REVIEW OF ANALYSIS AND MODEL REPORTS (AMRs)

- Characterize Framework for Igneous Activity at Yucca Mountain – ANL-MGR-GS-000001

OVERVIEW

Included in the packet are each of the original AMRs, a copy of each with my brief annotations and a summary sheet for each that reveals the purpose and principal conclusions, as excerpted from the original, as well as my comments.

The AMRs were reviewed during October 2000. Each of the AMRs relies principally upon geologic data, much of which is derived from field studies. In view of the lack of 1) extensive, three-dimensional rock exposures and 2) full geochemical, chronologic, petrologic and other information necessary to completely characterize the geologic evolution of this region, the analyses and models are heavily dependent upon well constrained interpretations. In general, thorough and fully considered analyses are contained in this group of AMRs. My comments generally reflect a difference of opinion leading to an alternative interpretation rather than an error or omission in the AMR.

CHARACTERIZE FRAMEWORK FOR IGNEOUS ACTIVITY AT YM ANL-MGR-GS-000001

INTRODUCTION

The U.S. Department of Energy considers volcanism to be a potentially disruptive event in the Total System Performance Assessment analysis supporting Site Recommendation for the potential Yucca Mountain repository. The two volcanic events (with individual probabilities and consequences) are being modeled: 1) The ascent of a basaltic dike or dike system (i.e., a set or swarm of multiple dikes comprising a single intrusive event) to repository level where it intersects drifts; 2) the development of a volcano within the repository footprint with one or more conduits that intersect waste packages. As a consequence of the first event, which is non-eruptive, waste from breached packages may provide a source of radionuclides when groundwater moves through the damaged packages at some time in the future (igneous intrusion groundwater release). The potential consequence of the second event is that waste packages entrained within a conduit may be breached, releasing radionuclides in the erupting ash plume where they can be dispersed downwind to a critical group.

This AMR describes the conceptual framework for volcanism in the Yucca Mountain region (YMR) consistent with the volcanic and tectonic history of this region and the assessment of this history by experts who participated in the Probabilistic Volcanic Hazard Analysis (PVHA) (CRWMS M&O, 1996). Conceptual models presented at PVHA are summarized and extended in areas in which new information has been presented. Alternative conceptual models are discussed as well as their impact on probability models. The relationship between volcanic source zones defined in the PVHA and structural features of the YMR are described based on discussions in the PVHA and studies presented since the PVHA. The PVHA included discussion of some aspects of the consequences of a volcanic event but not all the aspects required for the present analysis; therefore, additional were performed to complete supporting description of the volcanic risk. The risk from volcanism is described through the combination of work from the PVHA (probability) and the present enhanced analysis of consequence.

This AMR also presents the probability results and associated uncertainties for intersection of the potential repository by a basaltic dike and the probability of an eruption through the repository, conditional on a dike intersection. These probability results provide the basis for all further igneous consequence analysis (from AMR, SECTION 1. Purpose, p. 15 & 16).

COMMENT

Department of Energy sponsored the PVHA project in order to assess the probability of a future volcanic event intersecting the potential repository at Yucca Mountain. To ensure that a wide range of approaches was considered for the PVHA, the DOE identified 10 experts in the field to participate in the project and evaluate the data. The group includes well-qualified experts in the fields of geology, geochemistry and geophysics. Expertise in petrology and structure/tectonics is not attributed to any of the experts and the absence of such experts may have narrowed somewhat the breadth of discussion. However, overall the results of the probabilistic volcanic hazard analysis reveal a comprehensive, in-depth consideration of the nature and probability of a volcanic event. The experts took full advantage of the existing data.

A kinematic analysis of the structures at Yucca Mountain, especially faults, reveals an alternative conclusion to that reached by Fridrich (1999). He concludes (p. 54) that northeast-trending faults in the southwestern part of the region (Figure 7) are the result of clockwise rotation. The proximity of the NE-trending faults to the Rt. 95 (Carrara) fault is compatible with this idea, i.e. they may have rotated in response to simple shear during right-lateral strike-slip displacement. However, if the NE-trending faults record left-lateral sense of shear, they likely formed in this orientation without rotation. In either case the import of faults with this, i.e. northeast, orientation is that they may accommodate extension (therefore be probable conduits for fluid transport) within the stress regime that is postulated to currently exist as concluded from the studies of Stock et al. (1985), Warren and Smith (1985), and Frizzell and Zoback (1987).

This analysis is a good effort.