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Revision 0

Radioactive Classification of Waste in Containers

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Plateau Remediation Company

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CONTENTS

TABLES

1.0 INTRODUCTION

Transuranic (TRU) waste as a class of radioactive waste was established in 1970 and prohibited from shallow land disposal. A national program to manage and dispose of TRU waste was initiated in accordance with the *Waste Isolation Pilot Plant Land Withdrawal Act*. Since its inception, the national TRU waste program has matured culminating with the establishment of Waste Isolation Pilot Plant (WIPP) operating as the nations' TRU waste disposal site. The requirements and standards of the national TRU waste program to identify and dispose of TRU waste have been developed over time and are established in the WIPP waste acceptance criteria (WAC) and supporting documents.

The policies and methods use to identify TRU waste distinguishing it from low-level waste (LLW) used at Hanford have not been evaluated against the now mature national TRU waste program requirements. This document will evaluate Hanford practices used to identify TRU waste as compared to the national TRU waste program. This document will clarify policies and methods to be used at Hanford to ensure consistency with the national TRU waste program.

2.0 ISSUE

Typically, radioactive waste is generated and packaged into containers for management. The management of radioactive waste is, in part, dependent on and directed based on the classification of the waste such as TRU waste and LLW. If the waste is determined to be TRU waste it is then treated, as necessary, then disposed at WIPP. If the waste is determined to be LLW at Hanford it is then treated, as necessary, then disposed at the Environmental Restoration Disposal Facility (ERDF), Trenches 31 and 34 in the Hanford low-level waste burial ground (LLBG), or in another acceptable disposal facility. LLW when it is disposed at the ERDF must also be evaluated to determine NRC waste class.

Historically at Hanford and prior to the opening of WIPP, the weight of radioactive waste in a container has been identified as the waste material added into the container but did not include packaging material, such as absorbent, inner containers, cribbing, liners, and spacers, and shielding. With the maturation of the national TRU waste program including the opening of WIPP, the national program has established policies and methods that are different than the policies and methods used at Hanford in the past. These differences lead to some radioactive wastes to not have a path for disposal because they are not TRU waste in accordance with the national program but are TRU waste in accordance with historical Hanford practices. The current practices at Hanford must be consistent with the national TRU waste program to eliminate the creation of waste that requires detailed resolution to dispose of it.

3.0 RADIOACTIVE CLASSIFICATION REQUIREMENTS

3.1 U.S. Department of Energy Requirements

The DOE radioactive waste classes are identified in DOE Manual 435.1-1, *Radioactive Waste Management* with guidance provided in DOE Guidance 435.1-1, *Implementation Guide for Use with DOE M 435.1-1.* DOE M 435.1-1 identifies the possible radioactive waste classes as: high-level waste (HLW), TRU waste, and LLW. HLW is a source based determination not a radionuclide concentration based determination, therefore waste weight and concentration averaging does not affect the determination and so is not included further in this discussion.

The DOE concentration based radioactive waste classes are TRU waste or LLW. The DOE M 435.1-1 paragraphs III.A and IV.A state that "Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste..." and "Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste...." TRU waste then is radioactive waste with a concentration of alpha emitting transuranic radionuclides with half-lives of to greater than 20 years being greater than a numerical threshold. If a radioactive waste contains radioactivity less than the TRU waste threshold and is not HLW, spent fuel, or other exempted material then it is LLW. In order to determine if a radioactive waste is TRU waste or LLW the concentration of transuranic radionuclides must be calculated or measured in the waste.

Requirements have been established by the national TRU waste management program that apply to the calculation of radionuclide concentrations in waste. The disposal of TRU waste is governed by 40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Fuel, High-Level and Transuranic Radioactive Wastes." Further, 40 CFR 194 , " Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's (WIPP) Compliance with the 40 CFR Part 191 Disposal Regulations," provides certification requirements for the DOE to follow to dispose of TRU waste at the WIPP. The salient points of these regulations regarding concentration are noted below:

- 40 CFR 191.02(j) states that radioactive waste means high level waste and TRU waste covered by this part of the U.S. Environmental Protection Agency (EPA) regulations (includes 40 CFR 191 and 40 CFR 194)
- 40 CFR 194.3 states that waste is "radioactive waste, radioactive material, and coincidental material subject to the requirements of part 191 of this chapter"
- 40 CFR 194.24 states the requirements for waste characterization that the WIPP has to meet. The WIPP program implements and is compliant with the requirements regarding how the waste is described in the documentation that it receives.

The TRU waste program implementation of the regulatory requirements is embodied in the Waste Isolation Pilot Plant Waste Acceptance Criteria (WIPP-WAC), DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (TRU WIPP-WAC). The following text is excerpted from the TRU WIPP-WAC:

> 3.3.3 TRU Alpha Activity Concentration
>
> *Acceptance Criterion.* TRU waste payload containers shall contain more than 100 nCi/g of alpha-emitting TRU isotopes with half-lives greater than 20 years. Without taking into consideration the TMU[1], the TRU alpha activity concentration for a payload container is determined by dividing the TRU alpha activity of the waste by the weight of the waste. The weight of the waste is the weight of the material placed into the payload container (i.e., the net weight of the container). The weight of the waste is typically determined by subtracting the tare weight of the payload container (including the weight of the rigid liner and any shielding external from the waste, if applicable) from the gross weight of the payload container. In the event waste containers (e.g., 55-gallon drums) that have been radioassayed are overpacked in a payload container (e.g., in an SWB), sites shall sum the individual TRU alpha activity values of the individual waste containers and divide by the sum of the individual net waste weights (i.e., less container, shielding, and liner weights as appropriate) to determine the activity per gram for the payload container. Waste containers selected for payload management shall comply with the policy for the management of TRU alpha activity concentration (see Appendix E). Loading a 55-gallon pipe-overpack with cans is considered direct loading – not overpacking for the purposes of calculating the weight of the container. The TRU alpha activity concentration shall be reported to the WWIS; however, there are no reporting requirements for its associated TMU (Reference 2, Section 2[18]; Reference 17, Chapter 4).[2]

3.2 NRC Requirements

The NRC waste class identification and determination are governed by 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." Guidance in determining the NRC radioactive waste class is provided in branch technical position (BTP) papers *Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification* and *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position.*

In 10 CFR 61.55(a)(8) it states that "The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed in

[1] Total Measurement Uncertainty

[2] The text of section 4.3.3, which the equivalent section in the *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* to remote handled, is consistent with the text presented here that applies to contact handled TRU waste.

nanocuries per gram." The BTP papers provides further clarification that concentration averaging is permissible over the waste for radionuclides in many situations but in all cases the container or container liners are not included. The BTP papers describe constraints on the application of concentration averaging based on the waste type, if the waste has been treated, the level which the waste fills the container, if the waste is a mixture of waste types, and uniformity of the radioactivity in the waste. The NRC regulations and BTP papers should be consulted for guidance that is specific to the waste being disposed at the ERDF.

4.0 DISCUSSION

The radioactive waste classes and class determinations apply as two separate sets of requirements, the DOE requirements and NRC requirements. The DOE requirements apply throughout the management of the waste at Hanford including generation, storage, treatment, and disposal (as implemented via the CERCLA process). The NRC requirements generally only apply at the time and to the waste form being sent to the ERDF for disposal or treatment as it is a requirement specific to the ERDF and not usually being a requirement of radioactive waste managed under the authority of the DOE or specific to the most CERCLA authorizations governing cleanup at Hanford.

The fundamental question in both the DOE and NRC classification processes is what is waste. Waste is material that cannot continue to be used for its intended purpose or is discarded or abandoned. It follows then, that the waste and other material such as absorbent, cribbing, spacers, and inner containers placed inside of a container are waste unless it can be reused or are determined to not contain radioactivity (free-released). The inner container, spacers, cribbing, liner, and absorbent placed in a container with waste cannot be reused because of potential contamination, personnel exposure, and releases. It is not practical to free-release the inner containers and liners, absorbent, spacers, and cribbing material in compliance with DOE Order 5400.1, *General Environmental Protection Program*, due to the inability to survey some surfaces, the prohibitive cost to survey and decontaminate materials versus replacing with new equipment, and the additional personnel exposure. Shielding on the other hand, if it continues to be used for its intended purpose is not waste.

The Hanford TRU waste program's interpretation of the guidance provided in the WIPP-WAC is that the weight of waste in a container is the total container weight minus the waste container and rigid liner tare weight. The outer container is the "payload" container. Therefore, when the TRU waste program is characterizing the payload container, it is interpreted that everything inside the payload (outer) container except the rigid liner is waste; this is recorded on the radiography data sheet and used in the nondestructive assay calculations. This includes materials such as absorbent and cribbing placed between the inner and payload containers. At this time the Hanford TRU waste program has not processed remote handled TRU waste so a policy regarding shielding has not been implemented (i.e., shielding between the inner and outer containers, as well as shielding inside the inner container). The practices just described are consistent with

how other DOE TRU waste generation sites deal with waste in containers for characterization to WIPP disposal requirements.

The NRC BTP papers and regulation (10 CFR 61) provide more guidance than does the DOE in regard to determining the waste weight and volume appropriate for waste classification determination. The calculation of an average concentration for rubble generated from demolition has been evaluated against guidance provided by branch technical position (BTP) *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position* (NRC 1995). In regard to the application of concentration averaging to evaluate the waste class in accordance with 10 CFR 61.55, the BTP states:

> "Principal considerations include: (1) whether the distribution of radionuclides within the waste can be considered to be reasonably homogeneous (i.e., volume distributed); (2) whether the "as-generated" waste has been processed and, if so, what is the mass/volume of the processed waste; (3) whether the waste includes mixtures of various waste types (i.e., a waste stream with a particular set of physical characteristics); (4) whether the waste includes mixtures of the same waste type, but at differing radioactivity concentration levels; and (5) whether the volume of the waste container, if used to represent the volume of the waste, is significantly larger than the volume of the waste itself, and differential volume consists largely of void space."

The NRC regulations and BTP papers should be consulted for guidance that is specific to the form and condition of the waste at the time it is being sent for disposal at the ERDF.

5.0 CONCLUSION

The interpretation adopted in regard to radioactive waste classification of waste in containers is accomplished via two separate systems: 1) Radioactive waste classification evaluations in accordance with DOE process and 2) Radioactive waste classification evaluations in accordance with NRC process.

The DOE waste classification process requirements apply throughout the management of the waste at Hanford. The interpretation adopted of the DOE process to implement radioactive classification evaluations of waste in containers may be stated as:

> The contents of a container including waste material and packaging material including cribbing, spacers, inner containers, and absorbent material are considered waste. An inner rigid liner is not waste and is not included in radioactive waste classification determinations. Material that is placed in a container to provide shielding must be evaluated on a case-by-case basis to determine its status as waste.

The interpretation adopted is compliant with the requirements of DOE M 435.1-1 and consistent with the TRU waste program. The rules that implement this interpretation are presented in Table 1.

Table 1. DOE Radioactive Classification Rules

Material	Determination Rule
Container	Packaging - not waste.
Container Rigid Liner	Packaging - not waste.
Inner Container	The inner container and it's contents are waste.
Cribbing[3]	The same as described for the inner container.
Absorbent (between inner and containers)	The same as described for the inner container.
Shielding	A material that is shielding shall be identified as such on records or configured in the package such that it clearly is being used for its shielding properties is determined on a case-by-case basis as to whether it is the waste or not . If material that can be used for shielding is in a container but is not clearly identified as being used as shielding then it is presumed not to be shielding.

The NRC waste classification process requirements apply when a waste is being disposed at a NRC regulated disposal facility or if it is applied via the CERCLA process. The NRC waste classification process requirements have been applied to waste being disposed of at the ERDF via the CERCLA process. The NRC requirements do not apply when disposing at Trenches 31 and 34 in the LLBG. Waste classification evaluations in accordance with the NRC process apply at the time and to the waste form that is being sent to ERDF or NRC regulated disposal facility.

6.0 REFERENCES

1. DOE, 1990, DOE Order 5400.1, *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, Washington D.C.
2. DOE, 1999, DOE Manual 435.1-1 *Radioactive Waste Management*, U.S. Department of Energy, Washington D.C.
3. DOE, 1999, DOE Guidance 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*, U.S. Department of Energy, Washington D.C.
4. DOE, 2004, DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Rev. 6.5, U.S. Department of Energy, Carlsbad, New Mexico.
5. NRC, 1983, *Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification*, Rev. 0, U.S. Nuclear Regulatory Commission, Washington, D.C.

[3] Cribbing is material placed between the inner and outer containers to restrain the movement of the inner container and/or load it into the overpack and may include wood or metal spacers, absorbent, and disposable handling devices such a straps, cables, slings, shackles, clamshells, sleeves, or wraps.

6. NRC, 1995, *Issuance of final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position*, U.S. Nuclear Regulatory Commission, Washington, D.C.
7. Public Law 102-579, 106 Stat. 4777, 1992 (as amended by Public Law 104-201, 1996) Waste Isolation Pilot Plant Land Withdrawal Act.
8. Resource Conservation and Recovery Act of 1976, 42 USC 6901 et seq.
9. 10 CFR 61.55, *Waste Classification*, Code of Federal Regulations, as amended.