UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

(FSME-11-024, March, Program, LLW Proposals)

March 17, 2011

ALL AGREEMENT STATES, MICHIGAN

SUMMARY OF EXISTING GUIDANCE FOR REVIEWING LARGE-SCALE LOW-LEVEL RADIOACTIVE WASTE BLENDING PROPOSALS (FSME-11-024)

Purpose: To summarize current U.S. Nuclear Regulatory Commission (NRC) policy and guidance, which should assist in making informed decisions regarding large-scale low-level radioactive waste (LLW) blending applications or amendments from licensees until formal rulemaking and guidance is completed.

Background: At the direction of the Commission, the NRC staff is working to improve and strengthen the agency's standards for blending of LLW. The goal is to make NRC's regulation of LLW blending more risk-informed, performance-based, and in general more consistent with the agency's overall policy for regulating the nuclear industry. Blending, as defined here, refers to the mixing of LLW of different concentrations and concerns only disposal of the blended waste in a licensed facility, not its release to the general environment. “Large-scale” blending was evaluated by the staff in response to an industry proposal to perform intentional blending of multiple generators’ waste at an offsite processing facility (i.e., not the routine blending that has occurred in the past on waste generators’ sites). Large-scale blending operations could result in disposal of significant quantities of wastes at or near the Class A concentration limit, which was not considered in the analysis supporting the development of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61. Both quantity and the concentration of the blended wastes are factors potentially affecting the safety of an inadvertent intruder into a disposal facility.

The NRC has two activities underway to address the disposal of this type of blended waste. First, the NRC has initiated a limited rulemaking that would require a site-specific analysis of human intrusion into licensed waste disposal facilities. This rulemaking would ensure that wastes not previously considered in the development of 10 CFR Part 61, such as large-scale blended wastes and depleted uranium from commercial enrichment plants, can be disposed of safely. In addition to this limited rulemaking, NRC is also revising the Branch Technical Position (BTP) on Concentration Averaging and Encapsulation to address the characteristics of large-scale blended waste needed to ensure its safe disposal, including how uniform, or well-mixed, the waste must be.

Discussion: The NRC staff is issuing the enclosed guidance to Agreement States on how to evaluate proposals to blend large quantities of waste until the revisions to staff guidance and rulemaking noted above are completed. The NRC staff is providing this guidance to the Agreement States for their information, and for distribution to their licensees, as appropriate. Licensees should be advised that new requirements and guidance in the final Part 61 site-specific analysis rulemaking and Concentration Averaging BTP may require an update to

the processes and procedures for any blending activities that are approved under this Interim Guidance.

If you have any questions regarding this correspondence, please contact me at 301-415-3340, or the individuals named below.

Point of Contact:	James Kennedy	E-mail:	James.Kennedy@nrc.gov
Telephone:	301-415-6668	FAX:	301-415-5369
Point of Contact:	Christianne Ridge	E-mail:	Christianne.Ridge@nrc.gov
Telephone:	301-415-5673	FAX:	301-415-5369

/RA/ by James Luehman

Robert J. Lewis, Director
Division of Materials Safety
and State Agreements
Office of Federal and State Materials and
Environmental Management Programs

Enclosure:
Guidance for Reviewing Proposals for
Large-Scale Blending of LLW

GUIDANCE FOR REVIEWING PROPOSALS FOR LARGE-SCALE BLENDING OF LOW-LEVEL RADIOACTIVE WASTE

BACKGROUND

The framework for the analysis of the disposal of radioactive waste on land was developed in the 1980s in the draft (NUREG-0782) and final (NUREG-0945) environmental impact statements for Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61. Part 61 established a waste classification scheme based on the role that the concentration and form of waste plays in the long-term performance of near-surface land disposal facilities. The classification scheme involves consideration of the concentration of both long-lived and short-lived radionuclides. The classification of short-lived radionuclides considers the impact of institutional controls, improved waste form, and deeper near-surface disposal on keeping radiation exposures within acceptable limits. The potential hazard of long-lived radionuclides persists long after the precautions that protect against exposure to the short-lived radionuclides cease to be effective. This hazard can be mitigated by an improved waste form, greater disposal depth, and limiting the quantity and concentration of long-lived radionuclides disposed.

The waste classification system is designed to protect an inadvertent intruder at the near-surface disposal facility. An inadvertent intruder is a person who might occupy the disposal facility site after closure and engage in normal activities, such as agriculture, dwelling construction, or other pursuits that might lead the person to be unknowingly exposed to radiation from the waste. The connection between the waste classification system and protection of an inadvertent intruder originated in the development of the waste classification tables in 10 CFR 61.55(a). In the draft environmental impact statement (DEIS) for Part 61, the NRC analysis showed that protection of the inadvertent intruder was a function of the concentration of the radionuclides. In the 10 CFR Part 61 system, Class A waste, which has the lowest radionuclide concentrations, is expected to present the least hazard to an inadvertent intruder. Class A waste is not required to be physically stabilized, but, if it is not stabilized, it must be segregated from other waste classes at the disposal site. Class B waste is short-lived waste with higher radionuclide concentrations that must meet more rigorous waste form requirements to ensure stability after disposal. Class C waste also must meet rigorous requirements to ensure stability of the waste form, as well as additional measures at the disposal facility to protect against inadvertent intrusion. Waste exceeding the concentration limits for Class C waste is generally not acceptable for near-surface disposal. U.S. Nuclear Regulatory Commission (NRC) staff expects that processors engaged in large-scale blending will mix waste with Class B or C concentrations of radionuclides,[1] or both, with waste with Class A concentrations to create waste near the Class A concentration limit.

[1] Waste is not required to be classified until it is shipped for disposal, since classification is related to the safety of disposed waste only. Thus, waste may have Class B or C *concentrations* while it is being processed, but it is not classified as B or C waste.

ENCLOSURE

The NRC did not consider the disposal of significant volumes of waste at one of the classification limits during the original development of the Part 61 waste classification system. Instead, in the analysis supporting the development of the waste classification system, NRC staff assumed that not all of the waste encountered by an inadvertent intruder would be present at the classification limits. The staff assumed that any waste at the classification limit would be mixed with a significant amount of waste with radionuclide concentrations far below the classification limit. Thus, a waste stream that is blended so that a significant fraction of the waste that an inadvertent intruder could encounter is at or near the Class A limit is different from the waste that NRC considered in the original analysis.

In an October 8, 2009, memorandum to the NRC staff, Chairman Jaczko requested that the staff prepare a vote-paper that discussed, among other topics, safety issues related to intentional changes in waste classification due to blending, and recommendations for revisions, if necessary, to existing regulations, requirements, guidance, or oversight related to the blending of low-level radioactive waste (LLW). In response, the staff performed an analysis and documented the results in SECY-10-0043, "Blending of Low-Level Radioactive Waste." In that analysis, the staff recommended that the agency's position for near-surface disposal of large quantities of blended waste (or any other wastes at or near the concentration limit for Class A waste) be more risk-informed and performance-based, and that changes be implemented through a combination of rulemaking and guidance. The staff specifically noted that the disposal of large-scale blended waste may be appropriate, but not under all site conditions, and recommended that large-scale blended waste be addressed in an ongoing modification to 10 CFR Part 61 that, when completed, will address the safe disposal of waste streams not analyzed in the DEIS for 10 CFR Part 61 (e.g., depleted uranium from enrichment plants). The staff also recommended that the guidance on blending contained in the Concentration Averaging Branch Technical Position (BTP) be revised to be more risk-informed and performance-based, and that certain issues, such as the required homogeneity of the waste, be addressed.

In SRM-SECY-10-0043, the Commission directed the staff to proceed with implementing a more risk-informed, performance-based position on LLW blending through revisions to 10 CFR Part 61 and the Concentration Averaging BTP. The Commission also directed that, until the Concentration Averaging BTP revision was completed, licensing actions received by NRC for large-scale commercial blending facilities should be reviewed on a case-by-case basis. The staff plans to propose an amendment to Part 61 that would require a site-specific intruder analysis for blended waste. The proposed rulemaking is scheduled to be sent to the Commission in late 2011. The staff has also initiated revisions to the Concentration Averaging BTP, which it plans to complete in 2012. The staff noted in SECY-10-0043 that it would issue interim guidance to Agreement States on how to review proposals for large-scale blending of LLW. This document provides that interim guidance.

SUMMARY OF ISSUES

The performance objectives in 10 CFR Part 61 Subpart C ensure the safe land disposal of LLW, including large-scale blended waste. Section 61.13 describes the specific technical analyses that are necessary to demonstrate that the performance objectives of Subpart C will be met. In addition, 10 CFR Part 20 Appendix G Section I.C.12 requires waste generators to provide the

10 CFR 61.55 waste classification on the uniform shipment manifest for waste consigned to a disposal facility.

This guidance should assist the NRC staff and Agreement States in evaluating whether a large-scale low-level radioactive waste blending method proposed by a licensee or an applicant would be expected to generate waste that would meet the disposal requirements of Part 61 at an appropriate disposal facility.

Protection of the General Population

As discussed in the NRC staff's April 13, 2010, All Agreement States Letter (FSME-10-030), the analyses used to demonstrate compliance with the 10 CFR 61.13 requirements now may include performance assessment methodology. Protection of a member of the general population from releases of radioactivity can be demonstrated with a site-specific performance assessment. Because the resin waste that has been proposed as a candidate for large-scale blending is typically dominated by short-lived radionuclides, the performance assessment methods currently used for other LLW streams are expected to apply to performance assessments for large-scale blended waste. For example, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations" (NUREG-1854) Section 4.2 outlines a risk-informed performance-based approach that identifies generic technical review procedures for the evaluation of site-specific performance assessments. These generic technical review procedures are grouped into the following categories: system description, data sufficiency, data uncertainty, model uncertainty, and model support. In addition, "Consolidated Decommissioning Guidance" (NUREG-1757 Vol. 2) Section 3.5 provides guidance on the evaluation of engineered barriers used in site decommissioning. If similar barriers are used in the land disposal of low-level radioactive waste, then this guidance may be useful. The NRC staff guidance "A Performance Assessment Methodology for Low-Level Waste Performance Assessment" (NUREG-1573) provides guidance on: (1) an acceptable approach for systematically integrating site characterization, facility design, and performance modeling into a single performance assessment process; (2) five principal regulatory issues regarding interpreting and implementing Part 61 performance objectives and technical requirements integral to a low-level radioactive waste disposal facility performance assessment, and (3) implementation of NRC's performance assessment methodology. The guidance in NUREG-1573 may help ensure the consistency of different reviews.

In a few cases, blending waste may change predicted radionuclide release. For example, if radionuclide release in a higher-concentration waste stream is solubility-limited prior to blending, blending has the potential to increase radionuclide release. Radionuclide release could increase if waste that was solubility limited is spread over a larger area and therefore comes into contact with more water. However, if the dose-controlling radionuclides are short-lived and water contact with the waste can be limited effectively for several half-lives, solubility limits may not be a significant concern. In any case, the source term considered in a site-specific performance assessment should reflect the blended source term, including the effects of any management practices used to mitigate potential impacts (e.g., staggering placement of waste near the Class A limit to reduce potential doses to an inadvertent intruder). The underlying philosophy expressed throughout NRC guidance is that, in designing the disposal system and selecting a site, applicants should consider the desired facility performance and the characteristics of the waste being disposed.

NRC staff expects that the regulator of the disposal facility operator will ensure that an appropriate performance assessment has been completed to demonstrate that a member of the public will be protected from releases of radioactivity from the disposal site.

Protection of an Inadvertent Intruder

Section 61.13, *Technical Analyses*, requires analyses that demonstrate with reasonable assurance that the waste classification and segregation requirements will be met and that adequate barriers to inadvertent intrusion will be provided. Traditionally, a key component of demonstrating intruder protection is the demonstration of compliance with the waste classification requirements in 10 CFR 61.55. As previously indicated, NRC staff expects that processors engaged in large-scale blending will mix waste with Class B or C radionuclide concentrations, or both, with waste with Class A radionuclide concentrations to create waste near the Class A concentration limit. Because this practice was not envisioned during the development of Part 61, and because protection of an inadvertent intruder was a primary consideration in the development of the waste classification system, it would be prudent for disposal facility licensees considering the disposal of large-scale blended waste to perform a dose assessment to demonstrate protection of an inadvertent intruder.

In developing the radionuclide concentration limits in the 10 CFR 61.55 waste classification tables, the NRC staff performed intruder analyses using an annual dose limit of 5 millisievert (mSv) [500 millirem) (mrem] (NUREG-0782). The analyses assumed that inadvertent intrusion occurred at some point following the closure of a low-level radioactive waste disposal facility. The intruder was assumed to excavate and construct a residence on the disposal site (intruder–construction), or to occupy a dwelling located on the disposal site and ingest food grown in contaminated soil (intruder–agriculture).[2] The analyses also considered the exposure to radionuclides through inhalation of contaminated soil, dust, and air; direct radiation; and ingestion of contaminated food and water. Additional exposed waste scenarios were considered as well as other potential exposure pathways. Additional details on the inadvertent intruder analyses are provided in NUREG-0782 Appendix G. The analyses were updated in the "Update of Part 61 Impacts Analysis Methodology" (NUREG/CR-4370) to include consideration of additional potential inadvertent intrusion scenarios.

In conducting an intruder dose assessment, an applicant or licensee may propose a site-specific scenario instead of using one of the generic scenarios used to support the development of 10 CFR Part 61. For example, if waste is disposed at a depth that precludes disruption during construction of a typical dwelling, an intruder-construction scenario may be inapplicable. In this case, the regulator should consider reasonably foreseeable activities by an intruder that may result in inadvertent disruption of the disposal facility. For example, if the waste is protected from disruption during dwelling construction by the disposal depth, it may still be susceptible to disruption by an individual drilling a well (see e.g., NUREG/CR-4760). In this case, the regulator would assess the representation of the blended waste stream as well as the consistency of the proposed scenario with local practices and reasonably foreseeable land use. NRC guidance on scenario selection for decommissioning (NUREG-1757 Chapter 5, Section I.3, and Appendix M)

[2] The intruder–agriculture scenario was assumed to be possible only if the waste had degraded to an unrecognizable form.

may provide useful guidance on considering reasonably foreseeable land use and assessing appropriate exposure scenarios.

In either a generic or site-specific scenario, representation of the source term may have a significant effect on the estimated intruder dose. Licensees or applicants should consider appropriate representations of large-scale blended waste in the source term (i.e., a source term consistent with the physical and radiological characteristics of the blended waste). The regulator would assess the representation of the site-specific waste stream as well as the applicability of the exposure scenario to the site conditions.

The performance objective for the protection of inadvertent intruders (10 CFR 61.40 and 61.42) requires that there is reasonable assurance that individuals will be protected from inadvertent intrusion after institutional controls at the disposal site are removed. In considering what constitutes reasonable assurance, the regulator may consider the likelihood of intrusion into any particular location in the disposed waste. This consideration may be particularly relevant to the evaluation of a proposal to dispose of blended waste for two reasons: (1) waste from a large-scale blending operation, unlike the waste streams considered in the analyses supporting the development of 10 CFR Part 61, may be disposed of as a relatively large volume that all has concentrations near the Class A limit; and (2), because blended waste is expected to be made by mixing waste with Class B and C concentrations of radionuclides with less concentrated waste with Class A concentrations, incompletely blended waste, or waste that stratifies after blending, may have pockets of waste above the Class A limits, even though its average concentration is Class A.[3]

Licensees and regulators should consider these specific characteristics of blended waste when evaluating any intruder assessment supporting the disposal of blended waste. For example, if a large volume of blended waste near the classification limit is disposed of in one location, an intruder constructing a dwelling could exhume a significant amount of waste near the classification limit, instead of exhuming only a small portion of waste near the classification limit mixed with lower concentration waste, as assumed in the original analyses (NUREG-0782). The disposal of large volumes of waste near the classification limit also could affect scenarios in which less waste is exhumed, such as an intruder-driller scenario. In general, given current waste streams and disposal practices, a driller would encounter relatively few containers, one of which could be a container of waste at or near the classification limit. However, disposal of large volumes of waste near the classification limit could increase the likelihood that any single container encountered would be near the classification limit and also could increase the likelihood that several containers stacked vertically would all be at the classification limit if large batches of waste near the classification limit are all disposed of in the same area of a disposal site.

And if the waste has an average concentration below the Class A limits, but is likely to have pockets with concentrations above the Class A limit,[4] the regulator would need to consider the uncertainty in the characterization of the source term, the likely size of any volumes above the classification limit, and the likelihood that an intruder would encounter the higher-concentration

---

[3] 10 CFR 61.55(a)(8) allows for the averaging of waste concentrations over the volume or weight of the waste, as appropriate, in determining the classification of waste.
[4] *Ibid.*

waste. The simplest evaluation would use the waste characterization information to estimate the maximum size and concentration of a higher-concentration pocket and would evaluate the resulting dose to an intruder encountering this “worst case” volume of waste. If the dose is below 5 mSv/yr (500 mrem/yr) the analysis is complete. Although this type of “worst case” analysis may be done for simplicity, it is not necessary to assume that an intruder encounters waste at the upper end of the uncertainty range of radionuclide concentrations. If the dose estimated with a simple analysis is greater than 5 mSv/yr (500 mrem/yr), the regulator may want to consider whether the likelihood of encountering the poorly mixed waste is great enough to indicate a lack of reasonable assurance of protection of the inadvertent intruder. The NRC staff recognizes that it is difficult to estimate a numerical probability of intrusion at any particular location in a waste site. Instead, the NRC staff recommends that the likelihood of intrusion into a pocket of waste with a concentration above the average concentration in the waste stream be considered in the same manner that the likelihood of any particular intrusion scenario is considered. That is, in scenario selection mathematical probabilities of various scenarios are not assigned, but certain scenarios may be excluded because they are considered too unlikely (e.g., dwelling construction in waste disposed deeper than 10 feet [3 meters]).

Uncertainty in the source term is discussed further in the sections of this guidance related to waste characterization and homogeneity.

Waste Classification

As previously discussed, waste processors engaged in large-scale blending are expected to mix waste with Class B and C radionuclide concentrations with larger quantities waste with Class A concentrations to form a mixture with radionuclide concentrations near the Class A concentration limit. Because the average radionuclide concentrations in the waste are expected to be near the Class A limit (i.e., a sum-of-fractions near 1), additional measures may be necessary to demonstrate that the waste does in fact remain under the Class A concentration limit. Although a specific confidence interval for a sum of fractions sufficient to demonstrate that waste meets a classification limit has not previously been established in NRC regulations or guidance, the NRC staff identified the need for additional measures to limit the uncertainty of radionuclide concentrations in mixtures near a classification limit in the Waste Classification BTP (NRC, 1983). Specifically, the Waste Classification BTP indicates that the NRC staff anticipates that more sophisticated waste classification programs will be required for licensees generating waste for which minor process variations may cause a change in waste classification. A regulator evaluating an application for large-scale waste blending should review the applicant’s waste characterization methods and processes for evaluating waste classification (including the applicant’s handling of uncertainty in mean radionuclide concentrations and the resulting uncertainty in the sum-of-fractions of the appropriate waste classification limit).

The Concentration Averaging BTP (NRC, 1995) considered concentrations of radionuclides averaged over a waste container. In a *Federal Register* Notice (*Federal Register*, January 26, 2011, Volume 76, No. 17, pp 4739-4741) soliciting public comment on potential revisions to the Concentration Averaging BTP, NRC asked for comments on the benefits and drawbacks of using alternate averaging volumes, such as the volume of waste that an inadvertent intruder would be exposed to, or the volume of a disposal trench. Pending revision of the Concentration

Averaging BTP, licensees, applicants, and regulators should continue to use waste containers as the appropriate averaging volumes.

Determination of Radionuclide Concentrations

Sources of uncertainty in radionuclide concentrations in a container of large-scale blended waste are expected to include, but are not necessarily limited to: (1) analytical uncertainty in sampled radionuclides; (2) spatial variability in radionuclide concentrations in the blending equipment; (3) spatial variability in radionuclide concentrations in a disposal container; (4) uncertainty in radionuclide concentrations in inputs to the blending process, if the radionuclide concentrations in the product are based on the inputs and are not independently measured; and (5) uncertainty in any scaling factors used if each container of waste is not sampled.

Of these sources, analytical uncertainty may be the best quantified. For example, in current practice at some facilities, concentration data may be rejected if analytical uncertainty is greater than a certain percentage of the measured value. For some waste streams, it may be difficult to demonstrate that the samples of waste in process tanks or individual disposal containers are representative of all of the waste. For waste dominated by primary gamma emitters, dose surveys of waste as it is mixed or recalculated may provide assurance of adequate mixing. Surveys of waste as it is sluiced into disposal containers may provide further assurance that waste in disposal containers is relatively homogeneous. Waste dominated by beta emitters may be more difficult to characterize, or may be subject to additional uncertainty if dose-to-curie scaling factors are used.

The BTP on Radioactive Waste Classification (NRC, 1983) indicates that licensees should determine radionuclide concentrations to within a factor of 10. In many cases, this level of precision is expected to be sufficient. However, in some cases, better precision in radionuclide concentrations may be necessary to limit uncertainty in the site-specific performance assessment and intruder dose analysis. For example, if the best estimate for an intruder dose is 2 mSv/yr (200 mrem/yr), there may not be reasonable assurance of meeting the performance objective for protection of individuals from inadvertent intrusion (10 CFR 61.42) if the most dose-significant radionuclide concentrations are only known to within a factor of 10, but there may be reasonable assurance of meeting the performance objectives if the most dose-significant radionuclide concentrations are known to within a factor of 2. If uncertainty in radionuclide inventory affects a finding of reasonable assurance of meeting a performance objective, a generator may conclude it is cost-effective to take steps to limit uncertainty in radionuclide concentrations. For example, if radionuclide concentrations of resins are determined from samples in a holding tank, verification samples may be collected when the resin is sluiced into a high integrity container.

Appropriate methods of waste characterization are likely to depend on the degree of precision required to meet classification and dose limits, and the identity of classification- and dose-controlling radionuclides. For waste dominated by gamma emitters, it may be practical to use surveys at waste outlets or other areas of the blending equipment to demonstrate the degree of mixing achieved. It also may be practical to survey waste containers to provide additional evidence that waste emplaced in individual containers is representative of the larger batch of blended waste. For wastes dominated by other radionuclides, it may be necessary to take

multiple samples from the blending equipment to establish the variance in concentrations in the batch of waste. Additional samples taken as waste is sluiced into a disposal container may be used to verify concentrations in the disposal containers or to verify any dose-to-curie scaling factors that are used.

Homogeneity

Mathematical averaging of radionuclide concentrations in waste is allowed by 10 CFR 61.55(a)(8). The Concentration Averaging BTP (NRC, 1995) recommends limits on the range of radionuclide concentrations in waste that may be averaged together. For mixtures of relatively homogenous waste, the Concentration Averaging BTP discourages generators from averaging radionuclide concentrations that differ from the concentrations in the final mixture by more than a factor of 10. As discussed by the staff in SECY-10-0043, this restriction is not performance-based because it is based on the inputs to the mixing process, and not on the characteristics of the waste as disposed. In the SRM-SECY-10-0043, the Commission approved the staff's Option 2, which proposed eliminating this "factor of 10" rule for homogeneous waste mixtures. Although it is not performance-based, the factor of 10 rule did serve to limit the potential heterogeneity of the final blended waste by limiting the variation in the inputs. In the absence of the factor of 10 rule, licensees need to consider the potential effects of incomplete mixing and waste stratification after mixing.

Incomplete mixing could be a concern if disposal as Class A waste allows an intruder to exhume a significant volume of waste with Class B or C radionuclide concentrations. In SRM-SECY-10-0043, the Commission directed the staff to evaluate homogeneity in the context of the volumes of waste an intruder could encounter in reasonably foreseeable inadvertent intruder exposure scenarios. As previously discussed, the regulator will need to determine whether there is reasonable assurance that an intruder would not encounter pockets of waste with concentrations that could cause an unacceptable dose. For example, an applicant may wish to take multiple survey readings, or, if necessary for certain types of waste, multiple samples from the blending equipment, and demonstrate that the mean is known to a certain confidence limit and the variability does not exceed a certain limit established by the regulator.

While surveys or sampling may be used to provide reasonable assurance that blended waste is appropriately mixed when it is placed in a disposal container, these methods cannot eliminate the possibility that the waste will stratify after placement in disposal containers, leaving layers of waste with Class B or C radionuclide concentrations in a Class A waste container. However, this potential stratified waste configuration is similar to the configuration that could result if a generator placed Class A waste in a disposal container with waste with "low B" or "low C" radionuclide concentrations without undertaking any physical mixing and applied mathematical averaging to the result. This latter possibility is allowed in current practice, as described in the Concentration Averaging BTP (NRC, 1995), because it is assumed that any waste that is exhumed is mixed in the process (e.g., if a driller encounters a vertical slice of waste from several stacked disposal containers and brings the waste to the surface as drill cuttings). For stratification to affect dose, an intruder would need to exhume only the layers of waste in a disposal container that have the greatest radionuclide concentration. While possible (e.g., if dwelling construction disturbed only the top half of a layer of waste containers and all of the higher-concentration waste had risen to the top of the containers), this scenario is expected to be unlikely and is not considered to be reasonably foreseeable.

Dosimetry

The 10 CFR 61.41 performance objective requires that concentrations of radioactive material released to the general environment "not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public." As a matter of policy, in the final rule for disposal of high-level waste at Yucca Mountain (66 FR 55732), the Commission considered 0.25 mSv (25 mrem) total effective dose equivalent (TEDE) as the appropriate dose limit within the range of potential doses represented by the older limits found in regulations, such as 10 CFR 61.41, that were published prior to the adoption of a dosimetry system that was able to account for the radio-sensitivity of different organs.

Incidental waste determinations under the Ronald W. Reagan National Defense Authorization Act of Fiscal Year 2005 typically use the performance objectives specified in 10 CFR Part 61 Subpart C. In SRM-SECY-05-0073, the Commission directed the staff, in its responsibilities related to these incidental waste determinations, to use the latest science based on radiological protection requirements in the International Commission on Radiological Protection (ICRP) Publication 26 methodology instead of the older requirements in ICRP Publication 2. The ICRP-26 methodology basically uses a standard of 0.25 mSv (25 mrem) TEDE.

This position on the use of later versions of a dosimetry system is identical to that presented in FSME-10-030, the staff's April 13, 2010 letter to Agreement States on depleted uranium disposal.

Greater-than-Class C waste

In SRM-SECY-10-0043, the Commission directed the staff to not include waste at Greater-Than-Class-C (GTCC) concentrations in the scope of the Part 61 site-specific analysis rulemaking (i.e., blended waste should not include a GTCC component). GTCC waste is a Federal responsibility under the Low-Level Radioactive Waste Policy Amendments Act of 1985, and the Commission believes that this waste should not be made into a State responsibility, even if the waste has been blended into a lower classification.

Agreement States that review requests for authorization to blend LLW should consider the Commission's position on GTCC in blended waste. LLW generators and processors can determine waste concentrations (and the implied waste classification) using any of the methods in NRC's Waste Classification Technical Position. Subpart G, 10 CFR Part 20, "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests," and 10 CFR 61.55, "Waste classification," contain NRC requirements applicable to the classification of LLW.

OTHER CONSIDERATIONS

Licensees should be advised that new requirements and guidance in the final site-specific analysis rulemaking[5] and Concentration Averaging BTP[6] may require an update to the processes and procedures for any blending activities that are approved under this Interim Guidance.

Agreement States that either approve requests for large-scale blending of LLW, or that regulate the disposal of blended wastes, should consult with one another to ensure that blended wastes are acceptable for disposal.

In some cases, the State regulator for a processing facility operator may require the processor to obtain assurance form a disposal facility that the processed waste will be acceptable for disposal, if it meets certain requirements. NRC staff expects that, to provide this assurance, the disposal facility operator would coordinate with its regulator.

REFERENCES

International Commission on Radiological Protection, "Recommendations of the International Commission on Radiological Protection," *ICRP Publication 2*, Pergamon Press, Oxford, 1959.

———, "Publication 26: Recommendations of the International Commission on Radiological Protection," *Annals of the ICRP*, Vol. 1, Issue 3, 1977.

U.S. Code of Federal Regulations, "Licensing Requirements for Land Disposal of Radioactive Waste," Part 61, Chapter I, Title 10, "Energy."

U. S. Nuclear Regulatory Commission, "Draft Environmental Impact Statement on 10 CFR Part 61, 'Licensing Requirements for Land Disposal of Radioactive Waste,'" NUREG-0782, Vols. 1 through 4, September, 1981, Agencywide Document Access and Management System (ADAMS) Accession Nos. ML052590347, ML052590350, ML052590353, ML052590354.

———, "Final Environmental Impact Statement on 10 CFR Part 61 'Licensing Requirements for Land Disposal of Radioactive Waste,'" NUREG-0945, Vols. 1 through 3, November, 1982, ADAMS Accession Nos. ML052590184, ML052920727, ML052590187.

———, "Technical Position on Radioactive Waste Classification," May 11, 1983, ADAMS Accession No. ML033630755.

———, "Update of Part 61 Impacts Analysis Methodology," NUREG/CR-4370, Vol.1, January, 1986, ADAMS Accession No. ML100251399.

---

[5] See http://www.nrc.gov/about-nrc/regulatory/rulemaking/potential-rulemaking/uw-streams.html for current status of rulemaking.

[6] See http://www.nrc.gov/waste/llw-disposal/llw-pa/llw-btp.html for current status of revisions to Concentration Averaging BTP.

———, “Branch Technical Position on Concentration Averaging and Encapsulation,” January 17, 1995, ADAMS Accession No. ML033630732.

———, “A Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities: Recommendations of NRC's Performance Assessment Working Group,” NUREG-1573, October, 2000, ADAMS Accession No. ML003770778.

———, “Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada; Final Rule (10 CFR Parts 2, et al.),” *Federal Register*, Vol. 66, No. 213, November 2, 2001, pp. 55732-55816.

———, “Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria,” NUREG-1757, Vol. 2, September, 2003, ADAMS Accession No. ML032530405.

———, “Staff Requirements – SECY-05-0073 – Implementation of New USNRC Responsibilities under the National Defense Authorization Act of 2005 in Reviewing Waste Determinations for the USDOE,” Commission Staff Requirements Memorandum SRM-SECY-05-0073, June 30, 2005, ADAMS Accession No. ML051810375.

———, “NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations,” NUREG-1854 (Draft Final Report for Interim Use), August, 2007, ADAMS Accession No. ML072360184.

———, “Blending of Low-Level Radioactive Waste,” Commission Paper SECY-10-0043, April 7, 2010. ADAMS Accession No. ML090410531.

———, “Summary of Existing Guidance that May be Relevant for Reviewing Performance Assessments Supporting Disposal of Unique Waste Streams Including Significant Quantities of Depleted Uranium,” FSME-10-030, April 13, 2010, ADMS Accession No. ML100250501.

———, “Staff Requirements—SECY-10-0043 Blending of Low-Level Radioactive Waste,” October 13, 2010. ADAMS Accession No. ML102861764.