



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555-0001

June 30, 1998

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: SUMMARY REPORT - 101ST MEETING OF THE ADVISORY COMMITTEE ON
NUCLEAR WASTE, JUNE 10-12, 1998, AND OTHER RELATED COMMITTEE
ACTIVITIES

Dear Chairman Jackson:

During its 101st meeting on June 10-12, 1998, at Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, the Advisory Committee on Nuclear Waste (ACNW) discussed several matters and approved the following report:

- Report to the Honorable Shirley Ann Jackson, Chairman, NRC, from Dr. B. John Garrick, Chairman, ACNW, "ACNW Comments on NRC's Review of the Department of Energy's Viability Assessment," dated June 19, 1998.

HIGHLIGHTS OF KEY ISSUES CONSIDERED BY THE COMMITTEE

1. Meeting With the Chairman, U.S. Nuclear Regulatory Commission

Dr. Shirley Ann Jackson, Chairman, U.S. Nuclear Regulatory Commission (NRC), opened the meeting by addressing the Committee. Relevant to the working group's technical discussions on the "Near-Field Environment and Performance of Engineered Barriers in the Yucca Mountain Repository," she noted that in the past, because of the Department of Energy's (DOE's) emphasis, the NRC has concentrated on the performance of the natural barrier as compared with the engineered barriers.

She briefly addressed some of the ACNW's stated interests, such as (1) risk-informed, performance-based regulation, (2) the proposed 10 CFR Part 63, which is specific to Yucca Mountain, (3) the application of the

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defense-in-depth concept, and (4) the application of performance assessment to waste issues.

Chairman Jackson also discussed NRC pre-licensing responsibilities for Yucca Mountain [viability assessment (VA)] and recent Congressional budget activities. After answering several questions, she closed her discussion with the exhortation that the Committee's advice to the Commission be timely and efficient.

Conclusions/Action Items

The ACNW plans to continue to provide timely and efficient advice to the Commission.

2. Near-Field Environment and Performance of Engineered Barriers in the Yucca Mountain Repository

The ACNW held the working group session to develop a better understanding of the key issues and concerns for demonstrating the performance of the engineered barrier system (EBS) for the proposed Yucca Mountain high-level waste (HLW) repository. The working group brought together a panel of experts invited from academic, private, and governmental organizations [DOE, the NRC, and the NRC's Center for Nuclear Waste Regulatory Analyses (CNWRA)]. The meeting focused on the DOE's reference EBS design for the VA and other engineered barrier options that DOE is considering for the repository. The speakers discussed conditions and processes that could occur inside the disposal drifts and influence the release and transport of radionuclides from the near-field environment of the proposed HLW repository. The meeting provided a forum for raising significant technical issues and identifying information and modeling needs for evaluating the various design options that may be important for licensing.

The working group consisted of three half-day sessions and a panel discussion. Each session had two plenary speakers and presentations by DOE and NRC representatives. The discussion focused on three broad areas: (1) engineered barriers and environmental chemistry, (2) corrosion of waste packages, and (3) chemical processes affecting radionuclide releases in the near-field environment. On the afternoon of the second day, the panel discussion featured the plenary speakers who discussed their key concerns and what they believed to be additional

modeling and data needs. A public comment session followed. The meeting also was linked by video to the CNWRA in San Antonio, Texas, and the DOE Yucca Mountain Project Office in Las Vegas, Nevada, to facilitate technical interactions and enhance public participation.

The first working group session focused on engineered barriers and geochemical interactions that will affect the chemistry of water reacting with the waste package and waste forms. The first plenary speaker was Dr. Michael Apted of QuantiSci, Inc., who gave a presentation on "Engineered Barriers and Environmental Chemistry." He discussed the multibarrier concept for waste isolation, robustness and confidence building, and performance assessment of the near field. He also discussed an EBS design strategy and the Yucca Mountain EBS environment, and compared them with other nations' designs for geologic repositories. The next plenary speaker was Dr. William Murphy, CNWRA, who discussed "Environmental Chemistry Issues Specific to the Near Field at Yucca Mountain." Dr. Murphy covered the subissues for the Evolution of the Near-Field Environment Key Technical Issue, rock and water interactions, studies of water chemistry at Yucca Mountain, gas chemistry, and the effects of introduced materials, such as cement, metals, and waste forms. He also discussed the information requirements for characterizing the chemical environment. The DOE speaker was Dr. Abe Van Luik, who presented the "Near-Field Geochemical Environment Abstraction for Total System Performance Assessment-VA (TSPA-VA)." Dr. Van Luik spoke about the relationship to other TSPA-VA abstractions, identified the areas of analyses, presented an overview of the DOE base-case approach, discussed sensitivity analyses, and described the associated uncertainties and variability. Dr. Peter Lichtner, NRC/CNWRA, addressed "Thermal-Hydrologic-Chemical [THC] Coupled Near-Field Environment Models." He discussed THC coupling and near-field chemistry; process-level models; a number of near-field applications, including: different repository scale models (1-D and 2-D), evaporation and condensation effects, mineral alteration, and porosity and permeability changes.

The second working group session focused on the interactions of the water in the near field with the waste packages and the resulting corrosion processes as a function of the types of alloys and other materials proposed in DOE's reference design for VA. The first plenary speaker was Dr. Roger Staehle, adjunct professor, University of Minnesota, who discussed "Waste Package Corrosion." Dr. Staehle covered a variety of corrosion issues, including a recommended approach for handling corrosion, the composition of steel alloys, the environment of

corrosion, chemical processes, bounding approaches for handling different environmental conditions that affect corrosion, volume expansion of corrosion products, probabilistic features of corrosion, and approaches for minimizing corrosion. The next speaker, Dr. Joseph Payer, Case Western Reserve University, spoke on "Localized Corrosion: Relationships Among Waste Package Materials, Water Chemistry and Performance." Dr. Payer discussed the relationship between corrosion and performance, the behavior of metals, passive corrosion and durability, crevice corrosion, corrosion-resistant materials for oxidizing conditions, environmental issues, hypothetical scenarios, technical issues, and backfill issues. Dr. Joseph Farmer, Lawrence Livermore National Laboratory, presented the DOE material on the "Development of Corrosion Models to Support TSPA-VA." Dr. Farmer discussed the following issues: DOE's technical approach, general corrosion, various corrosion models, the long-term corrosion tests being performed by DOE, modeling details, and results of the DOE corrosion models being used. He also described in detail the corrosion test results for the C-22 alloy and other corrosion resistant materials and the abstractions for TSPA-VA. Dr. Narasi Sridhar, NRC/CNWRA, presented viewgraphs on "Modeling Container Corrosion-NRC Approach." He discussed the following: the primary container functions, topics relevant to container performance, understanding processes that affect performance, implementation in performance assessment, differences with the DOE approach, uncertainties, and future activities.

At the end of the first day, Dr. Martin Steindler, ACNW Consultant, gave an overview of key issues from the first day's presentations and discussion. This was followed by a period of general discussion by the Committee members, the panel of invited experts, other participants, and the audience, including interactions with observers in San Antonio and Las Vegas.

The second day of the meeting began with the third working group session addressing the chemistry of the near-field environment and its affect on the potential release of radionuclides. The first plenary speaker for this part was Dr. David Shoesmith, Atomic Energy of Canada Limited, who presented material on "Chemistry Considerations for Release and Transport of Radionuclides from Spent Fuel." Dr. Shoesmith discussed parameters required to model waste form degradation, including those for the waste package, fuel cladding, spent fuel degradation, and radionuclide source term. Dr. Shoesmith's discussion of fuel corrosion and radionuclide source term covered: the instant release fraction, mechanisms of fuel corrosion, the development of an intrinsic corrosion

rate, the effect of the accumulation of corrosion products, and the formation of colloids. The next plenary speaker was Dr. JoonHong Ahn, University of California at Berkeley, who addressed "Chemical Issues and Consideration for the Use of Backfill in a Repository." Dr. Ahn discussed a variety of issues related to the possible use of bentonite as a backfill for the Yucca Mountain Repository. His material focused mainly on work performed for the Japanese HLW repository program.

The DOE speaker was Dr. William Halsey, who presented material on "Waste-Form Degradation and Radionuclide Mobilization." Dr. Halsey addressed the following issues: the waste-form representation in TSPA-VA, waste forms, the results of an expert elicitation on waste forms, fuel cladding credit, dissolution rates for spent nuclear fuel, dissolution rates for defense HLW glass, and sensitivity studies. The next speaker, Dr. Brett Leslie, NRC staff, discussed "NRC's Approach to Modeling Radionuclide Release From the Engineered Barrier System." Dr. Leslie presented an overview of the general NRC approach, discussed total system performance assessment (TPA) waste form models, discussed some solubility considerations, described engineered barrier system interactions, and compared DOE and NRC approaches.

There were also presentations and discussions by Dr. Dave Stahl, Framatome Cogema Fuels, Management & Operations contractor, and Mr. Jerry Cogar from Las Vegas on the fabrication process for the waste package canisters.

On the afternoon of June 11, the panel of invited experts made their observations and discussed issues and concerns. Dr. Chris Whipple (ICF Kaiser) described information needs for performance assessment; waste package issues; other analysis and programmatic issues; complexity, simplicity, and robustness; and his perceptions of "defense in depth." Dr. Apted discussed the relative contributions of multiple barriers in repository systems, uranium dissolution rates, containment and initial conditions, and performance assessment and uncertainty. Dr. Murphy discussed near-field environment issues, the NRC and CNWRA program, bounds on environmental conditions, possible simplifications for modeling, and natural analogs to a Yucca Mountain repository. Dr. Staehle discussed corrosion issues for the alloy C-22, implications of using a bentonite backfill, weld issues, hydrogen embrittlement for Zirconium, development issues for containers, and three-dimensional models; he also provided a sketch of "engineering elements." Dr. Payer discussed the need for further information on crevice corrosion

and other issues for C-22; he defined the vulnerable temperature range approach for modeling C-22 corrosion; and talked about some key technical issues and research needs. Dr. David Shoesmith described a number of key issues in modeling waste-form degradation. Finally, Dr. JoonHong Ahn described how a systems engineering approach that is used for developing complex machines, such as airplanes, could be applied to HLW repository design.

A period of questions and answers to and from the panel, ACNW members, consultants, and the audience followed the panel discussion. There was also a period for public comment. Engelbrecht Von Tiesenhausen, who represented Clark County, raised a number of issues involving quality assurance. Other members of the public also raised questions during this question-answer period.

Conclusions/Action Items

The ACNW plans to develop a letter providing recommendations to the Commission on the engineered barrier system.

3. Meeting With the Nuclear Energy Institute

The Committee heard a presentation from and exchanged perspectives with the following NEI staff members: Ralph Beedle, Senior Vice President and Chief Nuclear Officer and Lynette Hendricks, Director, Plant Support Department.

After a brief discussion of the NEI organization and some of NEI's current active issues, Mr. Beedle presented the following five key issues as those in which the ACNW should become involved:

- problems caused by dual regulation (NRC and the Environmental Protection Agency) of nuclear facilities
- disposal of the Trojan reactor vessel
- low-level radioactive waste issues related to ensuring access to disposal sites
- clearance of materials
- the need for dry cask storage for spent fuel

He closed his presentation by stating that the ACNW could help the NRC fulfill its mission by promoting a better understanding of risk in the regulation of radioactive materials.

Conclusions/Action Items

The Committee noted that it has been involved in each of the preceding issues and intends to continue its involvement to the extent resources permit.

4. Election of Officers

The Committee re-elected Dr. B. John Garrick as Chairman and Dr. George M. Hornberger as Vice-Chairman. The terms of office run from July 1, 1998, through June 30, 1999.

PROPOSED SCHEDULE FOR THE 102ND ACNW MEETING

The Committee agreed to consider the following issues during its 102nd meeting on July 20-22, 1998:

- Planning for and Meeting With the Nuclear Regulatory Commission—The Committee will prepare for and meet with the Commission to discuss items of mutual interest. Topics will include the ACRS Plans and Priorities list and earlier Committee reports on the interim guidance in support of the final rule on radiological criteria for license termination; NRC waste-related research; and risk-informed, performance-based regulation. Observations will also be presented on the recent two-day working group discussions on the near-field environment and the performance of engineered barriers in the Yucca Mountain Repository. The Committee is currently scheduled to meet with the Commission on July 21, 1998, at 1:30 p.m.
- Yucca Mountain Regulatory Framework — The Committee will be briefed by the staff on the status and content of the site-specific regulatory framework to be used to judge the acceptability of DOE's license application for disposal of high-level waste at the proposed Yucca Mountain, Nevada, site. Topics might include a discussion of the proposed relevant 10 CFR Part 63, the Issue Resolution Status Report (IRSR) on Total System Performance Assessment (TSPA), and a description of important measures developed by the staff for application to the proposed repository as well as other waste disposal facilities.
- Generic LLW Disposal Facility Criticality Issues — The Committee will review recent staff papers on the potential for criticality and the need

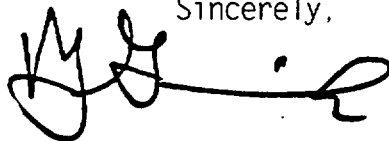
- to continue research on post-disposal criticality at low-level radioactive waste disposal facilities.
- Development of a Standard Review Plan (SRP) for Decommissioning – The Committee will be briefed by the staff on its plans to develop an SRP for use by the NRC in reviewing and evaluating nuclear facility decommissioning plans.
 - Meeting With NRC's Director, Division of Waste Management, Office of Nuclear Material Safety and Safeguards – The Committee will meet with the Director to discuss recent developments within the division, such as developments at the Yucca Mountain project, rules and guidance under development, available resources, and other items of mutual interest.
 - Preparation of ACNW Reports – The Committee will discuss planned reports; risk-informed, performance-based regulation; waste-related research; regulatory guides dealing with decommissioning; and other topics discussed during this and previous meetings.

OTHER RELATED ACTIVITIES OF THE COMMITTEE

The ACNW plans to meet with the Reaktorsicherheit-Kommission (Reactor Safety Commission, Germany) during the week of September 14-18, 1998. The Committee also plans to tour the Konrad, Morsleben, and Gorleben facilities during its visit to Germany.

The 103rd ACNW meeting is scheduled for October 19-22, 1998, in Las Vegas, Nevada.

Sincerely,

A handwritten signature in black ink, appearing to read 'B. John Garrick', written in a cursive style.

B. John Garrick
Chairman