**UNITED STATES**
**NUCLEAR REGULATORY COMMISSION**
**ADVISORY COMMITTEE ON REACTOR SAFEGUARDS**
**WASHINGTON, DC 20555 - 0001**

December 13, 2011

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REVISED BRANCH TECHNICAL POSITION ON CONCENTRATION AVERAGING AND ENCAPSULATION OF LOW-LEVEL RADIOACTIVE WASTE

Dear Chairman Jaczko:

During the 589th meeting of the Advisory Committee on Reactor Safeguards (ACRS), December 1-3, 2011, we reviewed the staff's draft Branch Technical Position (BTP) on Concentration Averaging and Encapsulation, Revision 1, for disposal of low-level radioactive waste (LLRW). Our Radiation Protection and Nuclear Materials Subcommittee also reviewed this matter and associated issues on October 4, 2011. During these meetings, we had the benefit of discussions with representatives of the NRC staff and the Department of Energy. We also had the benefit of the documents referenced.

**CONCLUSIONS AND RECOMMENDATIONS**

1. The revised BTP should be issued for public comment after consideration of our comments.

2. The guidance provided in the revised BTP on alternative approaches provides flexibility to LLRW generators and disposal licensees, and is a good first step in improving management of LLRW.

3. The guidance provided in the revised BTP for blending LLRW is also a good approach for managing LLRW. However, the staff should continue to develop appropriate guidance to ensure that constituents in blended wastes are compatible and will result in satisfactory waste forms.

4. The staff's approach to protect an inadvertent intruder from exposure to disposed LLRW uses generic, stylized bounding calculations that assume a fixed set of conditions to judge the acceptability of disposal of LLRW. This approach does not consider site specific physical or design features that would impact the likelihood of inadvertent intrusion. The use of stylized scenarios should be replaced with an approach that takes into consideration site specific geohydrological features, depth of burial, waste characteristics, engineered disposal features, and their degradation over time.

5. If the staff believes that 10 CFR Part 61 constrains the use of a more risk-informed, performance-based treatment of intruder scenarios, then we recommend using the same scenarios used to develop 10 CFR Part 61 without creating additional unrealistic scenarios to determine allowable concentrations or amounts of LLRW to be disposed.

**BACKGROUND**

On April 7, 2010, the staff transmitted SECY-10-0043, "Blending of Low-Level Radioactive Waste," with a recommendation that the Commission adopt a risk-informed, performance-based approach to LLRW blending. In a Staff Requirements Memorandum (SRM) dated October 13, 2010, the Commission approved the staff's plan and directed that the staff develop a revised BTP addressing the circumstances under which large-scale blending would be acceptable. This SRM also directed the ACRS to review the revised BTP prior to being issued for public comment.

**DISCUSSION**

The following discussion provides comments on four main topics in the revised BTP. These topics are guidance on alternative approaches, guidance on blending of LLRW, guidance on encapsulation of LLRW, and updates to the intruder scenarios.

Guidance on Alternative Approaches

The BTP has been revised to remove the restrictive Alternative Provision section from the 1995 version of the BTP and to provide applicable "look up" guidance for users of the BTP on alternative ways to address site-specific considerations to meet the provisions of the BTP. The staff stated they will include additional examples to demonstrate the use of the Alternative Approaches section of the revised BTP including factors such as likelihood of intrusion, large component disposal, and encapsulation of sealed sources. This approach will provide greater flexibility than the guidance in the 1995 version of the BTP.

Guidance on Blending of LLRW

The BTP has been revised to provide a method to average radionuclide concentrations of radioactive materials contained in packages of "blended" LLRW to assess conformance with the protection requirements for a hypothetical inadvertent intruder. The revised BTP removes several unnecessary conservatisms from its 1995 version. For example, the revised BTP removes the factor of 10 constraint for blending wastes[1] and the exceptions previously in place for homogeneous wastes.

The revised BTP also provides guidance by which to evaluate radioactive material homogeneity in wastes for the purpose of protecting inadvertent intruders (e.g. resident farmers, homesteaders, and others) from exposure scenarios consistent with those evaluated during the promulgation of 10 CFR Part 61. The staff's approach is consistent with Commission direction to revise the BTP regarding the circumstances under which large-scale blending would be acceptable.

Blending involves mixing of potentially large volumes of multiple classes of waste which when aggregated will be classified as a lower class of waste. This process is intended to create blended wastes that will meet Class A requirements. Care must be taken however, to assure that the final waste product will have appropriate physical and chemical characteristics so that the waste will meet all requirements for the entire period of performance. For example, blending resins of different forms (organic/styrene with mineral/chabazite/silica) may create or result in a final waste form with undesirable chemical characteristics, such as gas generation, that are not intended, or physical characteristics that cause the waste form to behave in undesirable ways.

Blending waste forms to achieve class reduction and or volume reduction should be preceded by tests or other actions to ensure that the final waste form has the required chemical and physical characteristics.

Guidance on Encapsulation

The BTP has been revised to provide additional guidance on encapsulation of wastes, specifically to address disposal of sealed sources. The limits on the disposal of these sources are driven by the consideration of inadvertent intruders.

The scenarios used to develop the limits on the encapsulation of sealed sources in the revised BTP are overly conservative. They are based on postulated future intrusion by persons with no knowledge regarding the disposed radioactive materials. These intruders are assumed to be unable to recognize or determine that they are on a radioactive waste disposal facility. They do not take into consideration important elements such as the depth of burial.

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[1] Section 3.1 Mixing of homogeneous waste types or streams, of the 1995 version of the BTP states, "Under the guidance in this position, the classification of a mixture, using the sum of fractions rule specified in 10 CFR 61.55, should be based on either: (a) the highest nuclide concentrations in any of the individual waste types contributing to the mixture; or (b) the volumetric or weight-averaged nuclide concentrations of the mixture; provided that the concentrations of the individual waste type contributors to the mixture are within a factor of 10 of the average concentration of the resulting mixture." The guidance in the revised BTP does not contain the "factor of 10" guidance described in Item (b).

The scenarios are also inconsistent with the scenarios used in development of 10 CFR Part 61, which themselves are overly conservative.

Regarding the inability of intruders to recognize the presence of a radioactive waste disposal site, in the Environmental Impact Statement (EIS) supporting 10 CFR Part 61, the intruder scenario most relevant to the encapsulated source is intruder discovery (exposure to an individual who digs into the waste, realizes something is wrong and ceases his excavation activities). The scenario used to calculate the limits in the revised BTP, where an item of waste, such as a sealed source, is discovered and carried away, was not considered likely in the EIS.

It is possible to consider new waste streams using the same assumptions as in 10 CFR Part 61 without creating additional stylized scenarios to determine allowable concentrations or amounts of disposed LLRW. If the staff believes 10 CFR Part 61 constrains the use of a more risk-informed, performance-based treatment of intruder scenarios in the revised BTP, then we recommend using the same scenarios used to develop 10 CFR Part 61.

Improving the Intruder Scenarios Evaluated in the BTP

In the EIS supporting 10 CFR Part 61 three intrusion events were considered. The events were characterized as "intruder construction (exposure to workers constructing a house at the site), intruder agriculture (exposure to individuals living in the house constructed and consuming food grown onsite), and intruder discovery (exposure to an individual who digs into the waste, realizes something is wrong and ceases his excavation activities)."

The use of a limited number of predefined stylized scenarios that presume an intruder would make direct contact with buried wastes does not realistically account for site-specific features that affect either the likelihood or the consequences of an intrusion event. Such scenarios should be replaced with an approach that takes into consideration site specific geohydrological features, depth of burial, waste characteristics, engineered disposal features, and their degradation over time.

The approach to developing intruder scenarios in the revised BTP also does not account for improvements in management practices made since promulgation of 10 CFR Part 61 that make intrusion less likely. Current disposal facilities have collected large perpetual care funds that provide for monitoring and maintenance over much longer periods of time than originally assumed. Record-keeping and information management technology have improved to the extent that there is little chance of a complete loss of information about the locations of LLRW disposal facilities. These institutional controls make inadvertent intrusion very unlikely.

Additionally, the revised BTP does not account properly for radioactive decay and the distribution of the remaining radioactive materials in the disposal facility as a function of time. After 300 years, most radionuclides in a typical LLRW inventory would have decayed to insignificant levels, leaving behind an inventory containing mainly U-238, C-14, I-129, Tc-99, and Ni-63. Guidance considering radioactive decay should be part of the revised BTP.

The staff explained that the current institutional control requirements of the rule (§61.59) constrain their assumptions in conducting the analysis that supports the revised BTP. Specifically, the analysis supporting 10 CFR Part 61 bounds the calculation for protecting the intruder by assuming institutional controls are not relied on at the end of the control period. The EIS supporting 10 CFR Part 61 states that the "NRC does not assume that the government fails at the end of the 100-year institutional control period, but rather that the government ceases active control over access to the site. The rule does not presuppose collapse or failure of government, but rather places a restriction on the character of radioactive material disposable by near surface disposal that serves to relieve government of the burden of actively excluding persons from the site in perpetuity."

As noted previously, if the staff believes 10 CFR Part 61 constrains the use of a more risk-informed, performance-based treatment of intruder scenarios in the revised BTP, then we recommend using the same scenarios used to develop 10 CFR Part 61.

Additional Considerations Regarding Inadvertent Intrusion

The relative importance of protection of the intruder versus the other performance objectives should be reconsidered. The protection of the intruder as described in the 10 CFR Part 61 performance objective (§61.42) which states, "Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed," should not overshadow the other performance objectives of 10 CFR Part 61 in any analyses conducted to support implementation of the rule. These are:

- protection of the general population from release of the radioactive materials over the period of performance (§61.41),
- protection of workers from unnecessary occupational exposure (§61.43), and
- stability of the disposal site after closure (§61.44).

As stated in our September 22, 2011, report on 10 CFR Part 61 rulemaking, the use of overly conservative scenarios "for inadvertent intrusion into presumably abandoned, unmarked, and unsecured LLRW disposal facilities can change the focus of the facility design from the protection of the health and safety of the public during the period of operation of the facility (and a reasonable period thereafter), to the protection of hypothetical intruders many thousands of years in the future."

We look forward to additional discussions with the staff on the guidance in the revised BTP.

Dr. Dana Powers did not participate in the Committee's discussions regarding this matter.

Sincerely,

***/RA/***

Said Abdel-Khalik
Chairman

**REFERENCES**


1. U.S. Nuclear Regulatory Commission, "*Draft Branch Technical Position on Concentration Averaging and Encapsulation, Revision 1*," August 2011 (ML112490287)

2. U.S. Nuclear Regulatory Commission, Title 10 Code of Federal Regulations, Part 61, "*Licensing Requirements for Land Disposal of Radioactive Waste*," 1982

3. U.S. Nuclear Regulatory Commission, SECY-10-0043, "*Blending of Low-Level Radioactive Waste*," April 7, 2010 (ML090410246)

4. U.S. Nuclear Regulatory Commission, Staff Requirements Memorandum (SRM)-SECY-10-0043, "*Blending of Low-Level Radioactive Waste*," October 13, 2010 (ML102861764)

5. ACRS Letter, "*Proposed Rulemaking to Introduce a Site-Specific Performance Assessment and Human Intrusion Analysis Requirement to 10 CFR Part 61*," dated September 22, 2011 (ML11256A191)

6. U.S. Nuclear Regulatory Commission, "*Final Branch Technical Position on Concentration Averaging and Encapsulation*," January 17, 1995 (ML033630732)

7. U.S. Nuclear Regulatory Commission, "*Final Environmental Impact Statement on 10 CFR Part 61, 'Licensing Requirements for Land Disposal of Radioactive Waste*,'" NUREG-0945, Volumes 1 through 3, November 1982 (ML052590184, ML052920727, ML052590187)

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8. U.S. Nuclear Regulatory Commission, "*Draft Branch Technical Position on Concentration Averaging and Encapsulation, Revision 1*," August 2011 (ML112490287)

9. U.S. Nuclear Regulatory Commission, Title 10 Code of Federal Regulations, Part 61, "*Licensing Requirements for Land Disposal of Radioactive Waste*," 1982

10. U.S. Nuclear Regulatory Commission, SECY-10-0043, "*Blending of Low-Level Radioactive Waste*," April 7, 2010 (ML090410246)

11. U.S. Nuclear Regulatory Commission, Staff Requirements Memorandum (SRM)-SECY-10-0043, "*Blending of Low-Level Radioactive Waste*," October 13, 2010 (ML102861764)

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13. U.S. Nuclear Regulatory Commission, "*Final Branch Technical Position on Concentration Averaging and Encapsulation*," January 17, 1995 (ML033630732)

14. U.S. Nuclear Regulatory Commission, "*Final Environmental Impact Statement on 10 CFR Part 61, 'Licensing Requirements for Land Disposal of Radioactive Waste*,'" NUREG-0945, Volumes 1 through 3, November 1982 (ML052590184, ML052920727, ML052590187)



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