

December 21, 2001

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Meserve:

SUBJECT: SUMMARY REPORT — 130TH MEETING OF THE ADVISORY COMMITTEE ON
NUCLEAR WASTE AND WORKSHOP ON THE NRC'S FUTURE RESEARCH
NEEDS, NOVEMBER 27–29, 2001, AND OTHER RELATED COMMITTEE
ACTIVITIES

The Advisory Committee on Nuclear Waste (ACNW or the Committee) held its 130th meeting on November 27–29, 2001, at Two White Flint North, 11545 Rockville Pike, Rockville, Maryland. During that meeting, the Committee discussed the topics identified below.

HIGHLIGHTS OF KEY ISSUES CONSIDERED BY THE COMMITTEE

1. ACNW Planning and Procedures

The Committee approved the following topics for discussion during its 131st meeting, scheduled for January 8–9, 2002:

- **ACNW Planning and Procedures**—The Committee will review items under consideration at this meeting and consider topics proposed for future ACNW meetings.
- **Proposed Rule on Probability of an Unlikely Event**—The staff will provide an information briefing on the proposed rulemaking to amend, 10 CFR Part 63, “Specification of a Probability for Unlikely Features, Events, and Processes.”
- **Status Report on Key Technical Issues**—The NRC staff will provide an overview on the status of the resolution of Yucca Mountain key technical issues (KTIs) and an update on each individual KTI.
- **ACNW Planning Retreat**—The Committee will finalize plans for its retreat, scheduled for February 27 through March 1, 2002.
- **Preparation of ACNW Reports** —The Committee will discuss proposed reports that were not completed at its last meeting.

2. Workshop on Research Needs

The ACNW sponsored a workshop on November 27 and 28, 2001, during which the NRC's future waste-related research needs were addressed. The workshop objectives included the following:

- Develop insights regarding the information and technical tools that will be needed for future regulatory decisions.
- Explore the views of the workshop participants as to what new knowledge and technical tools will be needed for these decisions.
- Discuss how research can be used to develop the necessary knowledge and technical tools.
- Explore processes for effective prioritization of research.

The speakers invited to participate in the workshop included recognized experts on geoscience, chemistry, hydrology, decision analysis, health physics, and policy and regulatory analysis. These speakers appear, in order of appearance, on the attached list of participants.

The NRC currently funds work at the Southwest Research Institute, Center for Nuclear Waste Regulatory Analyses (CNWRA), in support of agency activities related to the proposed Yucca Mountain high-level waste repository and research managed by the NRC's Office of Nuclear Regulatory Research (RES) on materials and waste safety. RES has recently released for stakeholder comment, a draft program plan for future research on radionuclide transport. The NRC's Office of Nuclear Material Safety and Safeguards (NMSS) has recently provided RES with its user needs request for work in this area. The workshop participants identified a number of areas related to waste safety that involve challenges that could be addressed through research.

There were extensive discussions between the ACNW members and the workshop participants as to what new information and technical tools are needed and how research could be used to develop them. The highlights of these discussions are as follows:

- Additional model development was generally believed to be necessary. Particular improvements cited include the development of more realistic conceptual models, use of experience and data to create simple and credible models for individual complex sites, and development of an accepted process for using the information obtained from multiple competing conceptual models in regulatory decisions. Some workshop participants believed that model uncertainty was the more significant uncertainty in performance assessment.

- The workshop participants generally agreed that realistic assessments should be made, with conservatism being added at the end to correctly account for uncertainty. This type of process will provide the best assessment of a system and the importance of the system's components, and can be used to identify needed research work. The participants also noted that the piecewise elimination of conservatism does not necessarily introduce more realism in the analysis. Risk information, research results, and experience should be used in a systematic, system-based manner to provide the basis for eliminating inappropriate conservatism.
- Performance assessment can provide valuable information as to where research is needed and what level of understanding is required for a regulatory decision. Participants noted that scientific research and research to provide information for a regulatory decision can have different objectives. Potential licensee and NRC research needs will also differ.
- Work designed to provide a better understanding of the effect of heterogeneous structure on flow (for example, fracture-matrix interaction) was judged to be important.
- Work designed to provide a better understanding of the integrity of engineered barrier systems and the associated chemistry was judged to be important.
- Coupled processes are complex, can lead to unexpected results, and need to be better understood.
- Identified weaknesses in the basic health physics models were judged to be very important areas where improvements are much needed. The linear no-threshold dose/health effects model was cited as an example.
- An important purpose for research is to examine system assessments for significant flaws. The NRC research program should be designed to help the agency discover and deal with the unexpected.
- The workshop participants strongly encouraged the use of the existing expertise and information in the scientific community as a resource. Participants also suggested that the use of panels of non-NRC experts would provide a cost-effective way of accessing state-of-the-art information.
- The workshop participants encouraged cooperative work and the use of applicable information obtained from work done for purposes other than nuclear waste safety. Participants also encouraged active participation of the NRC staff in scientific activities associated with the disciplines that are important to management and disposal.
- The workshop participants emphasized the need for regulatory decisions to be based on a clear, well-founded safety case, and stressed that research should be used to test this safety case. Participants also noted that a safety case has many elements, and even an exceptionally complete and accurate performance assessment will not provide the complete basis.

- The workshop participants emphasized the need to thoroughly understand and use existing work to avoid making incorrect assumptions as to the performance of a site. As examples, participants cited the discovery of CI-36 at the Yucca Mountain site and water in the tunnels at the Waste Isolation Pilot Plant site.
- The workshop participants noted that it is a worthwhile strategy to design research to attract the interest of other research organizations, with the intent of those organizations funding the completion of the work. Participation of NRC staff in outside scientific activities would promote this type of cooperation.
- The inherent heterogeneity of sites and the need to preserve site integrity limits site characterization. Improved approaches to site measurements and improved instrumentation need to be developed.
- “Blind” model validations are useful in the process of understanding and using conceptual models. Participants noted that the type and amount of data provided need to be carefully evaluated to ensure meaningful results.
- The workshop participants generally agreed as to the importance of obtaining field data. Possible sources include work being performed for activities other than radionuclide waste disposal, applicable natural analogs, and existing waste sites. Inverse modeling was judged to be a valuable tool for model improvement.

The last workshop session addressed research prioritization. The workshop participants recognized that the NRC has a limited research/technical support budget with which a variety of regulatory needs must be addressed. Participants also recognized that the NRR and NMSS needs for technical support must be met in order to satisfy the NRC’s licensing responsibilities.

The workshop participants generally believed that a research program must have a logical framework that provides clear measures of relevance and importance and identifies a proper basis for research prioritization. The framework should also ensure both the identification of all useful research and the proper selection of that work that will provide the most benefit to the NRC. The analytical hierarchy process used by RES was judged to be a worthwhile innovation, but in need of improvement.

The workshop participants generally believed that the identification and prioritization are best done by a qualitative means. Metrics such as those used in the analytical hierarchy process can provide a useful framework for discussion. External peer review provides cost-effective access to the resources of the scientific and technical communities and adds credibility to the results. The workshop participants generally believed that external peer review should be used and the NRC staff should be more active in external scientific and technical activities. The participants also stated that there would always be issues that would need to be resolved by high-level policy decisions. Examples are the partitioning of research funds between reactor, materials, and waste safety, and between anticipatory research and support of NRR and NMSS user needs requests.

Performance assessment and probabilistic risk analysis were judged to be valuable in identifying and prioritizing research projects. Cooperative work was judged to be an effective way of leveraging the NRC's resources and, therefore, deserving of a higher priority. Other suggested metrics for identifying and prioritizing research projects were the expected impact on a regulatory decision, sunk costs, total cost and expected cost/benefit, and the likelihood of success.

Committee Action

The Committee will use the insights from this workshop for its 2002 report to the Commission on NRC-sponsored research.

3. Performance Confirmation for the Proposed High-Level Waste Repository at Yucca Mountain, Nevada

The NRC staff presentation covered three main topics including (1) the NRC staff's perspective on performance confirmation, (2) pertinent regulations, and (3) planned performance confirmation activities by the NRC and CNWRA.

The NRC staff defined performance confirmation as a broad-based technical program of tests, experiments, and analyses to be conducted by the Department of Energy (DOE) to evaluate the adequacy of assumptions, data, and analyses in support of repository design and performance. The time frame for performance confirmation was defined as the period between site characterization and permanent closure. As an important part of a process to build public confidence, the objective of the performance confirmation activities is ultimately to ensure that DOE maintains safety.

The NRC staff indicated that the Commission's role is to integrate performance confirmation into the licensing process and to require DOE to do performance confirmation. In addition, the NRC has a responsibility to review DOE's performance confirmation program, oversee its implementation, and verify the subsurface conditions and long-term repository performance. The staff also indicated that it plans to identify risk-important inadequacies and gaps in the DOE program, and that performance confirmation activities will involve conducting reviews, evaluations, inspections, and independent experimental investigations. In addition, the staff indicated that it will continue to conduct performance assessment activities through its total system performance assessment reviews.

The NRC staff stated that performance confirmation is required by 10 CFR Part 63, and explained how performance confirmation is addressed in different parts of that regulation. According to this regulation, performance confirmation covers a broad scope, including designs, conceptual models, parameter values, and overall performance. Data and analyses pertaining to both subsurface conditions and natural and engineered systems affecting repository design and operation are subject to performance confirmation. In particular, the regulation gives the NRC the authority to require DOE to carry out tests at the site, as well as the authority to carry out NRC's own tests. The regulation also allows DOE to do research and development (R&D) tests and experiments that may be outside the scope of performance confirmation and NRC oversight. In addition, the regulation requires that the license applica-

tion and environmental impact statement be updated to reflect the results of performance confirmation activities.

Planned performance confirmation activities by the NRC and CNWRA staffs include (1) developing an NRC performance confirmation plan consistent with the requirements in 10 CFR Part 63 and review of DOE's performance confirmation plan and other relevant material to identify uncertainties and areas where DOE may need additional guidance or clarification; (2) interacting with DOE as the initial steps into a licensing framework are undertaken; (3) identifying and prioritizing elements for NRC staff performance confirmation oversight; (4) using the performance confirmation plan to guide performance confirmation reviews, evaluations, and inspections; and (5) periodically revising and updating a performance confirmation plan as appropriate.

The Committee members asked questions about a number of issues, including (1) the timeframe for performance confirmation activities; (2) post-closure performance monitoring; (3) precedent activities in other NRC programs; (4) planned performance confirmation activities by the NRC staff; (5) other inspection and surveillance activities; and (6) criteria to reach agreement between the NRC and DOE on performance confirmation activities.

Committee Action

The Committee plans to use information from this briefing to aid in making recommendations to the Commission concerning planned performance confirmation activities by the NRC and CNWRA staffs, and/or for developing observations and recommendations to augment or support the Committee's letter to the Commission on the NRC's long-term R&D needs (the subject of the ACNW workshop at this meeting).

4. Supplemental Science and Performance Analysis (SSPA)

The NRC staff presented a summary of its review of the DOE's Supplemental Science and Performance Analyses (SSPA). The staff identified 129 comments that need resolution. Areas where additional information is needed include the treatment of the waste package closure weld, temperature dependence for uniform corrosion of Alloy 22, and whether DOE should decide to use a below-boiling repository design. The staff identified concerns in 37 areas, and addressed a number of concerns raised by the Committee in recent reports. For example, in the area of conservatism and regulatory decisions, the staff believes that DOE is free to use the flexibility afforded by the NRC's risk-informed, performance-based regulations. DOE may develop a realistic performance assessment or introduce conservatism as long as their approach demonstrates compliance.

The Committee also heard highlights of a report funded by Clark County, Nevada, on DOE's Preliminary Site Suitability Evaluation for Yucca Mountain and supporting documents such as the SSPA. The principal findings included technical information concerning the observation that the total system performance assessment-site recommendation (TSPA-SR) is limited and difficult to trace within the documents, that many assumptions in the TSPA-SR are extreme

and not related to data or realism, and that the results of the supplemental TSPA for the repository compliance period depend solely on Alloy 22 performance, for which the current database is small and long-term performance is unknown.

Committee Action

The Committee and the NRC staff identified four areas for future ACNW concentration. Specifically, those areas include (1) an NRC staff document describing risk insights from ongoing work and how to implement those insights, (2) the Integrated Issue Resolution Status Report, (3) the Yucca Mountain Review Plan, and (4) the Performance Confirmation Action Plan.

Sincerely,

/RA/

George M. Hornberger
Chairman

ATTACHMENT

**LIST OF PARTICIPANTS
ADVISORY COMMITTEE ON NUCLEAR WASTE
130TH MEETING AND
WORKSHOP ON RESEARCH NEEDS
NOVEMBER 27–29, 2001**

PARTICIPANT

AFFILIATION

**Ashok Thadani
Martin Virgilio**

**NRC, Office of Nuclear Regulatory Research
NRC, Office of Nuclear Material Safety and
Safeguards**

**Kenneth Rogers
Malcom Knapp
John Kessler
Wesley Patrick**

**Private Consultant
Private Consultant
Electric Power Research Institute
Southwest Research Institute, Center for Nuclear
Waste Regulatory Analyses**

**Michael Ryan
William Hinze
Timothy McCartin**

**Charleston Southern University
ACNW Consultant
NRC, Office of Nuclear Material Safety and
Safeguards**

**William Ott
Jane Long
David Kocher
Darrell Nordstrom
John Wilson
John Rosenthal
Warner North
Steven Rattien**

**NRC, Office of Nuclear Regulatory Research
Mackay School of Mines, University of Nevada
SENES Oak Ridge, Inc.
U.S. Geological Survey
New Mexico Institute of Mining and Technology
NRC, Office of Nuclear Regulatory Research
Stanford University
RAND Science and Technology**