



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

ACNWR-0253

December 1, 2006

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

SUBJECT: STANDARD REVIEW PLAN FOR ACTIVITIES RELATED TO U.S.
DEPARTMENT OF ENERGY WASTE DETERMINATIONS

Dear Chairman Klein:

The U.S. Department of Energy (DOE) is expected to pursue a number of determinations that certain wastes resulting from spent nuclear fuel reprocessing are not high-level waste (HLW) as a prerequisite to allowing disposal at sites for non-HLW. The Nuclear Regulatory Commission (NRC) staff is currently developing a Standard Review Plan (SRP) to evaluate DOE's draft waste determinations and has released a draft¹ for public comment. In this letter, the Advisory Committee on Nuclear Waste (Committee) provides its observations and recommendations on the draft SRP, based on information obtained from the following:

- Activities in 2005 summarized in a previous letter² that provided the Committee's insights on development of the SRP. These activities included attending the SRP public scoping meeting, holding a two-day public working group meeting on waste determinations, and visits to the Savannah River and Idaho sites by one or more Committee and Committee staff members.
- A briefing by the National Academy of Sciences on their report³ concerning topics related to DOE waste determinations.

¹U.S. Nuclear Regulatory Commission, *Standard Review Plan for Activities Related to U.S. Department of Energy Waste Determinations*, NUREG-1854, draft for interim use and comment (May 2006).

²Ryan, M.T., Chairman/Advisory Committee on Nuclear Waste, Letter to the Honorable Nils J. Diaz, Chairman/U.S. Nuclear Regulatory Commission [Subject: "Development of a Standard Review Plan for U.S. Department of Energy Waste Determinations"], dated December 9, 2005.

³National Academy of Sciences, *Tank Waste Retrieval, Processing, and On-Site Disposal at Three Department of Energy Sites*, Committee on Management of Certain Radioactive Waste Streams Stored in Tanks at Three Department of Energy Sites, National Research Council (2006).

- A DOE technical exchange meeting on tank cleanup technologies that was attended by a Committee member and a member of the Committee staff.
- A general briefing by the NRC staff on their approach to developing the draft SRP during the 170th (May 23–26, 2006) Committee meeting.
- A detailed review of the draft SRP and briefings by the NRC staff in the 172nd (July 17–20, 2006) and 174th (November 13–16, 2006) Committee meetings.

The Committee believes that the NRC staff has done a commendable job preparing a draft SRP on a very complex topic. However, the Committee has a number of observations and recommendations aimed at better defining how the NRC staff will review information contained in a waste determination document. Committee observations and recommendations are provided on the following topics: performance assessment (PA), radionuclide removal and technology assessment, level of confidence, use of existing regulations and guidance, and waste classification and disposal.

1. Performance Assessment

The results of a PA are central to DOE's support for, and the NRC's evaluation of, draft waste determinations. Guidance in the draft SRP (p. 4-40, lines 6-21) states a preference for probabilistic PA approaches, but allows for deterministic PA approaches to demonstrate compliance with the performance objectives. The draft SRP states that if the deterministic modeling is used, it should be reasonably conservative and sufficiently documented. Additional sensitivity analyses may be needed if only deterministic analyses are performed. Deterministic PA results that are believed to be conservative have long been used to demonstrate compliance with a wide variety of regulations. This approach is not risk-informed. The Committee believes that conservative analyses can mask uncertainties and hinder identification of risk-significant items important to evaluating PA results as suggested in the draft SRP (p. 4-40, lines 19-21 and elsewhere). The Committee also notes that the draft SRP contains a good discussion of the advantages and disadvantages of probabilistic and deterministic PA approaches. However, an enhanced discussion that describes how a reviewer should evaluate the adequacy of models, assumptions, and data used in a deterministic PA, and how a reviewer should evaluate conceptual model uncertainty in a probabilistic PA would be helpful.

Recommendation: The SRP should more clearly indicate and expand on the preference for using a probabilistic PA approach and an associated uncertainty analysis. Further, the SRP should provide more detail regarding the review of the adequacy of information and models used in a deterministic PA approach. Finally, the SRP should be expanded to better inform a reviewer about the process to identify and evaluate risk-significant items in deterministic PAs.

2. Radionuclide Removal and Technology Assessment

One criterion used to determine that waste is not HLW is to confirm that radionuclides have been removed to the maximum extent practical.⁴ This section discusses the way to decide whether or not this criterion has been met and the assessment of technologies used for additional radionuclide removal.

2.1 Basis for Determining that Radionuclides Have Been Removed to the Maximum Extent Practical

The draft SRP (p. 3-12, lines 4-9) states that the NRC staff should verify the reliability of radionuclide removal efficiency, where efficiency is the amount or fraction of the initial waste volume or radionuclide inventory that has been removed. The Committee believes that removal efficiency is not a meaningful measure of risk from radionuclides disposed of on-site. While removal efficiency may be useful in evaluating the effectiveness of competing radionuclide removal technologies, it does not provide any insight into risks from residual radioactive material. The Committee believes that the parameters relevant to risk are the residual inventory and spatial distribution of radionuclides in wastes that will be disposed of or stabilized on-site after radionuclide removal to the maximum extent practical, not the fraction or amount of radionuclides removed.

The draft SRP provides guidance on evaluating DOE's decision that radionuclides have been removed to the maximum extent practical. This decision is typically based on a comparison of costs (monetary), risks (estimated worker dose and possible impacts on the public during operations), and benefits (estimated public dose averted) using cost-benefit techniques. The draft SRP discusses (p. 3-14) a traditional approach⁵ to determining collective dose to the public that could be used as a basis for evaluating DOE's decision. The draft SRP also notes some limitations in its use in waste determinations. As discussed in an earlier letter,⁶ the Committee believes collective dose is not meaningful in determining absolute risk and that its use as stated in the draft SRP is inappropriate. More appropriate measures of risk to the public are the dose of an appropriately selected, reasonably maximally exposed individual (RMEI) or the average member of the critical group.

⁴Radionuclide removal to the maximum extent practical involves two separate decisions: whether radionuclides have been retrieved from the tanks to the maximum extent practical; and whether radionuclides have been separated by processing from retrieved waste to the maximum extent practical.

⁵Dividing the estimated cost of some action by the integral of the estimated individual dose to an unbounded population and comparing this ratio to a metric of \$2000 per averted person-rem.

⁶Ryan, M.T., Chairman/Advisory Committee on Nuclear Waste, Letter to the Honorable Nils J. Diaz, Chairman/U.S. Nuclear Regulatory Commission [Subject: "Comments on USNRC Staff Recommendations of (sic) the use of Collective Dose"], dated September 30, 2005.

Recommendation: SRP guidance concerning whether radionuclides have been removed to the maximum extent practical should focus on the reduction of risk from the residual radionuclide inventory in non-HLW that will be disposed of or stabilized on-site and the multifaceted impacts (e.g., cost, worker risk) of achieving this reduction.

In addition, a traditional approach to collective dose to the public should not be used to evaluate the basis for DOE's decision that radionuclides have been removed to the maximum extent practical. The Committee suggests that the RMEI or the average member of the critical group are better measures of the dose impact of various alternatives.

2.2 Technology Assessment

The draft SRP (p. 3-8, 3-9) appropriately calls for an assessment of technologies as part of evaluating whether DOE has removed radionuclides to the maximum extent practical, and suggests that information about available technologies can be obtained from the reports from third parties (e.g., NAS, DNFSB), and from DOE sites and meetings. The Committee notes that additional sources of potentially applicable technology include other countries (e.g., Russia, U.K., France) and industries (e.g., petroleum industry) facing similar or related remediation situations.

The assessment of potential use of competing technologies in additional radionuclide removal depends on the time and cost required to take a specific technology from its present state of maturity to deployment, as well as its projected effectiveness at removing radionuclides. This assessment is constrained by the limited amount of time likely to exist between evaluation of a waste determination and commencement of radionuclide removal operations. This would logically lead a reviewer to focus on more mature technologies. The Committee believes that additional guidance that addresses the considerations involved in assessing competing radionuclide removal technologies would be useful. Further, the Committee notes that the time and cost to bring new technologies to maturity may constitute a disincentive to development of more effective technologies.

The draft SRP (p. 3-8, lines 28-38) provides guidance concerning the need to consider retrieval technologies that selectively remove radioactive materials from residual waste rather than removing bulk waste containing radionuclides. The Committee believes that the most practical radionuclide removal efforts may result from use of a suite of alternating, sequential, or situational technologies rather than repetitive use of one or two technologies.

Recommendation: The SRP guidance on assessing technologies used for radionuclide removal should focus on systematic consideration of the integrated cost, technology maturity, and extent to which additional radionuclides might be removed by relatively mature technologies, using information obtained from DOE, international, and industrial sources. The Committee believes that the staff's technology assessment should also include an effort to monitor the status of less mature radionuclide removal technologies for potential future consideration. Technology assessment should consider the sequencing of and synergism among candidate technologies.

3. Level of Confidence

The draft SRP (p. 10-2, lines 5-14) states that monitoring may be required to validate DOE assumptions and that relevant new information should be evaluated by NRC for its potential effect on whether DOE disposal actions are in compliance with the performance objectives. The Committee believes this approach has conceptual and technical limitations. First, it is impossible and potentially counter productive to monitor some aspects of the disposal system (e.g., the internal condition of a large grout monolith), because the required technology does not exist or monitoring could compromise some barriers to radionuclide release. Second, any monitoring data obtained after tank closure that potentially indicates noncompliance with performance objectives are most likely to be obtained well after irreversible closure has occurred. The Committee believes this puts greater emphasis on a robust PA.

Recommendation: The SRP should emphasize complying with performance objectives based on a robust PA, and that reviewers should not rely on post-closure monitoring as a substitute for inadequately supported information used in a PA.

4. Use of Existing Regulations and Guidance

The Committee notes there are basic differences between 10 CFR Part 61 and 10 CFR Part 835 concerning the methods used to calculate dose. In 10 CFR Part 61, the dosimetry is based on Report 2 of the International Commission on Radiological Protection (ICRP-2), which established an annual limit of dose from radioactive materials taken into the body and external exposure during a given year. However, dose calculations in 10 CFR Part 835 are based on reports ICRP-26 and ICRP-30 that call for assigning the calculated cumulative 50-year dose (i.e., the committed dose) resulting from radionuclide intakes in a given year to that year of practice. Updated metabolic models that follow the methods used in reports ICRP-26 and ICRP-30 are provided in report ICRP-72.

The dose associated with intakes in a given year from radionuclides that remain in the body for short times (days to months) (e.g., tritium) is the same using either approach. However, for radionuclides that remain in the body at essentially unchanging levels for at least 50 years, such as ²³⁹Pu, an annual dose of 1 rem leads to a 50-year committed dose of approximately 50 rem. Thus, meeting a performance objective of 25 mrem/yr using the ICRP-2 approach in 10 CFR Part 61 would result in a committed dose that is 50 times higher for many radionuclides (e.g., for most actinides) than using the dosimetry approach in 10 CFR Part 835.

The Committee believes the differences in these two methods could lead to inconsistent dose evaluations and confusion. The Committee also believes that allowing for use of more risk-informed regulations and guidance (e.g., the more recent dosimetry approaches in 10 CFR Parts 20 and 835) is appropriate.

Recommendation: The Committee recommends that more specific guidance concerning differences in approaches to dosimetry and preferred dosimetry approaches be provided in the SRP for key radionuclides anticipated to be important in waste determinations. This guidance should be consistent with other NRC staff guidance on dosimetry and should contain specific examples.

5. Waste Classification and Disposal

The draft SRP provides guidance (p. 3-18, lines 36-43) that extreme measures such as deliberate blending of lower- and higher-activity waste streams should not be undertaken to achieve waste classification objectives such as avoiding classification of a waste as greater-than Class C. The Committee believes that there can be sound technical reasons for deliberately blending some waste streams, such as to meet feed specifications for radionuclide removal and waste treatment processes, even though it might result in achieving waste classification objectives that might otherwise be deemed to be unacceptable.

The draft SRP provides general guidance (p. 3-18, lines 10-11) that radionuclide concentrations can be averaged over stabilizing material, such as grout added to immobilize the waste, but not material added to stabilize a structure such as a waste tank. In addition, the draft SRP provides specific guidance (p. 3-20, lines 16-18) that the average concentration of radionuclides in the waste plus the stabilizing material should generally be within a factor of 10 of the radionuclide concentration in the unstabilized waste. Guidance concerning averaging is important in determining the radionuclide concentrations to be compared to Tables 1 and 2 in 10 CFR Part 61 for the purpose of determining the classification of the waste.

The Committee believes that concentration averaging guidance in the draft SRP does not sufficiently take into account differences between scenarios appropriate for evaluating shallow (less than 5m below surface level) low-level waste disposal facilities and scenarios appropriate for non-high-level waste disposal facilities such as those for stabilized tank waste. In particular, the limiting scenario considered when developing 10 CFR Part 61 involved a person intruding into 232 m³ of low-level waste buried within a few meters of the earth's surface during construction of the foundation for a house and subsequently living at this location (NUREG-0782, p. G-58). In the case of DOE's large underground storage tanks, the topmost portion of the tanks is projected to be below the likely depth of a house foundation when closed and capped (several meters below the earth's surface), and that much of the residual radioactive material will be an additional several meters below the top of the tank beneath layers of grout and steel.

In addition, the Committee questions the technical basis for generally limiting the maximum reduction in radionuclide concentrations resulting from averaging to a factor of 10. This limit is based on the capability of grout to accommodate a 10% waste loading (p. 3-20, lines 18-21). The Committee believes the stated basis for limiting the reduction in radionuclide concentrations to a factor of 10 is not representative of the actual physical situation expected in the tank and a more risk-informed approach is warranted.

The draft SRP provides two guidelines (p. 2-6, lines 34-40) concerning how to evaluate whether a waste does not require disposal in a repository for HLW. The first is that the waste meets other technical criteria such as the performance objectives and removal of radionuclides to the maximum extent practical. The Committee believes this guideline to be risk-informed and appropriate. The second guideline the draft SRP states is that “no other characteristics of the waste would require that the waste be disposed of in a deep geological repository to protect public health and safety” without further elaboration. The Committee believes the second guideline is too vague to allow DOE to decide whether to submit a draft waste determination for a particular waste or for the NRC staff to use this guideline. Additionally, the Committee notes that the NRC staff has not identified any waste characteristics that might fall under this guideline.

If the waste addressed in some draft waste determinations is greater-than Class C, then DOE must consult with the NRC on its plans for on-site disposal of that waste. The draft SRP (p. 3-22, lines 46-48) directs the reviewer to consider how DOE’s disposal plans, with respect to form and disposal methods, are different and, in general, more stringent than plans that would be proposed for disposal of Class C waste. The Committee notes that requirements in 10 CFR Part 61 for disposal of Class C waste are generic as a consequence of needing to encompass sites having a broad range of characteristics, while a draft waste determination addresses the proposed disposal of a specific waste at a specific site. Thus, from a risk perspective it is entirely conceivable that the natural features of some specific sites would not require increased stringency to readily meet the performance objectives for some specific wastes. An example of this might be a thin layer of greater-than Class C waste in the bottom of a tank covered by several meters of grout located at a remote, arid DOE site. The Committee emphasizes that risks from wastes in a near surface disposal facility are more closely proportional to the total quantity of radioactive material constituting the source term, rather than the radionuclide concentration in or classification of specific wastes. The Committee believes the unconditional call for increased stringency based on a generic waste classification is not risk-informed.

The draft SRP guidance (p. 3-21, lines 34-37) discourages calculations from factoring in the likelihood of an the inadvertent intrusion scenario. However, the generic inadvertent intrusion scenario in 10 CFR Part 61 and an inadvertent intrusion scenario for a specific DOE waste determination site will involve different assumptions regarding disposed wastes and waste forms, site features, disposal technologies, barriers to intrusion, and institutional controls. The Committee believes the SRP guidance on evaluating the inadvertent intrusion scenario (p. 3-21, lines 12-24) is risk-informed and appropriate because it recognizes the potential need for assumptions other than those in 10 CFR Part 61, and focuses the reviewer on the performance objectives. The draft SRP guidance (p. 3-21, lines 34-37) is inconsistent with a risk-informed approach because it limits how the differences are to be addressed.

Recommendation: The SRP’s guidance concerning blending of lower and higher activity waste streams should be modified to state that blending should not be undertaken solely for the purpose of achieving waste classification objectives, but may be appropriate under certain circumstances.

Recommendation: The guidance that limits the extent to which radionuclide concentrations in radioactive material can be averaged over a mass or volume that includes non-radioactive materials such as soil, grout, packaging, or structural material should be replaced with risk-informed guidance. The new risk-informed guidance should use scenarios and assumptions to calculate the average radionuclide concentrations that are based on the specific characteristics of the waste, disposal site, and method of disposal for the proposed non-HLW consistent with the requirements in Section 3116 of the NDAA.

Recommendation: The guidance about characteristics that might lead to a waste requiring HLW repository disposal should be elaborated to indicate that no such characteristics have been identified. It should also state this section of the SRP will be developed if the need arises.

Recommendation: The guidance that a reviewer should expect disposal requirements for greater-than Class C waste to be more stringent than those for Class C waste should be modified. The modification should focus the reviewer on whether a specific instance of non-HLW disposal meets applicable performance objectives and allow for the necessary stringency of disposal requirements to be determined on a case-by-case basis.

Recommendation: The Committee recommends retaining the guidance concerning evaluation of the intruder scenario found at p. 3-21, lines 12-14 and deleting the guidance found at p. 3-21, lines 34-37.

The Committee looks forward to hearing from the NRC staff on the resolution of comments received on the draft SRP and reviewing the implementation of the SRP after its application in representative cases.

Sincerely,

/RA/

Michael T. Ryan
Chairman