



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

ACNWS-0166

November 1, 2006

The Honorable Dale E. Klein
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Klein:

SUBJECT: SUMMARY REPORT—173RD MEETING OF THE ADVISORY COMMITTEE ON NUCLEAR WASTE, SEPTEMBER 18–21, 2006, AND RELATED ACTIVITIES OF THE COMMITTEE

During its 173rd meeting, September 18–21, 2006, the Advisory Committee on Nuclear Waste (ACNW) discussed several matters and completed the following reports:

Reports to Dale E. Klein, Chairman, NRC, from Michael T. Ryan, Chairman, ACNW:

- Working Group Meeting on Evaluating the Long-Term Performance of Cement Barriers for Near-Surface Waste Disposal, dated October 12, 2006
- Prevention of Legacy Sites, dated October 17, 2006
- Probabilistic Risk Assessment of Dry Cask Storage of Spent Nuclear Fuel, dated October 17, 2006

HIGHLIGHTS OF KEY ISSUES

1. *Observations from ACNW and Staff Members on Recent Activities*

1.1 Visit at Crow Butte *In Situ* Leach Facility in Nebraska

ACNW member Dr. Ruth Weiner presented a brief summary of the field trip to the Crow Butte *In Situ* Uranium Leach Facility. Also participating in the trip were ACNW member William Hinze and ACNW staff Latif Hamdan. A trip report for this visit was prepared and is now publicly available as an NRC document.

1.2 Attendance at the U.S. Department of Energy (DOE) Workshop on Low Dose Radiation Research Program

Dr. Ryan summarized his impressions from attending the DOE workshop. ACNW staff Neil Coleman also attended the workshop. A trip report for this meeting was prepared.

1.3 Attendance at the International Commission on Radiological Protection Workshop

Dr. Ryan summarized his impressions from attending the International Commission on Radiological Protection (ICRP) workshop. Neil Coleman also attended this workshop. The main objectives for the workshop were to: evaluate and discuss the latest draft ICRP recommendations, discuss how proposed ICRP recommendations can best meet the health

and safety needs of national and international radiological protection, continue the open and broad dialogue between stakeholders to reach a common level of understanding of the issues at stake, and contribute in a positive and constructive manner to the evolution of new ICRP recommendations.

Committee Action

None

2. ACNW Working Group Meeting on Using Monitoring to Build Confidence in Models

During its 173rd meeting from September 18–21, 2006, ACNW held a 2-day working group meeting on using monitoring to build confidence in models. The ACNW organized the working group meeting in collaboration with staff from the NRC Office of Nuclear Regulatory Research. Invited outside experts and NRC staff members from the Office of Nuclear Material Safety and Safeguards made formal presentations.

The working group meeting was organized to obtain information and views of invited experts on using monitoring to enhance confidence in models and modeling results. The intent was to evaluate the use of monitoring, not only to demonstrate regulatory compliance, but also to build confidence in the conceptual and mathematical models employed to predict the performance of engineered systems and to track the transport and fate of radionuclides and hazardous chemicals that might be released to the environment. This work will support NRC activities by defining synergies among site monitoring and modeling activities that support risk-informed decisionmaking in the licensing process for nuclear materials and wastes. More specifically, the working group meeting will support action on a Commission request that the Committee work with the NRC staff to identify and assess methods of monitoring for compliance and to identify possible enhancements for increasing confidence in the validity of associated analytical models.

The working group meeting included four sessions that addressed four topics, specifically (1) the role of models and monitoring programs in licensing, (2) evaluation of radionuclide releases and ground-water contamination, (3) field experiences and insights, and (4) opportunities for integrating modeling and monitoring. The summaries below describe each session.

Session 1: Role of models and monitoring programs in licensing. This session focused on examining practitioners' use of models and monitoring programs in different regulatory contexts. The session included six formal presentations that addressed the following themes:

- (1) Two invited experts from Energy Solutions-Duratek-Chem Nuclear Systems and Radiation Safety & Control, Inc., addressed the licensee perspective on the role of models and monitoring in demonstrating compliance with licensing criteria.
- (2) Two members of the NRC staff addressed the regulator's perspective on the use of models and monitoring in decisionmaking for decommissioning.

- (3) An invited expert from Monitor Scientific, LLC, and an NRC staff member addressed the role of monitoring in performance assessment evaluations.

A panel discussion and a question-and-comment session involving the Committee members followed the formal presentations. Panelists included session speakers and other invited experts from Electric Power Research Institute (EPRI), and the University of Virginia.

Session 2: Evaluation of radionuclide releases and ground-water contamination. The session focused on obtaining information and sharing experiences on ground-water monitoring and modeling of contaminated sites (i.e., case studies). The session included five formal presentations by invited experts: two from the Pacific Northwest National Laboratory (PNNL), one from Savannah River National Laboratory (SRNL), one from Brookhaven National Laboratory, and one from Energy Solutions-Duratek-Chem Nuclear Systems. Main topics discussed included contaminant transport; detection, characterization, and delineation of subsurface contaminant plumes at different U.S. Department of Energy sites, including Hanford, Savannah River, and Brookhaven; and ground-water migration and modeling at the Barnwell low-level radioactive waste disposal site. The discussion covered the histories of these sites, including site characterization activities, ground-water monitoring and modeling studies, and remedial actions.

A panel discussion and a question-and-comment session involving the Committee members followed the formal presentations. Panelists included session speakers and an invited expert from the University of Virginia.

Session 3: Field experience and insights. The session focused on making the most and the best use of field experience and insights for improving both monitoring and the integration of monitoring and modeling activities. The session included six formal presentations by invited experts from the U.S. Geological Survey; U.S. Environmental Protection Agency; Advanced Environmental Solutions, LLC; University of Wisconsin-Madison; PNNL; and Stoller Corporation, representing the U.S. Department of Energy's Office of Legacy Management. Topics included site characterization to support development of conceptual models of ground-water contaminant transport, landfill and mill tailings covers, and integration of environmental monitoring and modeling to refine models and improve both modeling results and performance of nuclear facilities.

A panel discussion and a question-and-comment session involving the Committee members followed the formal presentations. Panelists included session speakers and an invited expert from the University of Virginia.

Session 4: Opportunities for integrating modeling and monitoring. This session provided a discussion of the opportunities and limitations of integrating monitoring and modeling activities with guidance that can be developed to support regulators. The session included two formal presentations by an NRC staff member and an invited expert from Fluor Hanford, Inc. Topics included coupling and interfaces among monitoring and modeling activities; generic technical issues, including what to monitor and model, where to monitor, when to monitor, and how to monitor; opportunities to build confidence in models; uncertainties; applications or simulations and measurement methodology; decision tools; future remediation technologies, including

removal and disposal actions as well as immobilization of contaminants left in place; instrumentation; sampling methods; and technology needs and trends in developing technologies.

This session also included a presentation by two invited experts from SRNL and the University of Georgia, who gave a brief overview of their work related to the American Nuclear Society standard on radiological transport in ground water for nuclear power sites.

A panel discussion and a question-and-comment session involving the Committee members followed the formal presentations. Panelists included session speakers and other invited experts from EPRI, and the University of Virginia.

Working Group Meeting Highlights

Participants expressed a range of views on the value of monitoring and the integration of monitoring and modeling activities. The discussion focused primarily on environmental monitoring, not source or in-system monitoring. Participants generally agreed that integrating monitoring and modeling activities is site specific and case specific. They noted that not all sites, all models, or all monitoring programs are the same; different models and monitoring programs have different functions and operate at different levels of complexity; and the selection and design of models and monitoring programs should suit conditions at specific sites. In low-risk situations, complicated modeling and extensive monitoring are unnecessary. In situations entailing significant risk, considerations should include detailed monitoring and modeling as well as integration.

Meeting participants expressed other key points, including the following:

- Monitoring should develop or enhance understanding, not just demonstrate compliance.
- Monitoring data and decommissioning studies have led to improvements in model parameterization relevant to future predictions or prediction updates.
- Monitoring and modeling represent a dynamic and iterative process. Feedback is important to inform the site conceptual model, performance assessment, choices of performance indicators, monitoring devices, and monitoring locations.
- The design of monitoring programs should include early detection, using monitoring points that are closer to the source than the compliance location so that contaminants can be detected before they reach the point of compliance. One panelist strongly endorsed monitoring of the “containment system” (i.e., cover, liner, and leachate collection system) to increase understanding of system performance and to improve confidence in modeling results. He noted that technology is currently available and that this approach would result in lower expenses than traditional compliance monitoring, which tends to detect contamination after it has traveled some distance from the source, a circumstance that requires additional monitoring to define the plume and imposes additional cleanup costs.

- Designers of modeling/monitoring programs should give increased consideration to the use of performance indicators to evaluate the behavior of key system features because these surrogate metrics can provide some early insight into system behavior. In addition, assessing the likelihood of failure and planning remedial/recovery actions are important features to consider before a crisis occurs.
- The approach to modeling and monitoring should be flexible, not prescriptive. Monitoring programs need to be sufficiently flexible to recognize temporal and spatial variations in the system (phenomena) being modeled.
- Practitioners should validate models with independent lines of evidence and, as appropriate, periodically review the models to determine whether updating is warranted given the availability of new information.
- Some experts supported the idea of staged monitoring, in which data collection is managed to build confidence in modeling and then optimized to achieve further confidence in modeling results and regulatory compliance.
- Modeling of contaminant transport can be problematic because of insufficient early characterizations, untested monitoring systems, changing flow conditions over time, uncertainty about the inventory of existing contamination and the contaminant source location, and sometimes unintended consequences.
- One expert was of the view that practitioners should view and use models as tools for total system management.
- According to one expert, monitoring of the gas phase is reliable and cost-effective and can complement other methods for monitoring metals and radionuclides.
- One expert was of the view that under certain conditions, decisionmakers will find limited utility in monitoring, especially when the phenomena of interest occur over timespans that exceed the duration of licensed activity.
- One expert suggested that compliance monitoring should be expanded and replaced with a “compliance assessment” concept.
- Contaminant transport in the subsurface environment is governed by a complex relationship of site-specific and contaminant-specific features, events, and processes. Recognizing and addressing this complexity are key to understanding, monitoring, and predicting contaminant transport.
- Proper identification of contaminant plumes is important, especially for multiple contaminants that travel at different rates.
- The use of nontraditional monitoring techniques—such as geoprobes, geophysical measurements, coring, low-rate pumping, and tracers—can enhance monitoring. One

panelist advocated the consideration of new approaches and monitoring technologies, including an adaptive stochastic control system with a feedback loop.

- There are chemical and physical constraints that limit the development of conceptual models for ground water. A need exists for site characterization to support the development of conceptual ground-water transport models and to establish characterization goals based on existing limitations.
- Monitoring of evapotranspiration covers over long periods of time can pose a challenge. Indirect measurements related to evapotranspiration covers are too imprecise, so measurements by direct methods are required. Long-term instrumentation monitoring of covers is not feasible. Plant dynamics constitute the largest uncertainty and plague all current evapotranspiration models.
- Different models of engineered cover systems can produce very different results, model results depend greatly on input, and evaluation of the accuracy of cover models requires monitoring data.
- Older covers do not perform as modeled, but some newer designs do.
- Modeling results for underground tritium and mercury are not consistent with the measured data and field observations at some sites.
- Sensitivity analyses can improve confidence in modeling results.
- A need exists for regular external peer reviews of models and modeling results.
- Several infiltration models can adequately simulate evapotranspiration covers; however, all models are strictly limited by uncertainties in plant parameters and dynamics that are time dependent.
- Modelers, monitoring program designers, and operators should increase communication and interaction.
- A significant effort is under way to rewrite many standards in preparation for the anticipated resurgence in nuclear power, and radionuclide transport in ground water for nuclear power facilities is one of the most important standards under consideration.

Committee Action

The Committee will write a letter to the Commission based on the working group meeting and other information regarding the use of monitoring to build confidence in models.

3. *Disposition of Public Comments on Spent Nuclear Fuel Transportation Package Responses to Tunnel Fire Scenarios (NUREG/CR-6886 and NUREG/CR-6894)*

In September 2005, staff members from the NRC's Spent Fuel Project Office (SFPO) announced in the *Federal Register* the availability of a contractor report prepared by PNNL that describes an updated, three-dimensional analysis of the 2002 Howard Street tunnel fire scenario, using three NRC-certified cask designs for the transportation of spent nuclear fuel (SNF). The NRC published this report as NUREG/CR-6886, "Spent Fuel Transportation Package Response to the Baltimore Tunnel Fire Scenario—Draft Report for Comment," issued November 2005, which PNNL staff prepared with the assistance of the National Institute of Standards and Technology and the Center for Nuclear Waste Regulatory Analyses.

During the 167th ACNW meeting in January 2006, the SFPO staff provided the Committee with an overview of the tunnel fire analysis in NUREG/CR-6886. This overview included the identification of key modeling assumptions, conservatisms, and results. Citing that report, SFPO representatives observed that the likelihood of such an event both occurring and including an SNF transportation cask is extremely low. Moreover, if such an event occurs, the staff noted that any releases of radioactive material would be extremely small and would pose no significant danger to the public or first responders. In light of these findings, the SFPO staff expressed the view that the NRC did not need to take any regulatory action to ensure public health and safety. The staff also noted that it had received public comments on NUREG/CR-6886 from the Northeast High-Level Radioactive Waste Transportation Project, the Brotherhood of Locomotive Engineers, and the State of Nevada. The SFPO staff reported that it was in the process of reviewing the public comments and agreed to brief the Committee on the disposition of those comments as part of the finalization of the tunnel fire analysis documentation.

During the 173rd ACNW meeting, the staff also introduced and summarized a second study sponsored by the NRC staff of a severe transportation fire that occurred in an automobile tunnel in Caldecott (California) in the 1980s. The Caldecott tunnel fire involved a tanker truck carrying 8800 gallons of gasoline. This tunnel fire is considered by the staff to be a very close "analog" to the 2001 Baltimore tunnel incident. Based on the analysis of a Caldecott intensity type of fire documented in NUREG/CR-6894¹, the staff noted that releases of radioactive material would be within regulatory limits for a NAC International Model LWT model or a similar spent fuel shipping cask involved. The SFPO staff provided ACNW with an overview of the public comments received on both NUREG/CR-6886 and NUREG/CR-6894 analysis as well as the disposition of those comments. The PNNL contractor that prepared both reports also participated in the briefing. The SFPO staff noted that public comments on the tunnel fire analysis addressed the following main themes:

- location, severity, and duration of the fire

¹Adkins, H.E., Jr., B.J. Koepfel, and J.M. Cuta, "Spent Fuel Transportation Package Response to the Caldecott Tunnel Fire Scenario – Draft Report for Comment," U.S. Nuclear Regulatory Commission, NUREG/CR-6894, February 2006.

- treatment of melted lead shielding in the fire (consequence) analysis and its potential impact on dose calculations
- composition assumed for crud (Chalk River unidentified deposit)
- effects of damaged and high-burnup fuel
- performance of cask seals
- risk perspectives on rail accidents in general

The staff also briefly reviewed key issues raised by the National Academy of Sciences in its 2006 report, "Going the Distance? The Safe Transport of Nuclear Fuel and High-Level Radioactive Waste in the United States," on the transportation of SNF and how NUREG/CR-6886 accounted for it. In general, the staff expressed the view that the NUREG/CR-6886 tunnel fire analysis required no major changes as a result of the public comment process, although the staff added several points of clarification to the report as a result of those comments.

Committee Action

The Committee intends to write a letter stating that no additional activity or followup action on this particular topic is needed.

RECONCILIATION OF ACNW COMMENTS AND RECOMMENDATIONS/EXECUTIVE DIRECTOR FOR OPERATIONS COMMITMENTS

The Committee considered the following reports from the NRC Executive Director for Operations (EDO) during its planning and procedures meeting on September 18, 2006:

- EDO response, dated July 11, 2006, to ACNW letter, dated June 9, 2006, on the Future Volcanism at Yucca Mountain — Comments on the NRC Staff Model for the Fluvial Redistribution of Volcanic Tephra

The response to two ACNW recommendations was satisfactory. The response to a third recommendation was not satisfactory because it implies that the effects of large floods have been included in staff analyses. However, the key effect of large floods on the active depositional fan has not been adequately considered by the staff. Even in the short historical period of record for Fortymile Wash, one and perhaps two large floods have traveled far beyond the active fan. Also, large floods can occur from local precipitation in the northern part of the drainage basin that cause little or no erosion of hypothetical ash near Yucca Mountain, but would selectively erode deposits from the active fan.

- EDO response, dated July 13, 2006, to ACNW letter, dated June 8, 2006, on the Comments on ICRP Draft Document — Scope of Radiation Protection Regulations (Spring 2006 Version). The Committee decided that it was satisfied with the EDO response.

- EDO response, dated July 13, 2006, to ACNW letter, dated June 9, 2006, on the Revised Decommissioning Guidance to Implement the License Termination Rule. The Committee decided that it was satisfied with the EDO response.
- EDO response, dated July 14, 2006, to ACNW letter, dated June 8, 2006, on the Future Volcanism at Yucca Mountain — Comments on the Igneous Intrusion Scenario. The Committee decided that it was partly satisfied with the EDO response.

The response to one ACNW recommendation was satisfactory. The response to two other recommendations was not satisfactory. First, the staff assumed without analysis that an evaluation of the risk significance of flank breakouts from a repository will be necessary. The staff reply also noted that the Woods et al. report provides a method the staff can use to evaluate the risk significance of flank breakouts, contrary to a statement in the briefing to ACNW. Second, the staff continues to assume without analysis that magma solidification effects will be very slow and that magma would penetrate large distances into repository drifts. The staff stated that ACNW analysis of increased magma viscosity is not consistent with routine observations made during basaltic eruptions. However, no specific “observations” were cited by the staff.

- EDO response, dated August 24, 2006, to ACNW letter, dated July 18, 2006, on The 2006 Draft Recommendations of the International Commission on Radiological Protection. The Committee decided that it was satisfied with the EDO response.

PROPOSED SCHEDULE FOR THE 174TH ACNW MEETING

The Committee agreed to consider the following topics during its 174th meeting, to be held November 13–16, 2006:

- Update on Status of Seismic Design Bases and Methodology: NRC Perspective
- Results from the Liquid Radioactive Release Lessons Learned Task Force
- Preparation for Meeting with NRC Commissioners
- ACNW Working Group Meeting on Decommissioning Lessons Learned
- Dose Effect Relationships and Estimation of the Carcinogenic Effects of Low Doses of Ionizing Radiation
- White Paper on Potential Advanced Fuel Cycles
- Proposed Revision to Regulatory Guide 1.112, Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Reactors

- Proposed Revision to Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) – Effluent Streams and the Environment
- Discussion of draft and possible letters and reports on the following:
 - Developing Model Confidence Through the Use of Site Monitoring
 - Spent Nuclear Fuel Transportation Package Responses to Tunnel Fire Scenarios
 - Update on Status of Seismic Design Bases and Methodology: NRC Perspective
 - Results from the Liquid Radioactive Release Lessons Learned Task Force
 - ACNW Working Group Meeting on Design and Construction Considerations for Decommissioning
 - Dose Effect Relationships and Estimation of the Carcinogenic Effects of Low Doses of Ionizing Radiation
 - Proposed Revision to Reg Guide 1.112, Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Reactors
 - Proposed Revision to Reg Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment

Sincerely,

/RA/

Michael T. Ryan
Chairman

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