



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

ACNWS-0163

May 23, 2006

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

Dear Chairman Diaz:

SUBJECT: SUMMARY REPORT—169TH MEETING OF THE ADVISORY COMMITTEE ON NUCLEAR WASTE, APRIL 18–20, 2006, AND RELATED ACTIVITIES OF THE COMMITTEE

During its 169th meeting, April 18–20, 2006, the Advisory Committee on Nuclear Waste (ACNW) discussed several matters and completed the following reports.

REPORTS

Reports to Nils J. Diaz, Chairman, NRC, from Michael T. Ryan, Chairman, ACNW:

- C Risk-Informed Decision-Making for Nuclear Materials and Wastes, dated May 2, 2006
- C Research at the Department of Energy Office of Science, Technology and International Programs, dated May 9, 2006

HIGHLIGHTS OF KEY ISSUES

1. Overview of Accelerator Mass Spectrometry

The Committee was briefed by Dr. David Elmore of the PRIME Laboratory, Purdue University. He provided an overview of the accelerator mass spectrometry (AMS) methodology, including a review of AMS theory and instrumentation, challenges, statistical data analyses, and checks and balances that are used. Although AMS can be used for other isotopes, the focus of this overview was on chlorine-36 analyses such as those that have been performed for Yucca Mountain. In practice the laboratory cycles through three isotopes of chlorine (chlorine-35, chlorine-36, and chlorine-37), cycles through samples 2–5 times, measures a standard every 3–5 samples, measures a blank every 10–20 samples, and stops when 5 percent uncertainty is achieved. Checks and balances include the use of chemistry blanks, analysis of multiple samples from each location, multiple collection dates, and the use of blind repeats. Dr. Elmore commented that a complete error analysis usually identifies samples with problems. In summary, AMS is a complex but powerful analysis tool for hydrologic studies.

Committee Action

The Committee expects to write a letter on Dr. Elmore's presentation and DOE's chlorine-36 validation report after receiving a briefing on methodologies for the collection, processing, and transportation of chlorine-36 samples. This briefing introduces additional sources of variability

and uncertainty in the ultimate analytical results. Dr. Fred Phillips (New Mexico School of Mining and Technology), a leading expert in chlorine-36 sampling and interpretation, has been invited to participate in an upcoming meeting. If this briefing does not occur for several months, the Committee may prepare two separate letters.

2. Update on U.S. Department of Energy Chlorine-36 Studies at Yucca Mountain

Mr. Drew Coleman (U.S. Department of Energy) provided the Committee with an update of the ongoing chlorine-36 studies. He reviewed the history of the U.S. Geological Survey–Los Alamos National Laboratory (USGS-LANL) validation activities, which began in 1999. After initially achieving similar results, both groups analyzed core samples from a location that previously had shown a bomb pulse signature. The new results disagreed: the USGS data indicating no bomb pulse; and LANL results indicating bomb pulse. DOE requested both groups write up their validation work in a joint report and document the results from both perspectives. The final report has been reviewed and is expected to be available to the public in a few weeks.

Mr. Coleman also gave the status of the University and Community College System of Nevada follow-on study on chlorine-36. This study is titled “Bomb-Pulse Cl-36 at the Proposed Yucca Mountain Repository Horizon: An Investigation of Previous Conflicting Results and Collection of New Data.” The purpose of this study is to determine the cause of the conflicting results and obtain new data. This study has now ended, and the investigators are preparing a final report. According to Mr. Coleman, the investigators are reasonably confident that the outstanding issues have been resolved. DOE will decide on a path forward from this point. One conclusion is that the use of chlorine-36 for testing a deep unsaturated zone for the presence of a bomb-pulse needs additional confirmation to build confidence in the data measurement and interpretation.

Committee Action

The Committee expects to write a letter on DOE’s briefing and chlorine-36 validation report after receiving a briefing on methodologies for the collection, processing, and transportation of chlorine-36 samples. This briefing introduces additional sources of variability and uncertainty in the ultimate analytical results. As noted above, Dr. Phillips has been invited to participate in an upcoming meeting. If this briefing does not occur for several months, the Committee may prepare two separate letters.

3. Briefing from the National Academy of Sciences (NAS) on Its 2006 Report on the Transportation of High-Level Nuclear Waste

The National Academy of Sciences Nuclear and Radiation Studies Board was tasked with providing an independent analysis of spent nuclear fuel and high-level waste transportation in the United States. The principal motivation consisted of proposals to construct and operate a repository at Yucca Mountain, Nevada, and to construct and operate an interim spent fuel storage facility in Utah. The study was later expanded to address the transport of spent research reactor fuel. The study does not address security risks associated with the transportation of radioactive waste. The study report called “Going the Distance? The Safe Transport of

Spent Nuclear Fuel and High-Level Radioactive Waste in the United States” was released in February 2006. The report conclusions included the following:

- The study committee could identify no fundamental technical barriers to the safe transportation of spent nuclear fuel and high-level radioactive waste in the United States.
- The study committee identified a number of social and institutional challenges that will require an expeditious resolution.
- The study committee recommended that an independent evaluation of transportation security be carried out prior to the commencement of large-quantity shipments.
- The study committee recommended that the NRC undertake a detailed analysis of the impact of long-duration fires on waste package performance.
- The study committee strongly endorsed the use of full-scale coding to determine how well packages perform under regulation and credible extra regulatory conditions.
- DOE procedures for selecting shipment routes appear on the whole to be adequate and reasonable.

Committee Action:

This briefing was for the ACNW’s information. The information provided will be utilized in the Committee future deliberations on transportation safety issues.

4. Proposed Rulemaking on Naturally-Occurring or Accelerator-Produced Radioactive Materials

Lydia Chang and Scott Moore of the Division of Industrial, Medical, and Nuclear Safety discussed the staff’s proposed rulemaking to implement Section 651(e) of the Energy Policy Act of 2005 (EPAAct) to include certain discrete sources of naturally-occurring and accelerator-produced radioactive materials (NARM) in NRC’s regulations for byproduct material. Ms. Chang discussed the definition of “discrete source,” developed by the NARM Rulemaking Working Group. The definition will exclude some well-documented sources of radiation produced by technologically-enhanced naturally-occurring radioactive materials (TENORM). Certain provisions in the draft rule, such as the proposal to generally license discrete sources of radium-226, were explained. Ms. Chang also explained the inclusion of some materials incidentally made radioactive from the use of particle accelerators. The proposed rulemaking is with the Commission for approval. The staff expects to receive feedback from the Commission following the May 15, 2006, Commission Meeting at which the proposed rulemaking will be discussed.

Committee Action

The Committee agreed to write a letter to the Commission commenting on the proposed rulemaking corresponding with the 45-day period scheduled for public comment.

5. Update on DOE Activities at the Yucca Mountain Site

Scott Wade, the Director of the Office of Facility Operations for DOE's Office of Civilian Radioactive Waste Management (OCRWM) provided an update of the improvements to the Yucca Mountain Site infrastructure. Mr. Wade explained the improvements to the Yucca Mountain Site entrance facilities at the North and South Portal, the roads on the site, and the site utilities, including underground ventilation, electricity, and communications. He also discussed the plan to locate OCRWM facilities in Pahrump, Caliente, Amargosa Valley, and Mercury, NV.

Committee Action

None at this time.

6. Update on Nye County's Independent Early Warning Drilling Program

Mr. Drew Coleman (DOE) gave a brief introduction about the scope and work elements under the cooperative agreement between DOE and Nye County. Mr. John Campanella (Norwest Questa), representing Nye County, Nevada, then gave an update on the county's Early Warning Drilling Program and results of recent testing. He reviewed the history, goals, and major accomplishments of the Nye County program.

Mr. Campanella provided information about the locations and completion of the Phase V wells, implementation and results of tracer testing at well site 22S (located near Fortymile Wash), installation of a U-tube in well EWDP-24PB (for water sampling under downhole ambient conditions), and plans for the drilling and testing of a horizontal well. He summarized the tracer testing results. Preliminary analysis of the tracer tests using both analytical and numerical simulation indicates that diffusion into immobile water was minimal or nonexistent and that a fast flow path exists between one of the injection wells and the pumping well in the shallow alluvial aquifer. A long pumping interruption between the two cross-hole tests allowed the natural drift of the groundwater to move the tracer plumes laterally. Other key findings of the Nye County work are that upward hydraulic gradients are generally observed from deeper to shallower aquifers (local downward gradients are seen at paleospring sites) and sonic coring is the best method to collect representative samples of saturated alluvium.

Committee Action

This was an informational briefing to provide the Committee with the latest information from the Nye County program. A letter is not planned at this time.

7. Modeling Igneous Activity: Dynamic Controls on Summit and Flank Eruptions of Basalt

The Committee was briefed by Andrew Woods (BP Institute, Cambridge, United Kingdom), a consultant to the Center for Nuclear Waste Regulatory Analyses (CNWRA), regarding CNWRA's draft paper titled "Modeling the Dynamics of Simultaneous Flank and Summit Eruptions of Basaltic Magma." This paper is currently undergoing peer review for possible publication in the Bulletin of Volcanology. The paper presents results from experimental modeling of a volcanic eruption in which two volcanic vents exist—one on the summit of a cinder cone and another on the flank of the cone at lower elevation.

Dr. Woods described the experimental setup, modeling of the results, and the conclusions reached. In the apparatus, gas was introduced to a liquid in a tube using porous plates to generate small bubbles. Several key assumptions were made, including the following: conduit geometry was fixed, the magma source maintained constant pressure, flow was at steady state, the vent sizes were the same, flow exits the vent either with atmosphere pressure or with the speed of sound in a two-phase mixture, and a simplified homogeneous flow of magma and gas occurs. The simple model assumed no separation of liquid and gas. Dr. Woods reported several results for the modeling. At low gas content, the lower flank vent is the preferred route to the surface. As the gas content and pressure increase, the shorter flow path to the summit vent provides the easier route to the surface.

Dr. Woods presented the following conclusions: (a) fluxes are partitioned between the summit and flank vents; (b) key controls were deduced from numerical and experimental modeling; (c) the gas content of the magma has important influence (if high, greater flow occurs from the summit; at smaller gas contents effusive eruption from the flank dominates); (d) if the flank vent is more distant, weaker secondary flow occurs; and (e) gas-liquid separation leads to explosive strombolian behavior at the summit and effusion at the flank vent.

Committee Action

This briefing will assist ACNW in preparing a white paper that is intended to provide an analysis of the current state of knowledge of igneous activity which the Commission can use as a technical basis for decisionmaking. The Committee will prepare a letter based on this talk and on earlier March 2006 volcanism briefings.

8. Modeling Igneous Activity: Magma Interactions With a Geologic Repository

Dr. Bruce Marsh (Johns Hopkins University and ACNW consultant) gave a talk titled, "Magma Interactions with the Repository: The Effects of Solidification." This talk was an update of the material he presented to the Committee in September 2005. He reviewed the basic theory of magma and mineral crystallization and discussed the fate of magma that rises from deep within the crust near-surface conditions. Dr. Marsh also reviewed observations from the field of the physical properties of lava flows, lava lakes, and phenomena such as magma quenching trees. He reviewed the effects of water content and magma crystallinity on rheology and the location of solidification fronts. He then analyzed the lava flow patterns from the Lathrop Wells event near Yucca Mountain and estimated the effective viscosity of the lava. The magma that erupted at Lathrop Wells appears to have been more viscous than originally thought, and this

would significantly limit how far a magma of similar composition could hypothetically penetrate a repository drift.

Committee Action

This briefing will assist ACNW in preparing a white paper that is intended to provide an analysis of the current state of knowledge of igneous activity which the Commission can use as a technical basis for decisionmaking. A working group on volcanism also is being planned. The Committee will prepare a letter based on this talk and on earlier March 2006 volcanism briefings.

9. DOE Performance Confirmation Program Plan: NRC Staff Perspective and Update

Jeff Pohle and Randall Fedors, two NRC staff representatives, briefed the Committee on staff accomplishments in this area during 2005. The staff has begun review of monitoring technologies for potential application to performance confirmation of hydrologic and geotechnical parameters. Two reports by the CNWRA will provide results of a literature review of monitoring technologies. These are (a) "Review of Vadose Zone Measurement and Monitoring Tools" and (b) "Review of Tools and Technologies to Monitor Repository Excavations." To prepare for future licensing review, the staff has initiated a preliminary review of DOE's Performance Confirmation Plan (Revision 5). The kinds of comments the staff is considering relate to activities that may not be practicable with current technologies, activities that may not provide useful data, and activities that may conflict with others. Examples of comments were presented. One staff comment was that DOE's plans to clean tunnel walls with water to photograph fractures could impact other planned activities requiring hydrologic or geochemical sampling or testing.

Committee Action

This was an informational briefing to provide the Committee with the latest information about the performance confirmation program from NRC's perspective. The members plan to further discuss this material at its May 2006 meeting and decide at that time whether a letter will be written.

10. Physical Capacity of Yucca Mountain for the Emplacement of High-Level Waste

The Committee was briefed by Drs. John Kessler and Mick Apted, representatives of the Electric Power Research Institute (EPRI), on a preliminary analysis of the maximum disposal capacity for commercial spent nuclear fuel (CSNF) in a potential geological repository at Yucca Mountain. Current repository capacity per the Nuclear Waste Policy Act, as amended, is 70,000 metric tons including 63,000 metric tons for disposal of CSNF. The EPRI's study considers three repository expansion options: an expanded repository footprint, a multi-level repository, and grouped single-level emplacement drifts. The study also accounted for design modifications regarding the spacing of waste packages and waste package positioning according to the relative aging of canisters (i.e., older is cooler). According to EPRI's representatives, these analyses have resulted in the following conclusions: (a) at least four times (~260,000 metric tons) the existing CSNF limit can be emplaced at Yucca Mountain with current

or limited additional site modification; and (b) upwards of nine times (~570,000 metric tons) the current CSNF limit could possibly be emplaced with additional site characterization and/or design optimization. It was indicated that additional work will explore these options in more detail in 2006. Also, an EPRI report on the physical capacity of Yucca Mountain to contain additional amounts of high-level waste is in preparation and will be published in the near future.

Committee Action

This was an informal briefing to familiarize the Committee with issues related to repository design and the physical capacity of Yucca Mountain. The Committee plans to monitor the progress of the EPRI study.

11. NRC Radiation Research Program

Representatives of the Office of Nuclear Regulatory Research (RES) briefed the ACNW on the radiation protection related work being carried out in the RES Health Effects Branch. The Health Effects Branch's programs are currently focused on supporting NRC reporting requirements, developing and improving analytical tools use to support licensing and inspection activities, and supporting the updating of identified Division 1 (Power Reactors), Division 4 (Environmental and siting), Division B (Occupational Health), and Division 10 (General Guidance) Regulatory Guides. The planned update of selected Regulatory Guides generally supports the anticipated licensing of new reactors. Possible approaches to the update of Regulatory Guides were discussed at some length.

Committee Action

The ACNW plans to issue a supplement to its April 14, 2006, report to the Commission on RES research and NMSS technical assistance programs. Insights gained from these discussions will be included in this report.

RECONCILIATION OF ACNW COMMENTS AND RECOMMENDATIONS/EDO COMMITMENTS

None

PROPOSED SCHEDULE FOR THE 170th ACNW MEETING

The Committee agreed to consider the following topics during the 170th ACNW meeting, to be held May 23–26, 2006:

- C ACNW Working Group Meeting on Low-level Radioactive (LLW) Waste Management Issues
- C NAS Report on the Management of Certain Tank Wastes at DOE Sites
- C NRC Standard Review Plan for Waste Determinations

- C Review of International Commission on Radiological Protection (ICRP) Draft Report, "The Scope of Radiological Protection Regulations"
- C Overview of NRC Spent Nuclear Fuel Storage Program
- C Discussion of draft and possible letters and reports on the following:
 - Additional Recommendations related to RES Programs
 - ACNW Working Group Meeting on Draft Final Guidance to Implement NRC's License Termination Rule
 - Recent Developments Related to Modeling the Igneous Activity in the Yucca Mountain Region
 - ACNW Working Group Meeting on LLW Management Issues
 - NAS Report on the Management of Certain Tank Wastes at DOE Sites
 - Review of ICRP Draft Report, "The Scope of Radiological Protection Regulations"
 - NRC SRP for Waste Determinations
 - Overview of NRC Spent Nuclear Fuel Storage Program

Sincerely,

/RA/

Michael T. Ryan
Chairman