

FEB 08 1994

Mr. Dwight Shelor, Associate Director for  
Systems and Compliance  
Office of Civilian Radioactive Waste Management  
U.S. Department of Energy, RW 30  
1000 Independence Avenue  
Washington, DC 20585

Dear Mr. Shelor:

SUBJECT: REVIEW OF U.S. DEPARTMENT OF ENERGY (DOE) STUDY PLAN "PROBABILITY OF MAGMATIC DISRUPTION OF THE REPOSITORY," REVISION 2

On April 2, 1993, DOE transmitted Revision 2 of the study plan, "Probability of Magmatic Disruption of the Repository" (Study Plan 8.3.1.8.1.1) to the U.S. Nuclear Regulatory Commission for review and comment. NRC has completed its review of this document using the Review Plan for NRC Staff Review of DOE Study Plans, Revision 2 (March 10, 1993). The material submitted in the study plan was considered to be consistent, to the extent possible at this time, with the revised NRC-DOE "Level of Detail Agreement and Review Process for Study Plans" (Shelor to Holonich, March 22, 1993).

A major purpose of the review is to identify concerns with studies, tests, or analyses that, if started, could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual usability of the data for licensing. Such concerns would constitute objections, as that term has been used in earlier NRC staff reviews of DOE's documents related to site characterization (Consultation Draft Site Characterization Plan and the Site Characterization Plan for the Yucca Mountain site). It does not appear that the conduct of the activities described in the revised study plan will have adverse impacts on repository performance and the review of this study plan identified no objections with any of the activities proposed.

As part of its study plan review, the NRC staff determines whether or not detailed comments or questions are warranted. No new detailed comments or questions have resulted from the staff's review of the subject study plan.

In a letter of March 9, 1993 (D. Shelor to J. Holonich) DOE provided responses to 13 comments and 1 question that resulted from the staff's review of Revision 1 of this study plan. As part of its review of Revision 2, the staff has provided an evaluation of DOE's responses to the comments and question (enclosure). The staff's evaluation has resulted in the determination that one comment and the question are resolved. The staff considers the remaining twelve comments to remain open. Those comments that remain open are similar to many of the concerns raised during the staff's review of the draft Los Alamos National Laboratory technical report (LA-9325, Volume III) on the status of volcanism studies for the Yucca Mountain Site Characterization Project. Those concerns were also discussed at the June 9, 1993, DOE/NRC Technical Exchange on volcanism studies (letter from J. Holonich to D. Shelor, June 30, 1993), and transmitted by letter to DOE on August 18, 1993 (J. Holonich to D. Shelor). Therefore, the remaining open comments reflect concerns not only relevant to the subject study plan, but with the overall DOE program of volcanism studies.

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Mr. Dwight E. Shelor

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If you have any questions concerning this letter or the enclosure, please contact Charlotte Abrams (301) 504-3403 of my staff.

Sincerely,

/S/

Joseph J. Holonich, Director  
Repository Licensing and Quality Assurance  
Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosures: As stated

cc: R. Loux, State of Nevada  
T. J. Hickey, Nevada Legislative Committee  
J. Meder, Nevada Legislative Counsel Bureau  
R. Nelson, YMPO  
M. Murphy, Nye County, NV  
M. Baughman, Lincoln County, NV  
D. Bechtel, Clark County, NV  
D. Weigel, GAO  
P. Niedzielski-Eichner, Nye County, NV  
B. Mettam, Inyo County, CA  
V. Poe, Mineral County, NV  
F. Sperry, White Pine County, NV  
R. Williams, Lander County, NV  
L. Fiorenzi, Eureka County, NV  
J. Hoffman, Esmeralda County, NV  
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Mr. Dwight E. Shelor

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If you have any questions concerning this letter or the enclosure, please contact Charlotte Abrams (301) 504-3403 of my staff.

Sincerely,

C. William Reamer, Acting Director  
Repository Licensing and Quality Assurance  
Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosures: As stated

cc: R. Loux, State of Nevada  
T. J. Hickey, Nevada Legislative Committee  
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OFC	HLPD	E	HLGE	E	HLGE	E	HLGE	e	HLPD	X
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**Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

**QUESTION 1**

In which document will the program for evaluation of silicic volcanism be described?

**EVALUATION OF DOE RESPONSE**

Section 3.1.1 of Study Plan 8.3.1.5.1, section 1.1 of Study Plan 8.3.1.8.1.1, and the Shelor to Holonich letter (DOE, 1993) indicate that resolution of this concern is based on evaluation of the volcanism drill holes and on evaluation of the Mt. Jackson silicic volcanics.

The staff considers this question resolved.

**REFERENCE**

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

**ENCLOSURE**

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 1**

The use of the term "event" in this study plan appears to be limited to cone formation, and therefore provides an incomplete description of magmatic processes and events, and the requirement to determine consequence of the resultant activity.

### **EVALUATION OF DOE RESPONSE**

The primary concern of the staff is that the analysis noted in the study plan consider the full range of potential magmatic processes and events when demonstrating compliance with the performance objectives. Therefore, the exploration program should be sufficient to provide the basis for demonstrating compliance.

In Section 4.0 of this study plan, it is indicated that this study plan will provide the data for assigning event probabilities for all aspects of igneous activity which could disrupt the repository.

However, in Subsection 3.4.2.1, the emphasis of the study plan appears aimed at resolving the "tripartite probability." The tripartite probability, and associated analysis, does not appear to consider all events of regulatory concern.

On Page 25, Section 3.4.2.1, it is stated that the probability of intrusive events and extrusive events is equal. No data or references are provided to support this assumption.

On Page 27 of Section 3.4.2.1, the study plan infers that certain scenarios and events of regulatory concern will be addressed in Study Plan 8.3.1.8.1.2; however, the discussion is restricted to direct release. The staff considers that the total probability of disruption should include both direct and indirect disruption of the repository.

Although Table 1 (Pages 12 and 14) provides a listing of other studies which are intended to supply information to this study, it is unclear how the other studies will supply the detail and resolution necessary to distinguish "features" that may have formed as a result of non-cone forming events.

The Shelor to Holonich letter (DOE, 1993) references Study Plan 8.3.1.8.5.1 as containing the characterization activities to identify all magmatic events, however, Study Plan 8.3.1.8.5.1 also appears to be aimed at only identifying large scale features, such as cones.

The NRC staff considers this comment open.

**REFERENCE**

**U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.**

## Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository

### COMMENT 2

Use of surface extrusion rates to approximate magma production rates could underestimate the effects of the magmatic process on repository performance.

### EVALUATION OF DOE RESPONSE

The staff agrees that the volume/time approach has been shown to be useful in estimating volcanic eruptive probability. As is stated in the Shelor to Holonich letter (DOE, 1993), this relationship has not been used in estimating the probability of intrusive events. The use of magma effusion rates is one of the main methods used in Section 3.4.2.2 of the study plan for estimating recurrence rates. As it is the probability of the total events of the process, not just the probability of extrusion which is of concern to the NRC, the use of this methodology is of concern to the staff.

The NRC staff's concern with the use of this method also is related to explicit statements such as those on Page 25 of the study plan where it is stated that "Because  $Pr_i = Pr_v$ , the remaining discussion will only mention  $Pr_v$  recognizing that the described assessments apply to both events." No data or reference is provided to support this assumption.

In the Shelor to Holonich (DOE, 1993) letter it is stated that "The assumption that has been universally applied ... is that the same volume of magma pushing from the asthenosphere into the upper crust is required for each eruptive event." Considering the temporal and spatial separation of the various cones which are used in this calculation within the region, the potential variations in structure and stress field for each eruptive event, along with the change in magma properties, and supposed depth of source material, this assumption appears suspect.

Even if this assumption is correct, the proportion of total material represented by the material at the surface is quite different for a cone of the size of Lathrop Wells when compared to a cone of the size of Little Cone.

Although the basic assumption regarding magma volume is tied into "eruptive events," the assumption appears to be used only to calculate a recurrence rate for "cone" formation. If, for example, Lathrop Wells cone is polycyclic and Little Cone is monocyclic, in addition to the material difference at the surface, the subsurface volume of Lathrop Wells cone would be some multiple of the subsurface volume of Little Cone as it would be necessary for each surface eruption at the Lathrop Wells cone to have the corresponding subsurface feeder material. The recurrence rate calculation that the magma volume calculations support does not appear to consider the possibility of multiple eruptive events.

The DOE has suggested that the Yucca Mountain region is in a stage of waning volcanic activity; however, there are also suggestions that the cycle may be evolving, changing from few large events to more small events. (See, for example, the discussion on page 160 of Crowe, et al., 1993) The effects of this type of cycle change on magma production rate curves and on the probability calculations has not been addressed.

In other DOE study plans, such as Study Plan 8.3.1.9.2.1, Natural Resources Assessment of Yucca Mountain, Nye County, Nevada, there is a recognized need to determine the inferred size, location, and age of the various intrusive bodies. Study Plan 8.3.1.9.2.1 recognizes that the ratio of intrusive to extrusive volumes normally range up to a factor of 6 to 1 for basaltic volcanism. There appears to be a variation in the assumptions in these two study plans.

The NRC staff considers this comment open.

#### REFERENCES

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

Crowe, B.M., F.V. Perry, and G.A. Valentine, Preliminary Draft: Status of Volcanic Hazard Studies for the Yucca Mountain Site Characterization Project, Los Alamos National Laboratory, 326 pp, 1993.

**Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

**COMMENT 3**

The evaluation of the presence of crustal magma bodies in the vicinity of Yucca Mountain must consider the requirements of 10 CFR Part 60.122(a)(2).

**EVALUATION OF DOE RESPONSE**

In the response to this comment (DOE, 1993) the DOE indicates that the geophysical data will be reviewed to determine the need for additional investigations.

Although this may be a prudent approach, the staff believes that sufficient information is present in the scientific literature to suggest the presence of low velocity zones and, therefore, the relationship of these zones to volcanic/magmatic activity must be adequately addressed.

The NRC staff considers this comment open.

**REFERENCE**

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 4**

One of the main activities within this study plan, as stated on page 8, is to estimate the probability of future magmatic disruption of the Yucca Mountain site; however, the probability calculations that this study plan is intended to produce appear too limited to resolve the geologic and regulatory concerns.

### **EVALUATION OF DOE RESPONSE**

The primary concern expressed by this comment was to assure that all significant processes and events which may affect the repository would be included in the determining compliance with the performance objectives.

Although it has been indicated in the response to Comment 1 (DOE, 1993) that characterization activities have included activities to identify all magmatic events, no other study plan that has been submitted to the NRC appears to contain information on how this is to be accomplished.

The focus of the probability determination in Study Plan 8.3.1.8.1.1 is on the "tripartite" probability, and this calculation appears to produce probability numbers that do not consider all possible processes and events which are of regulatory concern. (See also Comment 8.)

DOE's determinations of the probability of processes and events are partially based on the assumption the  $Pr_i$  is equal to  $Pr_v$ . The staff knows of no basis which justifies this assumption. (See also Comment 2.)

No program of investigation has been identified which is aimed at evaluating intrusive events of a size less than that of a cone, either within Study Plan 8.3.1.8.1.1 or Study Plan 8.3.1.8.5.1.

Study Plan 8.3.1.8.2.1, "Analysis of Waste Package Rupture due to Tectonic Processes and Events," states that the probability of disruption of the waste package from igneous processes and events will come from Activity 8.3.1.8.1.4. Therefore, if Study Plan 8.3.1.8.1.1 does not provide a probability value for all magmatic processes and events which could effect the waste package, the analysis under 8.3.1.8.2.1 will be incomplete.

It is unclear where the information needed for Study Plan 8.3.1.8.2.1, or the other studies listed in Table 2, will be obtained.

The NRC staff considers this comment open.

## **REFERENCE**

**U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.**

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 5**

It is unclear how a volcanic recurrence model can be constructed without knowledge of magmatic events of a size less than that needed to produce a cone.

### **EVALUATION OF DOE RESPONSE**

The DOE suggests that analog information will be used. The NRC staff agrees that this may be helpful.

No information has been presented that would demonstrate that volume predictive curves are valid for small scale fields, especially if the amount of material represented by the feeder system is neglected, and the question of monocyclic versus polycyclic volcanism is not resolved. (See also Comment 2.)

The response in the Shelor to Holonich letter (DOE, 1993) suggests that seismic recurrence curves and volcanic recurrence curves differ in one particular area. "The smallest magnitude of seismic events is determined by the threshold of detection. For volcanism, there is a volume limited cut-off."

The staff noted that the smallest surface eruption known was 26 cubic meters through a geothermal drill hole (Global Volcanism, 1975-1985). Although this is a special case, it demonstrates that, if there is a volume-limiting cut-off, this cut off can only be understood in reference to the other properties and features of the system. Although there may be a volume limiting cut-off, the DOE has not provided the data to demonstrate what this cut-off is in relation to the volcanism that has occurred in the Yucca Mountain region.

The staff notes that the threshold of detection for seismic events is dependent on such things as the sensitivity of the detection equipment, the location of the equipment, and the number of monitors. In other words, the threshold of detection is a function of the exploration program characteristics. A similar relationship exists for understanding of volcanic phenomena. For example, at Kilauea from 1975 through 1981, 2 eruptions and 15 intrusive episodes were documented. Documentation of these intrusive episodes has been attributed to "Development of sensitive monitoring techniques." (Global Volcanism, 1975-1985)

The staff notes in the study plan (i.e., Section 3.2.4.1) it is assumed that the probability of intrusion equals the probability of extrusion. The explicit assumption of the probability of intrusion, and therefore the intrusion ratio, does not appear justified as DOE has not identified a volcanic field in which this ratio has been documented. The staff believes that the assumption may not be justified.

The NRC staff considers this comment open.

## REFERENCE

Smithsonian Institution, 1991, Global volcanism 1975-1985. The First Decade of Reports from the Smithsonian Institutions Scientific Event Alert Network (SEAN), L. McClelland, T. Simkin, M Summers, E. Nielsen, and T. C. Stein, Editors, National Museum of Natural History, Smithsonian Institution, Washington D.C., Published by Prentice Hall and the American Geophysical Union.

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 6**

This study plan does not appear to be calculating a "recurrence rate," but rather the average recurrence rate for the sampled population.

### **EVALUATION OF DOE RESPONSE**

The staff agrees that the part of the issue raised in this comment has been discussed in previous publications. The staff was concerned, however, because the study plan did not appear to reflect the philosophy presented in the previous publications.

DOE has suggested (DOE, 1993) that the problem will be resolved by using cumulative volume curves; however, the NRC staff still has concerns related to this method. The staff notes that on page 34 of the study plan it is stated that the reproducibility and uncertainty of volume calculations is not commonly considered in volcanism field studies. The staff is concerned with the manner in which this presently unquantified uncertainty will be propagated through the calculations to assure that effects of the uncertainty will not result in an underestimation of the hazard.

The NRC staff does not consider that other investigations, such as those being conducted in geochemistry/petrology, provide a unambiguous conclusion as to the waxing/waning concerns, or to the concerns related to the proper time frame for use in averaging or projecting over the period of performance.

The "paradox" to which the DOE refers (DOE, 1993) suggests that the choice is to site a repository in the area of either a large volcanic field or recognize that a large uncertainty will exist in the area of a small volcanic field. 10 CFR 60 recognized that siting a repository in the area of Quaternary igneous activity would make licensing more complicated than siting in an area where this phenomena need not be considered. The question that must be evaluated is whether the Yucca Mountain site can meet the performance objectives.

The NRC staff considers this comment open.

### **REFERENCE**

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 7**

The study plan does not appear to adequately consider models that assume volcanism is a non-poissonian process.

### **EVALUATION OF DOE RESPONSE**

The staff recognizes the argument on the difficulty of using many of the potential "non-homogeneous poisson" or "non-poissonian" models with the limited data set available. However, the staff is concerned that, without explicit consideration of other types of mathematical models to describe the process, the possible effects resulting from igneous activity may be underestimated.

Although the study plan and the comment response appear to consider the effects of other types of distributions, existing documents such as the "Volcanism Status Report" (Crowe, et. al., 1993) provide no assurance that this will be accomplished. This is evident on page 250 of the report where the argument for the homogeneous poisson model is advanced, on page 255 where the formulas for the probability calculations are developed, and on page 325 where the conclusions of the report argue for the use of the poissonian models.

In Section 3.4 and the attachments to NRC 1993, an analysis is presented which indicates that the assumption of "homogenous poisson distribution" does not appear to be supported.

The NRC staff considers that the assumption of "homogeneous poisson distribution" does not adequately describe the distribution of igneous features in time or space in the Yucca Mountain Region.

The NRC staff considers this comment open.

### **REFERENCES**

Crowe, B.M., F. V. Perry, G.A. Valentine, Preliminary Draft Report Titled "Status of Volcanic Hazard Studies for the Yucca Mountain Site Characterization Project," Los Alamos National Laboratory, 1993.

U.S. Nuclear Regulatory Commission, Letter from Joseph J. Holonich of NRC to Dwight E. Shelor of DOE, Subject: Status of Volcanism Issues for the Proposed High-Level Waste Site at Yucca Mountain, August 18, 1993.

## Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository

### COMMENT 8

The conditional probability of disqualification, Formula 2, Page 30, does not appear to be formulated such that the probabilities that will be necessary to demonstrate compliance with the performance objectives can be obtained.

### EVALUATION OF DOE RESPONSE

The DOE suggested (DOE, 1993) that this calculational methodology would be revised. It is not apparent that this is the case, or that the revised and expanded text has addressed the concerns expressed in the original comment.

In Section 3.4.2.1 the "tripartite probability", formally the conditional probability of disqualification, is defined as:

$$Pr_{dr} = Pr(E3 \text{ given } E2, E1)Pr(E2 \text{ given } E1)Pr(E1)$$

where  $E1$  denotes the recurrence rate of volcanic events in the Yucca Mountain Region,  $E2$  denotes the probability that the future magmatic event intersects the repository, or waste isolation system, and  $E3$  denotes the probability that magmatic disruption of the repository leads to rapid releases of radionuclides to the surface (accessible environment) in quantities that exceed the regulatory requirements.

The NRC concern with  $E1$  is that the event being assumed, in all cases is the formation of a cone. In addition, as is stated on page 25 of the study plan, it is assumed that the probability of an intrusive event equals the probability of a volcanic event; therefore, there are no events other than those associated with cone formation, and the extrusive to intrusive ratio is 1.

Work in other areas indicates that extrusive-to-intrusive ratios are normally quite low. At mid-ocean ridges, this ratio is often 0.1 to 0.3 based on investigations of ophiolite sections (e.g., Nicolas, 1989) and 0.1 to 0.25 based on seismic investigations of mid-ocean ridges (e.g., Harding et al., 1989). These values are similar to those proposed for Kilauea (Shaw, 1987) and Krafla (Björnsson, 1985). In continental settings, the ratio might be quite different because of different rock densities, rock mechanical strengths, and the presence of pre-existing structures. Kurtz et al. (1986) identified very shallow dike intrusions in the Craters of the Moon field that did not result in extrusive activity. The 1980 activity at Long Valley caldera may provide another example of a dike reaching shallow depths in a continental setting without erupting. This example appears relevant because, although magma did not reach the surface, changes in hydrothermal activity and soil degassing were noted to result from this intrusion (e.g., Mastin and Pollard, 1988; Sorey et al., 1993). These occurrences indicate that shallow

degassing from dikes does occur on continents in some geologic settings. To our knowledge, there is not a single example of a volcanic field in which the extrusive-to-intrusive ratio is known to be as high as one-to-one, nor is an example cited in the study plan.

The calculation also does not appear to include consideration of factors such as polycyclic volcanic activity.

The value  $E2$  is area dependent, and all calculations that the NRC has seen assume some simple geometry, such as a single linear dike feeding a cone. Geologic mapping at the Lathrop Wells Volcanic Center (Crowe, et. al., 1988) strongly suggests that this assumption is not valid, because several fissures, not a single fissure, are present, and some of these fissures are at high angles to one another.

The calculation also does not include factors such as the area of fracturing from magmatic emplacement, the area of introduction of hydrothermal fluids, or the area of degassing, all of which could change the disruption ratio substantially.

The NRC concern with  $E3$  is that it only includes the effects of direct release of radionuclides to the surface. It does not include indirect effects, release to the groundwater system, or other effects that must be considered in determining compliance with the overall system performance objective of 10 CFR 60.112.

The NRC staff considers this comment open.

## REFERENCES

Björnsson, A., Dynamics of crustal rifting in NE Iceland, *Journal of Geophysical Research* 90: 10,151-10,162, 1985.

Crowe, B. C. Harrington, L. McFadden, F. Perry, S. Wells, B. Turrin, D. Champion, Preliminary Geologic Map of the Lathrop Wells Volcanic Center, Los Alamos National Laboratory Report LA-UR-88-4155, 1988.

Harding, A.J., J.A. Orcutt, M.E. Kappus, E.E. Vera, J.C. Mutter, P. Buhl, R.S. Detrick, and T.M. Brocher, Structure of the young oceanic crust at 13 °N on the East Pacific Rise from expanding spreading profiles, *Journal of Geophysical Research* 94: 12,163-12,196, 1989.

Kurtz, M.A., D.E. Champion, E.C. Spiker, and R.H. Lefebvre, Contrasting magma types and steady-state, volume-predictable, basaltic volcanism along the Great Rift, Idaho, *Geological Society of America, Bulletin* 97: 579-594, 1986.

Mastin, L.G., and D.D. Pollard, Surface Deformation and Shallow Dike Intrusion Process at Inyo Craters, Long Valley, California, *Journal of Geophysical Research* 90: 11,121-11,126, 1988.

Nicolis, A., Structures of Ophiolites and Dynamics of the Oceanic Lithosphere. Kluwer Academic Publishers: Dordrecht, 493 pp, 1989.

Shaw, H.R., Uniqueness of volcanic systems, Volcanism In Hawaii, R.W. Decker, T.L. Wright, and P. Stauffer, eds., Reston, VA: U.S. Geological Survey. U.S. Geological Survey Professional Paper 1350: 1,357-1,394, 1987.

Sorey, M.L. B.M. Kennedy, W.C. Evans, C.D. Farrar, and G.A. Suemnicht, Helium-Isotope and Gas-Discharge Variations Associated with Crustal Unrest in Long Valley Caldera, California. 1989-1992, Journal of Geophysics Research, 1993 (In Press).

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

## **Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

### **COMMENT 9**

The geophysical program described in the SCP and referred to in this study plan appears too limited to provide the information necessary to develop reasonable probability models.

### **EVALUATION OF DOE RESPONSE**

Part of the concern raised in this comment has been addressed by the DOE in its response to Comment 3 in which it suggests that the revisions to Study Plan 8.3.1.8.1.1 and 8.3.1.8.5.1 will provide part of the information necessary to resolve this comment.

The staff recognizes that the overall geophysical program will be described in other study plans and documents not under the direct jurisdiction of the principle investigator responsible for the igneous activity study plans.

The subject of the integrated geophysical program was the subject of a DOE/NRC technical exchange of June 8, 1993. During this exchange many planned and ongoing geophysical programs were described; however, the interrelationship of these programs, both from a technical perspective and from a scheduling perspective, is still unclear.

The staff notes that a consultant is being hired by DOE to evaluate existing data against information needs. The results of this assessment may help resolve NRC concerns.

The NRC staff considers this comment open.

**Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

**COMMENT 10**

The MODEL 1 methodology for calculating the probability for repository disruption presented in section 3.2.2.2 appears to be incorrect.

**EVALUATION OF DOE RESPONSE**

The DOE states that this was an example of how the disruption parameter might be calculated.

The staff believes that the example would be incorrect.

The staff considers this comment open pending receipt and review of the procedure titled "Methods for Calculating the Disruption Parameter for Calculations of the Probability of Disruption of the Repository by Magmatic Activity," referenced in Study Plan 8.3.1.8.1.1.

**Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

**COMMENT 11**

The equation for the disruption probability in Section 3.4.2.1 should be revised.

**EVALUATION OF DOE RESPONSE**

The primary concern expressed by this comment was that the formula, as written, could be misconstrued.

DOE has stated (DOE, 1993) that the probability form was simplified so that it could be easily understood by a wide audience of readers.

As the comment is a subcomment on the overall use of the tripartite probability, the staff considers that this comment can best be resolved in the context of Comment 8.

The NRC staff considers this comment closed.

**REFERENCE**

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.

**Study Plan 8.3.1.8.1.1 Probability of Magmatic Disruption of the Repository**

**COMMENT 12**

Bias is not necessarily reduced or limited by weighing alternative models as is implied on page 40. Use of weighted models may obscure information essential for regulatory decision.

AND

**COMMENT 13**

The study plan proposes to use expert judgement to weight alternative models. This is inconsistent with previous NRC comments on the Site Characterization Plan, does not necessarily reduce bias, and may reduce information essential for a regulatory decision.

**EVALUATION OF DOE RESPONSE**

The DOE suggests (DOE, 1993) that the resolution of these two comments be deferred until the procedure on the use of expert judgement is available so that the concerns can be discussed in the context of calculational data.

The staff consider these two comments open.

**REFERENCE**

U. S. Department of Energy, Letter from Dwight E. Shelor of DOE to Joseph J. Holonich of NRC, Subject: Response to NRC comments and questions regarding Study Plan 8.3.1.8.1.1, March 9, 1993.