosure provides the NRC staff's review of technical aspects of DOE's submittal in the letter of November 5, 2003, as related to IA KTI Agreement 1.02. The staff review indicates that the letter and enclosures contain little new information, and generally restate information provided in DOE's letter of September 26, 2002, particularly DOE's sensitivity analyses discussed in its attached document entitled, "*Interpretation of Aeromagnetic Data.*" The new information provided with DOE's response letter of November 5, 2003, is:

- (1) a commitment by DOE to complete a program of field and laboratory studies, data

analysis, and an update to their earlier expert elicitation of Probabilistic Volcanic Hazard Analysis (PVHA; CRWMS M&O, 1996). DOE plans to have final documentation of the results complete in early FY2006. This program is detailed in Enclosure 2 of the November 5, 2003, letter, and in DOE's subsequent presentation to the Advisory Committee on Nuclear Waste (ACNW) on November 20, 2003.

- (2) a new date for the basalt encountered at 400 m depth in Nye County Early Warning Hole NC-EWDP-23P, of 9.48 ± 0.5 (1 sigma) million years, as determined by $^{40}\text{Ar}/^{39}\text{Ar}$ analysis.
- (3) the result of a new analysis of the effect on DOE's probability model of adding five additional volcanic centers in Crater Flat and nine centers in Jackass Flat, which gives an approximate fivefold increase in mean annual frequency of intersection to $\sim 8 \times 10^{-8}$.

Enclosure 1 of DOE's letter of November 5, 2003, also discusses several aspects of the concepts and models used by DOE in their probability estimates. Only those that directly concern IA KTI Agreement 1.02 are evaluated and addressed here.

4.0 NRC EVALUATION AND COMMENT

In previous communications, the NRC staff stressed the importance of transparency and documentation of any evaluation or update by DOE concerning the PVHA. Guidance on updating expert judgments is in NUREG-1563 (Kotra et al., 1996, p. 30):

When new data or information becomes available before license application submittal, it could potentially change a DOE position with regard to the design and perhaps the performance of the geologic repository. To the extent practicable, any potential license application should address the significance and impact that any new information might have on the validity of all previously existing data and elicited judgments used. If the impacts are determined to be significant, then the data and expert judgments should be updated to incorporate the new data or information, as the information becomes available. Of course, the new information may resolve the issue by providing the objective data needed and thus obviate the need for a new elicitation.

The methods of updating the expert judgments range from the use of Bayes' Theorem for statistical updating, to conducting another set of individual elicitation for the same or a different set of experts. Whichever method is used for incorporating the new data or information into the existing expert opinions, it should be thoroughly documented to provide a transparent view of the updating process and resulting judgments.

By the same token, the significance of new information on the need for updating the PVHA must be carefully determined and well supported. NRC specifically stated in its previous response, dated December 19, 2002:

DOE will need to provide a technical basis to constrain the number and age of volcanic events which have occurred in the Yucca Mountain region, including events which may be present and undetected, and provide an analysis which

considers the full range of this uncertainty, not just the limited range considered in the Letter Report. DOE also will need to provide an evaluation of how these magnetic data could change the conceptual basis used during the original elicitation to develop probability models and associated parameter distributions, including consideration of such things as event definitions, and dike and event lengths. As is stated in NUREG-1563, acquisition and analysis of physical data should be the primary manner in which licensing information is collected, however, other considerations may preclude such collection. If expert elicitation is used and it needs to be updated, NUREG-1563 offers several choices as to how the updating could be accomplished. In all cases, however, it should be thoroughly documented to provide a transparent view of the updating process and resulting judgments. In future work, DOE also should recognize the staff does not consider that substituting the judgment of project staff for the expert judgment of the panel as an appropriate update to an existing expert elicitation.

NRC staff is concerned that the current DOE letter does not fully address these issues. Although the letter presents four statements concerning the sufficiency of information for the planned LA submittal, it does not directly address technical concerns in the NRC's letter of December 19, 2002 (hereafter referred to as Schlueter, 2002), as related to IA KTI Agreement 1.02. The following sections discuss the basis for the DOE's underlying conceptual model for volcanism in the Yucca Mountain region, and specific points previously raised concerning DOE's treatment of unexposed igneous bodies.

4.1 Technical Basis for the Conceptual Model of Volcanism in the Yucca Mountain Region

As noted in Enclosure 1 of DOE's letter of November 5, 2003, the experts of the PVHA considered several conceptual models for volcanism in the Yucca Mountain region. The models selected by each expert were composited into a single conceptual model, which has been used by DOE in its subsequent sensitivity analyses described in letters dated September 26, 2002 (hereafter referred to as Ziegler, 2002), and November 5, 2003 (hereafter referred to as Ziegler, 2003). These analyses considered different values and ranges for some model parameters, but were all based on the original PVHA conceptual model. Based on analyses, DOE states that the PVHA provided a robust estimate of the volcanic hazard for the Yucca Mountain region. This statement is true only if the conceptual model for volcanism selected in the PVHA remains valid and adequately represents volcanic processes in the Yucca Mountain region, especially as concerns possible future IA. It is not clear that the DOE technical basis to support this assertion fully considers all currently available information.

Currently available aeromagnetic surveys indicate possibly thirteen unexposed igneous bodies in the immediate area of Yucca Mountain (O'Leary, et al., 2002; Hill and Stamatakos, 2002). This number is large compared to the total number of igneous events considered by the PVHA experts (typically 5-15 events) and the relatively small uncertainty assigned for unexposed bodies (median of 10-20% additional "hidden events") in PVHA. In light of this amount of new information available since the PVHA, it is reasonable to consider whether, given the present knowledge and uncertainty on the distribution of unexposed igneous bodies, the experts who participated in PVHA would have selected the same conceptual model for volcanism that they determined in 1995 based on a significantly smaller distribution. To accommodate this greater level of uncertainty arising from new information, DOE needs to support its continued use of the PVHA conceptual model in a way that is transparent, traceable, and technically appropriate to

the standards outlined for a high-quality LA (i.e., in NUREG-1804).

The technical basis for any conceptual model of volcanism in the Yucca Mountain region relies on the understanding of the spatial and temporal distribution of past igneous events. In Enclosure 2 of Ziegler (2003), DOE has proposed a program of geophysical surveys, drilling, and laboratory analyses to constrain existing uncertainties in the number and age of potential buried igneous bodies in the region. Because not every recognized magnetic anomaly will be drilled in this program, residual uncertainties will remain on the number and age of past igneous events that can be interpreted from existing data. The potential for present-but-undetected buried events will thus need to be reevaluated. Data and interpretations developed in this proposed program could contribute to the technical basis for the conceptual model of regional volcanism.

DOE appears to consider an update of the PVHA as the logical outcome of its proposed program. As given in Enclosure 2 of Ziegler (2003), Phase 2 of this program commits DOE to develop a plan to update the PVHA, but with no explicit commitment to an actual update of the probability elicitation. DOE announced at the public Appendix 7 meeting on September 21, 2004, that it intends to proceed with an update of the elicitation, that the subject matter experts have been selected, and that the first meeting will take place on October 12-14, 2004.

In summary, DOE should provide a transparent, traceable, and technically supportable basis for any conceptual model of volcanism in the Yucca Mountain region. If DOE continues to use the model from PVHA, it should present a transparent technical basis as to why this model remains appropriate in light of significant new information. If a different model is used as the basis for the volcanic hazard assessment, incorporating current information or information developed in the proposed program, then DOE should likewise present its technical basis following accepted guidelines.

4.2 Technical Concerns On Treatment of Indications of Unexposed IA

NRC's letter of December 19, 2002 (Schlueter, 2002) presented nine specific technical concerns on how DOE's letter of September 26, 2002 (Ziegler, 2002) considered indications of unexposed igneous activity in the Yucca Mountain region. DOE's subsequent response (Ziegler, 2003) did not explicitly address these specific concerns.

These concerns cover DOE's sensitivity analyses, spatial and temporal patterns of volcanism, event length and orientation, uncertainties in the ages of events, and the relevant time period of past volcanism to be considered. NRC still views these concerns as important to understanding igneous activity in the region and how DOE is evaluating the probability of future events. A detailed explanation of each of these concerns is given in Enclosure 2 of this response.

4.0 SUMMARY

Additional information received from DOE (Ziegler, 2002, 2003) does not fully address the NRC request for an adequate technical basis to evaluate the likely effects that credible interpretations of new aeromagnetic data would have on DOE's probability estimate.

DOE's analyses in Ziegler (2002, 2003) have treated only a limited subset of model parameters in evaluating potential effects on DOE's probability estimate. DOE continues to base its probability estimate on the conceptual model that was developed by PVHA in 1995. Currently available aeromagnetic survey data demonstrate that the uncertainties in the number, distribution, and age of past igneous events are larger than those considered during the original 1995 elicitation. The magnitude of this difference indicates that DOE's current basis for the conceptual model volcanism selected in the PVHA may not adequately represent volcanic processes in the Yucca Mountain region, especially as concerns possible future IA.

The geophysical survey, drilling, and laboratory program proposed in Enclosure 2 of Ziegler (2003) may contribute to establishing a reasonable basis to constrain existing uncertainties in the number and age of potential buried igneous events in the Yucca Mountain region. Because of ambiguity in DOE's program description, DOE should clarify its commitment and provide NRC with the "Phased Analysis and Data Collection Plan," as stated in Enclosure 2 of the November 5, 2003, DOE response. Moreover, the current plan (Ziegler, 2003) indicates the field and laboratory investigations proposed in Enclosure 2 of the response is planned to be completed by early fiscal year 2006. NRC staff requests that it be kept updated on the progress of the planned program or other activities undertaken to address the aforementioned concerns.

5.0 STATUS OF THE AGREEMENT

Additional information in Ziegler (2003) did not fully address the NRC staff concerns presented in Schlueter (2002). Because DOE has not fully evaluated the effects of new aeromagnetic information on igneous event probability calculations for Yucca Mountain, Nevada, DOE has not provided a technically reasonable basis to support continued use of the PVHA conceptual model for volcanic activity in the region. Based on the above review, NRC does not agree with DOE that the information provided in Ziegler (2003) or Ziegler (2002) satisfies the intent of IA KTI Agreement 1.02. The NRC will make its final determination on the relevant aspects of this issue during review of a potential license application, in accordance with the requirements of 10 CFR Part 63.

6.0 REFERENCES

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