1/8

SUPPLEMENTARY REVIEW COMMENTS ON DOE STUDY PLAN 8.3.1.8.1.1 PROBABILITY OF MAGMATIC DISRUPTION OF THE REPOSITORY

Prepared for
The U.S. Nuclear Regulatory Commission
Contract No. NRC-02-88-005

Prepared by
Gerry L. Stirewalt
Center for Nuclear Waste Regulatory Analyses
Arlington, Virginia

and

Kenneth D. Mahrer
Southwest Research Institute
San Antonio, Texas

April 1992

CNWRA SUPPLEMENTARY REVIEW OF DOE STUDY PLAN 8.3.1.8.1.1 ENTITLED "PROBABILITY OF MAGMATIC DISRUPTION OF THE REPOSITORY"

The following comments resulted from a supplementary review of Department of Energy (DOE) Study Plan 8.3.1.8.1.1 by Dr. Kenneth D. Mahrer of Division 15 of Southwest Research Institute. This report was prepared by Dr. Gerry L. Stirewalt of the CNWRA and Dr. Mahrer.

Conduct of the supplementary review of this study plan is consistent with activities defined for Task 1 (Prelicensing Activities), Subtask 1.2 (Review of DOE Study Plans) of the Geologic Setting Program Element in Section 3.4 of the CNWRA FY92-93 Operations Plan (Revision 1, Change 5, dated March 1992) for the Nuclear Regulatory Commission's (NRC) Division of High-Level Waste Management (DHLWM). The review is also consistent with technical direction provided to the CNWRA by the NRC which was within cost, scope, and schedule for activities defined in Geologic Setting Program Element Subtask 1.2 of the CNWRA FY92-93 Operations Plan. This supplementary review was conducted in response to a request from Drs. John S. Trapp and Philip S. Justus of the NRC, who asked that the CNWRA specifically provide additional detail on Point 3 of the NRC Technical Direction which was approved by the CNWRA and transmitted to the NRC on December 5, 1991. Point 3 of the Technical Direction posed the question: "Would the methods for describing the hazard for the 10,000-year period of performance be representative for longer periods of performance?"

Specific directions for preparation of the supplementary review comments, agreed upon by the CNWRA and the NRC, delineated three aspects related to TD Point 3 which were to be addressed by the supplementary comments in connection with the analysis methods presented in DOE Study Plan 8.3.1.8.1.1. These three points were as follows:

(1) Extension of methods proposed in the study plan for assessing volcanic and magmatic hazards beyond 10,000 years (i.e., to 100,000 years).

   (a) Consider a non-Poisson versus a Poisson approach to analysis of volcanic and magmatic hazards beyond 10,000 years, since concerns exist regarding whether sufficient data can be collected to demonstrate if volcanic and magmatic activity is increasing or waning in the Yucca Mountain region.

   (b) Consider whether methods other than those specified in the study plan may be more applicable when the extended time frame is considered.

(2) Calculational/mathematical problems and concerns which may develop when hazards analysis is extended beyond the 10,000-year time frame using methods proposed in the study plan.

(3) Inherent problems for developing models and conducting modeling analyses using methods proposed in the study plan when the time frame is extended beyond the 10,000-year time period.

COMMENTS ADDRESSING DIRECTIONS FOR PREPARATION OF SUPPLEMENTARY REVIEW COMMENTS ON DOE STUDY PLAN 8.3.1.8.1.1

(1) Extension of proposed methods for assessing volcanic and magmatic hazards beyond 10,000 years.

Nothing in the proposed methods limits their predictive capability to a 10,000-year period, and extension of the methods to predictions for 100,000 years does not contradict the theory behind the methods. However, the reliability of a 10,000-year prediction versus a 100,000 year prediction is a concern, since confidence levels for a 10,000-year prediction are likely to be higher than for a 100,000-year prediction, particularly when sparse data (as is the case for the Yucca Mountain area) are available.

Although methods proposed in the study plan are not specific to the time frame of prediction, they are influenced by type, quantity, and accuracy of the data. Considering the paucity of data on basaltic volcanism/magmatism in the Yucca Mountain area, where field relationships indicate that basaltic events were not numerous, and the possibility that the proposed studies may not greatly increase volume or accuracy of the volcanic data base, the concept remains that a 10,000-year prediction will probably be more reliable than a 100,000-year prediction.

(a) Poisson versus non-Poisson approach

For a Poisson distribution, neither history of past occurrences nor nonrandom controlling factors need drive or control future occurrences. Sparse data are commonly treated as random using a Poisson distribution. Although data are sparse for basaltic volcanism and magmatism in the Yucca Mountain area, volcanism and its recurrence in this area were most likely influenced by nonrandom controlling factors. However, use of a non-Poisson distribution requires adequate data to determine the distribution, and the concern about sparse data will likely remain a problem for analysis of volcanic and magmatic hazards at Yucca Mountain no matter which approach is used.

(b) Other methods more applicable

An analysis of the data to see if any deterministic or driving behavior is evident may be warranted. Since the mechanics and dynamics of volcanism are so complex, nonlinear dynamics theory may be applicable. The study plan already indicates the author's cognizance of the concept of self-similarity as applied by Shaw (1987) for analysis of volcanoes of the Hawaiian Islands. However, the paucity of data on basaltic volcanic and magmatic activity in the Yucca

Mountain area may preclude a reliable conclusion if attempts are made to apply such techniques to that area.

Observations and collection of additional data on basaltic volcanic and magmatic activity from analogous areas may be helpful. Use of analog areas to acquire more data is already mentioned in the study plan.

(2) Calculational/mathematical problems when analyses extended beyond 10,000 years using proposed methods

As noted, a reasonable extension of the time window for the predictions is not restricted by the method, or likewise by computational and mathematical problems. Uncertainties in data, paucity of data, and decreased confidence as predictions are extended in time do pose concerns, however.

If confidence intervals, error bars, or some other means of assessing the quality of the data could be applied, then it may be possible to make more specific comments about reliability of the extended predictions. The study plan indicates that each data point will be weighed equivalently, so some means of assessing data quality perhaps should be included and carried through the analyses.

(3) Inherent problems for developing models and conducting analyses beyond 10,000 years using proposed methods

Any problems which arise with model development and analyses are not likely to be directly tied to a reasonable extension of the time window for the predictions. However, modeling and analyses problems will be tied, among other factors, to condition of the data and reliability of interpretations about controlling structures and future tectonic activity. Consequently, it may be necessary to take into account possible variations in tectonic activity, as well as evolution of faulting (based on consideration of known fault slip rates for the existing stress field and consideration of possible new faults under a different stress field) which may influence development of controlling structures, in order to develop viable models for analyses beyond 10,000 years. That is, models for addressing structural controls on volcanism, and possible variations of those controls with time as a function of changes in tectonic activity and the stress field, may be a subject of concern for assessing volcanic and magmatic hazards over time frames beyond 10,000 years in the Yucca Mountain area. While this could be viewed as a problem related to modeling and analyses of volcanic and magmatic hazards in the Yucca Mountain area, this potential problem would exist for any method applied.

c:\wpfil\gerry\volspkm2.dft