UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, DC 20555 - 0001

August 3, 2004

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: WORKING GROUP MEETING ON GEOSPHERE TRANSPORT AT YUCCA MOUNTAIN

Dear Chairman Diaz:

During the 151st meeting of the Advisory Committee on Nuclear Waste on June 22-24, 2004, the Committee held a Working Group Meeting (WGM) on Geosphere Transport. The Committee organized this meeting to review the expected behavior of radionuclides in the tuffs and valley-fill alluvium proximal to and south of Yucca Mountain. The WGM included a panel of four distinguished scientists from academia, research institutions, and the private sector renowned in the fields of the fate and transport of radioactive materials in geological media.[1] The Department of Energy (DOE), the Nuclear Regulatory Commission (NRC) staff, and representatives of Nye County, Nevada, and the Electric Power Research Institute made presentations.

The purpose of the meeting was to examine whether the results of experiments, conceptual models, mathematical implementations, and site data provide confidence that the geosphere is an effective barrier for retarding the movement of radionuclides from a potential repository at Yucca Mountain. In particular, the goals of the meeting were to review what is known about saturated zone pathways from Yucca Mountain to the compliance boundary in Amargosa Valley, and review the state of knowledge of radionuclide sorption in tuffs and alluvium down-gradient from Yucca Mountain.

Presentations made at the WGM confirmed the ACNW's view that NRC staff has done an excellent job of developing an approach to parsing and analyzing performance assessments for Yucca Mountain. This exposes how various flow and transport processes and behavior of specific radionuclides sharpened the staff's risk insights. The staff developed its approach using geosphere transport as the illustrative case. The ACNW believes that the general approach will help staff to focus their reviews and will also be invaluable in communicating results to all stakeholders.

The Committee recommends that the staff continue working to make performance assessment results transparent. We further recommend that the staff expand its approach to include the engineered barrier systems.

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[1]James Davis, US Geological Survey, Richard Parizek, Pennsylvania State University, Don Shettel, Geosciences Management Institute, and Ines Triay, US Department of Energy.

Observations From the WGM

The risk insights from analyses by NRC staff provide a framework for understanding the context of the discussions at the WGM.

1. The radionuclides ^{241}Am and ^{240}Pu constitute approximately 80% of the radioactivity (curies) in the proposed repository 1000 years postclosure, but their immobility keeps them in or near a repository for more than 10,000 years. They would therefore contribute little to estimated receptor dose.
2. The radionuclides ^{99}Tc and ^{129}I are mobile and make up a very small fraction of the waste inventory. Current analyses suggest that these radionuclides would move with water once a waste package is breached, reaching the compliance boundary after hundreds to thousands of years. The relatively small inventory and dilution in the aquifer make the estimated doses small.
3. There are significant uncertainties in the behavior of ^{237}Np. The uncertainty in the retardation factor for ^{237}Np in alluvium ranges over three orders of magnitude. The degree to which ^{237}Np is retarded by alluvium can have a major effect on calculated doses.

Flow path length, dilution, and sorption all contribute to the ability of the geosphere to serve as a barrier to radionuclide transport. Presentations and discussions at the WGM highlighted uncertainties in current understanding of those processes.

DOE, NRC, and EPRI all have modeled ground water flow and radionuclide transport to support their performance assessments. Different conceptualizations of the geologic environment, including major faults and fractures, the block sizes that influence matrix diffusion, and recharge fluxes result in similar projected flow paths and travel times. The overall conclusion is that ground water flow is to the east-southeast toward Fortymile Wash and then to the south.

Although the performance assessments for Yucca Mountain all indicate that the geosphere is an effective barrier to the transport of radionuclides, additional information on the geosphere as an effective barrier would enhance confidence in those analyses. A recent letter dated May 3, 2004, from R. Parizek (US NWTRB) to M. Chu (US DOE) regarding comments from the Nuclear Waste Technical Review Board Panel on the Natural System, Las Vegas, Nevada, March 9-10, 2004, makes a similar point.

A DOE representative identified ground water flow rates, matrix diffusion in fractured tuff, and sorption coefficients for the key radionuclides as areas where additional information might reduce uncertainties. NRC risk insights analysis suggests that additional information on flow path length in the alluvium would be helpful.

The portion of the groundwater flow path, from Yucca Mountain to the compliance boundary, that traverses the alluvium is a critical element in performance assessment models. Field information to constrain possibilities could be very useful in reducing modeling uncertainties. The work being done by Nye County to study ground water in the alluvium is producing the best available hydrogeological information in Amargosa Valley. Several comments were made at the WGM that large-scale field tests to determine how major faults may act as either conduits or barriers to flow would be beneficial. Work to reduce uncertainties in regional groundwater flux and matrix diffusion was also viewed as potentially useful in strengthening the evidence base.

The keynote presentation raised interesting questions relative to sorption of ^{237}Np at Yucca Mountain. Studies of uranium migration at a mill tailings site indicated that sorption depended much more on water chemistry than on geologic materials properties. Because factors that control sorption of neptunium are similar to those that control sorption of uranium, better characterization of the water chemistry in the alluvium at Yucca Mountain may help build confidence about sorption coefficients used in performance assessments.

Based on our past reviews and the results of the WGM, the ACNW concludes that there is strong evidence that the geosphere will provide significant barriers to the migration of radionuclides from a proposed repository at Yucca Mountain.

Sincerely,

/RA/

B. John Garrick
Chairman