MEMO: Summary of CNWRA workshop on the consequences of volcanic activity

TO: John Trapp

FROM: Workshop Participants

CNWRA Staff (Charles B. Connor, Laura Deere, Brittain E. Hill, Mark Jarzemba, Peter La Femina, James Weldy); NRC Staff (John Trapp, Chris McKennie); Peter Baxter (University of Cambridge Medical School); Stephen Sparks (University of Bristol); Andrew Woods (University of Bristol).

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Summary

Probabilities of volcanic disruption of the site (10^{-7} /yr) are significant enough to require estimation of the consequences of volcanism for repository performance (NRC, 1998). A workshop on the consequences of volcanic activity for repository performance was held at the CNWRA July 27-July 31 with a limited number of attendees from NRC and CNWRA. The goal of this workshop was to improve consequence models of volcanic disruption of the proposed repository for use in risk analysis. Specific goals were:

- Review current CNWRA approaches to evaluating the consequences of volcanism
- Identify areas that have received sufficient investigation and those areas that require additional investigation
- Where necessary, develop strategies for evaluating the consequences of volcanism

The workshop included CNWRA staff, NRC Staff and three consultants that are recognized experts in the areas of analytical and numerical modeling of mechanics of volcanic eruptions, volcanic eruption dynamics, and health effects of volcanic eruptions. Summaries of consequence models of volcanic disruption of the repository were prepared by the three consultants (attached). Sparks and Woods prepared a report on the physical aspects of volcanic disruption of the repository. Baxter prepared a report on human exposure to the contaminated tephra deposit resulting from an eruption through the repository. Major conclusions from the workshop were:

The styles of basaltic volcanic eruptions currently used in CNWRA performance assessment (PA) models are reasonable based on the geochemistry and physical volcanology of past eruptions. Experiments can be performed to augment and verify the physical properties of Yucca Mountain region magmas if this subissue is considered to be controversial.

Mechanics of the interaction between the repository and an intruding magmatic dike are

not currently understood in sufficient detail. Current PA models may significantly underestimate the extent of repository disruption and the number of canisters affected by a single igneous event. Therefore, magma-repository interaction should be investigated using physical analog experiments, analytical calculations, and numerical models. These investigations should provide relevant information about the phenomenology of volcanic eruptions through the repository block, the number of canisters affected by volcanic eruptions, and the transient and long-term conditions waste canisters would be subjected to during and subsequent to volcanic eruptions.

Models of eruption dynamics and tephra dispersion currently in use at the CNWRA provide a valid approach to characterize the main features of ash and waste dispersion by strombolian and violent strombolian volcanic eruptions.

A study into the ways waste could be incorporated into basaltic magma during potential eruptions is necessary because this process may have a profound effect on the subsequent distribution of waste in the tephra deposit. The current CNWRA model of waste incorporation into the basaltic magma is physically unrealistic. In addition, alternative models for the dispersion of fine particles (< 50μm) should be investigated.

PA models of dose to a critical group resulting from a contaminated tephra blanket can benefit significantly from recent experience measuring air particulate concentrations following the 1980 eruption of Mount St. Helens and the 1995-present eruption of Soufriere Hills, Montserrat. Additional experiments are required to measure particulate concentrations on basaltic tephra deposits, such as the tephra deposits from the 1995 eruption of Cerro Negro, Nicaragua. Particular attention should be paid to the differences between mass loading and particle counts because these differences may substantially affect calculated dose.

Workshop participants concluded that current approaches to assessing the consequences of volcanic activity may result in significant underestimation of risk. The number of waste packages affected by volcanism could be one to two orders of magnitude greater than assumed in current models, potentially resulting in larger releases (by direct transport to the surface and into hydrologic environment) than previously realized. More accurate assumptions about the distribution of waste in the ascending magma may increase waste concentration in the tephra deposit at the critical group location. Mass loading and exposure to contaminated waste resuspended from the tephra blanket may be greatly underestimated in current risk models. Nevertheless, risk estimates can be improved substantially through investigations designed to address the thermo-fluid-dynamics of magmas in the repository, the effects of these magmatic conditions on canisters, and resuspension of ash during realistic human activities. Workplans for FY99 and FY00, will be developed by the meeting participants during the next several weeks to address these major areas of concern.