RESPONSE TO ACNW RECOMMENDATIONS ON IGNEOUS ACTIVITIES

Recommendation 1. *The EPRI report on the intrusive release scenario presents a viable alternative concerning the impact of intruding magma on the repository and waste containers. As such it should be evaluated by the NRC staff as an alternative to their current position on the interaction between intruding magma and the Yucca Mountain repository and in particular with regard to the number of containers damaged*.

Response. As discussed with the Advisory Committee on Nuclear Waste (ACNW), staff is in the process of reviewing the recent Electrical Power Research Institute (EPRI) report. Although this review is not yet completed, staff notes that EPRI now agrees with U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) staff positions that waste packages in direct contact with intruded magma lose the ability to significantly isolate high-level waste from subsequent hydrologic flow and transport processes. The staff's review is focusing on the EPRI basis that potential magma intrusion into drifts may be of limited volume and duration. A key assumption in the EPRI analysis appears to be that magma may potentially enter a drift with negligible driving pressure and flow by gravitational force. As staff have documented in numerous reports, magmas at repository depths must be significantly pressurized when initially confined by solid rock. Potential magma flow into a drift will be driven by that significant overpressure and rapid expansion of gases. Staff continues to review new information relevant to understanding the risk significance of potential magma-drift interaction processes, including models and data in the recent EPRI report, peer-reviewed literature, and DOE reports.

Recommendation 2. *If further modeling of simultaneous eruption from summit and flank vents is conducted it is important that a clear connection be established between the experimental conditions and those anticipated in an actual intrusive event at the proposed Yucca Mountain Repository.*

Response. The staff agrees with the ACNW recommendation. As a clarification, staff has been using the terms "intrusive" and "extrusive" in a slightly different way than used in your June 8, 2006, letter. "Intrusive" events refer to the flow of magma into drifts and potential disruption of engineered barriers, but do not involve direct release of radionuclides during the event. For intrusive events, the release of radionuclides occurs after the event, through hydrologic flow and transport processes. However, an "extrusive" event refers to the direct release of potentially contaminated magma at the earth's surface (i.e., eruption of a volcanic plume). Investigations related to understanding relationships between flank and summit vents were undertaken to evaluate potential extrusive events. Thus, this work emphasized the understanding of gas partitioning and flow effects. These effects determine the ability of potential flank events to entrain and transport high-level radioactive waste.

The report that Professor Woods, et al., prepared used insights from the numerical and experimental models to explain summit-flank eruption processes at several basaltic volcanoes. The likelihood of secondary vents occurring during a potential extrusive event at Yucca Mountain remains an unresolved NRC/DOE topic. Although DOE has provided estimates of the likelihood of secondary events occurring, staff analyses indicate that such estimates will have large uncertainties and that some evaluation of the potential risk significance of this process will

be necessary. The approach documented in the Woods, et al., report provides one method the staff can use to evaluate the risk significance of this process when reviewing the DOE models and data. If staff decides to explicitly model flank (i.e., secondary breakout) eruption processes during a potential igneous event at Yucca Mountain, parameter ranges will be developed to link the experimentally derived models to conditions representative of the Yucca Mountain system.

Recommendation 3. *Consideration should be given to the potential for increased viscosity of basaltic magma at Yucca Mountain reaching the repository when evaluating the effect of magma flow into the repository, the partitioning of magma flux between the summit and flank eruptions, and the risk from igneous activity to the RMEI associated with the repository.*

Response. As discussed in the response to the December 9, 2005, ACNW letter on this topic, the magnitude and rate of solidification and degassing processes that likely affect magma viscosity are considerably slower than estimated by ACNW and appear unlikely to affect magma-flow models significantly. Information cited by ACNW in support of greatly increased viscosity is not consistent with routine observations made during volcanic eruptions analogous to those in the Yucca Mountain region. Nevertheless, staff continues to evaluate the potential effects of cooling and degassing on models for magma flow processes during extrusive and intrusive igneous events. Staff will continue to inform ACNW of the evaluations as they progress.