



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

December 24, 1991

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: GEOLOGIC DATING OF QUATERNARY VOLCANIC FEATURES AND MATERIALS

On November 19, 1991, a Working Group of the Advisory Committee on Nuclear Waste (ACNW) held a meeting on Geologic Dating of Quaternary Volcanic Features and Materials. This matter was also discussed during the 37th and 38th meetings of the ACNW on November 20-21, 1991 and December 18-19, 1991, respectively.

The dating of Quaternary volcanic features and materials in the Yucca Mountain region is a major factor in determining the probability of interference by volcanism within the repository region. If this probability is sufficiently high, the resulting level of risk may be unacceptable. Thus, the precision of dating the occurrence of volcanism over the past two million years (Quaternary Period) is important. Unfortunately, dating of volcanic rocks of Quaternary age, and especially for those more recently formed than 200 thousand years ago, has significant uncertainties. For example, the Lathrop Wells volcanic cone, located approximately 20 km from the proposed Yucca Mountain site, has been variously dated from a few tens of thousands of years to about 250 thousand years. The age of this feature remains controversial among geoscientists involved in characterizing the site. In view of this controversy, the ACNW invited eight experts on geologic dating techniques potentially applicable to Quaternary-age materials to discuss (1) the status of the science of these methods, (2) their advantages and limitations, (3) their potential applicability to dating volcanic rocks that occur in the Yucca Mountain region, and (4) the assumptions upon which these methods are based. These experts were from the U.S. Geological Survey, Woods Hole Oceanographic Institute, Los Alamos National Laboratories, the State of Nevada, Purdue University, and the Ohio State University. No attempt was made to directly address the ages of volcanic materials and features in the Yucca Mountain region.

Considering all the methods discussed at the Working Group meeting, the potassium/argon (K/Ar) method is considered to be the most well established. K/Ar ages of about 140 thousand years have been obtained recently for Lathrop Wells volcanic materials, but the

validity of this age is still in question. One reason for questioning this age is a concern about the possible incorporation of excess or inherited argon within the sample. This concern illustrates the need to foster the refinement and application of the K/Ar method as well as other independent age-dating techniques.

As a result of the Working Group meeting and our deliberations, we have reached the following conclusions regarding the nature of future specific dating activities:

- (1) Isotopic dating methods should be independently replicated by different scientists at different laboratories. Such replication is important not only because it is accepted scientific practice, but also because dating is a difficult problem.
- (2) Multiple dating techniques should be applied with the expectation that they will produce convergence (or a "concordant" age). However, the techniques considered should be limited to those that have the highest potential accuracy. The techniques should also be based upon different chemical/physical/geological systematics that have firm chemical/physical/geological foundations.
- (3) Improper selection and inadequate characterization of samples may lead to additional age uncertainty. For this reason, care must be taken to ensure that samples represent a full range of sources from volcanic units to specific minerals.

Despite the precautions noted above, differences in the measured ages of volcanic materials are likely to remain. In view of the limitations, problems, and uncertainties in these ages, it is important that the NRC consider the impact of varying degrees of age uncertainty on the calculation of risk due to volcanism at the Yucca Mountain site and what degree of age uncertainty is acceptable. The latter is an important form of guidance yet to be developed by NRC for the Department of Energy and its contractors.

We plan to continue to monitor progress on this subject.

Sincerely,



Dade W. Moeller
Chairman