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U.S. Nuclear Regulatory Commission

NRC Releases Implementation Document re 2015 Concentration Averaging Branch Technical Position

On October 30, 2015, the U.S. Nuclear Regulatory Commission (NRC) released a document providing implementation questions and answers related to Revision 1 of the Branch Technical Position on Concentration Averaging and Encapsulation (CA BTP).

Revision 1 of the CA BTP was originally published at 80 *Federal Register* 10,165 on February 25, 2015. (See *LLW Notes,* March/April 2015, pp. 41-45.) The guidance provides acceptable methods that can be used to perform concentration averaging of low-level radioactive waste for the purpose of determining its waste class for disposal.

Revision 1 of the CA BTP consists of two volumes. Volume 1 (ADAMS Accession No. ML12254B065) contains the staff technical positions on averaging and certain other information. Volume 2 (ADAMS Accession No. ML12326A611) contains staff responses to stakeholder comments on the May 2012 draft (ADAMS Accession No. ML121170418) and the technical bases for the staff positions.

Revision 1 of the CA BTP can be found online at http://www.gpo.gov/fdsys/pkg/FR-2015-02-25/pdf/2015-03913.pdf.

Brief Overview re Revised CA BTP

Revision 1 of the CA BTP provides updated guidance on the interpretation of § 61.55(a)(8) of Title 10 of the *Code of Federal Regulations* (10 CFR), ‘‘Determination of concentrations in wastes,’’ as it applies to the classification (as Class A, B, or C waste) of a variety of different types and forms of low-level radioactive waste.

Paragraph 61.55(a)(8) states that radionuclide concentrations can be averaged over the volume of the waste or its weight if the units are expressed as nanocuries per gram. The average radionuclide concentrations are compared with the waste classification tables in 10 CFR 61.55 to determine the class of the waste. The waste class determines the minimum safety measures to be applied in order to provide reasonable assurance of safe disposal of the waste.

The previous version of the CA BTP, published in 1995 (ADAMS Accession No. ML033630732), was issued before the NRC adopted its risk-informed and performance-based regulatory policy. Revision 1 of the CA BTP, which has been informed by that policy, contains new guidance related to blending of low-level radioactive waste, as directed by the Commission in its Staff Requirements Memorandum for SECY–10–0043, ‘‘Blending of Low-Level Radioactive Waste,’’ (ADAMS Accession No. ML102861764).

The major changes in Revision 1 of the CA BTP include, among other things, the following:

- an increase in the limits for disposal of cesium-137 (Cs-137) sealed sources from 1.1 TBq (30 Ci) to 4.8 TBq (130 Ci), based on new, more risk-informed analysis;

- specification of certain thresholds on radionuclide concentrations of waste streams that are blended together, based on a probabilistic dose assessment, above which licensees should demonstrate that the waste is adequately blended;

- the addition of specific guidance for licensees to use in proposing site- or waste-specific averaging approaches, rather than the generic approaches specified in the body of the CA BTP, consistent with NRC’s performance-based regulatory policy;

- application of a more risk-informed position to allow for the treatment of cartridge filters as blendable waste, with a documented justification; and,

- a tying of the averaging factors for discrete items to the class limit for radionuclide concentrations (not the average of the mixture), which has a relationship to risk because the class limits are based on a dose of 5 mSv/yr (500 mrem/yr) exposure to an inadvertent intruder, as well as revision of the Factor of 1.5 to 2, since the uncertainty associated with intruder protection does not justify the precision implied by the first factor.

A more complete list of changes can be found in Appendix B of Volume 1 of Revision 1 of the CA BTP. In addition, NRC staff responses to individual public comments are contained in Section 3 of Volume 2 of Revision 1 of the CA BTP. Finally, a summary of the changes to the May 2012 version published for public comment is available in ADAMS Accession No. ML14157A227.

Implementation of the Revised CA BTP

Revision 1 of the CA BTP describes and makes available to NRC and Agreement State licensees, Agreement States, and the public, methods that the NRC believes are acceptable for implementing specific parts of the Commission’s regulations. The positions in Revision 1 of the CA BTP are not intended as a substitute for regulations, and compliance with them is not required. Agreement States may use this information in establishing waste acceptance criteria for their licensees who are operating waste disposal sites. Applicants and licensees may use the information in Revision 1 of the CA BTP when developing applications for initial licenses, amendments to licenses, or requests for NRC regulatory approval. Licensees may use the information in Revision 1 of the CA BTP for actions (*i.e.,* in determining average radionuclide

concentrations in waste) that do not require prior NRC review and approval. Licensees may also use the information in Revision 1 of the CA BTP to assist in attempting to resolve regulatory or inspection issues. Agreement States and current licensees may continue to use the previous guidance for complying with the concentration averaging provision in 10 CFR 61.55(a)(8) (*i.e.,* the January 23, 1995, ''Final Branch Technical Position on Concentration Averaging and Encapsulation''). Current licensees may also voluntarily use positions in Revision 1 of the CA BTP.

In addition to the guidance in Revision 1 of the CA BTP, licensees that ship waste for disposal in a 10 CFR Part 61 or Agreement State equivalent facility should ensure that the waste meets the concentration averaging provisions in the land disposal facility license. Where there are conflicts with this guidance, the land disposal facility license conditions issued by the regulatory authority (*i.e.,* the Agreement State) must be met.

Implementation Questions and Answers

The document released by NRC on October 30, 2015 provides the following 11 questions and answers related to implementation of Revision 1 of the CA BTP:

1. *Is there a significant difference between the guidance in Revision 1 of the Concentration Averaging Branch Technical Position (CA BTP) on when to apply the Factor of 2, which replaced the 1995 CA BTP Factor of 1.5, and the 1995 CA BTP guidance on when to apply the Factor of 1.5?*

   The 1995 CA BTP guidance for activated metals, components incorporating radioactivity in their design, contaminated materials, and cartridge filters stated that the Factor of 1.5 should be applied to primary gamma emitting radionuclides when the primary gamma-emitting radionuclides "dictate the classification of the waste." Similarly, for these waste types, Revision 1 of the CA BTP states that the Factor of 2 should be applied to primary gamma- emitting radionuclides, "[i]f the primary gamma-emitting radionuclides are classification- controlling." Revision 1 also states the Factor of 2 should be applied to sealed sources that are not encapsulated. In addition, the 1995 BTP stated that the Factor of 1.5 should be applied to cartridge filters in all cases, whereas Revision 1 only applies the Factor of 2 to cartridge filters when they are treated as discrete items instead of blendable waste.

   Revision 1 of the CA BTP provides a step-by-step process to determine whether the primary gamma-emitting radionuclides are classification-controlling, based on the process for determining waste classification in 10 CFR 61.55. The U.S. Nuclear Regulatory Commission (NRC) staff finds no significant difference between the phrases "dictate the classification of the waste" and "classification-controlling." However, some stakeholders have noted that the step-by-step process outlined in Revision 1 of the CA BTP may be slightly different from common practice in determining when primary gamma-emitting radionuclides dictate the classification of the waste.

2. *There is a provision in both the 1995 BTP and the revised BTP that if a container is at least 90 percent full, the nominal internal volume of the container can be used for averaging. This provision is included in Section 3.2.1, "Concentration Averaging for a Single Blendable Waste Stream," of Revision 1 of the CA BTP, but is not repeated in Section 3.2.2, "Concentration Averaging for Multiple Blendable Waste Streams." Does the provision apply to waste discussed in Section 3.2.2?*

   Section 3.2.1 of Revision 1 of the CA BTP addresses concentration averaging for a single blendable waste stream. There are three topics addressed in Section 3.2.1 including: (1) using the nominal fill volume for containers filled to at least 90 percent; (2) the averaging volume for absorbed liquids; and, (3) the treatment of small check sources. For efficiency, these provisions were not repeated in Section 3.2.2, "Concentration Averaging for Multiple Blendable Waste Streams." However, each of these three provisions also is applicable to blended waste (i.e., mixtures of two or more blendable waste streams) if the additional constraints in Section 3.2.2 are met. Similarly, each of these three provisions are applicable to mixtures of multiple blendable waste types if the constraints of both Sections 3.2.2 and 3.4 are met.

3. *Section 3.4 of Revision 1 of the CA BTP addresses mixtures of two or more different waste types. However, for blendable waste, it only discusses physical and chemical compatibility of the waste types, it does not provide averaging constraints. What are the averaging constraints for mixtures of two or more blendable waste types?*

   Section 3.2.2 of Revision 1 of the CA BTP addresses blending of different waste streams within the same waste type. The phrases "of the same waste type" or "of a single waste type" were used in several places in Section 3.2.2 because additional constraints are recommended for blending waste streams of different waste types in Section 3.4 of the guidance. The guidance on blendable waste in Section 3.4 applies in addition to the guidance in Section 3.2.2. For efficiency and clarity, the guidance in Section 3.2.2 was not repeated in Section 3.4; however, the guidance in Section 3.2.2 is applicable to blending waste streams of different waste types, provided the additional constraints in Section 3.4 are met.

4. *If a generator pours resin into a HIC containing cartridge filters, and the cartridge filters are justified as being treated as blendable waste, does the operational efficiency clause apply?*

   Cartridge filters and resins are different waste types, even if the cartridge filters are justified as being treated as blendable waste. Therefore, as discussed in response to Question #3, the guidance in Section 3.2.2 and Section 3.4 is applicable to such a case. The generator determines if combining the waste types was done for operational efficiency, occupational safety, or occupational dose reduction. The NRC staff encourages licensees to communicate with disposal site State regulators on acceptable averaging practices; however, because this language in the 2015 CA BTP is very similar to language in the 1995 CA BTP, this provision should not result in a significant change in current practice. Because the resins and cartridge filters are

different waste types, at least one of which is blendable, the licensee should document the physical and chemical compatibility of the waste types and make the documentation available for inspection.

5. *Given that Revision 1 of the CA BTP relies on the Uniform Waste Manifest (UWM) to identify waste types, can anion and cation exchange resins be considered a single waste type even though they are listed on the UWM separately?*

   Yes. Anion and cation resins need not be treated as separate waste types for the purposes of the CA BTP. Anion and cation resin are considered a single waste type for the purposes of the CA BTP just as primary and secondary resins are considered a single waste type (but still different waste streams). Similarly, for the purposes of the CA BTP, a bed of mixed ion exchange media is considered a single waste type (even when charcoal is a constituent of the mixed bed). Staff will look into further clarifying the UWM, which is currently undergoing revision.

6. *Revision 1 of the CA BTP provides guidance for single blendable waste streams, mixtures of two or more blendable waste streams of the same waste type, and mixtures of two or more blendable waste streams from different waste types. What guidance applies to single waste streams from multiple waste types?*

   As defined in the CA BTP, a waste type has a "unique physical description" and a waste stream has both "relatively uniform radiological and physical characteristics." Under the CA BTP, waste streams are subsets of waste types. That is, a waste type could contain separate waste streams, but a single waste stream would not include more than one waste type. Stakeholders have noted that there appears to be a different standard for physical uniformity applied to waste types as compared to waste streams, noting "a unique physical description" could be interpreted to be a more stringent standard than "relatively uniform" physical characteristics. Under the CA BTP, there is no distinction between these two phases. The term "unique physical description" was used for consistency with the definition of waste type in 10 CFR Part 20. For the purposes of the CA BTP, waste types are not more physically uniform than waste streams.

   Other stakeholders asked specifically if mixed-bed resins represented a single waste stream that contains more than one waste type. For the purposes of the CA BTP, the purpose of distinguishing blendable waste types from one another is to determine when physical and chemical compatibility should be documented. In this case, because the different physical materials in a mixed bed resin are used in contact with one another, the physical and chemical compatibility are generally apparent, and the mixed bed resin can generally be treated as a single waste type for the purposes of the CA BTP.

7. *If a waste container is approximately 80 percent full, it is common practice to add nonradioactive material so that it reaches 85 percent full, which is a waste acceptance criterion (WAC) at Barnwell. What happens if nonradioactive material is*

added to make the container 90 percent full? Can averaging then be used over the entire internal volume? Guidance in Revision 1 of the CA BTP says that added material should have a purpose other than lowering the classification. However, adding material to meet a WAC of 85 percent could be considered "necessary," and adding more nonradioactive material would make the waste package more stable (i.e., less void space), and would therefore have a purpose other than lowering the classification.

In general, it is not clear why licensees would add nonradioactive materials to containers to achieve an 85 percent - 90 percent fill volume when they could add radioactive material, which would likewise reduce void space. However, staff does not believe an increase of 5 percent constitutes an extreme measure; therefore, averaging could be used over the entire internal volume.

8. *In the encapsulation guidance (Section 3.3.4), the CA BTP specifies that containers "up to" 9.5 m^3 may be used. Did staff mean to state "up to and including" 9.5 m^3?*

   Yes, as found in the CA BTP, staff interprets "up to" to mean the same as "up to and including."

9. *If a generator has two partially filled waste containers, and combines them to fill void space and reduce the number of containers for disposal, is that "operational efficiency?"*

   In general, yes, this would be considered operational efficiency for the purposes of the CA BTP.

10. *What does staff interpret as "extreme measures" to avoid when performing solidification, encapsulation, or thermal processing?*

    The term "extreme measures" is used in the 1995 BTP. As in the 1995 CA BTP, the staff interprets the phrase to mean that any non-radioactive material added to the waste should have a purpose other than lowering the waste classification (e.g., stabilization or thermal process control). Revision 1 of the CA BTP does not change the meaning of the term "extreme measures." As in the 1995 CA BTP, the staff has not specif[ied] any particular numerical constraints, and instead has chosen to allow state regulators flexibility in their determination of what constitutes "extreme measures."

11. *Absent a specific numerical standard for "extreme measures," can the 14 percent waste loading criterion used for encapsulation in containers larger than 0.2 m^3 also be used for solidification and thermal processing?*

    The 14 percent waste loading value used in the encapsulation guidance is based on a topical report for an encapsulation process submitted to NRC and is not necessarily transferrable to solidification or thermal processing. The key factor in determining

whether or not a particular waste loading would be appropriate for another process is to determine whether the material added has a purpose other than changing the waste classification. If a particular waste loading is the highest waste loading that allows for a solidified waste form to have the necessary properties to meet stability requirements (or other waste acceptance criteria), that waste loading would generally not be considered an extreme measure. Similarly for thermal processing, if the material added is needed for process control or to control some property of the final waste form, it would generally not be considered an extreme measure. The NRC staff encourages communication with disposal State regulators on these issues.

(citations omitted)

Background

To provide protection for individuals who inadvertently intrude into a waste disposal facility, radioactive waste proposed for near-surface disposal must be classified based on its hazard to the intruder. The NRC's regulation, ''Licensing Requirements for Land Disposal of Radioactive Waste,'' 10 CFR Part 61, establishes a waste classification system based on the concentration of specific radionuclides contained in the waste. This system is one of the key components in ensuring protection of an inadvertent intruder. In determining these concentrations, the regulation states in 10 CFR 61.55(a)(8), that radionuclide concentrations can be averaged over the volume of the waste or its weight if the units are expressed as nanocuries per gram.

1983 Technical Position and 1995 CA BTP Although 10 CFR Part 61 acknowledges that concentration averaging for the purposes of classifying waste for disposal is acceptable, it does not specify limitations on the implementation of concentration averaging. The staff published a technical position on radioactive waste classification, initially developed in May 1983 (ADAMS Accession No. ML033630755), that provided guidance on concentration averaging. This 1983 technical position describes overall procedures acceptable to NRC staff that could be used by licensees to determine the presence and concentrations of the radionuclides listed in 10 CFR 61.55, and thereby classify waste for near-surface disposal. Section C.3 of the 1983 technical position provided guidance on averaging of radionuclide concentrations for the purpose of classifying the waste.

In 1995, the NRC staff updated a portion of the 1983 technical position, publishing as a separate document the ''Branch Technical Position on Concentration Averaging and Encapsulation,'' (60 *Federal Register* 4451, January 23, 1995). The 1995 CA BTP significantly expanded and further defined Section C.3 of the 1983 technical position dealing with concentration averaging, specifying a number of constraints on concentration averaging.

Significant Changes Necessitating Revision The 2015 update to the CA BTP was necessitated by the significant number of changes in the low-level radioactive waste program since the CA BTP was published in 1995. First, the Commission reviewed the 1995 CA BTP's position on blending of low-level radioactive waste in 2010 and directed the staff to revise it to be more risk-informed and performance-based. The 1995 version constrained the concentration of certain waste types put into a mixture (*e.g.,* ion exchange resins) to within a factor of 10 of the average

concentration of the final mixture. The Commission directed the staff to replace this position and to implement a risk-informed, performance-based approach for low-level radioactive waste blending that made the hazard (*i.e.,* the radioactivity concentration) of the final mixture the primary consideration for averaging constraints. Second, the NRC adopted a risk-informed, performance-based regulatory approach for its programs in the late 1990's, after the 1995 CA BTP was published. Revision 1 of the CA BTP more fully reflects that approach, not just for the blending position, but for other topics as well. One example is for concentration averaging of sealed radioactive sources.

The 1995 CA BTP significantly constrained disposal of sealed sources. Many sources have no disposal path because of the constraints recommended in the 1995 BTP. Licensees must store sealed sources for potentially long periods of time if there is no disposal option, and the sources are subject to loss or abandonment. The staff has reexamined the 1995 assumptions underlying the radioactivity constraints on their disposal. The CA BTP's revised positions are based on different, but conservative assumptions and will allow for the safe disposal of more sealed sources than the 1995 CA BTP. The revised position will enhance national security by ensuring that the safest and most secure method for managing sealed sources (*i.e.,* permanent disposal in a licensed facility) is available to licensees.

Opportunities for and Response to Public Comments Revision 1 of the CA BTP was developed after consideration of public comments on three drafts. The first draft (ADAMS Accession No. ML103430088) was noticed in the *Federal Register* on January 26, 2011 (76 FR 4739). The second draft (ADAMS Accession No. ML112061191) was made available to the public in September 2011—in advance of a public workshop held in Albuquerque, New Mexico—on October 20, 2011. The third draft (ADAMS Accession No. ML121170418) was noticed in the *Federal Register* for public comment on June 11, 2012, (77 *Federal Register* 34411).

Fifteen organizations representing a variety of interests submitted comments on the drafts. They included federal and state agencies and organizations, a nuclear power plant research organization, disposal and waste processing facility licensees, industry professional organizations, an advocacy group, and a waste services company. The NRC staff considered these comments in developing Revision 1 of the CA BTP. An overview of the changes to the 1995 CA BTP is presented in the *Federal Register* notice dated February 25, 2015. Detailed responses to each of the public comments are available in Volume 2 of Revision 1 of the CA BTP.

For additional information, please contact Maurice Heath of the NRC's Office of Nuclear Material Safety and Safeguards (NMSS) at (301) 415-3137 or at Maurice.Heath@nrc.gov. Please refer to Docket ID NRC–2011–0022.

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