U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

ACNW&M MEETING WITH THE U. S. NUCLEAR REGULATORY COMMISSION

November 14, 2007

OVERVIEW

Michael T. Ryan

Accomplishments

- 17 Letter Reports
- 4 Working Group Meetings
- Issued:
  - Low-Level Waste NUREG
  - Igneous Activity White Paper
  - Reprocessing White Paper

Accomplishments (cont'd)

- In development
  - White Paper on Seismic issues (Yucca Mountain)
  - White Paper on Decommissioning

ACNW&M Charter

- Expanded Charter to include Materials Safety
- The Committee will continue to study:
  - *In-situ* Leach Mining
  - Enrichment Facilities
  - Transportation
  - Storage and Disposal Facilities
  - Waste Determinations

ACNW&M Charter (cont'd)

- Health Effects
- Decommissioning
- Materials Safety
- Application of Risk-Informed, Performance-Based Regulations

2007/2008 Action Plan

- Joint ACRS/ACNW&M Subcommittees
- Review of Regulatory Guides and SRP Chapters

Future Activities

- Working Group Meetings
  - Low Activity Radioactive Waste
  - Modeling Landscape Evolution for Performance Assessment
  - Low Dose Radiation Effects

ACNW&M LETTERS

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

ACNWR-0256

January 4, 2007

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

Dear Chairman Klein:

SUBJECT: PROPOSED REVISION 1 TO REGULATORY GUIDE 1.112, "CALCULATION OF RELEASES OF RADIOACTIVE MATERIALS IN GASEOUS AND LIQUID EFFLUENTS FROM LIGHT-WATER-COOLED NUCLEAR POWER REACTORS"

During its 174th meeting, on November 13–16, 2006, the Advisory Committee on Nuclear Waste (ACNW) heard a presentation from the U.S. Nuclear Regulatory Commission (NRC) staff on a proposed Revision 1 to Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors." This Regulatory Guide describes an acceptable method for calculating the annual radioactive liquid and gaseous source terms used in evaluating the adequacy of radioactive effluent control systems for nuclear reactors. The Regulatory Guide references NUREG-0016 (BWR-GALE) and NUREG-0017 (PWR-GALE)[1] as acceptable approaches for calculating average annual expected releases of radioactive material in gaseous and liquid effluents from a reactor. The Office of Nuclear Regulatory Research requested that the Committee review Revision 1 to Regulatory Guide 1.112 for consideration in support of new reactor licensing activities.

OBSERVATIONS

1. The staff reported its priorities and tentative schedule to make changes as follows:

   a. Make currently proposed administrative changes (March 2007)
   b. Technical update of the GALE Computer Codes (Late 2007)
   c. Update Regulatory Guide 1.112 and issue for public comments (2008)
   d. Publish Revised Regulatory Guide (six months after the draft comment period is complete)

   The Committee notes that updates to the technical basis documents that support this Regulatory Guide are planned to occur later in the process rather than at the beginning.

[1]The BWR and PWR GALE Codes are computerized mathematical models for calculating the releases of radioactive material in gaseous and liquid effluents (i.e., the gaseous and liquid source terms) to determine conformance with the requirements of Appendix I to 10 CFR Part 50.

2. It was reported that many of the assumptions and parameters in the GALE codes are represented by fixed values based on design approaches and operating experience for reactors prior to 1980. The Committee is concerned with the relevance of these values to new applications.

3. The staff reported that its short term focus will be to (a) make changes to the Regulatory Guide for consistency with ANSI standard 18.1-1999 because applicants are likely to refer to this standard in their applications and (b) update the Regulatory Guide to be consistent with the current terminology and other requirements of 10 CFR Part 20. The Committee believes that making the changes to the Regulatory Guide before the GALE code and its basis are updated is not efficient or technically defensible.

RECOMMENDATION

Staff priorities should be to evaluate and update the technical aspects of the GALE codes and their associated documentation first. The Regulatory Guide should then be revised to reflect these updates. The emphasis should be assuring that the GALE codes and Regulatory Guide are based on up-to-date approaches for estimating radioactive gaseous and liquid effluent source terms.

Sincerely,

/RA/

Michael T. Ryan
Chairman

References:

1. Memorandum dated September 25, 2006, from Jimi T. Yerokun, Chief, Risk Applications and Special Project Branch, RES to Michael R. Snodderly, Chief for Technical Support Branch, ACRS, Subject: Additional Information - Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-water-cooled Nuclear Power Reactors" (DG-1160).

2. NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)," Revision 1, issued 1979.

3. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," Revision 1, issued 1985.

4. ANS/ANSI 18.1-1999, "Radioactive Source Term for Normal Operation of Light Water Reactors."

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

ACNWS-0266

August 1, 2007

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

SUBJECT: CHAPTERS 11.2 THROUGH 11.5 OF NUREG-0800, "STANDARD REVIEW PLAN (SRP) FOR THE REVIEW OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS"

Dear Chairman Klein:

At the request of the Advisory Committee on Reactor Safeguards, the Advisory Committee on Nuclear Waste and Materials (the Committee) reviewed the revisions to Chapters 11.2 through 11.5 of NUREG-0800, "Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants." The staff of the Office of New Reactors (NRO), Health Physics Branch, provided presentations on the revised SRP chapters to the Committee at recent Committee meetings including the following:

- SRP Chapter 11.2, *Liquid Waste Management System*, at the 175th Meeting (December 2006)
- SRP Chapter 11.3, *Gaseous Waste Management System*, and Chapter 11.4, *Solid Waste Management Systems*, at the 178th Meeting (April 2007)
- SRP Chapter 11.5, *Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems,* at the 179th Meeting (May 2007)

These SRP chapters were revised by March 2007 and posted on the Nuclear Regulatory Commission's (NRC) website to be available to potential applicants for new nuclear power reactors 6 months in advance of when the new license applications are expected to be transmitted to the NRC. The revisions did not receive stakeholder review before posting on the website, although some industry feedback has been received after the posting.

The revisions to these SPR chapters include the following:

- Adding 10 CFR Part 20.1406, *Minimization of Contamination*, as an acceptance criteria
- Adding supplemental guidance on meeting 10 CFR Part 20.1301(e) and 40 CFR Part 190, *Environmental Radiation Protection Standards for Nuclear Power Operations*

- Updates to address modernization of equipment used (e.g., mobile radioactive waste treatment systems) and updated regulatory documentation employed in licensing reactors (e.g., the Offsite Dose Calculation Manual)

- Updates to regulations that have been issued after the last revision (e.g., Department of Transportation shipping requirements in 10 CFR Parts 171 to 180)

RECOMMENDATION

As soon as practical, the technical bases referenced in the SRP sections should be updated, including computer codes, methodologies, and parameter values cited in referenced regulatory guides, supporting NUREGs, and other documents.

OBSERVATIONS

Although these SRP chapters have been recently reissued, some of their fundamental technical bases have not been updated. Underlying dose analysis methodologies used in the regulatory guides supporting these SRP chapters and the supporting documentation is outdated. Dose methodologies first published in 1959 are still used (International Commission on Radiological Protection (ICRP) Publication 2). Newer dosimetry methods in ICRP Publication 60 and Publication 64 that have updated dosimetric models and methods are not used. The dose methodologies that underpin SRP chapters use guidance that spans over 40 years, proscribe the calculation of very different dose quantities and result in different calculated doses. The NRO health physics staff suggested an approach that addresses the weaknesses in dose methodologies that updates them in a multi-step fashion. They suggested that the first step could update critical parameters such as dose conversion factors. The second step could update other important parameters such as shielding and biological accumulation factors. The third step could systematically review all dose methodologies used and comprehensively update all of them to ensure that a risk-informed approach is employed.

Some regulatory guides referenced in the SRP chapters are new and under development (e.g., Draft Regulatory Guide 4012 for implementing 10 CFR Part 20.1406) or being revised (e.g., Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants"), and were not available when the SRP chapters were revised.

Some of the regulatory guides have never been finalized (e.g., Regulatory Guide 4.8, "Environmental Technical Specifications for Nuclear Power Plants," issued for comment in December 1975). Other regulatory guides are up to 30 years old (e.g., Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," October 1977) or are not scheduled for revision (e.g., Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)," Revision 2, February 1978) in the near future.

Supporting analysis cited in some of the regulatory guides is outdated (e.g., NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," April 1991 and NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors," April 1991, use the 1979 Branch Technical Position on Radiological Assessment). Therefore, the supporting methodologies cited in the regulatory guides may not be representative of expected performance from the new reactor designs, and may not take into account modern fuel characteristics and performance, and improvements to reactor coolant water quality since the analysis was conducted.

The Committee reported earlier on one of the technical bases in need of updating, the Gaseous and Liquid Effluent (GALE) code, in its letter report dated January 4, 2007, on Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors."

The Committee plans to continue its evaluation of regulatory guides and technical bases documents regarding radiation protection, radioactive waste management, protection of the environment, and other areas consistent with the Committee's Charter and Action Plan.

Sincerely,

/RA/

Michael T. Ryan
Chairman

ICRP's RECOMMENDATIONS

Michael T. Ryan

ICRP's Recommendations

- The Committee has reviewed previous drafts of the ICRP recommendations
- The Committee continues to closely follow ICRP's work

ACNW&M Conclusion

- The Committee concurs with the NRC staff that "there may be no compelling public health and safety argument to change NRC regulations"
- ICRP publication 103 is expected soon

ACNW&M LETTERS

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

ACNWR-0258

January 11, 2007

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

SUBJECT: REPORT OF THE FRENCH ACADEMY OF SCIENCES, "THE DOSE-EFFECT RELATIONSHIP AND ESTIMATING THE CARCINOGENIC EFFECTS OF LOW DOSES OF IONIZING RADIATION"

Dear Chairman Klein:

In response to an SRM dated February 9, 2006, during its 174th meeting on November 13-16, 2006, the Advisory Committee on Nuclear Waste (the Committee) heard a presentation from representatives of the French Academy of Sciences. The report was titled "The Dose-Effect Relationship and Estimating the Carcinogenic Effects of Low Doses of Ionizing Radiation." This report provided the Committee with excellent and detailed insights regarding the French Academy's study of the current state of radiation biology related to low dose exposures; their views regarding the linear no-threshold (LNT) theory of radiation injury; and the appropriate context for uses of the LNT.

Observations

The Committee offers the following observations from the presentation and discussion of the Academy's report:

1. The French Academy of Sciences report focuses on the radiobiological science and does not try to interpret these results in a policy context. In contrast, the BEIR VII report attempts to interpret the current state of knowledge into a policy context. The French Academy of Sciences presenters pointed out that the LNT theory of radiation damage can be appropriately used as a risk management tool but not as a risk assessment tool.

2. The presenters reported that collective dose is useful as a management tool for work planning and assessing worker exposure (ALARA), but should not be used as a risk assessment tool. Cancer risks for individuals or groups cannot be estimated using collective dose, nor can potential future cancer risk be projected from estimates of dose. The presenters stated that extrapolation of cancer risk using the LNT theory assumes that a very low dose administered to many people has the same carcinogenic effect as high doses administered to a small number of people. They further noted that this assumption does not have a scientific foundation, as UNSCEAR and ICRP have pointed out. The Committee has concurred with this view and reiterates it here.

3. The French Academy report, based on current data, raises doubts about the validity of using the LNT theory to estimate carcinogenic risks at doses less than 10 rem (< 100 mSv) and is even more skeptical of such estimates at doses less than 1 rem (< 10 mSv). However, an actual threshold in the probability of cancer as a function of dose cannot be demonstrated with data available today.

4. In contrast to the French Academy report, the BEIR VII report states:

   "The [National Academy of Sciences] Committee concludes that the current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold dose-response relationship between exposure to ionizing radiation and the development of cancer in humans."

   The BEIR VII report does not conclude that the LNT theory is correct but the data appear to be consistent with the LNT theory. The report does not rule out the possibility of a threshold.

5. A recent paper by several authors of the French Academy study compares their report with the BEIR VII report and the recent ICRP Report on cancer risk from low doses of radiation. One forward looking conclusion from this paper observes:

   > "The controversy related to the carcinogenic effect of low doses of genotoxic agents started over a decade ago (Abelson 1994, Ames and Gold 1997). However, the recent biological data have brought about new arguments which, when confirmed, would be convincing. The epidemiological studies have not yet been able to demonstrate a detrimental effect of low dose irradiation. They should be pursued and a meta-analysis of the available data should be carried out. The controversy between the reports should not be ignored. Discussion could clarify the problem and pave the way for new investigations and hopefully a consensus on many points. A few years ago the general impression was that it was important to obtain quantitative data regarding the effect of low doses but that it would always be impossible to reach a reliable conclusion. The perspectives have dramatically changed over the past few years. It clearly appears that in a decade or so we shall have conclusive data. In the meantime it would be proper to reconsider the ways the detrimental effects of low doses are assessed since an overestimation of the risks currently has a negative effect on the physical and mental health of the population."

6. Radiobiology studies at the cellular, tissue, organ, and organism level are useful because, through these studies, understanding of the fundamental mechanisms of radiation injury and the response to such injury is being developed. Many factors influence biological responses to radiation at the cellular, tissue, organ

and organism levels. These include dose, dose rate, duration of exposure, and radiation quality. This information contributes to developing understanding of radiation carcinogenesis. As the Committee noted in its letter (dated November 8, 2006) to the Commission on the current efforts on low-dose research:

> "This body of DOE research is unearthing interesting radiobiology on the mechanisms for radiation injury, repair, and responses to radiation mainly at the molecular and cellular level. However, much of the work is evaluating effects at doses several times to orders of magnitude above levels at which exposures to the public and to most workers are regulated. Extrapolation to lower doses and reconciliation with epidemiology studies have so far not been performed at a level of detail that would be directly useful in policy making or in revising current or developing new radiation protection standards at this time."

7. The French Academy presenters stated that effects at low doses should not be extrapolated from effects at high doses because damage repair mechanisms at the cellular level can be quite different. Further, extrapolating observations at the cellular level to the tissue, organ, or organism level is also uncertain.

8. The French Academy report considered data from the Department of Energy (DOE) low-dose study, while in a letter dated July 15, 2005 from Raymond Orbach (Director, Office of Science, U.S. Department of Energy) to the National Academies it was pointed out that some epidemiological studies and new biological research were left out of the final deliberations of the BEIR VII Committee. It is not apparent to the ACNW that these differences in the data reviewed by either group would explicitly impact the ACNW's recommendations.

9. Exposure to a particular source cannot be evaluated in isolation. There are many sources of ionizing radiation (see public health statement for ionizing radiation at http://www.atsdr.cdc.gov/toxprofiles/phs149.html). Radiation exposure for any individual includes contributions from:

   a. Terrestrial background
   b. Cosmic radiation
   c. Radon
   d. Radioactive materials incorporated into the body
   e. Medical exposures from diagnosis and therapy
   f. Other man-made sources and human activities including air travel, consumer products, and nuclear power

The Committee has learned that the National Council on Radiation Protection and Measurements (NCRP) is undertaking a detailed study that will produce an update of NRCP Report No. 93, *Ionizing Radiation Exposure of the Population of the United States*, which was published in 1987. The scope of work includes all sources of radiation exposure: background radiation, industrial sources, medical patient, occupational, consumer products, and miscellaneous sources.

Conclusions and Recommendations:

1. Based on the Committee's review of the French Academy report and the BEIR VII report, the Committee finds the current state of knowledge does not warrant any change to current NRC radiation protection standards or limits.

2. The Committee affirms its earlier recommendations that the Committee and NRC staff should remain informed of continuing developments in this area. In support of this recommendation, the Committee plans a half-day Working Group session. The focus of the Working Group would be to give summaries of the state of knowledge of radiation biology with emphasis on implications for radiation risk models and radiation protection practice.

3. The Committee also reaffirms its previous recommendations that collective dose is only appropriate as a measure to be used in comparing alternatives and not as a method of estimating absolute cancer risk.

Sincerely,

/RA/

Michael T. Ryan
Chairman

References:

1. Dose-effect relationships and estimation of the carcinogenic effects of low doses of ionizing radiation, Académie des Sciences [Academy of Sciences] - Académie nationale de Médecine [National Academy of Medicine], André Aurengo[1] (Rapporteur), Dietrich Averbeck, André Bonnin[1] (†), Bernard Le Guen, Roland Masse[2], Roger Monier[3], Maurice Tubiana[1,3] (Chairman), Alain-Jacques Valleron[3], Florent de Vathaire.[1] Member of the Académie nationale de Médecine. [2] Correspondent Member of the Académie nationale de Médecine. [3] Member of the Académie des Sciences

2. Health Risks From Exposure To Low Levels Of Ionizing Radiation: BEIR VII PHASE 2, Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation Board on Radiation Effects Research, Division on Earth and Life Studies, NATIONAL RESEARCH COUNCIL *OF THE NATIONAL ACADEMIES,* THE NATIONAL ACADEMIES PRESS, Washington, D.C. **www.nap.edu**

3. September 30, 2005 Letter to The Honorable Nils J. Diaz Chairman U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001 "COMMENTS ON USNRC STAFF RECOMMENDATION OF THE USE OF COLLECTIVE DOSE"

4. OPINION The debate on the use of linear no threshold for assessing the effects of low doses M Tubiana, A Aurengo, D Averbeck and R Masse J. Radiol. Prot. 26 (2006) 317–324

5. ICRP 2004 ICRP Draft report of Committee I/Task Group. Low dose extrapolation of radiation related cancer risk

6. November 8, 2006 Letter to The Honorable Dale E. Klein, Chairman, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 titled "DOE LOW DOSE RADIATION RESEARCH WORKSHOP (VI)"

7. July 15, 2005 letter to Dr. Ralph Cicerone, President National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001

8. National Council on Radiation Protection and Measurements, Program Area Committee on Radiation Measurements and Dosimetry PAC 6, Subcommittee on Radiation Expo-sure of the U.S. Population SC 6-2 (available at http://www.ncrponline.org/Current_Prog/SC_6-2.html)

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

ACNWR-0259

February 28, 2007

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

SUBJECT: COMMENTS ON "DRAFT RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION," DATED JANUARY 12, 2007

Dear Chairman Klein:

The Advisory Committee on Nuclear Waste has consulted with the U.S. Nuclear Regulatory Commission (NRC) staff on the latest draft[1] of the International Commission on Radiological Protection (ICRP) document, "Draft Recommendations of the International Commission on Radiological Protection," dated January 12, 2007. The Committee understands that the staff's comments are in the concurrence process before transmission to ICRP.

Although ICRP did not allow sufficient time for a comprehensive review of these draft recommendations, the Committee believes that the NRC staff has performed a thorough review[2] and that its comments are appropriate. Although the staff recognizes improvements in this draft compared to previous drafts, it concludes that problems remain.

The following two issues are noteworthy:

(1) ICRP relied on unpublished reports and data as a basis for its recommendations. This is a poor practice. The Committee believes that the staff should advise ICRP accordingly.

(2) The Committee supports the staff view that it is not necessary to develop a radiation exposure standard for nonhuman species.

The Committee prepared this short letter to offer its independent review of, and agreement with, the staff comments so that the Commission would have the benefit of the Committee views before the ICRP comment deadline. Furthermore, the Committee concurs with the staff conclusion[2] that "there may be no compelling public health and safety argument to change NRC regulations..." based on the current draft of the ICRP recommendations[1].

Sincerely,

/RA/

Michael T. Ryan
Chairman

References:

1. Draft Recommendations of the International Commission on Radiological Protection, January 12, 2007 (http://www.icrp.org/docs/ICRP_Draft_Recommendations_12_January_2007.pdf).

2. Draft NRC staff comments (February 2007) on the January 12, 2007 Draft Recommendations of the International Commission on Radiological Protection.

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

ACNWR-0265

July 27, 2007

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

SUBJECT: AGENCY EFFORTS REGARDING RADIATION PROTECTION INFORMATION

Dear Chairman Klein:

On June 20, 2007, at the 180th meeting of the Advisory Committee on Nuclear Waste and Materials (the Committee), Mr. David McIntyre, from the Office of Public Affairs (OPA), briefed the Committee on the U.S. Nuclear Regulatory Commission (NRC) program regarding outreach on radiation. He described the NRC's efforts to inform the public about the health effects of low-dose radiation exposure and to elicit the public's perceptions of radiation.

RECOMMENDATIONS

Public outreach information on the NRC Web site should be organized to better respond to questions typically raised by the public. Activities to reorganize information for the public should complement the current structure of the Web site.

The agency should develop and proactively disseminate non-Web-based materials supporting agency actions to targeted audiences.

The agency should continue to use focus groups to evaluate the effectiveness of NRC public outreach activities.

OBSERVATIONS

Mr. McIntyre reported that NRC outreach focuses on the agency's mission to protect people and the environment. He also noted that every office has a public outreach program, not only OPA. The Committee also learned that the goal of OPA is to ensure openness in the NRC's regulatory process by making clear, accurate information available in a timely manner to the news media and the public about the NRC's policies, decisions, programs, and activities. Representatives from OPA typically serve as the points of contact for the press, persons from other media, and the public. The office focuses on areas such as preparing responses to public inquiries; supporting agency public meetings; and developing information for dissemination via the Web, videos, brochures, and fact sheets.

Mr. McIntyre reported that both the agency and the office seek to become the public's first choice as a source for information regarding radiation protection. In conclusion, Mr. McIntyre presented examples of information currently available on the NRC Web site and on other Web sites. He reported that OPA, with support from the Office of Federal and State Materials and Environmental Management Programs, has begun efforts to revamp the Web site and to make radiation protection information readily available and easily accessible.

The Committee reviewed the following related NRC publications:

- NUREG/BR-0308, "Effective Risk Communications," January 2004
- NUREG/BR-0322, "Radiation Protection and the NRC," February 2006
- Fact Sheet, "Biological Effects of Radiation," December 2004
- Fact Sheet, "Radiation Monitoring at Nuclear Power Plants and the 'Tooth Fairy' Issue," January 2005
- Fact Sheet, "Tritium, Radiation Protection Limits, and Drinking Water Standards," July 2006
- Backgrounder, "Radiation Protection and the 'Tooth Fairy' Issue," December 2004
- the agency Web site at http://www.nrc.gov and various sub pages discussed below

Currently, the header buttons on the home page are organized according to the regulatory areas and the organization's structure. The agency should consider adding a header button labeled Radiation Information that would link to a page that reflects a focus on questions asked by members of the public. Educational materials could also be organized under these key questions and issues.

The NRC's outreach program focuses on the use of Web-based tools. The staff develops and uses written materials (pamphlets, brochures, fact sheets) in support of specific agency actions. The agency has no system for the targeted distribution of information related to radiation protection through school systems, libraries, or other outlets readily accessible to members of the public.

The staff currently evaluates the effectiveness of the NRC's public outreach program by discussing "lessons learned" at staff meetings held after public meetings. The program offices usually conduct the meetings and then apply the "lessons learned." The agency has attempted to assess national changes in attitudes using focus groups.

Sincerely,

/RA/

Michael T. Ryan
Chairman

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

ACNWMR-0267

September 25, 2007

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

SUBJECT: ENGAGEMENT WITH THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP)

Dear Chairman Klein:

The Advisory Committee on Nuclear Waste and Materials (the Committee) believes that the staff is well prepared and engaged in contemporaneous activities associated with the International Commission on Radiological Protection (ICRP) and other national and international regulatory and recommending bodies. The staff is currently engaged through:

1. Direct review of and comment on ICRP draft documents;

2. Membership, by invitation, on the ICRP Committee 4: Application of the Commission's Recommendations;

3. Membership on the Nuclear Energy Agency's Committee on Radiation Protection and Public Health, which provides a forum to develop consensus views on ICRP recommendations; and

4. Federal interagency coordination of views on ICRP recommendations through the Interagency Steering Committee on Radiation Standards.

In addition to the participation of its staff, the U.S. Nuclear Regulatory Commission (NRC), through grants and contracts, provides financial support to the ICRP. These activities are effective in keeping the NRC current with the emerging guidance being offered by the ICRP.

The Committee notes that publication of the new (2007) ICRP recommendations will provide the NRC with the opportunity to work with other Federal agencies to move toward a consistent radiation protection framework for the United States.

RECOMMENDATIONS

The Committee recommends that:

1. The Commission invite representatives of organizations such as the ICRP, Nuclear Energy Agency, International Atomic Energy Agency, and National Council on Radiation Protection & Measurements to meet with the Commission, staff, and key U.S. stakeholders. This exchange should provide the Commission with important insights regarding radiation protection issues and initiatives, and the programs that address them. This engagement and follow-up will offer the opportunity for the Commission to take a leadership role and set a course for radiation protection practice.

2. The current staff activities continue and, in addition, the staff institute a more formal process in order to:

    a. Identify emerging radiation protection issues with lead times longer than 3 to 5 years.

    b. Assess the potential impact of emerging issues on current NRC regulations.

    c. Develop strategies for reacting to changes in national and ICRP recommendations.

Sincerely,

/RA/

Michael T. Ryan
Chairman

CURRENT ISSUES - LOW-LEVEL WASTE

Michael T. Ryan

Status of LLW Disposal

- Barnwell will likely close to out-of-Compact waste in June 2008
- Northwest and Rocky Mountain Compacts are unchanged
- Energy Solutions will continue to receive Class A LLW
- Storage of LLW will increase

ACNW&M LETTERS

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

ACNWMR-0268

October 1, 2007

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

SUBJECT: LOW-LEVEL RADIOACTIVE WASTE (LLW) MINIMIZATION STRATEGIES AND VIEWS ON COMMERCIAL LLW MANAGEMENT

Dear Chairman Klein:

In June 2008, the Barnwell disposal facility in South Carolina, one of only three licensed, commercially operated, low-level radioactive waste (LLW) disposal facilities in the country, will likely stop accepting LLW from states outside the Atlantic Compact (South Carolina, New Jersey, and Connecticut). LLW generators in 36 States will be affected when the Barnwell facility closes to non-compact states. In anticipation of this change, at the182nd meeting of the Advisory Committee on Nuclear Waste and Materials, the Nuclear Energy Institute (NEI) presented its plans for the management of commercial LLW.

The NEI presentation covered the following topics:

1 Plans to store Class B and Class C LLW safely and securely at nuclear power plant sites.

1 Operational changes at nuclear power plants to reduce Class B and Class C LLW generation.

1 Plans to reduce waste, particularly Class B and Class C LLW.

The NEI representative reported on both the short-term and long-term (strategic) issues that NEI is studying. The speaker noted that NEI recently formed the LLW Executive Committee (Executive Committee) to consider what should be done in the long term to improve the management of commercial LLW. The Executive Committee will focus on the following questions:

1 Is central processing, packaging, and storage of LLW feasible?

2 Is access to Federal disposal an option?

3 Should a Federal title be established for some classes of LLW?

4 Should the industry and government encourage development of other LLW commercial disposal sites?

5 Should industry petition rulemaking to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"?

6 Should there be improved U.S. alignment with International Atomic Energy Agency (IAEA) framework for waste classification?

7 Are changes to the LLW Policy Act and its amendments necessary?

The Executive Committee intends to issue a report in early 2008 with its views on these issues.

OBSERVATIONS

Nuclear power plants are focused on interim LLW storage from the present through 2035. This is based on the predicted decommissioning schedules of the current fleet of power reactors at the end of one 20-year license renewal. The nuclear power industry reports that it is prepared to store Class B and Class C LLW for an extended period of time in interim waste storage facilities collocated at the reactor sites. To achieve this objective, the utilities have considered ways to reduce the volumes of Class B and Class C LLW that they generate. NEI indicated that by volume, nuclear power plant wastes are 86 percent, 11.9 percent, and 1.2 percent Class A, B, and C LLW, respectively. The key radionuclides that are driving overall classification are nickel-63, cesium-137, and strontium-90.

The types and kinds of commercial LLW being generated by other industries are less certain, and this sector is likely to be less prepared to manage and store LLW for any extended period of time.

The NEI representative reported that they are looking at the original technical bases (waste volumes, radioactive material content, waste form, and waste packaging) underlying the 10 CFR Part 61 regulation and are comparing these bases against LLW produced today. NEI is further considering a petition under 10 CFR 61.58, "Alternative Requirements for Waste Classification and Characteristics," to propose an alterative LLW waste classification system. They would like the alternative classification to maintain compliance with the protection criteria for the LLW disposal site as defined in 10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity"; 10 CFR 61.42, "Protection of Individuals from Inadvertent Intrusion"; 10 CFR 61.43, "Protection of Individuals During Operations"; and 10 CFR 61.44, "Stability of the Disposal Site After Closure." Additionally, NEI is reexamining staff guidance found in the Branch Technical Position on Waste Averaging. This review will consider alternative averaging schemes that account for the characteristics of currently generated waste.

To ease the disposal burden on other LLW generators (hospitals, universities, research institutions, etc.), non-Part 61 disposal options, such as Resources Conservation and Recovery

Act (RCRA) Subtitle C and D sites, might be suitable for certain types of Class A LLW and other low-activity radioactive wastes (LAW) without having significant impacts on public health and safety and the environment.

Improved information is needed regarding types and kinds of LLW and LAW being generated by other industries to make decisions concerning alternative disposal of these wastes. This information could provide the technical basis for possible guidance or rulemaking regarding disposal of LAW at RCRA sites. The Committee intends to examine this issue in more detail over the next year and is developing a white paper on this topic.

RECOMMENDATION

The Committee recommends that the Commission initiate efforts in the near future to address interim storage and ultimate disposal options for LLW. Both the regulatory and institutional issues need to be addressed. It is important to integrate stakeholders into this dialogue as early as possible since this is a topic of significant public interest.

The Committee intends to track developments related to the forthcoming Executive Committee findings and compare those with the staff's 2006 LLW strategic planning recommendations.

Sincerely,
/RA/
Michael T. Ryan
Chairman

IGNEOUS ACTIVITY AT THE PROPOSED YUCCA MOUNTAIN REPOSITORY

William J. Hinze

Recent Activities

- Working Group on Igneous Activity
- Published White Paper on Igneous Activity – June 2007
- Monitored DOE expert elicitation update on volcanism probability and NRC staff's reports

Technical Basis for Decisionmaking

- Review and analysis of views
  - What could happen?
  - How likely is it?
  - What are the potential consequences?
- Evaluation of hypothetical extrusive and intrusive scenarios

Extrusive Scenario

- Inhalation of dispersed respirable ash ejected from molten rock erupting through the repository
- Maximum effect during first thousand years after closure
- Current analysis indicates risk is a small fraction of proposed standard

Intrusive Scenario

- Waste from canisters destroyed by intruding molten rock is carried by ground water to nearby aquifers
- Maximum effect not anticipated for tens of thousands of years due to slow groundwater movement
- Current analysis indicates risk is a small fraction of proposed standard

Evaluation of Scenarios

- Considers:
  - Nature
  - Likelihood
  - Consequences
- White Paper presents range of credible views

Nature of Possible Igneous Event

- Characteristics similar to most recent volcano in region – Lathrop Wells
  - Small volume, single episode eruptive event that disperses ash over surrounding region
  - General agreement

Likelihood of Igneous Event

- Forecasting from previous events
- Volcanism is waning
- 1 chance in a billion to 1 chance in ten million per year of an event intersecting the repository
- Ongoing DOE expert elicitation will update probability estimates in 2008

Source Term Resulting From an Extrusive Event

- Number of waste packages involved
- Quantity of radioactive material released
- Fraction of material that is respirable
- Wide range of views

Consequences of an Extrusive Event

- Relatively mature models
- Evolving consideration of
  - Range of waste particle size
  - Fraction of waste in ash vs. lava flows
  - Preferential remobilization of respirable ash by water and wind

Consequences of an Intrusive Event

- Less well understood and no natural analogs lead to differing views
- Range of views on
  - Interaction of molten rock with waste packages and repository
  - Governing molten rock properties
  - Number of waste canisters affected and potential for secondary vents from repository

Consequences of an Igneous Event

- Continuing analysis will reduce uncertainties, but credible alternative views are likely to remain with regard to:
  - Source term in extrusive scenario
  - Interaction of molten rock, waste packages, and the repository in the intrusive scenario
- Current analysis indicates risk is a small fraction of proposed standard

ACNW&M LETTERS

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

ACWNR-0264

June 6, 2007

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

SUBJECT: IGNEOUS ACTIVITY AT YUCCA MOUNTAIN: TECHNICAL BASIS FOR DECISION MAKING

Dear Chairman Klein:

The Advisory Committee on Nuclear Waste and Materials (the Committee) is pleased to forward the attached report "Igneous Activity at Yucca Mountain: Technical Basis for Decision Making." This report was prepared by the Committee at the request of the Commission in SRM M060111B, February 9, 2006, "to provide the Commission with an analysis of the current state of the knowledge regarding igneous activity which the Commission can use as a technical basis for its decisionmaking." The report presents a review and analysis of the range of current technical views on the nature, likelihood, and potential consequences of future igneous activity at the proposed repository. The Committee appreciates the ongoing dialogue with the U.S. Nuclear Regulatory Commission (NRC) staff regarding alternative igneous activity views presented in the report.

The Committee considered the full range of current views on igneous activity when it determined its general observations, presented in the Executive Summary of the report. Briefly summarized, these observations are as follows:

1. *The nature and consequences of an igneous event in the Yucca Mountain vicinity lead to differing professional judgments and alternative views on the expected impacts of igneous activity on the proposed high-level waste repository. As a result, evaluation of risk from an igneous event requires quantitative consideration of credible alternative views.*

2. *Despite the broad range of conceptual models and parameters used there is general agreement on many aspects of the nature of potential igneous events and the range of probability of these events in the future.*

3. *The consequences of an igneous event on the repository are more controversial and less well understood than other aspects of igneous activity, but consequence models are evolving through consideration of magma physics. The significance to risk of differences in these views is not well documented.*

4. *Limitations in fundamental information and knowledge of consequence processes result in inherent uncertainties in evaluating igneous activity models. Application of the principles of magma physics as illustrated in this report can constrain uncertainties in consequence analyses that can minimize the need for conservatisms in performance assessment.*

5. *Both the extrusive (volcanic) and intrusive igneous scenarios are credible at Yucca Mountain. The extrusive scenario is likely to cause the larger relative risk and the effect is greatest within the first thousand years after closure of the repository. On the other hand, the maximum risk from the intrusive scenario would not occur for several tens of thousands of years.*

6. *Preliminary performance assessment indicates that the consequences from either scenario would be only a fraction of the dose standard.*

7. *Future igneous activity in the Yucca Mountain region will likely be similar to the small-volume, single-episode basaltic Lathrop Wells volcano and would likely occur within basins rather than on ridges. Certain styles of volcanism are not expected. For example, large-volume felsic volcanism which formed the rocks of Yucca Mountain is not anticipated and conditions necessary for explosive phreatic eruptions (maar volcanism, involving heating and expansion of ground water) do not exist at Yucca Mountain.*

8. *General, but not total, agreement is that the igneous activity at Yucca Mountain is waning, with the probability that future igneous activity intersecting the repository in the range of 10^{-9} to 10^{-7}/yr. The ongoing expert elicitation of volcanic experts in the DOE's Probabilistic Volcanic Hazard – Update which incorporates the latest geophysical and drilling data will be the most up to date, credible estimate of the range of igneous activity intersection with the proposed repository. The results of the drilling have reduced uncertainty about the number and age of buried basalts near Yucca Mountain.*

9. *Significant disagreement exists regarding the extent of flow of magma into drifts of the repository during a possible intrusive igneous event and the number of waste packages destroyed by invading magma. However, magma physics indicates that flow of intruding magma into drifts would be limited and a secondary (satellite) vent branching from a drift (including the "dogleg" scenario) is unlikely to form at any time in the style of volcanism expected at Yucca Mountain.*

10. *The current technical bases of several aspects of igneous activity appear to be insufficiently developed or supported by available information and analyses. These include the range of waste particle sizes in the ash, the effects of large floods on the volume and distribution of contaminated ash in the vicinity of the RMEI, the amount of waste incorporated into ash versus lava during early eruptive phase of the extrusive scenario, and the importance of setbacks of the repository from faults and fractured zones.*

The NRC staff has committed to brief the Committee regarding their analysis of alternative views on igneous activity issues and the related risk significance using the newest version of the NRC Total-System Performance Assessment code. This information together with the attached report will be the basis for the Committee's evaluation of risk-significant topics pertinent to decisionmaking on igneous activity at Yucca Mountain that will be reported to the Commission.

Sincerely,

/RA/

Michael T. Ryan
Chairman

Attachment:
As stated

TRANSPORTATION

Ruth F. Weiner

Transportation

- Met with staff and stakeholders
  - Moderator Exclusion
  - Burnup Credit
    - commercial spent fuel
- Moderator exclusion and burnup credit are related

Burnup Credit

- Burnup credit is not precluded by regulation
- Full burnup credit would allow fewer shipments of spent fuel
- NRC has approved one application for actinide burnup credit and partial credit for fission product poisoning

Moderator Exclusion

- Moderator exclusion is regulated by Part 71 and staff guidance
- NRC has not yet approved shipments that rely on moderator exclusion – applications are expected

Moderator Exclusion

- 10 CFR 71.55
  - (c) provides basis for moderator exclusion
  - (e) and Interim Staff Guidance 19 provide for moderator exclusion under accident conditions

Recommendations

- Use existing regulations for moderator exclusion
- Risk-inform regulatory guidance on burnup credit and moderator exclusion

ACNW&M LETTERS

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

ACNWR-0260

April 23, 2007

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

SUBJECT: USE OF CREDIT FOR MODERATOR EXCLUSION IN THE LICENSING OF SPENT NUCLEAR FUEL TRANSPORTATION PACKAGES

Dear Chairman Klein:

At the 176th meeting of the Advisory Committee on Nuclear Waste (the Committee or ACNW) on February 13–15, 2007, staff from the Office of Nuclear Materials Safety and Safeguards, Division of Spent Fuel Storage and Transportation, briefed the Committee on taking credit for moderator exclusion for spent nuclear fuel (SNF) transportation packages. The staff of the U.S. Nuclear Regulatory Commission (NRC) sought advice from the Committee on its intention to begin background preparation for a rulemaking on moderator exclusion. At the Committee's 177th meeting on March 20–22, 2007, representatives from the Nuclear Energy Institute (NEI), the Electric Power Research Institute (EPRI), the Idaho National Laboratory (INL), and H322 Consulting LLC briefed the Committee on this topic. The briefings addressed the advantages and disadvantages of taking credit for moderator exclusion (with some discussion of burnup credit) in preventing criticality during transportation. The meeting included a roundtable discussion involving all presenters. The participants did not discuss safeguards and security aspects of the transportation of SNF.

The NRC staff briefing highlighted the current regulatory framework for transportation of fissile material, regulations for fissile material packages, current staff practice with respect to criticality prevention and moderator exclusion, considerations if the practice is changed, and interim staff guidance (ISG-19, "Moderator Exclusion under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel under the Requirements of 10 CFR 71.55(e)").

The current rule (Title 10, Section 71.55, "General Requirements for Fissile Material Packages," of the *Code of Federal Regulations* (10 CFR 71.55)) requires that fissile material being transported be in a configuration such that criticality cannot occur even if water, a neutron moderator, partly or completely fills the package. The requirements of 10 CFR 71.83, "Assumptions as to Unknown Properties," provide a bounding case for determining the assumptions for fissile content of SNF. If the inventory of germane radionuclides is known, burnup credit can be granted. Prevention of criticality could be demonstrated by either guaranteeing that water is excluded (moderator exclusion) or recognizing that the material does not have its original fissile content and contains some fission poisons (burnup credit), or both. Presenters from NEI and EPRI indicated that if burnup credit, including credit for fission products, were considered for commercial SNF in criticality analyses, credit for moderator exclusion might not be needed because the combination of less fissile material and poisoning by fission products could be shown to prevent a criticality.

Industry participants reported that if burnup credit were granted for the current fleet of dual-purpose storage and transportation casks, some of these casks could then be transported. This would avoid the need to repackage them for transport.

In addition, the U.S. Department of Energy has an inventory of noncommercial SNF destined for the proposed high-level waste repository. This noncommercial SNF exhibits such a wide range of enrichment and burnup that it is difficult to adequately characterize it for burnup credit. The INL representative presented the test sequence for the canister-in-canister transportation package, showing that water would not infiltrate the inner canister and thereby strengthening the proposal for moderator exclusion.

SNF could be shipped more efficiently than at present in transportation packages granted an exception under 10 CFR 71.55(c). This exception would allow such shipments with the following conditions:

> if the package incorporates special design features that ensure that no single packaging error would permit leakage, and if appropriate measures are taken before each shipment to ensure that the containment system does not leak.

ACNW Observations

- The regulations in 10 CFR 71.55(b) require that fissile transportation packages be subcritical even when optimally moderated (fully flooded), so that criticality is impossible in the as-loaded condition. Credit for moderator exclusion is a demonstration of subcriticality without moderator (no water in-leakage) inside a transportation package containment system. Under 10 CFR 71.55(c), the NRC can approve an exception to 10 FR 71.55(b) if the applicant can show that water in-leakage can be completely excluded from the transportation package, or if the amount of water that could enter is not sufficient to cause criticality. To date, the NRC has not received a request for an exception for an SNF transportation package design or for shipments that rely on moderator exclusion for criticality safety, though industry participants seem willing to make such requests.

- As currently written, 10 CFR 71.55 is deterministic and not risk-informed. Exceptions to 10 CFR 71.55 may be risk-informed, but this does not affect the deterministic nature of the regulation. The regulation as written concentrates on preventing a criticality during transportation but considers alternate methods of reducing risks only as case-by-case exceptions.

- ISG-19 allows moderator exclusion for commercial SNF transportation during hypothetical accident conditions (as described in 10 CFR 71.55(e)). However, ISG-19 does not give relief from 10 CFR 71.55(b) (i.e., subcriticality must still be ensured with water inside the containment system with the fuel in the as-loaded configuration).

- Moderator exclusion and burnup credit are not separate issues. Either or both would allow a larger amount of SNF to be transported in a single package.

- To date, the NRC staff has approved one application for a transportation package with partial (actinide plus some fission products) burnup credit. The staff is now considering a second application.

- Current staff thinking suggests that rulemaking might be appropriate to codify moderator exclusion for certain packages under certain conditions. In addition, rulemaking would provide an opportunity for public input.

- The staff expressed concern that if major vendors seek exceptions under 10 CFR 71.55(c), many SNF shipments will be made under an exception rather than an affirmative rule. Routine use of the exception under 10 CFR 71.55(c) may call into question the assumptions underlying the generic environmental impact statement for transportation of radioactive materials.

ACNW Recommendations

- The Committee recommends that the staff use the existing rule at 10 CFR 71.55(c) to evaluate submittals from applicants seeking to apply moderator exclusion provisions of the rule. A decision about rulemaking should be deferred until more experience is obtained using the existing provisions of the rule.

- The Committee recommends that guidance be made risk-informed and include consideration of both moderator exclusion and burnup credit.

Sincerely,

/RA/

Michael T. Ryan
Chairman

References

1. *Code of Federal Regulations*, Title 10, Part 71, "Packaging and Transportation of Radioactive Material."

2. Nuclear Regulatory Commission, "Moderator Exclusion under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel under the Requirements of 10 CFR 71.55(e)," Interim Staff Guidance 19, Rev. 0, May 2003.

In-Situ Leach Uranium Recovery Activities

Ruth F. Weiner

OBJECTIVES

- **Advise the Commission on Rulemaking**
  - **Environmental protection issues**
  - **Resolution of issues associated with *in-situ* leach mining and groundwater contamination**

Proposed Rulemaking Recommendations

- Rule should be risk informed and provide:
  - Location of the point of compliance
  - Groundwater monitoring requirements
  - Methods of demonstrating compliance
  - Financial surety

Proposed Rulemaking Recommendations (Cont'd)

- Rule should provide:
  - Measures to reduce the likelihood of contaminant release
  - Groundwater remediation
  - Establishing pre-mining background or baseline groundwater quality

Proposed Rulemaking Recommendations (Cont'd)

- Rule should consider:
  - Groundwater use
  - Onsite effluent disposal
  - Decommissioning and license termination requirements

Next Steps

- Review staff progress regarding Rulemaking
- Evaluate NRC staff resolution of public comments on the draft rule

ACNW&M LETTERS

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

R-0261

May 9, 2007

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

SUBJECT: PROPOSED RULEMAKING ON GROUNDWATER PROTECTION AT IN SITU LEACH URANIUM RECOVERY FACILITIES

Dear Chairman Klein:

During its 178th meeting on April 10-12, 2007, the Advisory Committee on Nuclear Waste (the Committee) received a briefing by NRC staff from the Office of Federal and State Materials Safety and Environmental Management Programs (FSME) on the status of a proposed rulemaking on groundwater protection at in situ leach (ISL) uranium recovery facilities. The FSME staff discussed the legislative and regulatory background of ISL, efforts to eliminate dual regulation, staff interactions with the U.S. Environmental Agency (EPA) and the National Mining Association, staff rulemaking strategy, the path forward, and future interactions with the Committee. The staff indicated that the technical basis for the rulemaking is under development. The rulemaking will add a new criterion addressing ISL uranium mining to the existing regulations for conventional uranium mills and mill tailing facilities in 10 CFR Part 40, Appendix A.

RECOMMENDATIONS

- The FSME staff should proceed with developing the proposed rule, including codification of the appropriate standards specified by the EPA.

- The rule should provide specific guidance on the three-dimensional location of the point of compliance, groundwater monitoring requirements, methods of demonstrating compliance, and financial surety considerations.

- The rule should establish guidance on measures to reduce the likelihood of contaminant excursions outside the mined zone (the exempted aquifer unit that contains the uranium ore deposit) and the site property (the land that is under control of the licensee), and for remediation outside the mined zone if excursion occurs.

- The rule should be risk-informed and should consider groundwater use, onsite effluent disposal, and decommissioning and license termination requirements.

- The rule should provide requirements for establishing pre-mining background or baseline groundwater quality.

DISCUSSION

The NRC staff is developing a rulemaking to codify regulations and standards to protect groundwater at ISL uranium mining sites. The main concerns are multiplicity of regulations and regulators, protection of uncontaminated groundwater outside the mined zone and restoration of groundwater quality in the mined zone after the mining is terminated. The latter represents a challenge in practice because groundwater restoration involves flushing of the mined zone to remove contaminants, and the resulting asymptotic concentration of contaminants may exceed the concentration desired in the mined ore body. Therefore, full restoration of the mined ore body may not be achievable and an alternate concentration limit (ACL) may be appropriate.

Currently groundwater protection at licensed uranium recovery facilities is regulated pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA) and the Atomic Energy Act, as amended. The applicable EPA standards are provided in 40 CFR Part 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," and NRC regulations in 10 CFR Part 40, Appendix A "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content." These regulations require groundwater restoration to pre-mining background levels, or to maximum concentration limits (MCLs), or to alternate concentration limits (ACLs). They are generally applied to uranium mill and mill tailings sites and do not explicitly address ISL facilities.

Guidance for licensing of ISL facilities is currently provided in NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," which calls for restoration of groundwater quality within the mined zone and any affected aquifers to pre-operational (baseline) water quality conditions ("Primary Restoration Standards"), or pre-operational class of use ("Secondary Restoration Standards"). If a constituent cannot technically or economically be restored, an applicant must demonstrate that the resulting higher concentration would not degrade adjacent groundwater resources unacceptably or threaten health and safety. In some cases the affected state also regulates groundwater protection at ISL mines. There is a need to codify standards for groundwater protection at ISL sites in NRC regulations.

Committee Activities Pertinent to ISL

In two Staff Requirements Memoranda "COMSECY-05-0064-Fiscal Year 2006 and 2007 Action Plan for the ACNW" (ML060380593), dated February 7, 2006, and "Meeting with Advisory Committee on Nuclear Waste" (ML070170041), dated January 16, 2007, the Commission requested that the Committee advise the Commission as to:

1. The unique waste management, decommissioning, and environmental protection issues related to the licensing of ISL uranium recovery facilities that may arise from a Part 41 rulemaking addressing uranium recovery, and

2. The potential resolution of issues associated with ISL mining and resulting groundwater contamination.

The Commission also stated that the Committee's advice should be appropriately coordinated with the NRC staff so that they are not in conflict with ongoing efforts of the staff. In support of this direction, the Committee appreciates the interaction with the FSME staff on their rulemaking plans and looks forward to commenting on the technical basis for the rule when it is completed.

Sincerely,

/RA/

Michael T. Ryan
Chairman

ABBREVIATIONS

ACNW&M	Advisory Committee on Nuclear Waste and Materials
ACRS	Advisory Committee on Reactor Safeguards
CFR	Code of Federal Regulations
DOE	Department of Energy, U.S.
ICRP	International Commission on Radiological Protection
LLW	Low-Level Waste
NRC	Nuclear Regulatory Commission, U.S.
NUREG	NRC Technical Report Designation (Nuclear Regulatory Commission)
SRP	Standard Review Plan

REMAINING ACNW&M LETTERS

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

ACNWR-0255

December 27, 2006

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

SUBJECT: WORKING GROUP MEETING ON USING MONITORING TO BUILD MODEL CONFIDENCE

Dear Chairman Klein:

In a Staff Requirements Memorandum (M060111B) dated February 9, 2006, the Advisory Committee on Nuclear Waste (Committee) was requested by the Commission to work with the Nuclear Regulatory Commission (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 Committee worked closely with staff from the Office of Nuclear Regulatory Research (RES) to organize and conduct a 2-day working group meeting on "Monitoring to Build Model Confidence" during the ACNW 173rd meeting, September 18-21, 2006. This letter provides Committee recommendations, along with comments and observations, based on the working group meeting.

The meeting included presentations by invited experts as well as members of the NRC staff, panel discussions, and question-answer sessions involving the participants and Committee members. Outside participants included representatives from the U.S. Environmental Protection Agency, the U.S. Geological Survey, the American Nuclear Society, the Electric Power Research Institute, the Department of Energy national laboratories, private consulting firms, waste management companies, and universities. Professor George Hornberger of the University of Virginia served as moderator for the panel discussions.

Recommendations

1. Staff should develop guidance on integrating monitoring and modeling programs to increase confidence in the validity of the performance assessment predictive models and their results, and to demonstrate compliance with regulatory limits at licensed sites. The guidance should consider risk, facility and subsurface complexity, environmental setting, and subsurface flow and transport regimes. The approach should be risk-informed and performance-based.

2. Monitoring and modeling should be used together in a graded approach to demonstrate compliance, including long-term compliance.

3. Licensees and applicants should be offered financial incentives to use integrated monitoring and modeling approaches to demonstrate compliance with the regulations (e.g., reductions in decommissioning costs or other obligations).

4. Licensees and applicants should be encouraged to develop monitoring programs that are designed to include detection near the source and before contaminants reach a point of compliance.

5. Monitoring and modeling should be linked through a dynamic and iterative process beginning with initial site characterization.

6. Performance assessment models should be updated when new information that alters the site conceptual model becomes available.

7. NRC staff should become involved in research designed to identify performance indicators and approaches to their implementation into early warning systems, and in the development and implementation of additional non-invasive monitoring technologies.

8. Post construction monitoring should not be used as a substitute for a robust performance assessment. NRC decisionmaking should be based on robust performance assessment models using site-specific information such as monitoring data, and other supporting information such as laboratory bench-scale testing.

Comments and Observations

- There are currently no systematic incentives or requirements to coordinate and integrate monitoring and modeling activities to build model confidence.

- Many decommissioning sites have little to no existing soil and/or ground-water contamination. Monitoring may be of limited utility at sites where the phenomena of interest occur over time spans that exceed the duration of licensed activity and when extending the license is not warranted. In these cases, decommissioning decisions can be made with relatively simple calculational tools. When significant subsurface contamination exists and has reached ground water, a higher level of analysis is required. This analysis would identify the need for and selection of remediation strategies.

- Mining of the monitoring data for temporal and spatial variations can provide important confirmatory feedback that is useful to inform the site conceptual model, performance assessment, choices of performance indicators, monitoring devices, and monitoring locations. The results of the models can provide important confirmatory feedback with regard to the monitoring locations and critical data to be collected, and models can also be used as management tools for the site data.

- Building confidence in performance assessment models through integration with monitoring will yield increased capability and confidence in assessing the necessity for and duration of institutional controls.

- For some facilities, it is appropriate to consider systems that incorporate the monitoring of precursors to engineered system failure (performance indicators) so corrective measures can be taken to prevent contaminant release.

- Natural analogues can provide information that is useful in selecting and assessing long-term performance of engineered contaminant isolation systems.

- Evaluation of engineered barrier performance should consider both the physical (engineered barriers) and chemical (waste form) isolation of radionuclides depending upon the specific source term. The service life of physical barriers may be limited (100's of years).

- There are chemical and physical constraints that limit the development of conceptual models for ground water. There is a need for site characterization to support the development of conceptual ground-water transport models and to establish characterization goals based on existing limitations.

- There are new cost-effective monitoring techniques and approaches that can be pursued and implemented, including geoprobes, tracers, new coring techniques, geophysical measurements, low-rate pumping, and gas-phase monitoring including soil vapor extraction.

- Experts supported the idea of phased monitoring, in which data collection is managed to build confidence in modeling and then optimized to achieve further confidence in modeling results.

- Guidance is needed to assist licensees/applicants and NRC reviewers of radiological environmental monitoring programs and assessments involving releases to ground water. Guidance is needed for determining the level of analysis, and the monitoring and modeling tools and approaches that can be used to build model confidence.

- Historical emphasis for licensed facilities has not been on early site characterization data to develop a conceptual site model to facilitate compliance assessment throughout the facility lifetime. Contamination issues typically emerge during decommissioning rather than during normal operations.

The Committee would like to take this opportunity to acknowledge RES staff for their help in organizing and participation in this working group meeting, and the staff from the Office of Federal and State Materials and Environmental Management Programs for their presentations and participation in the panel discussions. We look forward to continued interaction with the staff on this important subject.

Sincerely,

/RA/

Michael T. Ryan
Chairman

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

ACNWR-0257

January 8, 2007

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

SUBJECT: WORKING GROUP MEETING ON DECOMMISSIONING LESSONS LEARNED

Dear Chairman Klein:

At its 174th meeting on November 14, 2006, the Advisory Committee on Nuclear Waste (the Committee) conducted a working group meeting (WGM) on Decommissioning Lessons Learned. The meeting featured presentations from representatives of the Nuclear Energy Institute (NEI), the Fuel Cycle Facilities Forum, Argonne National Laboratory, the Army Corps of Engineers, the Kansas Department of Health and Environment, the Nuclear Regulatory Commission (NRC) Offices of Nuclear Regulatory Research, Federal and State Materials and Environmental Management Programs, and Nuclear Reactor Regulation. The meeting also included an invited expert panel, whose members have participated in other WGMs on decommissioning issues. [1]

The following recommendations are provided:

Recommendations

- The staff should continue and expand its efforts to seek coherent decommissioning requirements with states and the Environmental Protection Agency. Differences in requirements contribute substantially to increased costs and delays.

- The staff should evaluate the potential impact of cumulative releases that, while permitted and legal, can cause the derived concentration guideline levels (DCGLs) for soil and groundwater to be exceeded when the facility is decommissioned. Derivations of DCGLs should consider the interrelationships between contaminated soil and future groundwater contamination.

[1] The expert panel consisted of Eric Darois, Radiation Safety and Control; David Kocher, SENES Oak Ridge and consultant to the ACNW, Tracey Ikenberry, Dade Moeller and Associates; and Thomas Nauman, of Shaw, Stone and Webster.

- The staff should continue its development of guidance related to decommissioning lessons learned into the planning for new facilities. Approaches to capturing unintended releases, providing access to potentially contaminated system components, and providing secondary containment and environmentally sound management of potentially contaminated liquids should be included in guidance.

Observations

- Several other groups in addition to the NRC staff are capturing decommissioning lessons learned. These groups include the NEI, the Electric Power Research Institute, the International Atomic Energy Agency, and the Department of Energy.

- Allowed discharges to the atmosphere and surface waters during the facility lifetime can result in DCGLs for remediation being exceeded. Early development of DCGLs during the licensing process and potential modification of DCGLs during the facility operating period may have merit.

- Multi-agency jurisdictions impact decommissioning costs and schedule. Variations in the cleanup requirements adopted by different states and regulatory agencies and the lack of a risk-informed waste classification system can lead to increased decommissioning costs and schedule delays. Consistency in requirements and approaches that are risk-informed would be very beneficial.

- In many decommissioning projects, waste disposal costs drive the ultimate cost of decommissioning. The total cost includes the disposal cost as well as substantial transportation costs resulting from the typically long distances from decommissioning sites to disposal facilities. Additional disposal facilities that provide cost-competition and are closer to decommissioning sites would lower total decommissioning costs significantly.

- An additional contributor to increased decommissioning costs is the need to remove unanticipated contaminated material from unknown legacy disposal or releases.

- Effective environmental management of liquids that can become contaminated is essential to minimization of decommissioning costs. Secondary containment of process liquids and storm-water management are critical in this regard.

- Preliminary site characterization typically addresses licensing requirements only. Baseline characterization of subsurface and hydro-geological factors is best done when construction is complete since construction affects site subsurface conditions. On-site backfilling of construction debris can affect subsurface hydro-geology as well.

- Accessibility of potentially contaminated system components is essential. Embedded or buried piping should be avoided or designed and constructed in such a way that access for inspection and needed maintenance is provided.

- Decommissioning of facilities decades from now may be very different from the current practices of decommissioning. Representatives of the expert panel urged that the lessons learned process be continued in the future. Lessons learned should be revisited to assess their continued applicability over time.

The Committee supports the capture and dissemination of information concerning decommissioning lessons learned. The Committee is planning the development of a white paper that integrates what it has learned about several key aspects of decommissioning. The Committee looks forward to continued interactions with the staff and other stakeholders as this initiative progresses.

Sincerely,

/RA/

Michael T. Ryan
Chairman

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

ACNWR-0262

June 27, 2007

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

SUBJECT: NRC OFFICE OF NUCLEAR REGULATORY RESEARCH (RES) LONG-TERM RESEARCH: FISCAL YEAR 2009 ACTIVITIES

Dear Chairman Klein:

During the 179th meeting of the Advisory Committee on Nuclear Waste and Materials (ACNW&M or the Committee), May 16-17, 2007, the Office of Nuclear Regulatory Research (RES) briefed the Committee on their draft plan (Reference 1), "U.S. Nuclear Regulatory Long-Term Research: FY 2009 Activities." RES will use the plan as a basis for the fiscal year (FY) 2009 research budget request, as well as for budget requests for subsequent years. The plan is intended to be a living document, and recommendations are made based on this understanding.

In preparing the plan, the staff solicited candidate research topics from NRC internal stakeholders as reported in SECY 07-0068 (Reference 2). The Advisory Committee on Reactor Safeguards (ACRS) has already been briefed and has written a letter (Reference 3) on research topics associated with the reactor programs. This letter responds to the briefing that the Committee received on activities associated with the nuclear waste and materials area.

RES plays an important role in the regulatory process by developing the technical bases for new and existing regulations, facility licensing, regulatory guidance, and by investigating emerging scientific and technical issues on public and worker health and safety. An additional long-term research focus would support the potential licensing of the next generation of nuclear facilities.

In this context, RES presented the following three general topical areas for long-term consideration:

1. The aspects of the proposed Global Nuclear Energy Partnership (GNEP) that deal with radioactive waste, effluents, and materials

2. Extended in-situ and real-time inspection and monitoring techniques

3. Advanced quantitative risk assessment methods, including the Advanced Offsite Consequence Code

The ensuing text discusses each of these topics and makes reference to the recommendations pertaining to that topic. The Committee has also included some additional recommendations.

Topic 1: The GNEP and Fuel Recycle Facilities (Recommendation 1)

Reprocessing spent nuclear fuel produces a variety of effluent releases and waste streams that may challenge the current regulatory scheme. Managing the radioactive waste streams and effluents associated with recycled spent nuclear fuel may require new technology and related regulatory initiatives. Licensing recycling facilities is likely to require new or modified regulation based on technical principles that the NRC has not yet considered intensively. Candidate research on recycle facilities should address waste streams and effluents as well as focusing on the facilities.

Regulation of the waste generated by fuel recycling may suggest consideration of a different waste classification system. An intermediate class for radioactive waste that is between low-level radioactive waste (LLW) and high-level waste (HLW) is used in other countries (Reference 4) where recycling of nuclear fuels occurs, as well as by the International Atomic Energy Agency (IAEA). The current two-tiered system (HLW and LLW), with the provision of Title 10 of the Code of Federal Regulation (10 CFR) 61.58, "Alternative Requirements for Waste Classification and Characteristics," that allows the Commission to develop alternate schemes of waste classification, could be crafted to regulate the radioactive materials in wastes generated by recycling.

Topic 2. In-Situ And Real-Time Inspection And Monitoring Techniques (Recommendation 2)

Research is needed to develop and improve in-situ and real-time inspection and monitoring techniques that focus on predicting behavior. The use of real-time sensor technology and advanced performance assessment methods could benefit licensees by establishing a basis for lower decommissioning costs, and reduced inspections. The need to allocate resources to deal with decommissioning at the end of life, together with reduced decommissioning costs, could become one of the major benefits of the program.

Topic 3. Advanced Quantitative Risk Assessment Methods (Recommendation 3)

The Committee has previously commented (Reference 5) on the need for quantitative risk assessment for fuel cycle facilities other than reactors. Integrated Safety Assessments (ISAs) currently used to assess the safety of fuel fabrication facilities may not be robust enough for reprocessing facilities, which are more complex and produce larger quantities of, and a variety of different kinds of, waste streams. The staff should ensure that codes used in ISAs are up-to-date and should continue to develop them consonant with both their application to advanced systems and current computer technology. The best risk tools available should be applied to the design features and human actions that are important to facility operation and oversight.

In addition, the Committee believes that "long term" research planning should look further into the future than FY2009 for perhaps 5 to 10 years. A long-term plan is expected to include future technical needs (e.g., experimental and test facilities, computer models and codes, data) and a forward-looking regulatory perspective (e.g., rules, regulatory guides, standard review plans).

The Committee also observes the continuing need for research efforts to maintain up-to-date information technology, including data management and retrieval related to RES activities.

RECOMMENDATIONS

1. Regarding recycled fuel, RES should consider issues of waste classification with respect to the adequacy of the current two-tiered system (HLW and LLW) of waste classification versus the three-tiered system (low, intermediate, high) used in other countries that recycle fuel. Research should be undertaken on technology for management and disposition of waste and effluents produced in the recycling of spent nuclear fuels.

2. RES should maintain and continue to develop real-time inspection and monitoring techniques, and focus future efforts on "early-warning" monitoring systems as well as monitoring for compliance.

3. RES should improve research-related data organization and retrieval, and investigate advanced programming and artificial intelligence techniques for data management and analysis.

4. The RES plan should take a longer range view of perhaps 5 to 10 years in the future. RES's definitions of "short-term" and "long-term" research planning could be misinterpreted. While the staff reported on plans that were specific through FY 2009, no details were provided for activities beyond FY 2009.

The Committee supports RES long-term planning of research activities and believes it is important that the plan be kept as a living document and be updated periodically to include new information. RES has a successful history of leveraging limited resources by undertaking cooperative programs with other Federal and state agencies. Investigation of cooperative research should continue in the long term.

The Committee would like to remain informed of the plan's evolution and of any significant updates.

Sincerely,

/RA/

Michael T. Ryan
Chairman

References:

1. Office of Nuclear Regulatory Research Report, Subject: "U.S. Nuclear Regulatory Commission Long-Term Research: FY 2009 Activities," March 2007 (Official Use Only - Sensitive Internal Information – Draft)

2. Memorandum to The Commissioners from Luis A. Reyes, Executive Director for Operations, Subject: SECY-07-0068, "Candidate Agency Long-Term Research Activities for Fiscal Year 2009," April 6, 2007. (Official Use Only Document - Sensitive Internal Information - Limited to NRC Unless the Commission Determines Otherwise)

3. Report dated May 16, 2007, from William J. Shack, Chairman, ACRS to Dale E. Klein, Chairman, NRC, Subject: Development of an Integrated Long-Term Regulatory Research Plan

4. ACNW White Paper NUREG-1853, "History and Framework of Commercial Low-Level Radioactive Waste Management in the United States," January 2007

5. Report dated January 14, 2002, from, George M. Hornberger, Chairman, ACNW to Richard A. Meserve, Chairman, NRC, Subject: Risk-Informed Activities in the Office of Nuclear Material Safety and Safeguards

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

ACNWR-0263

June 28, 2007

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

Dear Chairman Klein:

SUBJECT: WORKING GROUP MEETING ON 10 CFR 20.1406 MINIMIZATION OF CONTAMINATION AND PROPOSED REGULATORY GUIDE 4012

At its 180th meeting on June 19, 2007, the Advisory Committee on Nuclear Waste and Materials (the Committee) held a working group meeting on Draft Regulatory Guide DG-4012, "Minimization of Contamination and Radioactive Waste Generation in Support of Decommissioning," that would provide guidance for Title 10 of the *Code of Federal Regulations* (10 CFR) 20.1406, "Minimization of Contamination." This working group meeting was held in response to SRM-M060111B, "Staff Requirements - Meeting with Advisory Committee on Nuclear Waste," that charged the Committee with reviewing best practices in decommissioning in order to look for ways to improve the design and construction of reactor and materials facilities that would lead to less environmental impact and more efficient decommissioning.

During the working group meeting the Committee heard presentations from industry vendors on the Westinghouse AP1000 and the General Electric Nuclear Economic Simplified Boiling Water Reactor, and additionally from the Nuclear Energy Institute (NEI), and U.S. Nuclear Regulatory Commission (NRC) staff on the proposed guidance. Invited experts[1] who have assisted the Committee in the areas of revised guidance for decommissioning, prevention of legacy sites, and decommissioning lessons learned also participated.

DISCUSSION

10 CFR 20.1406, "Minimization of Contamination," states that:

> Applicants for licenses, other than renewals, after August 20, 1997, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

This regulation applies to all license applications for new facilities submitted after 1997. 10 CFR 20.1406 is currently being revised. The staff feels that it is important to issue guidance as soon as possible for use by applicants for new licenses for nuclear power reactors.

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[1] Eric L. Darois, Radiation Safety and Control Services, Inc. and Eric W. Abelquist, Oak Ridge Institute for Science and Education.

The staff is to be commended for its efforts in capturing decommissioning lessons learned in the proposed guidance. The staff's approach to minimizing contamination stresses three major components: prevention, detection, and correction. Over the past several months, both the NRC and the NEI have been engaged in initiatives to capture and document decommissioning lessons learned so that this information can be incorporated into designs for new reactors.

The Committee learned that vend23ors have incorporated features to prevent releases and provide early detection of releases into their standard reactor designs. These features include use of construction materials and techniques that provide improved barriers, secondary containment of potential liquid releases, avoidance of underground piping, and incorporation of leak detection systems. These features reflect the proactive approach being taken by these vendors to incorporate decommissioning lessons learned into the design of new facilities.

The NEI representative urged that the guidance provide a clear statement of performance objectives and sufficient information to identify the measures needed to comply with the regulation.

RECOMMENDATIONS

The Committee offers the following recommendations:

1. The Committee recommends that the guidance in its present form apply only to new reactor licensing. The Committee further recommends that the guidance in its present form should not be applied to non-reactor licensees. The Committee recommends that after 10 CFR 20.1406 is revised, the guidance should be revisited regarding its applicability to reactor licensees and other licensees.

2. The Committee believes that since 10 CFR 20.1406 applies to all NRC licensees and all Agreement State licensees, care should be taken to organize the guidance so that what is applicable to each type of licensee is clearly identified. A graded approach should be developed to determine what parts of the guidance would apply to various categories of licensees.

3. The guidance should clearly provide licensees with enough information to determine what steps they need to take to comply with the requirements of 10 CFR 20.1406. Additionally, guidance should be clear enough to avoid confusion or misinterpretation during the license application review or inspection processes.

The Committee appreciates the opportunity to interact with the staff and looks forward to continued interaction as the rulemaking and associated guidance go forward.

Sincerely,

/RA/

Michael T. Ryan
Chairman

Reference:

1. Memorandum dated May 1, 2007, from Jimi T. Yerokun, Chief, Risk Applications and Special Projects Branch, Division of Risk Assessment and Special Projects, Office of Nuclear Regulatory Research, to Cayetano Santos, Chief, Technical Support Branch, Advisory Committee on Reactor Safeguards, Subject: Draft Regulatory Guide DG-4012, "Minimization of Contamination and Radioactive Waste Generation in Support of Decommissioning"

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

August 13, 2007

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

SUBJECT: CONCERNING THE RESPONSE FROM THE EDO REGARDING THE COMMITTEE'S LETTER ON PREVENTION OF LEGACY SITES

Dear Chairman Klein:

The Committee is responding to the Executive Director for Operations' (EDO) letter dated June 14, 2007, which responds to the Advisory Committee on Nuclear Waste and Materials' (the Committee) letter dated October 17, 2006, concerning the development of rulemaking and guidance for the prevention of legacy sites. The EDO's letter states that five of the six recommendations made by the Committee in its October 2006 letter are being implemented by the staff in the current rulemaking and guidance efforts. The Committee commends the staff for its continuing improvements in decommissioning rulemaking and guidance based on the Committee's recommendations.

The EDO letter also states that the sixth recommendation, reducing the financial assurance requirements for licensees who effectively implement the guidance and requirements for preventing legacy sites, is inconsistent with NRC requirements, and that it is critical that all licensees maintain the minimum financial assurance necessary to remediate their sites.

The Committee agrees with the staff that all licensees must maintain the minimum financial assurance as required in the regulations. Unfortunately, the Committee did not frame its recommendation clearly based on the staff's presentation of the material at the 172nd meeting of the Committee.

The Committee's recommendation should have referenced the *guidance* for prevention of legacy sites for those licensees required to prepare decommissioning cost estimates and to establish financial assurance amounts based on those estimates. Often these financial assurance requirements are set well above the minimum values based on the required assessments. The Committee believes that the consolidated decommissioning guidance found in NUREG-1757, Volume 3, "Consolidated NMSS Decommissioning Guidance – Financial Assurance, Recordkeeping, and Timeliness – Final Report," should discuss how decommissioning financial requirements could be maintained at or near their threshold amounts based on successful implementation of legacy site avoidance strategies. The Committee believes that licensees with large amounts of radioactive material and complex operations could perform actions during operations, such as initiating a spill cleanup immediately, installing leak detection systems in critical areas, or reengineering systems to eliminate hard to monitor features or components. Such guidance would allow licensees to consider reducing the amount of financial assurance required for license termination versus improvements during the active life of facility.

The Committee expects to be briefed by the staff again on the rulemaking and guidance for prevention of legacy sites at the 183rd meeting of the Committee in October, and we will discuss this issue with them again at that time.

Sincerely,

/RA/

Michael T. Ryan
Chairman

Reference: NUREG-1757, Volume 3, "Consolidated NMSS Decommissioning Guidance - Financial Assurance, Recordkeeping, and Timeliness - Final Report"

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

ACNWMR-0269

October 2, 2007

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

Dear Chairman Klein:

SUBJECT: NRC PLANS FOR MONITORING DISPOSAL ACTIONS FOR WASTE INCIDENTAL TO REPROCESSING AT U.S. DEPARTMENT OF ENERGY FACILITIES AT THE IDAHO NATIONAL LABORATORY AND SAVANNAH RIVER SITES

In May 2007, the Advisory Committee on Nuclear Waste (the Committee) received and reviewed draft copies of plans for monitoring actions to dispose of waste incidental to reprocessing (WIR) at the U.S. Department of Energy (DOE) at the Idaho National Laboratory (INL) Nuclear Technology and Engineering Center (INTEC) tank farm facility and the salt waste disposal facility at the Savannah River Site (SRS) (References 1 & 2). During its 181st meeting on July 17-19, 2007, the Committee received a briefing by U.S. Nuclear Regulatory Commission (NRC) staff members from the Office of Federal and State Materials Safety and Environmental Management Programs on these plans. The staff has prepared the monitoring plans for both sites in fulfillment of the NRC responsibilities under Section 3116 of the Ronald Reagan National Defense Authorization Act of 2005 (NDAA)[1].

The staff discussed the NRC's responsibilities under the NDAA, their general monitoring approach (that includes technical reviews and onsite observations), coordination with the DOE and the concerned states (Idaho and South Carolina), and specifics of the monitoring plans. The staff reported that they had completed technical evaluation reports (TERs) for both facilities, and that the monitoring plans address the key monitoring areas identified in these reports. The staff also discussed the criteria for compliance with the performance objectives for waste determinations provided in both the legislation and the TERs. They also indicated that they will prepare periodic compliance monitoring reports that will assess and document whether there is reasonable assurance that the DOE complies, and will continue to comply, with the performance objectives of 10 CFR 61.40 through 61.44.

The monitoring plans for disposal actions for WIR at the SRS salt waste disposal facility and INTEC tank farm are high quality, risk-informed, performance-based, and largely responsive to previous Committee recommendations. The Committee commends the staff for developing these plans in a complex technical and institutional environment.

[1] Ronald Reagan National Defense Authorization Act for Fiscal year 2005, Public Law 108-375, 118 Stat 2162, October 28, 2004

RECOMMENDATIONS

When preparing periodic compliance monitoring reports, the NRC staff should evaluate the adequacy of information produced by environmental monitoring programs performed by DOE and the host States.

The Committee recommends that future versions of these and other plans for monitoring WIR disposal actions seek environmental monitoring information from points beneath, beside, or within the WIR disposal site to provide early warning of potential radionuclide release.

The Committee recommends that future versions of these and other plans seek performance assessment results based on best-estimate and central tendency models and input parameters, preferably including a probabilistic uncertainty analysis.

Monitoring plans should focus on the extent to which the residual radionuclide inventory in WIR has been reduced considering other factors (e.g., cost, worker risk) involved in achieving this reduction, and not on evaluating whether separation efficiency goals are met.

OBSERVATIONS

The monitoring activities are focused on the performance objectives in 10 CFR 61.40 through 61.44, and the uncertainty in the DOE's evaluation of whether the performance objectives will continue to be met. Implementation of the plans uses the (1) results of monitoring activities performed by DOE and the host States, (2) modeling activities performed by the DOE, and (3) onsite observation of the DOE's experimental activities and waste disposal actions. The NRC staff reported that the plans have been favorably received by the DOE, the host States, and other stakeholder groups. The NRC staff expects these plans to be 'living documents' that evolve as the DOE's waste disposal actions progress and lessons are learned. The Committee believes that the monitoring plans embody many of the Committee's previous recommendations on related subjects, such as performance assessment, review of the DOE's draft waste determinations, and iterative monitoring and modeling of closed waste disposal sites (References 3 & 4).

The NRC staff reported that existing environmental monitoring efforts performed by the DOE and the host States will provide an adequate basis for the NRC's independent assessment of whether there is reasonable assurance the DOE will continue to comply with the performance objectives. The Committee accepts this judgment at present but notes that the validity of the staff's conclusion could be affected by information obtained from future environmental monitoring and the DOE's research programs concerning contaminant migration and the performance of engineered barriers, as well as potential changes in the DOE's approaches to the disposing of WIR.

The Committee has previously recommended that monitoring be performed near the source to provide early warning before releases occur (Reference 4). The Committee notes that existing DOE/State environmental monitoring points are at least several meters from the waste.[2]

The Committee has previously recommended that performance assessments be based on best estimates instead of conservative assumptions and models because the latter can obscure risk-significant features, events, and processes (References 3, 5-7). In their briefing, the NRC staff noted that comparison of the DOE's conservative performance assessment results is not consistent with environmental modeling.

The monitoring plan for the salt waste disposal facility at the SRS states:

> "Predicted removal efficiencies of highly radioactive radionuclides by each of the planned salt waste treatment processes are a key factor in determining the radiological inventory disposed of in saltstone."

As previously observed by the Committee (Reference 3), removal efficiency is not a meaningful measure of risk from radionuclides disposed of onsite. While removal efficiency may be useful in evaluating the effectiveness of competing radionuclide separation technologies, it does not provide insights into risks from material sent to a disposal facility unless it is combined with information concerning the initial inventory of radionuclides being sent through the separation process. The Committee reiterates its belief that the parameters relevant to risk are the inventory and spatial distribution of radionuclides in wastes that will be disposed of or stabilized onsite (e.g., saltstone) after radionuclide removal to the maximum extent practical, not the fraction or amount of radionuclides removed.

In conclusion, the Committee appreciates the forthright and responsive discussions concerning the NRC's draft monitoring plans for WIR disposal actions. We look forward to future discussions on implementation of the monitoring plans regarding evaluation of whether there is reasonable assurance that the DOE's WIR disposal actions will continue to meet the performance objectives in 10 CFR 61.40 through 61.44, and generic technical topics related to managing WIR.

Sincerely,

/RA/

Michael T. Ryan
Chairman

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[2] The terms of the settlement of a recent lawsuit brought by the National Resources Defense Council against the DOE call for monitoring beneath the SRS salt waste disposal vaults.

References

1. U.S. Nuclear Regulatory Commission Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005, dated April 13, 2007. (Adams Accession No. ML070650222)

2. U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005, dated May 3, 2007. (Adams Accession No. ML070730363)

3. Letter dated December 1, 2006, from Michael T. Ryan, Chairman, Advisory Committee on Nuclear Waste, to Dale E. Klein, Chairman, Nuclear Regulatory Commission, "Standard Review Plan for Activities Related to U.S. Department of Energy Waste Determination." (Adams Accession No. ML063380158)

4. Letter dated December 27, 2006, from Michael T. Ryan, Chairman, Advisory Committee on Nuclear Waste, to Dale E. Klein, Chairman, Nuclear Regulatory Commission, "Working Group Meeting on Using Monitoring to Build Model Confidence." (Adams Accession No. ML063620174)

5. Letter dated August 2, 2000, from B. John Garrick, Chairman, Advisory Committee on Nuclear Waste, to Richard A. Meserve, Chairman, Nuclear Regulatory, "Branch Technical Position on a Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities." (Adams Accession No. ML003737348)

6. Letter dated January 17, 2002, from George M. Hornberger, Chairman, Advisory Committee on Nuclear Waste, to Richard A. Meserve, Chairman, Nuclear Regulatory Commission, "Total System Performance Assessment and Conservatism." (Adams Accession No. 020240467)

7. Letter dated September 18, 2001, from George M. Hornberger, Chairman, Advisory Committee on Nuclear Waste, to Richard A. Meserve, Chairman, Nuclear Regulatory Commission, "Total System Performance Assessment-Site Recommendation (TSPA-SR)." (Adams Accession No. ML 012690661)

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

ACNWMR-0270

October 11, 2007

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

Dear Chairman Klein:

SUBJECT: REGULATION OF ADVANCED SPENT NUCLEAR FUEL REPROCESSING AND REFABRICATION FACILITIES

SUMMARY

Facilities for reprocessing spent nuclear fuel (SNF) and fabricating new fuels (i.e., recycle) as envisioned by the U.S. Department of Energy (DOE) would produce a range of products, wastes, and effluents that are unfamiliar to the U.S. civilian sector. Examples of such unfamiliar materials are cladding waste, a mixture of cesium and strontium, krypton-85 (^{85}Kr), technetium-99 (^{99}Tc), recycled uranium, and a mixture of transuranic elements. The potential existence of these materials raises the need to develop regulations concerning their classification, form, packaging, storage, and disposal or release.

As envisioned by DOE, future recycle facilities would be much more complex than existing recycle facilities and would contain substantial inventories of (1) liquids that could be flammable, corrosive, and highly radioactive and (2) zircaloy-clad SNF in storage pools that can burn under certain conditions. Accidents involving these materials could lead to significant offsite releases of radioactive material. The U.S. Nuclear Regulatory Commission (NRC) needs to consider these unique hazards when developing or revising regulations to license recycle facilities.

Major Recommendations

The Advisory Committee on Nuclear Waste and Materials (the Committee) makes the following key recommendations concerning regulation of SNF recycle facilities:

- Regulations for licensing recycle facilities should require the use of an approach based on probabilistic risk analysis (PRA) for facilities processing large inventories of solid and liquid radioactive materials and hazardous chemicals.

- The NRC should consider using a two-step licensing process for SNF recycle facilities until the NRC staff becomes familiar with the processes, equipment, and materials in the recycle facilities.

- The gap analysis and the technical basis document being prepared by the NRC staff should include an analysis of the current civilian waste classification and disposal system for the range of wastes that may be produced by SNF recycle facilities.

The remainder of this letter provides supporting observations and additional recommendations.

BACKGROUND

DOE is pursuing programs to develop and deploy SNF recycle[1] technology. The current DOE recycle program contemplates building a nuclear fuel recycle facility, an advanced power (burner) reactor for irradiating transuranic elements, and a research facility to develop the required recycle technology. The NRC may license the first two of these facilities. Congress directed DOE to select a site for the nuclear fuel recycle facility by fiscal year (FY) 2007 [Congress, 2005] and to initiate construction of one or more such facilities by FY 2010. Licensing SNF recycle facilities will require changes to the NRC's existing regulatory framework, which is now structured to license light-water reactors and facilities associated with the once-through fuel cycle. The Commission directed [NRC, 2006 a,b] that the Committee become knowledgeable about developments in fuel recycle and help in defining the issues most important to the NRC concerning potential licensing of fuel recycle facilities.

In FY 2006, the Committee received initial briefings by Committee consultants, NRC staff, and DOE staff on SNF recycle. Based on these briefings, the Committee decided to prepare a white paper on this subject and chartered a group of experts[2] to do so. The goal of the paper is to summarize the technical, regulatory, and legal aspects of the history, status, and issues concerning SNF recycle for the following two purposes:

(1) to provide the primary basis for the Committee's initial observations on important regulatory issues that SNF recycle would raise and recommendations to address these issues

(2) to capture the knowledge of experts and the history of SNF recycle and implications for current SNF recycle programs in line with the Commission's knowledge management goals

The Committee and NRC staff offices reviewed successive drafts of the paper. A revised draft was posted on the Agencywide Documents Access and Management System (ADAMS) site, which is accessible to the public, and a list of expert reviewers (see Enclosure 1) was invited to submit comments. The draft final version of the white paper in Enclosure 2 incorporated

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1 For the purposes of this document, "SNF recycle" involves SNF reprocessing (separating or potentially fractionating SNF into its constituent parts without producing a separated plutonium stream); refabrication (making the recovered uranium, transuranic elements, and possibly some fission products into fresh fuel or targets); storage of spent fuel; management of solid, liquid, and gaseous wastes; and incorporating radionuclides that cannot be readily destroyed by irradiation into tailored waste forms for disposal appropriate to their hazard and longevity.

2 These experts included R.G. Wymer, Oak Ridge National Laboratory (retired); L.T. Tavlarides, Syracuse University; H.J. Larson, NRC (retired); J.H. Flack (Committee staff); and A.G. Croff (Committee).

comments on the public review draft, and final comments by the Committee and its staff. The Committee also obtained information on fuel recycle from numerous other public briefings and discussions, which are listed in Enclosure 3.

OBSERVATIONS AND RECOMMENDATIONS

Primary Licensing Regulation for Recycle Facilities

The NRC could use several regulatory options to license SNF recycle facilities. All have deficiencies that must be addressed to make them suitable for this purpose [Enclosure 2, Section VIII; NRC, 2007b]. To address these deficiencies, the Commission directed the staff [NRC, 2007a] to begin developing the regulatory framework to license SNF recycle facilities using an option based on Title 10, Part 70, "Domestic Licensing of Special Nuclear Material," of the *Code of Federal Regulations* (10 CFR Part 70) by preparing the following:

- a technical basis document to support rulemaking for 10 CFR Part 70 with revisions to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," as appropriate to eliminate its applicability to licensing a SNF reprocessing plant

- a gap analysis for all NRC regulations (10 CFR Chapter I) to identify changes in regulatory requirements that would be necessary to license a reprocessing facility

The NRC has used 10 CFR Part 70 to license fuel fabrication facilities, and the regulation is currently the basis for reviewing the license application for the mixed-oxide fuel refabrication plant at the Savannah River Site. Experience and lessons learned from previous and ongoing use of 10 CFR Part 70 to license fuel refabrication facilities are likely to be useful when deciding how the regulation should be modified to license SNF recycle facilities. However, the Committee observes that important aspects of 10 CFR Part 70 will need to be addressed for it to be an efficient and effective regulation for licensing SNF recycle facilities. These aspects include the following:

- Use of an Integrated Safety Analysis (ISA): The regulations at 10 CFR Part 70 call for the use of an ISA to evaluate the hazards in a facility processing nuclear materials. Use of an ISA is an important step towards quantifying risk. However, the Committee believes that the effort required to prepare an ISA adequate for complex SNF recycle processes handling liquids containing substantial quantities of concentrated cesium, strontium, and transuranic elements is likely to approach the effort that would be required to evaluate risks using a PRA. The Committee and the Advisory Committee on Reactor Safeguards (ACRS) continue to recommend [Committee, 2002, 2006] that a regulation based on PRA is preferable to one based on ISA because the latter has significant limitations in its treatment of dependent failures, human reliability, uncertainties, and aggregation of event sequences.

  Recommendation 1: The revision of 10 CFR Part 70 for application in licensing recycle facilities should require use of PRA-based approaches for facilities processing large inventories of solid and liquid radioactive materials and hazardous chemicals.

- One-Step Construction and Operating License (Combined License): 10 CFR Part 70 allows for a one-step licensing process, which means that the design and process details necessary to review the adequacy of a recycle facility would not be available until relatively late in the licensing process. The Committee believes this approach is appropriate for facilities containing well-established processes and equipment and where there is prior licensing experience (e.g., reactors, fuel fabrication plants). SNF recycle facilities could involve equipment, processes, and materials that may require modification as a result of regulatory requirements that evolve as the license application is being reviewed.

  Recommendation 2: The NRC should consider using a two-step licensing process for SNF recycle facilities until the NRC staff becomes familiar with the processes, equipment, and materials.

- Risk-Informing Changes to 10 CFR Part 70: The NRC uses 10 CFR Part 70 to license many other nuclear material processing facilities that are much smaller, less costly, and less complex than an anticipated SNF recycle facility. Licensing requirements appropriate to SNF recycle facilities could be unduly burdensome and may need to be tempered to be cost-effective for applicants with simpler designs and well-established technology.

  Recommendation 3: The revision of 10 CFR Part 70 to license SNF recycle facilities could have unintended consequences for other types of facilities. The revision of 10 CFR Part 70 to accommodate SNF recycle facility licensing should be risk informed by embodying a graded approach to licensing requirements. Decisions in applying the graded approach should be based on the complexity of the facility and the size, form, and potential hazard of the projected nuclear material inventory. Guidance that supports the regulations could specify requirements for various facility types.

- Basing 10 CFR Part 70 Changes on Performance: It is important that 10 CFR Part 70 be performance based. Performance-based criteria for granting a license are expressed in terms of the requirements the applicant must meet but not the means by which the applicant meets the requirement. This allows the applicant to select the most efficient means to meet the requirements based on the specific circumstances of each facility.

  Recommendation 4: Revisions to 10 CFR Part 70 to accommodate SNF recycle facilities should be performance based.

- Specificity of Changes to 10 CFR Part 70: The NRC staff paper [NRC, 2007b] presenting options for licensing SNF recycle facilities focused on the DOE Global Nuclear Energy Partnership (GNEP) and the facilities currently being proposed by the GNEP. The Committee believes the scope, functional requirements, size, and timing of these facilities are still evolving and are likely to change in response to factors such as technology development, budget considerations, stakeholder input, and broader U.S. and international decisions on nuclear and energy policy.

Recommendation 5: Revisions to 10 CFR Part 70 should be sufficiently flexible so that they apply to a broad range of recycle technologies, equipment, and facility design concepts.

Impacts of SNF Recycle on Waste Management and Classification

Recycle of SNF could generate waste types that have not been produced in the U.S. civilian sector in decades (e.g., high-level liquid waste, cladding waste) and some that have never been produced anywhere (e.g., ^{85}Kr waste, combined cesium/strontium waste). The number and nature of these wastes are presently not known. They depend on future decisions such as the number of streams into which the SNF is fractionated and the extent to which internal streams are combined for purposes of waste management. To provide a basis for the discussion of the waste management and classification system, the white paper (Enclosure 2) includes an analysis of the types of wastes that might be generated if SNF recycle were to be implemented using the UREX+1a process under development by DOE.

The UREX+1a process could result in the following products and wastes:

- uranium containing traces of radionuclides such as ^{99}Tc and neptunium-237 (^{237}Np) that is expected to be reused
- a mixture of transuranic elements that could be stored for a few decades and eventually refabricated and fissioned in a reactor
- separate waste forms destined for disposal containing hydrogen-3 (^{3}H), carbon-14 (^{14}C), ^{85}Kr, iodine-129 (^{129}I), and, in the case of fuel that has been out of the reactor for less than about 5 years, ruthenium-106 (^{106}Ru) and antimony-125 (^{125}Sb)
- a waste form destined for disposal containing the cladding from which most of the SNF matrix has been removed, insoluble solids that remain after dissolving most of the SNF matrix, and possibly most of the ^{99}Tc
- a waste form containing essentially all of the strontium-90 (^{90}Sr) and cesium-135 and -137 (^{135,137}Cs) destined for long-term (about 300 years) storage in an engineered surface facility followed by closure in place
- a vitrified waste form destined for disposal containing essentially all of the fission products not mentioned above plus traces of actinides
- a wide variety of solid wastes (e.g., failed process and laboratory equipment, used protective clothing) or wastes converted to solids (e.g., analytical solutions, ion exchange material) destined for disposal and containing concentrations of transuranic radionuclides greater than 100 nanocuries per gram (nCi/g)

Based on traditional interpretations of the definition of high-level waste (HLW) and waste classification Tables 1 and 2 in 10 CFR Part 61.55, "Waste Classification," the following classifications would apply:

- Captured ^{85}Kr would be Class A waste because it is not listed in the tables.

- ^{14}C, ^{129}I, and cladding waste with or without ^{99}Tc are all likely to be greater-than-Class C (GTCC).

- The vitrified fission product waste would be HLW.

- Cesium/strontium waste could be HLW, GTCC low-level waste (LLW), or Class C LLW depending on the interpretation of the definition of HLW, the extent to which credit is given for decay occurring during about 300 years of interim storage, and how risks posed by long-lived ^{135}Cs (not included in the tables) are taken into account.

The Committee believes these classifications raise questions such as the following:

- Are the classifications appropriate given the risks posed by the wastes?

- Do current efforts to define a disposal destination for GTCC wastes consider potential SNF recycle wastes?

- How should the unique features of a waste incidental to reprocessing determination for cesium/strontium waste be addressed if this waste is determined to be HLW?

As described above, reprocessing SNF yields a variety of wastes having differing radionuclide concentrations. Reprocessing plant operations [Vernaz, 2006] have improved to the point that the volume of wastes (excluding uranium and plutonium) from a reprocessing plant that are destined for disposal in a deep geologic repository is about the same as the volume of the SNF fed to the plant. The combined radioactivity of the wastes from reprocessing SNF is essentially the same as that of the original SNF.

Risk-informed, performance-based criteria will also need to be devised for (1) appropriate waste forms for an inert gas (^{85}Kr) and two very-long-lived and environmentally mobile radionuclides (^{14}C and ^{129}I) and (2) acceptable disposal destinations for each type of waste (e.g., near-surface disposal, deep geologic disposal, intermediate-depth disposal). Finally, requirements for engineered and institutional controls for long-term, near-surface storage of nuclear material may be needed for facilities storing very radioactive transuranic product for times extending to decades and cesium/strontium waste for a few hundred years followed by facility closure as a cesium/strontium disposal site.

Recommendation 5: The gap analysis and the technical basis document being prepared by the NRC staff should include an analysis of the current civilian waste classification and disposal system for the range of wastes that may be produced by SNF recycle facilities.

Recommendation 6: The NRC should consider initiating a comprehensive study on the durability of engineered and institutional controls for the purpose of establishing the basis for a consistent risk-informed NRC policy on the extent to which credit can be taken for such controls. Applications to be considered include radioactive material storage, near-surface waste disposal, and control of decommissioned sites and facilities.

Impacts of SNF Recycle on Regulation of Effluent Releases

Reprocessing SNF releases volatile radionuclides to gas streams inside the facility. A U.S. Environmental Protection Agency (EPA) standard (40 CFR Part 190) effectively requires capturing 99.5 percent of the ^{129}I and 85 percent of the ^{85}Kr originally present in the SNF. The regulation does not provide specific limits on the amount of other volatile radionuclides that can be released. Captured radionuclides would be converted to a suitable form,[3] packaged, and sent to a disposal facility. Reprocessing facilities in France capture about 99.5 percent of the ^{129}I and about 35 percent of the ^{14}C and release them to the sea. The ^{3}H, which is present in low concentrations in process water, is also released to the sea.

The Committee notes the following:

- EPA had planned to consider limits on the releases of ^{3}H and ^{14}C but never completed this activity. These radionuclides could be significant contributors to the dose from releases to the environment from recycle facilities.

- The approach used by EPA to establish the existing release limits in 40 CFR Part 190 involved dividing the estimated cost of various options for removing a volatile radionuclide by the collective dose (person-rem) to the affected population and comparing the result to criteria such as limiting expenditures on effluent treatment to $1000/person-rem. For the volatile radionuclides, calculation of the collective dose involved multiplying a small dose to individuals by a large population that is exposed to the dispersed radionuclides. Previous Committee letters [Committee, 2005] have stated that this approach to estimating the absolute impacts of radionuclides is not technically defensible, and the Committee reiterates that position here.

- Capture of ^{129}I in the French and United Kingdom reprocessing plants is accomplished by aqueous scrubbing of the off-gas. This approach is efficient in this situation because the resulting solutions are intended to be released to the sea. However, water scrubbing is not efficient if radionuclides need to be recovered for packaging and land disposal, as is likely in the United States, because additional recovery processes would be required. If ^{129}I is to be captured for land disposal, the currently preferred approach uses a solid sorbent containing silver in one of a number of forms. The Rokkasho reprocessing plant, which is just beginning operations, uses such sorbents, but there is little experience with silver-based sorbents in large, modern reprocessing plants or in combination with other off-gas treatment systems that may be required in the United States.

Recommendation 7: The NRC should hold interagency discussions with EPA on whether (1) existing release limits for ^{85}Kr and ^{129}I need to be reexamined to reflect current technology and (2) release limits need to be established for ^{3}H and ^{14}C. Additionally, methodologies based on concepts other than collective dose should be used as a basis for revised release limits.

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3 Potential waste forms for ^{85}Kr include pressurized gas cylinders, a solid zeolite waste form, and a sputtered metal waste form.

Impacts of SNF Recycle on Other Regulations

Implementation of civilian SNF recycle would require modification of regulations other than the primary regulation for licensing SNF recycle facilities. The Committee believes that 10 CFR Part 61 and 10 CFR Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada," should receive particular attention.

Regarding 10 CFR Part 61, the Committee is aware that the NRC staff, pursuant to Commission direction [NRC, 2005], is undertaking an analysis of whether depleted uranium warrants inclusion in the waste classification tables in 10 CFR 61.55, "Waste Classification." Wastes resulting from SNF recycle that might be considered for near-surface disposal may contain other significant concentrations of radionuclides that are also not listed in the waste classification tables, including ^{85}Kr, ^{135}Cs, and recycled uranium containing minor uranium isotopes and trace amounts of some fission product and transuranic elements if the uranium were to be declared waste.

Recommendation 8: The NRC staff's ongoing evaluation of whether a specific concentration limit and classification should be developed for depleted uranium in the 10 CFR Part 61 waste classification tables should consider including ^{85}Kr, ^{135}Cs, and uranium recovered from a recycle facility.

Implementation of SNF recycle could have major impacts on a deep geologic repository. Depending on the outcome of decisions on disposal of GTCC waste, the repository might receive a variety of wastes that could affect its design and operation. The Committee believes that repository licensing regulations and associated guidance have not been devised with these situations in mind.

Recommendation 9: The NRC staff should assess the possible impacts of SNF recycle and associated wastes on a potential deep geologic repository. Accommodating SNF recycle may change the licensing requirements for a deep geologic repository.

Implications of SNF Recycle for NRC Infrastructure and Knowledge Needs

The NRC staff may need access to facilities and equipment for confirmatory research to validate key assumptions and data used by an applicant to support an SNF recycle facility license application. Of particular importance are hot cell facilities capable of handling significant quantities of highly radioactive solid and liquid materials. In the United States, such facilities exist almost exclusively at DOE sites. The number of appropriate hot cells is dwindling as is the NRC's access to them. This is evidenced by the delays that lack of access to a key hot cell at Argonne National Laboratory (ANL) has caused the NRC in obtaining information concerning the performance of high-burnup (greater than 45 GWd/MT) SNF.

Recommendation 10: The NRC should assess its future needs for hot cells and the potential availability of hot cells for the purpose of deciding on a strategy to maintain the required level of access for NRC confirmatory research. Options considered should include hot cells in the United States and in other countries.

The Committee believes it is necessary for the NRC staff (and the Committee) to remain abreast of DOE technical activities to provide the historical context (e.g., the alternatives that

were considered and rejected and the reasons for it) and technical insights to support development of regulations and then review a license application. The Committee believes the recent establishment of a memorandum of understanding between the NRC and DOE in this regard is a positive step.

Recommendation 11: The Committee recommends that the NRC staff continue to keep abreast of the DOE SNF recycle technology development program and that such involvement extends to NRC observation of key experimental activities such as the GNEP Coupled End-to-End Demonstration being conducted over the next few years.

Research Needs

To fulfill its role in developing regulations and reviewing a license application for SNF recycle facilities, the NRC staff needs to independently assess the safety of the facilities. Such an assessment requires sufficient understanding of key technical aspects of the processes and materials in the plant. The Committee noted a number of research needs likely to be important to the NRC's regulatory role. Enclosure 4 summarizes these needs.

Recommendation 12: The NRC should consider supporting research concerning radionuclide separation factors, integrated modeling of SNF recycle facilities, data and methods supporting cost-benefit analyses to assess effluent controls, chemical and radiolytic degradation of solvents and ion exchange media, the durability of institutional controls and cement for 300 years or more, the performance of novel waste forms (e.g., for krypton, iodine, carbon, and cesium/strontium), and the behavior of tritium in cladding under high-temperature oxidizing conditions.

Timing and Urgency[4]

The Committee notes a number of time-consuming activities that should be completed before receipt of a license application for SNF recycle facilities to provide the basis for preparation and efficient review of the application. These activities include developing the licensing requirements for recycle facilities, modifying supporting regulations (e.g., 10 CFR Parts 50, 51, 61, 63, 73, 74, and 75), preparing guidance documents underpinning the foregoing, establishing release limits for volatile radionuclides such as ^{3}H and ^{14}C, and reconsidering the waste classification and disposal technology system. Establishing release limits for volatile radionuclides could take a particularly long time because of the likely need to perform engineering design, cost, and risk studies as a basis for the limits.

The Committee notes that DOE also needs to complete a number of time-consuming activities before it can submit a license application for a recycle facility having the full capabilities presently envisioned by DOE (i.e., using the UREX+1a or other flowsheet). These activities include completing the development and testing of a complex four-step reprocessing flowsheet, testing equipment to implement the flowsheet, developing waste treatment processes and disposal facilities for a number of novel waste streams, completing a generic environmental impact statement for the recycle program, designing the facility, and preparing the license application and other regulatory documents.

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4 See discussion in Section IX.F of Enclosure 3.

The Committee estimates that, in the foregoing scenario, the time required to accomplish both the regulatory and DOE activities is likely to be at least several years, but this estimate has substantial uncertainty. The Committee notes that DOE could decide to initially deploy SNF recycle facilities that do not have the full capabilities presently envisioned by the department and add additional modules over time to achieve the full capabilities. Such a facility is significantly less complex than a facility having all the envisioned capabilities at the outset and represents only a modest extension of existing technology. As a consequence, the time required to develop and submit a license application could be significantly less than the time needed to prepare an application for a fully capable facility, but the time required to undertake the required regulatory development would not be significantly reduced.

Recommendation 13: The Committee recommends that the highest priority should be given to modifying regulations concerning release limits for volatile radionuclides from SNF recycle facilities and addressing the interrelated issues related to waste classification and disposal destinations for novel wastes that could be produced by SNF recycle facilities.

Recommendation 14: The Committee recommends that the NRC staff monitor DOE plans for implementing SNF recycle because DOE could develop a license application for a recycle facility based on a modest extension of existing technology in a timeframe that could challenge the ability of the NRC to establish a regulatory framework for recycle facilities.

Path Forward

The Committee appreciates the many informative briefings and discussions with staff members from the Office of Nuclear Material Safety and Safeguards, the Office of Federal and State Materials and Environmental Management Programs, and the Office of Nuclear Regulatory Research. The Committee looks forward to future interactions with NRC staff on activities that impinge on SNF recycle. Additionally, the Committee plans to continue modest efforts to keep abreast of SNF recycle technology and plans.

Enclosures: As stated

Sincerely,

Michael T. Ryan
Chairman

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