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Secretary
U.S. Nuclear Regulatory Commission
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The enclosed document provides comments on the Nuclear Regulatory Commission's Draft Branch Technical Position on Concentration Averaging and Encapsulation, Revision 1 from the U.S. Department of Energy (DOE), Office of Environmental Management (EM). EM provided comments on the August 2011 version of this document on November 18, 2011. In that set of comments, EM provided a description of how low-level radioactive waste disposal facilities at DOE conduct blending/consolidation of waste streams to improve waste handling and minimize potential worker doses. Several modifications in this May 2012 version have been made that could result in implementation difficulties for disposal at NRC and Agreement State licensed facilities and EM believes it appropriate to provide comments in greater detail. The enclosure includes general and specific comments.

If you have any questions, please feel free to contact Mr. Mark Senderling, Office of Disposition Planning and Policy, at (301) 903-7514 or Ms. Linda Suttora, Office of Environmental Compliance, at (301) 903-8482.

Sincerely,

Frank Marcinowski
Deputy Assistant Secretary for
Waste Management

Enclosure

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E-RIDS = ADM-03

SUNSI Review Complete

Template = ADM-013

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Enclosure

Office of Environmental Management Comments on the Nuclear Regulatory Commission Branch Technical Position on Concentration Averaging May 2012 version

General Comments:

- The Office of Environmental Management (EM) believes that it is good practice to encourage waste handlers to minimize contact with radioactive waste and to encourage the "one-touch" practice of waste handling during generation. This refers to the practice of packaging waste, at the time of generation, with the intent of preparing the waste for disposal. By minimizing waste handling, unnecessary worker doses can be minimized, a goal under any well-designed As Low As Reasonably Achievable program. It is not clear in the Branch Technical Position (BTP) that the Nuclear Regulatory Commission (NRC) encourages this practice and in fact, there are many instances throughout the BTP where NRC encourages segregating waste streams resulting in increasing the worker exposure while not indicating how segregation of waste provides additional protection for future generations. EM believes that it is only necessary to segregate waste streams when the potential to negatively impact future generations is greater than the impact to workers.

- The BTP identifies activity level (37MBq) as the primary decision factor for classifying a container with multiple items, yet there is no description of how this equates to dose to an inadvertent intruder in 100 or 500 years. Since each isotope decays at different rates and is associated with different potential doses at different times, knowing the radioactivity at the time of disposal provides only a small portion of the required information. It appears as though this chosen activity level is associated with Nb-94. Nb-94 has a half-life of 20,000 years which is far longer than Co-60 or Ce-137 and its activity is not at all relatable to other isotopes. Based on research conducted by the Electric Power Research Institute and presented at the 2012 RadWaste Summit, it appears as though many of the assumptions made by NRC on radioactivity in the activated metals may need to be updated.

- The BTP makes many references to homogeneous waste and the desire for homogeneity, but no reference to risk as a decision-making factor. This focus appears mismatched with many of the statements that after several hundred years the waste would be indistinguishable from the surrounding soils. It would be unfortunate to unnecessarily expose workers to much greater risk for little benefit in the long-term. In addition, throughout the document there are references to specific fill volume percentage criteria for mixing wastes in containers, and there is no technical basis provided for these

percentages. For example, in section 4.2.1, page 14, there are references to fill volumes of around 90 percent needed prior to volumetric-averaging the concentration over the container. It is not clear why that fill volume would be required and no indication that the waste handler may choose to fill to a lower volume and compress the container after filling to minimize void spaces. In section 4.2.2, page 15, there is a statement that blending dissimilar mixable waste streams would not be desirable, but no justification provided for that statement. Again, it might be appropriate if the waste is indistinguishable from soils in several hundred years to blend dissimilar mixable waste if there is no increase in worker risk and no decrease in risk to a future member of the public.

- Throughout the document there are discussions of the size of hot spots in the disposed waste. There is an assumption that a hot spot of greater than a specific size has significance to a future inadvertent intruder. In fact, the important issue is the probability of the intruder hitting a hot spot in a large disposal facility, the isotopes in the hot spot, its decay rate, and the year that the intrusion occurs. However, the size of the hot spot should not be the determining factor. This BTP becomes extremely difficult to implement, given the complexity of the calculations, the assumptions regarding the isotopes of the hot spot (or only using the longest lived isotopes found in activated metals as the basis for calculations for all activated metals hot spots, whether the longest-lived radionuclide are present or not) and the assumptions about the size of the hot spots in the waste stream.

- The document should provide additional definitions in the glossary where terms or waste types are identified. For example, in section 4.2, page 14, the term "relatively uniform" is used, but not defined. The document also identifies some waste types generically and it is difficult to determine the origin of this waste. For example, the sections on mixable waste specify "spent ion-exchange resins mixed as part of the design of a nuclear power plant" and other sections discuss "filter cartridges." Are there some ion-exchange resins that are not included in this definition? Is there a technical reason for eliminating certain ion-exchange resins from consideration? What if the ion-exchange resins are generated from a different source? See below for the cartridge filter question. For the "filter cartridges", is this referencing a specific waste stream? The origin of the named waste streams should be clearly defined either in the BTP, the glossary, or both.

- The BTP focuses on waste in containers. It needs to also address bulk waste disposal.

Specific Comments:

- Section 4.1, page 9-10 and Figure 1, page 11: It appears as though the BTP is advocating for segregation of waste, particularly in the examples provided at the node C and node D portions of classification of mixtures. The BTP does not take into account the impacts to workers or the potential lack of impacts to future members of the public by this segregation approach. This concept should be reworked to require an impacts analysis and worker potential dose should be included in the analysis. In deciding whether to segregate blended wastes, an important consideration should be whether doses would be much greater to workers than to possible future members of the public, particularly for short-lived radionuclides.

- Section 4.2.2.1, page 16 (first full paragraph): The discussion in this paragraph relates container size to hot spot activity. It is not clear how or whether container size correlates with risk. Please clarify how this discussion is to be used in establishing requirements.

- Section 4.2.2.1, page 16 (second paragraph): It is stated here that, "While an intruder exhuming many waste packages...will naturally homogenize waste over a relatively large volume, an intruder exhuming a relatively small volume of waste (e.g., a well driller) is more susceptible to encountering hot spots in the waste and averaging the exhumed waste of a much smaller volume." It is not intuitively obvious why someone excavating a smaller volume is more likely to hit a hot spot, or why the exhumed waste would necessarily be homogenized over a smaller area or volume (e.g., bore hole cuttings can be greatly diluted with drilling mud). Please provide the basis or rationale for these assumptions.

- Section 4.2.2.1, page 17 (last paragraph): Please provide the technical analysis which provides a risk basis for establishing the volume limit beyond which it is appropriate to demonstrate waste homogeneity at 0.1 percent of the country's annual commercial volumes of the applicable class of waste disposed of in licensed facilities.

- Section 4.2.2.1, page 18: While it is appropriate to identify the small quantity generators that are exempt from conducting the complex calculations required to comply with the BTP, NRC should provide justification for the threshold chosen (0.6 m^3/yr). The decision of whether a waste generator is exempt from demonstrating homogeneity should be based on the potential risk of the waste generated, not merely on volume generated.

- Section 4.3, page 20: There is no justification provided for the 37MBq (1mCi) activity level threshold identified in the BTP as the basis for distinguishing

the waste disposal techniques. Suggest explaining the reason for choosing this activity level as the basis for decisionmaking.

- Section 4.3, page 21: The discussion of whether to conservatively classify a mixture by the highest classification piece in the mixture is counter to the risk of blending waste streams. There does not appear to be a need to identify specific hot spots based on current activity levels, particularly for those radionuclides which decay quickly. Also, it is not clear what the basis is for "two times the classification limit" for a nuclide, particularly where it is a short-lived radionuclide and might be indistinguishable from the other wastes in the container in 100 years. There is no link to actual or potential risk to a future member of the public or inadvertent intruder. These assumptions should be reconsidered in a risk-informed framework.

- Section 4.3.4, page 24: In the discussion regarding the cartridge filters as homogeneous waste, there are several references to the use and styles of cartridge filters. There should be greater detail provided to the reader regarding the source of these cartridge filters and the types of radionuclides. There are many filters used in radioactive waste management and it is confusing to the reader exactly which filters are being discussed. In addition, the statement that radioactive material may spill out of a filter if handled by an inadvertent intruder appears counter-intuitive. What if the material spilled onto the intruder? That would be conceivably more dangerous.

- Section 4.9.4, Page 32: This section does not accurately capture the Department of Energy (DOE) system of conducting probability of intrusion calculations. While it is true that the government intends long-term control of DOE disposal sites, DOE requires that inadvertent intruder assessments be conducted at all DOE-owned disposal facilities in the unlikely case the government loses those institutional controls. This requirement is found in the Manual (M) to the Order, DOE M 435.1-1, IV.P.(2)(h), *Radioactive Waste Management Manual*. Sites can request to assess to a longer time period for inadvertent intruder analyses for those sites that are unlikely to support an inadvertent homesteader. Only one DOE disposal site has provided this justification.

- Appendix A: The Glossary should include the terms and meaning of "Concentration Averaging" and "Stability." Additional definitions for the more specific terms found throughout the document would be helpful.

- Appendix B, section B.3, page 39: the following statement is made: "Five hundred years after closure of a LLRW landfill, the LLRW containers have decayed and the mixable wastes and encapsulating materials have become soil like." This statement appears to be overly conservative. More realistic scenarios should be able to be considered, particularly for very dry sites. It is

understood that cement or metal will eventually degrade; however, after 500 years it is unlikely that the containers or encapsulations will degrade to or become "soil like" materials in very dry environments. Degradation will take place and it would be expected that the container or encapsulation will eventually crack and large pieces of cement or metals (55 gallon drums) holding the source will eventually open but not to the point of disintegration of the physical structure, as is inferred in this statement, especially for durable metals like stainless steel.

- Appendix B, section B.3, page 40: As described in the NRC analysis, using a 130 Ci Cs-137 source would provide an exposure to an intruder of about 500 mrem at 500 years. This is an actual acute dose to an immediate event. Therefore, in the second paragraph of the NRC analysis, the sentence "The dose from a 5.2 TBq (140 Ci) Co- 60 source will be 5 mSv/yr (500 mrem/yr) at 111 years." should be corrected to read "5 mSv (500 mrem)" and the calculation should be reported at 100 years.

- Appendix B, section B.3, page 40: "Additional Modeling details:" In order to appropriately calculate the potential future dose, as described in the BTP, it would be necessary to know the presumed distance from source to receptor. Within this paragraph consider including all additional parameters that were used in "MicroShield" code, e.g., equivalent density shielding for the human body(muscles, bones), distance to the organs of interest, and what ICRP tissue weighting factors were used (ICRP 26/30, ICRP 60) in order to determine Total Effective Dose to the receptor.

- Appendix B, section B.4, page 41: In the last paragraph under "NRC Analysis:" change "...5 mSv (505 mrem)." to "...5 mSv (500 mrem)."

- The intruder scenarios described in the Sealed Source sections and appendix B could be improved in several ways:

    - Making reasonably representative stylized inadvertent scenarios in terms of behavior. While an isolated rare member of the population might pick up interesting rocks and bring them home to display, we do not typically plan to protect the "rare" future individuals in a population but plan to protect the future average member of the public.

    - In EM's earlier set of comments, we provided a probabilistic methodology for assessing a future inadvertent intruder. In that method, we calculate the size of the "hot spots" expected in a large disposal facility against the total size of the facility and conduct an analysis of the likelihood that any inadvertent intruder would happen

upon just those hot spots. That probability would be far less than one. We suggest that NRC give further consideration to such an approach.

- The inadvertent intruder scenarios described in the background section in appendix B are based on several advertent intruder scenarios described in NRC's prior environmental impact statement. It would be helpful if the scenarios were updated in the BTP to include more realistic inadvertent intruder scenarios.

- The statement that hot spots of gamma activity may be more significant to intruder doses than hot spots associated with "other nuclides" (presumable alpha and beta emitters) has not been justified. While the pathways of concern for alpha/beta emitters are inhalation and ingestion instead of external exposure, inhalation and ingestion would be likely pathways following the disturbances of intrusion.