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Revision 0

Waste Acceptance Criteria for the Integrated Disposal Facility

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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LIST OF TERMS

ALARA	as low as reasonably achievable
CH-TRAMPAC	contact-handled transuranic waste authorized method for payload control
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HC	hazard category
IDF	Integrated Disposal Facility
LDR	land disposal restriction
LLW	low-level waste
LTHC-3	less than hazard category 3
MLLW	mixed low-level waste
OWTF	Onsite Waste Tracking Form
PA	performance assessment
QAP	quality assurance plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
SOR	sum of ratios
TRU	transuranic
TSD	treatment, storage, and/or disposal
WAC	*Washington Administrative Code*

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1.0 INTRODUCTION

DOE O 435.1, *Radioactive Waste Management*, requires that each treatment, storage, and/or disposal (TSD) facility that manages low-level waste (LLW) and mixed low-level waste (MLLW) maintain waste acceptance criteria. These criteria must address the various requirements to operate the TSD facility in compliance with applicable requirements (e.g., safety, environmental).

As described in DOE O 435.1, the Radioactive Waste Management Basis for a disposal facility consists of the performance assessment, composite analysis, disposal authorization statement, closure plan, waste acceptance criteria, and monitoring plan. In particular, this document provides criteria for complying with the conditions described in the *Operating Disposal Authorization Statement for the Integrated Disposal Facility, Hanford Site* (DOE, 2018; hereinafter called the DAS). The DAS is the license for disposal of radioactive materials granted by the U.S. Department of Energy (DOE). Appendix A, "DOE-STD-5002-2017, Chapter 6 – Waste Acceptance Criteria Crosswalk," to this document provides a crosswalk to document compliance with the change control process guidance in Table 6-2 of DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation*.

Additional acceptance criteria are provided for compliance with the *Washington Administrative Code* (WAC) 173-303, "Dangerous Waste Regulations," as identified in WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, For the Treatment, Storage, and Disposal of Dangerous Waste* (Operating Unit Group 11) dangerous waste (specifically the subset of MLLW) authorized by the Washington State Department of Ecology (Ecology).

1.1 PURPOSE AND SCOPE

This document provides criteria for acceptance of LLW and MLLW waste at the Integrated Disposal Facility (IDF). The DAS stipulates that the waste acceptance requirements include specific radionuclide disposal limits, waste form restrictions, and descriptions of acceptable waste packages. Additionally, waste acceptance procedures are maintained to describe requirements for waste characterization, waste certification, and record keeping, as well as the process for authorizing deviations from the requirements. The acceptance criteria include the waste designation and management requirements of WAC 173-303-140, "Dangerous Waste Regulations," "Land Disposal Restrictions," requirements.

1.1.1 Policy Statement

This document provides criteria for complying with requirements governing waste disposal at the IDF to:

- Ensure safe and compliant disposal of LLW and MLLW.
- Protect human health and the environment in accordance with the requirements of the WAC 173-303 and the *Revised Code of Washington* (RCW) 70.105, "Hazardous Waste Management."
- Protect the workers, members of the public, and the environment in accordance with DOE O 435.1, and applicable U.S. Department of Transportation (DOT) regulations.
- Ensure that present and future radiation exposures are kept as low as reasonably achievable (ALARA) and do not exceed the radiation protection standards established in 10 CFR 835, "Occupational Radiation Protection."
- Ensure that quality assurance programs are established and implemented to fulfill the requirements of DOE O 435.1; 10 CFR 830.122, "Nuclear Safety Management," "Quality Assurance Criteria"; and DOE O 414.1D, *Quality Assurance*.
- Be consistent with applicable federal, state, and local regulations.

1.1.2 Scope of Waste Acceptance Criteria Document

The IDF waste acceptance criteria are established in this document to ensure that waste accepted can be managed within the operating requirements, including environmental regulations, DOE orders, permits, technical safety requirements, waste analysis plans, and performance assessments. Acceptance criteria in this document apply to LLW and MLLW from Hanford Site waste generators.

Waste acceptance criteria will ensure the required treatment has been performed before the waste is disposed and will prohibit the disposal of ignitable and reactive wastes.

1.2 INTEGRATED DISPOSAL FACILITY DESCRIPTION

The IDF Operating Unit Group comprises the following four dangerous waste management units:

- A storage pad is used for unloading, staging, and temporarily storing incoming waste containers. This ground level concrete pad is located west of the disposal cells.
- A treatment pad is used for treating waste to meet disposal requirements. Treatment capabilities include debris immobilization technologies from 40 CFR 268.45, "Treatment Standards for Hazardous Debris" (sealing, microencapsulation, and macroencapsulation). This ground-level concrete pad is also located west of the disposal cells.
- Two disposal cells (cells 1 and 2) are two large excavations designed for the disposal of both LLW and MLLW. The IDF disposal cells are equipped with primary and secondary geomembrane liners and are constructed to RCRA Subtitle C standards.

The IDF also contains a tank system; however, the tank system is managed according to the generator requirements of WAC 173-303. Leachate from the liners is collected and managed by a leachate collection and removal system and accumulated in the tanks.

1.3 WASTE TYPES ACCEPTED FOR DISPOSAL

This section identifies the types of wastes accepted for disposal at IDF.

1.3.1 Low-Level Waste (LLW)

LLW is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic (TRU) waste, byproduct material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*), or naturally occurring radioactive material (DOE M 435.1-1, *Radioactive Waste Management Manual*).

1.3.2 Mixed Low-Level Waste (MLLW)

Hanford Tank Dangerous waste is solid waste designated in accordance with WAC 173-303-070, "Designation of Dangerous Waste," through WAC 173-303-100, "Dangerous Waste Criteria," as dangerous or extremely hazardous. A subset of dangerous waste, MLLW is defined in WAC 173-303-040, "Definitions," as:

> means a dangerous, extremely hazardous, or acutely hazardous waste that contains both a nonradioactive hazardous component and, as defined by 10 C.F.R. 20.1003, source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.).

1.4 DEVIATIONS TO THE WASTE ACCEPTANCE CRITERIA

Deviations to the acceptance criteria will be approved by DOE, and as applicable, Ecology. Deviations to the acceptance criteria may be granted in certain cases (e.g., safety basis and performance assessment,

TSD unit container size limits, compliance with regulations, permit conditions, compliance orders, or other requirements imposed by a regulatory agency).

A generator can request a deviation from one or more of the criteria in this document. The request should be a written letter to the IDF waste acceptance team that includes the following information:

- Specific requirement(s) in this document for which a deviation is desired
- Waste type (e.g., LLW and MLLW)
- Waste characteristics (e.g., physical descriptions, dose rates, radiological constituents, and hazardous waste constituents)
- Packaging information (e.g., volume, weight, dimensions, internal configuration, and materials)
- Efforts made to comply with the requirements of this document
- How the generator complied with the waste generation/life cycle planning requirements of DOE M 435.1-1
- Alternative analyses (including life cycle estimates) showing that acceptance of waste that is not compliant with requirement(s) of this document is the most cost-effective solution for DOE

2.0 WASTE ACCEPTANCE PROCESS

Waste generators must receive approval from IDF before shipment of waste to the IDF as specified in this document. Use of the waste acceptance process is mandatory. Based on the waste certification information required under Section 2.4, waste profiles and a waste designation shall be developed and approved for each waste source (or sufficiently similar group of waste sources). The waste profile includes the waste form, characterization data, appropriate waste codes (known Dangerous Waste numbers), and state and federal land disposal restrictions (LDRs) (e.g., treatment required).

Waste profiles shall be provided to and approved by the IDF waste acceptance team prior to initiating shipments to ensure compliance with the IDF waste acceptance criteria and to facilitate planning of waste receiving and disposal actions. Waste designations shall be confirmed through the waste certification and verification programs.

2.1 WASTE GENERATOR RESPONSIBILITIES

Generators of radioactive waste have certain general responsibilities under DOE O 435.1. Acceptance of waste at the IDF is contingent on effectively fulfilling these responsibilities.

2.1.1 Waste Certification Program

Waste generators must implement and maintain a waste certification program to ensure that any waste sent to the IDF meets the requirements established in Section 3.0 in accordance with DOE M 435.1-1 and WAC 173-303. Activities that may be performed by the generators include application of process knowledge, observation, process monitoring, sample collection and analysis, or a combination thereof.

2.1.2 Quality Assurance Requirements

Each generator shall have a quality assurance plan (QAP) as part of its overall waste certification program. The QAP shall implement the requirements of 10 CFR 830, “Nuclear Safety Management,” Subpart A, “Quality Assurance Requirements,” and DOE O 414.1D (DOE M 435.1-1). The generator QAP shall be subject to evaluation according to the requirements of Section 2.4.

2.1.3 Waste Forecast

Waste generators shall provide an annual waste forecast to IDF. Annual waste forecasts shall include yearly waste shipment estimates to IDF through the next 10 years. The timing and format of the waste forecast will be provided by IDF.

2.1.4 Records

The waste generator shall retain a copy of the information and data (e.g., process knowledge, sampling information, analytical data, inventory records, and related information) used to characterize and designate the waste in each profile in accordance with federal and state requirements and DOE orders. The waste generator must provide copies of the waste characterization information and data as requested by IDF through the waste acceptance process.

2.1.5 Physical and Chemical Characterization

Waste must be characterized in a sufficient manner to ensure that the waste can be managed in accordance with the requirements set forth in this document. This includes sufficient knowledge to:

- Demonstrate that the waste is not prohibited
- Segregate waste containers for compatibility
- Ensure compatibility of waste with containers
- Ensure that the waste can be safely managed

The waste generator must determine the physical and chemical characteristics of the waste with sufficient accuracy and detail to properly designate and manage the waste in accordance with the IDF acceptance criteria and applicable regulations (i.e., acceptable knowledge) such as the following:

- WAC 173-303-300, “General Waste Analysis”
- 40 CFR 761, “Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions” (Note: The IDF is not a Chemical Waste Landfill as defined by 40 CFR 761.75.)

The waste generator shall perform the activities necessary to characterize, support, and designate the waste for dangerous waste sources, characteristics, and as applicable, the dangerous waste criteria pursuant to WAC 173-303-070. The sampling preparation and testing methods shall conform to requirements in WAC 173-303-110, “Sampling, Testing Methods and Analytes.”

2.1.5.1 General Waste Knowledge Requirements

General waste knowledge must be sufficient to determine the waste stream designation and to manage the waste in accordance with the IDF waste acceptance criteria necessary for proper management of the waste.

Analytical data and/or knowledge of the waste must be sufficient to determine whether the waste is regulated under WAC 173-303 to assign correct waste codes and 40 CFR 761. Knowledge of the waste-generating process alone is used to determine whether a waste stream is a listed waste identified in WAC 173-303-080, “Dangerous Waste Lists,” through WAC-173-303-082, “Dangerous Waste Sources.” Solid waste that might exhibit characteristics that would cause the waste to be dangerous waste shall be designated in accordance with WAC 173-303-090, “Dangerous Waste Characteristics.” Book designation of solid wastes for persistence and toxicity or bioassay testing for toxicity shall be in accordance with WAC-173-303-100. For characteristic waste codes and for classification under 40 CFR 761, if the

available process knowledge is not sufficient to determine whether the waste is regulated and to assign waste codes, sampling and analysis of a representative sample must be performed. The sampling and testing methods outlined in WAC 173-303-110 must be used for the toxicity characteristics, corrosivity, and free liquids. Appropriate test methods include those defined in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, or other methods with proper quality assurance and quality control requirements.

2.1.5.2 Types of Acceptable Knowledge

The types of information that can be used for physical/chemical characterization include data from analysis of the waste and knowledge of the materials and/or processes that generate the waste. Acceptable knowledge can be obtained using the following types of information:

- Mass balance data from the waste generating process, to the extent that such data provides a sufficient understanding of the characteristics of and constituents in the waste stream. Guidance is provided in Appendix B, "Guidance for Mass Balance of Hazardous/Mixed Waste," to this document.
- Safety Data Sheets for commercial chemical products
- Analysis data from a representative sample of the waste or for a waste generated by a similar process
- Interview information
- Logbooks
- Procurement records
- Qualified analytical data
- Radiation work packages
- Procedures and/or methods
- Process flow charts
- Inventory sheets
- Vendor information
- Mass balance from an uncontrolled process (e.g., spill cleanup)
- Mass balance from a controlled process with variable inputs and outputs (e.g., washing/cleaning methods)

2.1.6 Waste Profiles

The waste profile provides a detailed physical, radiological, chemical, and biological analysis of low-level or mixed waste to be accepted at IDF. The waste profile must provide a detailed description of the waste stream's physical, radiological, and chemical characteristics, regulatory classification, and packaging methods. Relevant background information, documents, and analytical data must be referenced or attached. The waste profile includes the following information:

- Generator information (e.g., name, address, point-of-contact, telephone number)
- Waste-generating process description
- Waste category (e.g., LLW or MLLW)

- Estimated volume of the waste
- Estimated number of waste containers to be shipped
- Knowledge used for characterization of the waste stream
- Sampling and analysis performed to characterize the waste stream
- Regulatory requirements of the waste stream (e.g., testing for underlying hazardous constituents) including applicable state and federal LDRs
- Waste characteristics (e.g., flash point and pH), physical state (e.g., sludge and debris), liquid content information, and the waste composition
- Description of the packaging to be used, including container compatibility with the waste
- Provisions for handling (e.g., maximum container size and weight, and special handling requirements)
- Conditions of approval, when applicable (e.g., profile approval may be contingent upon additional detail and/or documentation requested of the generator)

Waste profiles shall include waste codes and applicable treatment standard, subcategory, and underlying dangerous/hazardous constituents. If the treatment standard is expressed in terms of a concentration limit, the actual concentration of the restricted constituent shall also be reported. If the waste has no listed waste codes and no longer exhibits the characteristic of a dangerous/hazardous waste because it has been treated, the waste profile shall include a certification that the waste meets LDRs in accordance with 40 CFR 268.7, "Testing, Tracking, and Recordkeeping Requirements for Generators, Treaters, and Disposal Facilities," or 40 CFR 268.9, "Special Rules Regarding Wastes that Exhibit a Characteristic," incorporated by reference at WAC 173-303-140.

Waste profiles include a certification by the waste generator that the waste sent to the IDF meets the IDF waste acceptance requirements.

2.1.6.1 New Waste Profiles

Generators shall designate the waste and submit a request for a waste profile and supporting documentation for each new waste stream intended for IDF. Each waste profile is assigned a unique number for tracking purposes. Once the waste profile request is received, the IDF waste acceptance team performs a review of the generator's data provided in the waste profile request. The IDF waste acceptance team evaluates the data for consistency between the identified information and subsequent determinations. Errors discovered during the waste profile review process must be reconciled by the generator, and the profile information must be updated accordingly. Upon successful review and approval of the waste profile, IDF sends an approval notice to the generator.

2.1.6.2 Standing Waste Profiles

A standing waste profile is used to receive multiple shipments from the same generator for the same waste stream. Standing waste profiles are subject to review and must be recertified at least annually or revised (if applicable) when notified by the generator of waste stream or generating process changes. In addition, standing waste profiles are subject to review and revision if the IDF waste acceptance team has reason to suspect a change in the waste, based on inconsistencies in packaging, labeling, or visual verification of the waste. A generator may also request that a standing waste profile be revised and

approved for additional waste generated that consists of the same types of waste. The IDF waste acceptance team will coordinate the waste profile revisions and recertification.

When waste profiles are revised, depending on the significance of the revision, authorization for continued shipping under the current approved waste profile may be suspended until the changes have been reviewed and accepted.

2.2 WASTE CERTIFICATION

Physical, radiological, and chemical characterization data for a waste stream must be recertified at least annually or whenever the waste generating process changes (Section 2.1.6.2). Waste generators shall notify the IDF waste acceptance team of any changes to the waste generator's physical, chemical, or radiological characterization of the waste stream. At a minimum, recertification shall identify changes to the generating process and any additional analytical data obtained from the waste stream. Sampling and analysis of the waste stream is not required to be performed more frequently than required by the regulations.
The radiological characterization of waste streams must be recertified with sufficient frequency to account for changes in the generating process, radiological composition, and radiological decay.

2.3 WASTE VERIFICATION

Generator waste verification may include one or more of the following:

- Site visits
- Reviewing sample data and other information
- Observation of process monitoring, sample collection, and/or container packaging activities, as allowed by the generator and ALARA concerns

The level of review will be determined by the IDF waste acceptance team. Nonconformances identified during IDF review will be transmitted to the generator for resolution. Nonconformances may result in increased IDF oversight.

2.4 EVALUATION OF GENERATOR WASTE CERTIFICATION PROGRAM

Under DOE M 435.1-1, waste received must be evaluated to ensure the waste meets the IDF acceptance criteria. This requirement is implemented through review of information submitted by the waste generator and observations of generator activities (Section 2.3). When repeated or serious nonconformances are found, additional evaluations will be performed as identified in Section 2.6.

2.5 AUTHORIZATION TO SHIP WASTE

Waste receipts at IDF shall be scheduled at least 3 weeks in advance, unless approved otherwise by the IDF waste acceptance team. Authorization to ship is provided by the IDF waste acceptance team to the waste generator through the use of an Onsite Waste Tracking Form (OWTF) (Site Form A-6007-124) with a unique waste disposal approval number that is obtained from the IDF waste acceptance team on a per-shipment basis. The waste generator is required to provide the information necessary to complete the OWTF, including the following:

- Characterization information and waste code designations
- LDR certification/notification (required for waste subject to the requirements of WAC 173-303-140, which includes by reference 40 CFR 268, "Land Disposal Restrictions").
- List of containers, each with a unique identification number

- Container inventory information:
  - Name and location of the waste-generating facility
  - Specific contents of each container
  - Approximate weight of waste in each container
- Container labeling requirements (e.g., DOT-required labels)

IDF will conduct a preshipment review of the OWTF. This review ensures that the shipment complies with the approved waste profile. If IDF discovers an error during the preshipment review, the generator must reconcile the error and provide updated information, as applicable.

Waste generators are responsible for coordinating shipment of their waste to IDF and shall ensure that packaging, labeling, and handling of each shipment complies with this document and appropriate state and federal waste and transportation regulations, and applicable DOE orders pertaining to waste transport requirements.

2.6 NONCONFORMING WASTE

Nonconforming waste or waste received with shipping document discrepancies may be temporarily stored at IDF pending generator resolution of discrepancies or returned to the waste generator. IDF reviews the nature, frequency, and severity of the waste acceptance nonconformance issues. Based on the results of the review, IDF may request that the generator act to correct nonconformance issues. In addition, IDF may take the following actions:

- Increase the level of oversight for the waste streams that have incurred verification failures or for waste that has been received and deemed nonconforming. Increases to oversight are established based on the severity of the nonconformance and issues observed at the generator locations.
- Evaluate the generator's other waste streams to determine whether waste streams or a subset of waste streams might be subject to the same type of nonconformance issue.
- Reject waste from acceptance into the IDF if conformance issues cannot be resolved.

3.0 WASTE ACCEPTANCE CRITERIA

This section identifies the IDF waste acceptance criteria.

3.1 GENERAL CRITERIA

The requirements identified in this section are general requirements that apply to acceptance of waste at IDF. Sections 3.2 and 3.3 specify additional requirements for LLW and MLLW, respectively.

3.1.1 Physical and Chemical Criteria

The following sections identify the physical and chemical criteria for acceptance of waste.

3.1.1.1 Chemical Compatibility

Waste shall be chemically compatible with the container it is placed in (WAC 173-303-630, "Use and Management of Containers").

3.1.1.2 Asbestos-Containing Waste

Asbestos-containing waste material shall be packaged in accordance with 40 CFR 61.150, "National Emission Standards for Hazardous Air Pollutants," "Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations." Wetting with water is allowed as long as the liquid does not exceed applicable free-liquid requirements.

3.1.1.3 Heat Generation

If heat generation from radiological decay in the waste package exceeds 3.5 W/m^3 (0.1 W/ft^3),[1] the package must be evaluated to ensure that the heat does not affect the integrity of the container or surrounding containers in storage and after disposal. This evaluation must be provided to and approved by the IDF waste acceptance team prior to waste shipment.

3.1.1.4 Gas Generation

Waste generators shall provide evidence of compliance with Chapter IV, Section G.1(d)4 in DOE M 435.1-1. When vents are required, a certificate of conformance shall be provided stating the vent model number that has been installed on the waste container and that the waste packaging meets the requirements of this section.

When LLW is packaged, vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container (Chapter IV, L.1.b in DOE M 435.1-1). Unless otherwise specified by IDF, a minimum 5-year time value shall be used to demonstrate compliance when performing gas generation calculations for LLW going directly to disposal.

If required, the following mitigating measures (or alternative measures approved by IDF) must be used for the control of hydrogen from radiolytic decomposition. Use an approved vent, as listed in Appendix C, "Approved Vents for Waste Containers," to this document or an alternative approved by IDF. Container liners and inner bags must be closed in a manner that allows gas to reach the vent filter (e.g., twist and tape method for bags). When 90 mm liners are used, the hole size used to vent the liner shall be documented. In addition to filtering, palladium or platinum catalyst packs may be used to control hydrogen concentrations in the container.

3.1.1.5 Compatibility of Waste and Liner System

Waste disposed in IDF must be compatible with the IDF liner system. An assessment will be performed by the IDF waste acceptance team on each waste stream to confirm the compatibility of the waste with the liner. In cases where a waste contains constituents that have not been evaluated previously for liner compatibility, testing by Method 9090 of SW-846 could be required.

Appendix D, "Chemical Constituents/Liner System Compatibility," to this document lists certain chemical constituents in concentrated form that have been evaluated and determined to be incompatible with the IDF disposal cell liner system.

[1] The heat generation limit is based on conservative assumptions and calculation methodology as presented in Appendix F.

3.1.2 Prohibited Waste

The following waste types are prohibited from shipment to IDF:

- Dangerous waste only
- MLLW having dangerous waste codes not listed on the Hanford Facility RCRA Permit (WA7890008967) "Part A Form" for the IDF (Operating Unit Group 11, Addendum A)
- Ignitable or reactive waste (WAC 173-303-090)
- Wastes containing free-standing liquids (Chapter IV, Sections G.1.d.2 and 10 in DOE M 435.1) unless free-standing liquids:
  - Have been removed by decanting or other methods
  - Have been mixed with sorbent or stabilized (solidified) so that free-standing liquid is no longer observed
  - Have otherwise been eliminated
  - Container is very small, such as an ampule
  - Container is a lab pack and is disposed in accordance with WAC 173-303-161, "Overpacked Containers (Labpacks)"
  - Container is designed to hold free liquids for use other than storage (e.g., battery or capacitor)
  - Have been approved by Ecology through the nondangerous liquid provision of WAC 173-303-140(4)(b)(v)

There could be cases in which small amounts of residual liquids are present in mixed waste containers because condensate has formed following packaging or free liquids remain in debris items (e.g., pumps, tubing) even after draining. When it is not practical to remove this residual liquid, the free liquid must be eliminated to the extent possible by adding a quantity of sorbent sufficient to absorb residual liquids as specified in Appendix E, "Void Fillers, Sorbents, and Stabilizing Materials," to this document.

Free liquid is determined by SW-846, Method 9095 (Paint Filter Liquids Test) (WAC 173-303-140(4)(b)) only for waste that has the potential for free liquid formation.

- Waste that does not comply with the requirement of Chapter IV, G.1.d.5 in DOE M 435.1-1. Waste in a gaseous form must be packaged such that the pressure does not exceed 1.5 atmospheres absolute at 20°C (68°F) (DOE M 435.1-1). Compressed gases as defined by 49 CFR 173.115, "Transportation," "Shippers—General Requirements for Shipments and Packagings," "Class 2, Divisions 2.1, 2.2, and 2.3—Definitions," shall not be accepted. Examples of compliance methods include puncturing containers and removing the valve mechanism from expended gas cylinders.
- Explosive waste, shock-sensitive waste, or pyrophoric waste. Waste that does not comply with the requirement of Chapter IV, G.1.d.3 in DOE M 435.1-1. Waste must not be readily capable of detonation or of explosive decomposition or reaction at anticipated pressures and temperatures, or of explosive reaction with water. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable (Chapter IV, N.1 in DOE M 435.1-1). Waste containing <1 wt% pyrophoric material partially or completely dispersed in each package is not considered pyrophoric for the purposes of this requirement.

- Solid acid waste (WAC 173-303-140(4)(c)).
- Extremely hazardous as defined by WAC 173-303-040 unless allowed by RCW 70.105.050(2), "Disposal at Other than Approved Site Prohibited—Disposal of Radioactive Wastes."
- Organic/carbonaceous waste that does not meet WAC 173-303-140(4)(d).
- Nondebris waste that requires treatment prior to disposal.
- Class IV oxidizer waste.
- TRU content (as calculated per Section F2.0 in Appendix F, "Radiological Calculation Methods," of this document) shall not exceed 100 nCi/g (3,700 Bq/g) of waste (Chapter III, Section A in DOE M 435.1-1).
- *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* waste.
- *Toxic Substances Control Act of 1976*-regulated polychlorinated biphenyl waste is prohibited except as specifically authorized under 40 CFR 761 or a U.S. Environmental Protection Agency (EPA)-issued Risk Based Disposal Authorization.
- Waste that does not comply with the requirement of Chapter IV, G.1.d.1 in DOE M 435.1-1. Waste must contribute to and not detract from achieving long-term stability of the facility, minimizing the need for long-term active maintenance, minimizing subsidence, and minimizing contact of water with waste. Void spaces within the waste and, if containers are used between the waste and its container shall be reduced to the extent practical (Chapter IV, G.1.d.1 in DOE M 435.1-1).
- Waste that does not comply with the requirement of Chapter IV, G.1.d.4 in DOE M 435.1-1. Waste must not contain or be capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapors, or fumes harmful to the public or workers or disposal facility personnel, or harmful to the long-term structural stability of the disposal site (DOE M 435.1-1).
- Refrigerant-bearing equipment containing chlorofluorocarbons, unless chlorofluorocarbon removal has been completed (40 CFR 82, "Protection of Stratospheric Ozone").
- Waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance.
- Waste containing biological, pathogenic, or infectious material (including "any substance that may harbor or transmit pathogenic organisms" [e.g., septic tank sludge]) unless disinfected (10 CFR 61.56, "Licensing Requirements for Land Disposal of Radioactive Waste," "Waste Characteristics").
- Spent nuclear fuel or high-level waste.
- Non-LDR compliant MLLW debris waste that is not vitrified, mixed with a cementitious matrix, or encapsulated with grout, unless approved for acceptance by IDF on a case-by-case basis as specified in Section 3.3.2.
- Waste that is incompatible with the trench liner as defined in Section 3.1.1.5 (WAC 173-303-665, "Landfills").

3.2 LOW-LEVEL WASTE

The requirements for LLW are those presented in this section in addition to those in Section 2.0. These requirements are based on the IDF performance assessment (RPP-RPT-59958, *Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington*, hereinafter called the IDF PA).

3.2.1 Radiological Characterization

The major radionuclides in the waste and concentration of each major radionuclide must be established with sufficient sensitivity and accuracy to classify and manage waste properly in accordance with the radiological criteria (DOE M 435.1-1) listed in Appendix G, "Radiological Acceptance Limits," to this document.

3.2.2 Identification of Major Radionuclides

Radionuclide reporting is critical for compliance with the IDF PA (RPP-RPT-59958). The concentration of each major radionuclide must be established and compared to the Table G-1 in Appendix G reporting limit using process knowledge and/or sampling and analysis. Major radionuclides are defined as those radionuclides that meet any of the following conditions. Appendix F describes the calculational methods for determining these limits.

- Any TRU radionuclide present in the waste in concentration exceeding 1 nCi/g.
- Any fissionable radionuclide present in the waste in a quantity exceeding 0.1 fissile gram equivalent per container. Section 3.2.4.3, "Criticality Safety Limits," in this document describes the fissionable material content limits.
- For waste that has no detectable radiological activity but cannot be radiologically released, major radionuclides are those believed to contribute more than 1% each to the radiological activity based on available process knowledge. The estimated concentration of the radionuclides should be based on the limit of detection of the analysis method used.
- The amount of uranium-235 and uranium-238 in each waste container must be reported if there is at least 0.1 g of uranium-235 in the container or if either isotope is a major radionuclide. The amount of uranium-233 in each waste container must be reported if it contains at least 0.1 g of uranium-233.
- Any radionuclide that accounts for more than 1% of the total radiological activity of the waste must be reported. However, a radionuclide in concentration $<1.0\times10^{-6}$ Ci/m^3 and not otherwise reportable is exempt from reporting.

3.2.3 Methods for Establishing Radionuclide Inventory

The radionuclide inventory of a waste must be established using a method or combination of methods capable of identifying and quantifying the major radionuclides present. The methods chosen must provide adequate sensitivity and accuracy to ensure that the waste is categorized correctly (e.g., correct TRU determination). A graded approach (DOE M 435.1-1) should be applied when planning radiological characterization of waste streams. Using that approach, more frequent and detailed analysis is performed when a waste approaches one or more of the limits of these criteria. Conversely, waste that is far below applicable limits of these criteria would not require as extensive or frequent analysis. Use of the data quality objectives process (or a comparable process) in accordance with DOE M 435.1-1 should be used to ensure that the appropriate type, quantity, and quality of radiological characterization data are obtained.

Both direct and indirect methods can be used for characterization (DOE M 435.1-1). When indirect methods are used, these methods must be corroborated periodically with direct measurements. The frequency of corroborative analysis should be based on the variability of the waste generating

process, and the extent and consistency of previous analytical data. A graded approach should be applied when determining the appropriate type and frequency of corroborative analysis.

The following characterization methods can be used individually or in combination to establish the radionuclide inventory of the waste.

- **Process knowledge**—Process knowledge includes documented knowledge of the radioactive materials used and the processes that contributed to the radiological content of the waste, along with historical analysis of waste and radiological contamination from the process. Process knowledge can be used to establish the suspected major radionuclides in a waste stream. In addition, process knowledge can be used to eliminate from further consideration those radionuclides not present in sufficient concentration to be major radionuclides, as long as the basis of this determination is documented.

  If process knowledge alone is used to determine that a major radionuclide is not present in a waste stream at the reporting limit, the basis for this determination must be clearly documented. If available analysis techniques cannot detect a radionuclide at its reporting limit, the concentration could be estimated using a combination of process knowledge, scaling factors, and analytical detection limits.

- **Radionuclide material accountability**—The content of a given radionuclide in a waste can be determined by documented logs detailing the mass or activity of that radionuclide added to and leaving the waste in a controlled process. In addition, data relating the total inventory of a radionuclide in a process or facility can be used to determine the radionuclide inventory but must be corroborated periodically with direct measurement methods.

- **Field and laboratory analysis methods**—Field and laboratory analysis methods, such as nondestructive assay, radiochemical analysis, and surveys with field instruments, must be selected as appropriate to detect and quantify the major radionuclides with adequate sensitivity and accuracy for waste classification. Analysis methods that measure gross activity (i.e., not radionuclide specific) must be used in conjunction with other methods to determine the relative concentration (scaling factors) of each suspected radionuclide and must be corroborated periodically with radionuclide-specific analysis.

- **Computer modeling**—Computer modeling, applied appropriately, could be used in conjunction with other methods for radiological characterization. An individual who is knowledgeable and experienced in the use and limitations of the model must perform the modeling. The assumptions and measurements used as inputs to computer modeling must be documented. The computer software must be controlled in a manner that meets conventional quality assurance requirements. Computer models must be corroborated periodically with direct measurement methods.

- **Scaling factors**—Scaling factors can be used to relate the concentration of a readily measured radionuclide to more difficult-to-measure radionuclides. Scaling factors must be developed from one of the previous methods and must be corroborated periodically with radionuclide-specific analysis.

Other methods of radiological characterization could be used but must be documented clearly and approved by IDF. Documentation of the method must include a detailed description of the method, radionuclides identifiable by the method, and a discussion of precision, accuracy, quality assurance, and quality control methods.

3.2.4 Radiological Acceptance Limits

This section identifies the radiological acceptance limits for IDF.

3.2.4.1 IDF Performance Assessment Limits and Waste Forms

Waste disposed in IDF must meet the radiological performance objectives established in DOE O 435.1 and DOE M 435.1-1. The IDF PA (RPP-RPT-59958) calculated the concentration limits for the radionuclides and waste forms expected to be disposed in IDF. The radionuclide concentration limits are listed in Table G-1 in Appendix G. The LLW and MLLW inventories, volumes, and waste forms planned for disposal in the IDF are summarized in the IDF PA (RPP-RPT-59958).

Waste shipments having radionuclide concentrations above the limits in Table G-1 in Appendix G or in waste forms different than what was modelled in the IDF PA may be approved on a case-by-case basis through the waste profile review process if overall disposal facility performance objectives will not be compromised as evaluated using the IDF-PRO-EN-54165, *IDF Unreviewed Disposal Question (UDQ)*, procedure.

3.2.4.2 IDF Hazard Categorization Limits

IDF intends to operate the facility as a DOE-STD-1027-2018, *Hazard Categorization of DOE Nuclear Facilities*, Less Than Hazard Category 3 (LTHC-3) radiological facility by maintaining the radiological inventory sum of ratios (SOR) for the unburied waste packages less than the adjusted Hazard Category (HC)-3 threshold quantity values in accordance with IDF-00001, *Integrated Disposal Facility Final Hazard Categorization*. Alternate release fractions for certain waste forms (i.e., vitrified, mixed with a cementitious matrix, or encapsulated grout) can be used to adjust threshold quantities.

To ensure that the IDF LTHC-3 hazard categorization remains bounding, waste packages with an initial, unadjusted HC-2 or HC-3 SOR radiological inventory will be reviewed for acceptance by the IDF waste acceptance team on a case-by-case basis to determine if the final, adjusted hazard categorization SOR is LTHC-3 in accordance with IDF-00001. The waste generator shall provide the radionuclide inventory and waste form data needed to perform the LTHC-3 evaluation.

3.2.4.3 Criticality Safety Limits

The acceptable fissile and fissionable material is defined in Section 2.1.2 of HNF-7098, *Criticality Safety Program*:

- LLW material containing <100 nCi/g (waste) of transuranic nuclides with half-lives greater than 20 years and no enriched uranium.
- Packaged waste material containing ≤15 g uranium-235 and/or plutonium-239 in each 55 gal or larger waste drum/package. The mass value for this control may be interpreted as fissile grams equivalent (FGE), where the value is assumed to be derived from the data in DOE, 2013, *CH-TRAMPAC*, contact-handled transuranic waste authorized method for payload control (CH-TRAMPAC) (plutonium based).
- Fifteen grams or less of americium-241 or any fissile nuclide with atomic number <95 (uranium-233, uranium-235, plutonium-239, and plutonium-241).
- One-half gram of 242 mAm, 1.2 g of 245 Cm, 0.6 g of 251 Cf, or 2 g or less of any other fissile nuclide with atomic number ≥95.
- Depleted and natural uranium in any amount.
- Uranium solutions, compounds, and metal (if homogeneous, not latticed) are enriched to ≤1.0 wt% uranium-235. All mass volumes are nominal.

3.3 MIXED LOW-LEVEL WASTE

MLLW is a dangerous waste that also contains LLW. MLLW with only dangerous waste codes identified in the Hanford Facility RCRA Permit (WA7890008967) "Part A Form" for the IDF (Operating Unit Group 11, Addendum A) is accepted. The requirements for MLLW are those presented in this section in addition to those in Sections 2.0 and 3.2.

3.3.1 LDR Waste Treatment Requirements

MLLW subject to RCRA LDR (40 CFR 268, "Land Disposal Restrictions," incorporated by reference at WAC 173-303-140(2)) and/or the Washington State LDR (WAC 173-303-140(4)) must be demonstrated to meet applicable treatment standards and requirements prior to shipment to the IDF, unless approved otherwise by the IDF waste acceptance team as specified in Section 3.3.2.

- The treatment and performance standard for dangerous/hazardous debris is specified in 40 CFR 268.45. Dangerous/hazardous debris must be treated either by the waste specific standards in 40 CFR 268.40, "Applicability of Treatment Standards," for each waste contaminating the debris or standards presented in the alternative treatment standards for dangerous/hazardous debris table found in 40 CFR 268.45.
- Hazardous debris that is managed in accordance with the alternative treatment standards for hazardous debris (40 CFR 268.45) does not require sampling and analysis for adequate physical/chemical characterization.
- For waste that has been treated to concentration-based treatment standards for specific hazardous constituents under 40 CFR 268, the waste generator or treatment facility shall have the waste tested at a Hanford Site laboratory or another independent laboratory to comply with the land disposal facility requirements in 40 CFR 268.7(c).
- For waste that has treatment standards that are not concentration based, the waste generator and/or treatment facility must demonstrate that the waste meets the applicable treatment standards using process knowledge and/or by waste analysis, as required by the applicable sections of 40 CFR 268 and WAC 173-303-140.
- Waste generators are required to submit all information, notifications, and certifications described in WAC 173-303-380(1)(j), (k), and (o), "Facility Recordkeeping," and maintain LDR records in accordance with WAC 173-303-380(1)(m).
- An alternative to treatment of dangerous/hazardous waste to meet the LDR standards and allow for disposal of waste in IDF is a determination of equivalent treatment (40 CFR 268.42(b), "Treatment Standards Expressed as Specified Technologies") or a treatability variance (40 CFR 268.44, "Variance from a Treatment Standard"). Appropriate documentation is required before shipment of any dangerous/hazardous waste to the IDF that has previously been exempted from meeting the LDR treatment standard.

3.3.2 LDR Treatment Performed at IDF

The following exception can be made to the requirement of treating the waste prior to shipment to the IDF. Nondebris waste cannot be treated at the IDF. Hazardous debris that can be treated using immobilization technologies (i.e., macroencapsulation, microencapsulation, and sealing) may be treated at the IDF if the untreated debris meets the radiological acceptance limits specified in Section 3.2.4.

3.4 CONFLICTING REQUIREMENTS

Cases might arise where two or more similar requirements or limits occur in the acceptance criteria.

All requirements and limits must be met. If it appears that one requirement or limit will be less restrictive than others, the more restrictive one must be met.

4.0 PACKAGING CRITERIA

Waste to be disposed of at the IDF is to be packaged, except for waste that cannot be containerized (e.g., failed or spent locally shielded low-activity waste melters, long-length equipment) and approved by the IDF waste acceptance team (Section 4.5). Unless exempted, waste packages must comply with the requirements in Chapter IV, Section L.1.a in DOE M 435.1, WAC 173-303-630, and the criteria specified in Appendix H, "Containers, Coatings, and Liners," to this document. The following sections define the packaging criteria for acceptance.

4.1 PACKAGING CONSTRUCTION

Containers must meet one of the following criteria to ensure compliance with CHPRC-03378, *Preliminary Fire Hazards Analysis for the Integrated Disposal Facility*:

- Constructed of metal, concrete, or masonry.
- Constructed of rigid plastic that has a maximum flame spread rating of 25 when tested by a nationally recognized testing laboratory to the most current version of ASTM E-84, *Standard Test Method for Surface Burning Characteristics of Building Materials*. These containers will only be accepted if approved by the IDF waste acceptance team.
- Other containers as authorized under CHPRC-03378 and approved by the IDF waste acceptance team.
- Sacrificial rigging shall not contain regulated materials (e.g., lead).
- Containers shall be compatible with the waste and maintain containment during handling and storage before disposal (WAC 173-303-630). Where required, an appropriate combination of protective coatings and liners shall be used to prevent loss of container integrity. The general requirements for the selection of compatible containers, coatings, and liners are addressed in Appendix H of this document.

4.2 CONDITION OF CONTAINERS

Outer containers shall be in good condition, with no visible cracks, holes, dents, bulges, pit or scale corrosion, or other damage that could compromise container integrity (WAC 173-303-630). Minor external surface rust that can be sanded or brushed off will be acceptable.

4.3 HANDLING OF PACKAGES

Packages must be configured for safe unloading by forklift or crane. Alternate means of unloading could be allowed with approval from IDF. Packages that must be unloaded shall be equipped with a lifting system designed to lift the fully loaded package safely. Slings and lifting devices shall meet the requirements of the most current version of DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*. For packages that have special unloading requirements (e.g., grapple for ILAW glass containers), information must be provided to IDF concerning the methods for unloading before the shipment is scheduled. Sacrificial rigging shall be provided for remote-handled waste packages. Rigging shall not contain regulated materials such as lead.

4.4 LABELING

Containers sent to the IDF must be labeled for identification and to communicate information needed for proper waste management. The general requirements for labels are addressed in Appendix I, "Labeling of Waste Containers," of this document. For unusual waste forms, special labeling provisions can be arranged with the IDF.

4.5 NONCONTAINERIZED WASTE

Certain types of waste can be disposed without packaging in containers (e.g., failed or spent locally shielded low-activity waste melters, long-length equipment) with IDF approval on a case-by-case basis. Any mitigating measures required to meet the conditions of the safety basis will be determined on a case-by-case basis.

Waste types such as activated metal or internally contaminated equipment that are not surface contaminated with readily dispersible radiological or hazardous chemical contamination may be considered containerized. As such, they are subject to the radionuclide and chemical concentration requirements for containerized waste.

4.6 MINIMIZATION OF SUBSIDENCE

Except for packages where IDF will perform void filling activities, waste shall be in a form that minimizes settling and subsidence of the IDF (Chapter IV, Section G.1.d.1 in DOE M 435.1-1; WAC 173-303-665). For packages where IDF personnel will perform void filling, the generator shall provide packages with void filling ports approved by the IDF waste acceptance team, and the package shall be configured to facilitate successful void filling.

Waste accepted for disposal shall meet one of the following minimization of subsidence criteria at the time of disposal:

- Packaged in a structurally stable corrosion resistant container approved by the IDF waste acceptance team that will maintain its physical dimensions and form under the expected disposal conditions, such as weight of overburden and equipment (minimum composite compressive strength of 85 psi[2]).
- Compactable waste that has been compacted to a minimum of 85 psi[2].
- Be a solid waste with a minimum "confined" compressive strength of 85 psi[2].
- Stabilized in concrete or other stabilization agent specified in Appendix E of this document with a minimum composite compressive strength of 85 psi[2].
- Containerized waste, except for containers within a structurally stable corrosion resistant container approved by the IDF waste acceptance team, must be filled at least 90% of the internal volume of the container when placed in the disposal unit.
- Noncontainerized waste must be a solid waste with a minimum "confined" compressive strength of 85 psi[2].

4.7 PACKAGE CONTAMINATION LIMITS

Removable contamination on accessible surfaces of waste packages shall not exceed the limits listed in Table 2-2 of CHPRC-00073, *CHPRC Radiological Control Manual*.

[2] 85 psi is the maximum expected loading at the bottom of the IDF disposal cells (Appendix C.8.a in RPP-18486, *Integrated Disposal Facility (IDF), Phase I Critical Systems Design Report*).

Use of fixatives may be allowed with approval from the IDF radiological control manager to meet the criteria. Use of fixatives on returnable equipment will result in the items being controlled as radioactive material. For returnable overpacks, the contamination limits and use of fixatives also apply to the outside of the inner package. Fixed contamination levels should not exceed of 0.5 mR/hr (contact open window uncorrected).

4.8 PACKAGE DOSE RATE LIMITS

Containers with dose rates ≤2 mSv/hr (200 mrem/hr) at contact, <1 mSv/hr (100 mrem/hr) at 30 cm (1 ft), and <0.1 mSv/hr (10 mrem/hr) at 2 m (6.5 ft) are acceptable at the IDF. Contact-handled containers (as defined in Section 5.0, "Definitions") exceeding these limits require container-specific review and approval.

Remote-handled waste is acceptable at the IDF if approved through both a waste stream profile and a container-specific shipment. Remote-handled waste shall meet the applicable DOT dose rate restrictions or an approved package-specific safety document. Remote-handled waste shall be configured for unloading such that personnel exposures are maintained ALARA.

4.9 CLASSIFIED AND ACCOUNTABLE NUCLEAR MATERIAL

Radioactive waste to which access has been limited for national security reasons and which cannot be declassified shall be managed in accordance with the requirements of DOE O 473.3A, *Protection Program Operations*, and DOE O 470.4B, *Safeguards and Security Program* (DOE M 435.1-1).

During the acceptance process, the waste generator shall notify the IDF waste acceptance team of any classified waste. Classified waste is managed on a case-by-case basis.

A DOE/NRC 741 form must be completed for waste that contains accountable nuclear material (DOE O 470.4B).

4.10 SECURING WASTE AND SHIELDING

Drums on pallets shall be strapped together prior to loading on the shipping transport vehicle. Large heavy items must be secured in containers by bracing, blocking, or other means to prevent damage to the container during handling and transportation. When shielding is used to reduce the surface dose rate of a waste container, the shielding and waste must be secured to prevent shifting during handling and transportation.

4.11 WASTE SHIPMENT RECORDS

The waste generator shall maintain a detailed record of the contents, volume, and weight as well as any added void fillers, sorbents, stabilization agents, or solidification agents for each waste shipment. For containerized waste, the container type, weight, internal and external volume, any shielding provided, liner information (including vent hole size where used), and the date packaged must be recorded. In the case of lab packs, the record shall include the exact number, type, and volume of inner containers.

5.0 DEFINITIONS

Acceptable knowledge. Characterization information collected by a waste generator to meet waste management requirements and determined to be adequate by the disposal unit. See also definition of "knowledge" and "process knowledge."

Asbestos-containing waste material. Mill tailings or any waste that contains commercial asbestos and is generated by a source subject to 40 CFR 61, Subpart M, "National Emissions Standard for Asbestos." This term includes filters from control devices, friable asbestos waste material, and bags or other similar packaging contaminated with commercial asbestos. As applied to demolition and renovation operations, this term also includes regulated asbestos-containing material waste and waste materials contaminated with asbestos including disposable equipment and clothing. (40 CFR 61.141, "Definitions")

Byproduct material. (1) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. (DOE M 435.1-1)

Chelating compound. Amine polycarboxylic acids (e.g., ethylenediamine tetra-acetic acid, diethylenetriaminepentaacetic acid), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, and glucinic acid). (10 CFR 61.02, "Definitions")

Class IV oxidizer. An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. In addition, the oxidizer will enhance the burning rate and could cause spontaneous ignition of combustible materials. (ICBO 1997, *Uniform Building Code*)

Combustible material. Any material that does not meet the definition of noncombustible waste.

Contact-handled. Packaged waste whose external surface dose rate does not exceed 2 mSv/hr (200 mrem/hr), except that packages larger than 208 L (55 gal) could have a marked point on the bottom or side with a surface dose rate up to 10 mSv/hr (1,000 mrem/hr).

Container. Any portable device in which a material is stored, transported, treated, disposed, or otherwise handled (WAC 173-303-040). In this document, this term also describes the device into which immobilized low-activity waste melt is poured.

Dangerous waste. Solid waste designated in WAC 173-303-070 through -100 as dangerous or extremely hazardous waste, or mixed waste. (WAC 173-303-040)

Debris. Solid material exceeding a 60 mm particle size that is intended for disposal and that is a manufactured object; or plant or animal matter; or natural geologic material (40 CFR 268.2(g), "Definitions Applicable in This Part"). However, the following materials are not debris: any material for which a specific treatment standard is provided in 40 CFR 268, Subpart D, "Treatment Standards," namely lead acid batteries, cadmium batteries, and radioactive lead solids; process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and intact containers of hazardous waste that are not ruptured and that retain at least 75% of their original volume. A mixture of debris that has not been treated to the standards provided by 40 CFR 268.45, "Treatment Standards for Hazardous Debris," and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection.

Disposal facility. The land, structures, and equipment comprising a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure.

Dose-equivalent curie. A method of normalizing the radiotoxicity of various radionuclides to plutonium-239 for use in establishing that operations remain within approved safety bases at certain Hanford Site waste management units. The normalization is based on the relative committed effective dose equivalent from inhalation of each radionuclide to that of plutonium-239 using the conversion

factors from ICRP Publication 71, "Age Dependent Doses to Members of the Public from Intake of Radionuclides: Part 4 Inhalation Dose Coefficients."

Explosive waste. A waste that meets the definition of WAC 173-303-090(7)(a)(vi), (vii) or (viii).

Extremely hazardous waste. Dangerous waste and mixed waste designated in WAC 173-303-100 as extremely hazardous. (WAC 173-303-040)

Fissile material. Material made up of radionuclides that will sustain a chain reaction by thermal (slow) neutron induced fission. For the Hanford Site criticality safety program, uranium-233, uranium-235, plutonium-239, and plutonium-241 are the primary radionuclides of interest. In addition, plutonium-238 is considered fissile material for transportation under 49 CFR 173.

Fissionable materials. Substances containing radionuclides capable of sustaining a nuclear fission chain reaction (regardless of neutron energy). Such material could be fissionable only by nature of its form, configuration, or environment. This includes but is not limited to uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-240, plutonium-241, neptunium-237, americium-241, and curium-244.

Free liquids. Those liquids determined to be present in a waste as defined by SW-846.

Generator. Any person by site whose act or process produces radioactive or mixed waste or whose act first causes a waste to become subject to regulation under WAC 173-303 (WAC 173-303-040). The term generator also includes any person or organization that manages a dangerous waste at the generating site on behalf of the generator.

Hazardous waste. Solid waste designated by 40 CFR 261, "Identification and Listing of Hazardous Waste," and regulated as a hazardous waste and/or mixed waste by EPA.

Immobilized low-activity waste. The low-activity fraction of Hanford Site tank waste that has been immobilized.

Infectious waste. Any waste that contains or is suspected to contain pathogenic microorganisms infectious to humans, including: cultures and stocks of infectious agents, human blood and body fluids, contaminated animal carcasses, body parts, bedding exposed to infectious agents, and human pathological waste. Waste that has been treated by heat (e.g., incineration, autoclaving) or chemical disinfectants to destroy pathogenic organisms is not considered infectious waste.

Sufficient information about a waste to reliably substitute for direct testing of the waste. To be sufficient and reliable, the "knowledge" used must provide information necessary to manage the waste in accordance with the requirements of this chapter.

> Note: "Knowledge" may be used by itself or in combination with testing to designate a waste pursuant to WAC 173-303-070 (3)(c)((e)), or to obtain a detailed chemical, physical, and/or biological analysis of a waste as required in WAC 173-303-300(2). (WAC 173-303-040)

Lab pack. A packaging method where a number of inner containers of waste are packaged into an outer drum as specified in 49 CFR 173.12(b), "Exceptions for Shipment of Waste Materials." For this document, the term also could be used for DOT Class 7 materials packaged in the same manner.

Land disposal restrictions. The restrictions and requirements for land disposal of hazardous or dangerous waste as specified in 40 CFR 268 and WAC 173-303-140. (Refer to definitions for RCRA land disposal restrictions and Washington State land disposal restrictions.)

Low-activity waste. Radioactive tank waste supernate that has been treated to remove radionuclides, principally cesium, strontium, and actinides.

Low-level waste (LLW). Radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*), or naturally occurring radioactive material. (DOE O 435.1)

Major radionuclides. Those radionuclides in a waste that contribute significantly to the overall hazards of the waste, including criticality and human exposure by various pathways, as the waste is managed.

Mixed low-level waste (MLLW). Waste that meets the definition of both low-level and mixed waste.

Mixed waste. A dangerous, extremely hazardous, or acutely hazardous waste that contains both a nonradioactive hazardous component and, as defined by 10 CFR 20.1003, "Standards for Protection Against Radiation," "Definitions," source, special nuclear, or by-product material subject to the *Atomic Energy Act of 1954*. (WAC 173-303-040)

Noncontainerized waste. Waste that is not containerized for disposal, such as immobilized low-activity melters and long-length equipment.

Onsite. Any property within the Hanford Site boundary.

> Note: The DOT and RCRA regulations have varying definitions of "onsite." The use of the term in this document does not imply those precise meanings of the term.

Technical safety requirements. Those requirements that define the conditions, safe boundaries, and bases thereof and the management or administrative controls required to ensure the safe operation of a nuclear facility.

Organic liquid. A chemical compound having carbon-carbon chemical bonds and that is a liquid at standard temperature and pressure. Typical organic liquids include organic solvents, petroleum oils, and synthetic oils.

Package. A filled immobilized low-activity waste product container, after cooling and solidification. The constituent parts of a package are a sealed, stainless-steel product container enclosing a poured glass waste form and an optional filler material of sand or glass.

Performance assessment. An analysis of a radioactive waste disposal facility conducted to demonstrate there is a reasonable expectation that performance objectives established for the long-term protection of the public and the environment will not be exceeded following closure of the facility. (DOE M 435.1-1)

Polychlorinated biphenyl. Any chemical substance limited to the biphenyl molecule chlorinated to varying degrees or any combination of substances that contains such substance. (40 CFR 761.3, "Definitions")

Process knowledge. Knowledge the waste generator applies to a solid waste to determine if it is a dangerous or mixed waste in light of the materials or the processes used, when such knowledge can be demonstrated to be sufficient for determining whether a solid waste is designated properly. Process knowledge includes information on waste obtained from existing published or documented waste analysis data or studies conducted on mixed waste from processes similar to that which generated the waste. Process knowledge for mixed waste also could include information obtained from surrogate material. See also the definition of "knowledge" and the definition of "acceptable knowledge."

Pyrophoric material. A liquid or solid that, even in small quantities and without an external ignition source, can ignite within 5 minutes after coming in contact with air when tested as specified by 49 CFR 173.124, "Class 4, Divisions 4.1, 4.2 and 4.3—Definitions."

Qualified analytical data. Waste analyses data that are not fully compliant with an approved sampling and/or analysis method (e.g., where quality assurance/quality control deficiencies were identified from the sampling and/or analysis of the waste).

Radioactive waste. Any garbage, refuse, sludge, and other discarded material, including solid, liquid, semisolid, or contained gaseous material that must be managed for its radioactive content. (DOE M 435.1-1)

Remote-handled. Packaged waste whose external surface dose rate exceeds the limits for contact-handled waste.

***Resource Conservation and Recovery Act of 1976* (RCRA) land disposal restrictions**. The requirements and restrictions for land disposal of hazardous waste codified in 40 CFR 268.

Secular equilibrium. Equilibrium that occurs between a parent radionuclide and daughter radionuclide where the half-life of the parent is significantly longer than the daughter.

Shock-sensitive waste. Reactive waste meeting the definition of WAC 173-303-090(7)(a)(vii) (waste is readily capable of detonation or explosive composition or reaction at standard temperature and pressure).

Solidification. See "Stabilization."

Sorbent. A material used to soak up free liquids by either adsorption or absorption, or both.

Spent nuclear fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. Test specimens of fissionable material irradiated for research and development only, and not production of power or plutonium, may be classified as waste, and managed in accordance with the requirements of DOE O 435.1 when it is technically infeasible, cost prohibitive, or would increase worker exposure to separate the remaining test specimens from other contaminated material. (DOE M 435.1-1)

Stabilization and Solidification. Techniques that limit the solubility and mobility of dangerous waste constituents. Solidification immobilizes a waste through physical means and stabilization immobilizes the waste by bonding or chemically reacting with the stabilizing material (WAC 173-303-040). Note also stabilization is to used meet land disposal restrictions when the specific definition of Table 1 in 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies," is applicable to the waste.

State-only dangerous waste. Any waste that is regulated as a dangerous waste under WAC 173-303 but is not regulated as a hazardous waste under 40 CFR 261. (WAC 173-303-040)

Storage. The holding of waste for a temporary period. (WAC 173-303-040; DOE O 435.1)

Toxic. Having the properties to cause or to significantly contribute to death, injury, or illness of humans or wildlife. (WAC 173-303-040)

Toxic Substances Control Act of 1976. Any polychlorinated biphenyls containing waste that is regulated under the *Toxic Substances Control Act of 1976* requirements codified in 40 CFR 761.

Transuranic waste. Waste containing more than 100 nCi of alpha-emitting transuranic isotopes per gram of waste, with half-lives >20 years, except for (1) high-level waste; (2) waste that the Secretary of Energy has determined, with the concurrence from the EPA administrator, does not need the degree of

isolation required by the disposal regulations of 40 CFR 191; or (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61. (DOE O 435.1)

Treatment. The physical, chemical, or biological processing of dangerous waste to make such waste nondangerous or less dangerous, safer for transport, amenable for energy or material resource recovery, amenable for storage, or reduced in volume, with the exception of compacting, repackaging, and sorting as allowed under WAC 173-303-400(2) "Interim Status Facility Standards," and WAC 173-303-600(3), "Final Facility Standards." (WAC 173-303-040)

U.S. Department of Energy. Operates the Hanford Site and may include the DOE, Richland Operations Office; DOE, Office of River Protection; DOE-Headquarters; and/or DOE-designated contractor representatives.

Washington State land disposal restrictions. The additional state-only land disposal restrictions of WAC 173-303-140(4) applicable to state-only dangerous waste for the disposal in Washington State.

Waste stream. A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties. (DOE O 435.1)

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APPENDIX A

DOE-STD-5002-2017, CHAPTER 6 – WASTE ACCEPTANCE CRITERIA CROSSWALK

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APPENDIX A
DOE-STD-5002-2017, CHAPTER 6 – WASTE ACCEPTANCE CRITERIA CROSSWALK

This appendix provides a crosswalk to document compliance with the Waste Acceptance Criteria Review Criteria in Table 6-2 in DOE-STD-5002-2017, *DOE Standard Disposal Authorization Statement and Tank Closure Documentation*.

ID	Table 6-2 from DOE-STD-5002-2017	Comments
W-1	Provide a brief background discussion of the disposal facility for which the WAC apply, and the technical basis upon which the criteria are based. (6.2.1 Introduction)	Sections 1.0, 1.1, and 1.2
W-2	Identify the radioactivity, concentration and inventory limits, waste classes or categories that may be managed at the facility. Identify any acceptable limits for a waste package's external surface dose rate for contact and remote-handled packages, acceptable contamination levels, and heat generation. (6.2.2 Radiological Limits)	Sections 3.1.1.3, 3.2*, and 4.9; Appendices F and G
W-3	Define radiological limits for the disposal facilities based on the PA. In addition, other source documents such as the DSA, EPA, RCRA, or DOT limits should be included as part of the basis for radiological limits. Use the most restrictive limit in the WAC when other source documents limits overlap the PA limits. Any limitations on non-radiological content should also be specified. (6.2.2.1 Inventory Concentration Limits Summary)	Sections 3.2.4* and 3.3*
W-4	Identify the radionuclide, waste form, material or containers prohibited from acceptance at the receiving facility, including the basis for any prohibition. (6.2.2.2 Prohibited Radionuclides Summary)	Section 3.1.2
W-5	Identify the following:	
	• Acceptable waste forms. The PA should be used as one of the bases for acceptable waste forms	Section 3.2.4.1
	• Restrictions or prohibitions of waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance	Section 3.1.2
	• Requirements associated with acceptance of MLLW and classified waste/material containers, if the facility accepts these wastes	Sections 3.3 and 4.9
	• Requirements for waste streams needing special attention for receipt, handling, storage treatment, or disposal (e.g., sealed sources), including any additional restrictions or limitations on the waste or specifications for handling the waste containers	Section 3.2.4.1 and Appendix G
	• Site-specific classification or categorization system(s) that require waste stabilization, or additional management steps, for wastes containing certain concentrations of specific radionuclides	Section 4.5
	• Requirements associated with acceptance of bulk waste, including any additional restricted materials or limitations on materials; any specific technical requirements the bulk waste should meet for compatibility with treatment, storage, or disposal operations; and the conditions or specifications for handling bulk waste containers that will be returned	Section 3.1.2 and Appendix E
	• Acceptable limits for free liquid content on a per-package basis. (6.2.3 Waste Form Criteria)	

ID	Table 6-2 from DOE-STD-5002-2017	Comments
W-6	This section should:	
	• Specify acceptable combinations of waste forms, containers, and packages providing structural stability or inadvertent intrusion protection throughout the life cycle of the waste. The PA should be used as one of the bases for acceptable package criteria; and	Section 4.0* and Appendix H
	• Establish acceptable facility package and conveyance system contamination levels.	Section 4.9
	(6.2.4 Waste Package Criteria)	
W-7	Identify applicable package labeling and marking requirements including any necessary information about bar coding or other tracking systems used at the facility receiving the waste and the application of the system by generators and operators identifying final disposal location at the disposal facility. (6.2.4.1 Package Tracking)	Section 4.5 and Appendix I
W-8	Specify waste packages and closures designed to ensure that the package will withstand the effects of changing temperatures, weather, pressures, and/or vibrations under normal handling and shipping conditions and not breach or lose the package contents. Identify acceptable void space limits consistent with requirements associated with potential subsidence at the disposal facility. (6.2.4.2 Package Durability and Stability)	Sections 4.1 and 4.2; Appendix E
W-9	Identify the guidance for bulk non-containerized waste. (6.2.4.3 Bulk Waste Packaging)	Section 4.6
W-10	This section should:	
	• Identify the waste transfer requirements (generator facility to the treatment, storage, or disposal facility) and documentation/record requirements	Section 2.5
	• Specify acceptable transportation routes to minimize radiological/chemical risk. Information on accident rates, time in transit, population density, construction activities, and time of day should be considered when determining radiological risk	N/A (onsite transport only)
	• Specify if necessary shipping arrangements, including any electronic traffic data bases or scheduling systems being used	N/A (onsite transport only)
	• Identify any package protection requirements to provide physical protection to the packages to prevent breaching or ensure wastes certification status is preserved	Section 4.2
	• Identify any specific DOE Order (e.g., DOE O 460.1C, O 460.2A, and O 461.1B & O 461.2) and/or DOT requirements	Section 2.5
	(6.2.5 Waste Transfer and Transportation Requirements)	
W-11	This section should:	
	• Identify the waste evaluation requirements for the receiving facility, including confirmation that both technical and administrative requirements of the WAC have been met	Section 2.0*
	• Specify the process to be followed for the disposition of non-conforming wastes	Section 2.6
	• Specify the process for evaluating proposed and discovered changes to the WAC for compliance with requirements in the approved RWMB(s)	Section 1.4
	(6.2.6 Evaluation and Acceptance)	

ID	Table 6-2 from DOE-STD-5002-2017	Comments
W-12	Specify the process for WAC deviations and include: • The nature of the WAC deviation • The rationale for the deviation • Demonstration that the deviation does not violate the DAS, supporting technical basis documentation (i.e., PA/CA), DSA, or requirements as applicable from EPA, NRC, DOT, state, and federal programs (6.2.6.1 WAC Deviations)	Section 1.4
W-13	Identify the documentation/quality records, including waste characterization data and supporting information that should be provided by the waste generator. (6.2.7 Waste Documentation and Records Management)	Sections 2.1.4 and 3.3.1
W-14	Include a complete list of citations for materials referenced in the WAC. (6.2.8 References)	Section 6.0
W-15	Include appendices to the WAC as necessary to provide technical details supporting the data and analyses. (6.2.9 Appendices)	Appendices B through I

*Includes subsections.

CA	=	composite analyses	N/A	=	not applicable
DAS	=	Disposal Authorization Statement	NRC	=	U.S. Nuclear Regulatory Commission
DOE	=	U.S. Department of Energy	PA	=	performance assessment
DOT	=	U.S. Department of Transportation	RCRA	=	*Resource Conservation and Recovery Act of 1976*
DSA	=	documented safety analysis	RWMB	=	radioactive waste management basis
EPA	=	U.S. Environmental Protection Agency	WAC	=	waste acceptance criteria
MLLW	=	mixed low-level waste			

REFERENCES

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APPENDIX B

GUIDANCE FOR MASS BALANCE OF HAZARDOUS/MIXED WASTE

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APPENDIX B
GUIDANCE FOR MASS BALANCE OF HAZARDOUS/MIXED WASTE

Use the following guidance when documenting the mixed waste characterization.

1. References should clearly identify the constituent material by chemical composition or unique generic material description (e.g., polyethylene plastic, Buna-N rubber, or cuprous oxide). Minimize the use of acronyms and product nicknames not commonly known.

2. Do NOT use the waste package or container weight and volume in the weight-averaging calculations. Include materials added to the waste for the purpose of liquid absorption or padding, such as paper/cloth pads in the characterization of the waste.

3. Ensure previous characterizations performed on the same waste are complete and accurate based on current characterization criteria. If unsure perform a current characterization of the waste.

4. Toxicity characteristics: Weight averaging is acceptable when evaluating a complex waste component that is not easily separated into individual components. In order to determine if a complex waste component could contain sufficient toxic metals to fail the Toxicity Characteristic Leaching procedure (TCLP) test, consider the total component weight (not the individual component) when making the hazardous waste determination. For example, when waste components are painted or plated with a lead, chromium or cadmium containing product, the entire waste component weight is used for calculations not the weight of the paint or plating only. Consider the paint or plating as part of the waste component. Complex components will be disassembled to the extent technically practicable consistent with radiation and chemical exposure limits to personnel. Intentional dilution of hazardous/dangerous waste is prohibited by regulations.

    4.1. Use either of the following methods to determine if the toxicity of suspect toxic wastes for which TCLP samples cannot be taken:

    - Compare the total weight percent of each TCLP regulated constituent to the TCLP maximum weight percent as given in Table B-1, or

    - Compare the concentration of each TCLP regulated constituent in the waste to 20 times the TCLP regulatory level as listed in Table B-1.

    4.2. Use the most conservative estimate if laboratory data or literature information is limited. For example, use the highest chromium value available from literature or test data for a type of paint of unknown chromium concentration.

    4.3. Use the TCLP leachability proportioning to demonstrate a waste characterization when to total weight percent or concentration of the TCLP regulated constituent is nearly equal to the regulatory limit. The method applies the proportion of the suspected TCLP leachability of the individual parts of a complex component to the entire component.

    - For example: Consider a complex component that consists of two materials: component "A" leached cadmium at 5.0 mg/l in a TCLP test, and component "A" comprises 10% by weight of the complex component. No cadmium is present in component "B." The proportioned TCLP leachability of the entire component is the following:

    $$(5.0 \text{ mg/l Cd} \times 10\%) + (0.0 \text{ mg/l Cd} \times 90\%) = 0.5 \text{ mg/ppm Cd}$$

    Therefore, the complex component is below the regulatory limit of 1.0 mg/l Cd.

4.4. For materials estimated to contain TCLP regulated constituents in quantities approaching the TCLP limits, justify the estimated TCLP values used in the waste designation. Include any supporting documentation for the estimated TCLP value.

4.5. Table B-1 provides leachability data from some common metals and alloys.

Table B-1. TCLP Test Results for Leachability Factors

Metal/Alloy	Material Composition	TCLP Result (mg/L)	TCLP Limit (mg/L)	Pass/Fail
Silver-braze alloy	Ag @ 34%	Ag <1.0	Ag @ 5.0	Pass
	Cd @ 17%	Cd = 2.7	Cd @ 1.0	Fail
Cadmium plating	Cd (chromated)	Cd = 362	Cd @ 1.0	Fail
		Cr = 0.2	Cr @ 5.0	Pass
Leaded brass/Bronze	Pb @ 22.2%	Pb = 251	Pb @ 5.0	Fail
	Pb @ 1.4%	Pb = 25.5	Pb @ 5.0	Fail
	Pb @ 1.02%	Pb = 2.6	Pb @ 5.0	Pass
Chromium plating	Cr @ 100%	Cr = 0.8	Cr @ 5.0	Pass
Zinc galvanize (electrodeposited)	Zn (chromated)	Cr = 0.3	Cr @ 5.0	Pass
Zinc galvanize (hot dipped)	Zn with lead	Pb <0.1	Pb @ 5.0	Pass
Silver plating	Ag @ 100%	Ag = 2.4	Ag @ 5.0	Pass
Zinc anode	Zn with trace Pb & Cd	Cd = 0.46	Cd @ 1.0	Pass
		Pb = 0.003	Pb @ 5.0	Pass
Leaded steel	Pb @ 0.2%	Pb <0.1	Pb @ 5.0	Pass
430 Stainless steel	Cr @ 16.5 %	Cr = 0.3	Cr @ 5.0	Pass
410 Stainless steel	Cr @ 12.5 %	Cr = 2.2	Cr @ 5.0	Pass

APPENDIX C

APPROVED VENTS FOR WASTE CONTAINERS

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APPENDIX C
APPROVED VENTS FOR WASTE CONTAINERS

Containers requiring a vent shall have a vent installed. Table C-1 provides a list of the approved vents.

Table C-1. Approved Vents

Manufacturer	Model Number	
Fairey®		
99421		
Nuclear Filter Technology		
NucFil®-007	NucFil-019	NucFil-073
NucFil-007LS	NucFil-019 DS	NucFil-075
NucFil-007LW	NucFil-019-EPD	NucFil-08DS
NucFil-007S	NucFil-019-EPDDS	NucFil-307DS
NucFil-007W	NucFil-019S DS	NucFil-347DS
NucFil-007WS	NucFil-020	NucFil-357DS
NucFil-012	NucFil-020DS	NucFil-357S
NucFil-013	NucFil-020S	NucFil-407DS
NucFil-013 GorTex	NucFil-049	NucFil-7DS
NucFil-013 SS	NucFil-049S	NucFil-DVS3
NucFil-015 D S	NucFil-051	NucFil-DVS3A
NucFil-016	NucFil-072	NucFil-DVS307
NucFil-016LPDS	NucFil-072S	NucFil-NFS7A
NucFil-016 SS HP		
UltraTech		
9400	9416T	9500
9402	9423	9550
9408	9423T	9810
9412	9424	9812
9412L	9424X	9815
9412LX	9450	9817
9416	9460	

®Fairey is a registered trademark of the Fairey Holdings Limited Company, Middlesex, England.

®NucFil is a registered trademark of the Nuclear Filter Technology Corporation, Lakewood, Colorado.

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APPENDIX D

CHEMICAL CONSTITUENTS/LINER SYSTEM COMPATIBILITY

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APPENDIX D
CHEMICAL CONSTITUENTS/LINER SYSTEM COMPATIBILITY

Direct disposal of liquid wastes is prohibited at the Integrated Disposal Facility. Liquids are either solidified or absorbed before disposal; thus, direct contact of liquid wastes with the liner cannot occur. Solidification/absorption will inhibit dissolution of any organics into the leachate. Dust suppression water and rain/snowmelt are the primary sources for liquid ultimately reaching the liner/sump system. Pumps are used to automatically remove the accumulated leachate, minimizing the long-term contact with the high-density polyethylene liners. Based on a nominal cell leachate generation of only 100,000 gal/yr (the 2018 cell actual generation rate was approximately 450,000 gal/yr), approximately 23 kg (50 lb) of any specific organic released over the year in a given cell would not exceed 50 ppm concentration in the leachate. Constituent evaluations for potential liner impacts are only necessary prior to approving a waste profile that proposes disposal of bulk (i.e., >23 kg [>50 lb]) quantities of organic chemicals unless the waste profile indicates that organic concentrations will not exceed 50 ppm in the as-disposed material.

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APPENDIX E

VOID FILLERS, SORBENTS, AND STABILIZING MATERIALS

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APPENDIX E
VOID FILLERS, SORBENTS, AND STABILIZING MATERIALS

E1.0 INTRODUCTION

Sorbents and stabilizing materials can be used to meet free-liquid requirements, void fill requirements, or to provide a safer waste form for handling and storage. Sorbents and stabilizing materials must be nonhazardous, compatible with the waste being absorbed or stabilized, and nonbiodegradable as defined in WAC 173-303-140(4)(b), "Dangerous Waste Regulations," incorporated by reference at WAC 173-303-665(13), Table E-1 lists the general types of sorbents and stabilizing materials that can be used for major Hanford Site waste streams. Specific products used must meet the definitions that have been listed on an approved Waste Profile Sheet.

Table E-1. Sorbent Selection Based on Waste Type

Waste Type	Subgroup	Allowable Sorbents/ Stabilizing Materials
Low-level waste	Low-level liquids for disposal	• Mineral sorbents • Polymer sorbents • Stabilizing materials
	Low-level organic liquids and chelating agents for disposal	Stabilizing materials
Mixed waste	All types (note – sorbent for lab packs is placed around containers, not mixed with liquids)	• Mineral sorbents • Polymer sorbents

Use of these materials to meet radiological stabilization or *Resource Conservation and Recovery Act of 1976* land disposal restrictions treatment standards is not addressed in this appendix. A more specific evaluation must be performed as specified elsewhere in this document to demonstrate radiological stabilization or land disposal restrictions compliance.

E2.0 GENERAL TYPES OF SORBENTS AND STABILIZING MATERIALS POTENTIALLY ALLOWED

The following general types of sorbents and stabilizing materials are potentially allowed:

- Inorganic mineral sorbents including aluminosilicates, clays, vermiculite, zeolites, lime, silica sand, diatomaceous earth, perlite, fly ash and other inorganic materials used for absorption.
- High molecular weight synthetic polymers (polymer sorbents) including polyethylene, high-density polyethylene, polypropylene, polyacrylate, and other synthetic polymers. This excludes polymers derived from biological material (e.g., cellulose-based materials), and polymers specifically designed to be degradable.
- Stabilizing materials including concrete, portland cement, lime/pozzolans, and a variety of other inorganic materials.

  Note: Selection of specific materials must be in accordance with Section E3.0.

Specialty stabilization agents for organic liquids include certain products that stabilize organic liquids. These products chemically react with organic liquids to prevent their release in the disposal environment.

E3.0 SELECTION AND USE OF SORBENTS AND STABILIZING MATERIALS

Selection and use of a specific product for absorption of a given waste must address the following:

- Determine from Table E-1 what general classes of materials can be used and the conditions for use.
- Use allowable types of sorbents for various waste streams that are based on the anticipated treatment/disposal methods.
- Select a product that is appropriate for the material to be treated. Waste generators can request approval of products in the waste stream profile sheet by providing data to support the intended use. Approval of the profile constitutes approval of the product.
- Obtain manufacturer's instructions and limitations for use of the product. It is critical to use sorbents and stabilizing materials in accordance with the manufacturer's instructions. The following information is required:
  - Compatibility of the sorbent or stabilizing material with the waste
  - Recommended ratio of sorbent to waste for the liquid being absorbed
  - For stabilizing materials, the exact ratio of liquid-to-stabilizing materials and methods of mixing.

It might be necessary to run a test of the waste or a surrogate to ensure that the product works adequately with the waste requiring sorption or stabilization.

E4.0 HANFORD SITE REQUIREMENTS FOR USE OF SORBENTS

Sorbents must be used in sufficient quantity. Based on data from the manufacturer or testing, the minimum ratio of sorbent to liquid is determined. For Hanford Site applications, a minimum of twice the minimum amount of sorbent shall be used.

E5.0 REFERENCES

Resource Conservation and Recovery Act of 1976, Pub. L. 94-580, 42 USC 6901 et seq. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

173-303-140, "Land Disposal Restrictions."

173-303-665, "Landfills."

APPENDIX F

RADIOLOGICAL CALCULATION METHODS

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APPENDIX F
RADIOLOGICAL CALCULATION METHODS

F1.0 INTRODUCTION

A variety of radiological calculations are required to determine whether a waste can be managed at the Integrated Disposal Facility (IDF). The following sections describe the methodology for performing these calculations. For each calculation, the following assumptions shall be used:

- Major radionuclides in the waste must be considered in the calculations. If there is a major radionuclide in the waste that is not listed in Table F-1, the waste generator must notify IDF waste acceptance team to calculate the applicable limits and conversion factors.
- If a daughter radionuclide has a half-life <10 days and the parent radionuclide has a half-life greater than the daughter, the activity of the daughter should not be considered in the calculations.
- The volume of the outer waste container shall be used when limits are expressed in volume concentration. For example, a waste generator packaging a 1 L (0.26 gal) jar inside of a 208 L (55 gal) drum (0.208 m^3 [7 ft^3]) would use the 0.208 m^3 (7 ft^3) volume for radiological calculation purposes. An additional example is a concrete lined 208 L (55 gal) drum (0.208 m^3 [7 ft^3]) having a 0.15 m^3 (5.3 ft^3) waste capacity. The waste generator would again use 0.208 m^3 (7 ft^3) for the radiological calculation volume. If the waste is not containerized, the volume is the anticipated volume that the waste will occupy in the IDF.

F2.0 TRANSURANIC WASTE DETERMINATION

To determine whether a waste is transuranic, compute the sum of the specific activity of the alpha-emitting radionuclides having half-lives greater than 20 years. If the total alpha activity exceeds 100 nCi/g (3,700 Bq/g), the waste is transuranic (DOE M 435.1-1, *Radioactive Waste Management Manual*). For the mass of the waste matrix used in the transuranic determination, the following direction will be used:

- The mass of added shielding, the container, and any rigid liners is excluded.
- The mass of stabilization media and similar materials added to meet waste acceptance criteria is used in accordance with Chapter III.A in DOE G 435.1-1, *Implementation Guide for Use with DOE Manual 435.1-1*.

F3.0 CALCULATION OF PLUTONIUM-239 FISSILE GRAM EQUIVALENTS

Fissile gram equivalent (FGE) is defined as the amount of plutonium-239 (in g) that will produce the equivalent reactivity as another isotope at optimal shape, moderation, and reflection. FGE normally is calculated using the following steps:

1. Multiply the grams of each fissionable isotope by the FGE conversion factor (FGE/g) to yield the FGE for the isotope:

   Isotope mass (g) × isotope conversion factor (FGE/g) = Isotope FGE.

2. Sum the FGE for each fissionable isotope to a total FGE for all isotopes.

If there is more than 1 g (0.04 oz) of uranium-235, the IDF criticality safety representative could use an alternate method for determining the FGE for uranium-235 in specific cases. Natural uranium (i.e., 0.72% uranium-235) and depleted uranium (i.e., <0.72%) are normally exempt for criticality purposes at IDF.

F4.0 CALCULATION OF THERMAL POWER

The thermal power of the waste in a container is calculated from the concentration of radionuclides in the waste and the heat of decay from Table F-1. The thermal power calculation is performed using the following steps:

1. The concentration of each isotope is multiplied by the heat of decay for that isotope from the value in Table F-1, yielding the thermal power for each isotope:

   Isotope concentration (Ci/m^3) × decay heat (W/Ci) = decay heat/thermal power (W/m^3).

2. Thermal power is the sum of the thermal power of all isotopes in the waste.

F5.0 CALCULATING DOSE-EQUIVALENT CURIES

Calculation of dose-equivalent curies (DE-Ci) is a method of normalizing the exposure risk of various isotopes. Calculation of the DE-Ci of a waste container is performed using the following steps:

1. Multiply the activity (in curies) of each isotope in a given container by its respective ICRP 71, "Age Dependent Doses to Members of the Public from Intake of Radionuclides: Part 4 Inhalation Dose Coefficients," correction factor from Table F-1.

2. The total DE-Ci of the waste package is the sum of the DE-Ci values for all isotopes in the waste.

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
H-3	3.891 E+08	9.613 E+03	3.383 E-05	5.20 E-06
Be-7	4.605 E+06	3.491 E+05	1.996 E-03	1.00 E-06
Be-10	5.049 E+13	2.231 E-02	1.495 E-03	1.92 E-04
C-14	1.808 E+11	4.455 E+00	2.933 E-04	1.16 E-04
Na-22	8.214 E+07	6.244 E+03	1.420 E-02	2.60 E-05
P-32	1.232 E+06	2.864 E+05	4.119 E-03	1.54 E-05
Si-32	5.428 E+09	6.500 E+01	4.079 E-04	2.20 E-03
P-33	2.195 E+06	1.559 E+05	4.539 E-04	1.84 E-06
S-35	7.560 E+06	4.267 E+04	2.895 E-04	2.80 E-05
Cl-36	9.530 E+12	3.291 E-02	1.622 E-03	1.46 E-04
Ar-39	8.489 E+09	3.411 E+01	1.296 E-03	0.00 E+00
K-40	4.039 E+16	6.989 E-06	4.025 E-03	4.20 E-05

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
Ca-41	3.249 E+12	8.500 E-02	1.408 E-02	1.90 E-06
Ar-42	1.041 E+09	2.582 E+02	1.381 E-03	0.00 E+00
Ti-44[a]	1.490 E+09	1.722 E+02	1.708 E-02	1.22 E-03
Ca-45	1.406 E+07	1.785 E+04	4.577 E-04	5.40 E-05
Sc-46	7.242 E+06	3.390 E+04	1.258 E-02	1.36 E-04
V-49	2.851 E+07	8.084 E+03	2.685 E-05	4.20 E-07
Cr-51	2.394 E+06	9.251 E+04	2.170 E-04	4.00 E-07
Mn-54	2.698 E+07	7.751 E+03	4.981 E-03	1.70 E-05
Fe-55	8.631 E+07	2.379 E+03	3.492 E-05	1.54 E-05
Co-56	6.679 E+06	3.020 E+04	2.200 E-02	9.60 E-05
Co-57	2.348 E+07	8.438 E+03	8.536 E-04	1.10 E-05
Co-58	6.122 E+06	3.181 E+04	5.990 E-03	3.20 E-05
Fe-59	3.845 E+06	4.979 E+04	7.749 E-03	4.40 E-05
Fe-60	4.752 E+13	1.300 E-04	2.900 E-02	5.60 E-03
Ni-59	2.398 E+12	7.982 E-02	4.248 E-05	3.60 E-06
Co-60	1.664 E+08	1.131 E+03	1.542 E-02	2.00 E-04
Ni-63	3.124 E+09	5.738 E+01	1.016 E-04	8.80 E-06
Zn-65	2.110 E+07	8.233 E+03	3.495 E-03	4.00 E-05
Ge-68	2.340 E+07	7.098 E+03	5.264 E-05	1.04 E-05
Se-75	1.034 E+07	1.457 E+04	2.400 E-03	2.00 E-05
Se-79	2.051 E+12	6.969 E-02	6.019 E-04	2.20 E-05
Sr-82	2.208 E+06	6.237 E+04	7.665 E-05	4.20 E-05
Rb-83	7.448 E+06	1.827 E+04	2.934 E-03	1.38 E-05
Rb-84	2.831 E+06	4.749 E+04	6.236 E-03	2.00 E-05
Kr-85	3.383 E+08	3.927 E+02	1.498 E-03	0.00 E+00
Sr-85	5.603 E+06	2.371 E+04	3.128 E-03	7.60 E-06
Rb-86	1.612 E+06	8.145 E+04	4.518 E-03	1.86 E-05
Y-88	9.213 E+06	1.393 E+04	1.603 E-02	8.20 E-05
Sr-89	4.365 E+06	2.907 E+04	3.460 E-03	2.00 E-05
Sr-90 [a]	9.037 E+08	1.388 E+02	6.695 E-03	4.80 E-04
Nb-91	2.146 E+10	5.783 E+00	1.021 E-04	2.20 E-04
Mo-93	9.504 E+10	1.278 E+00	9.834 E-05	2.00 E-05

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
Nb-93m	5.089 E+08	2.386 E+02	1.834 E-04	1.02 E-05
Zr-93	4.828 E+13	2.515 E-03	1.130 E-04	5.00 E-04
Nb-94	6.307 E+11	1.905 E-01	1.031 E-02	2.20 E-04
Nb-95	3.022 E+06	3.934 E+04	4.795 E-03	3.00 E-05
Zr-95 [a]	5.532 E+06	2.149 E+04	5.047 E-03	5.00 E-05
Tc-99	6.668 E+12	1.711 E-02	5.986 E-04	5.80 E-06
Ru-103 [a]	3.392 E+06	3.232 E+04	3.578 E-03	9.60 E-06
Ru-106 [a]	3.181 E+07	3.349 E+03	9.670 E-03	1.58 E-04
Pd-107	2.050 E+14	5.148 E-04	5.513 E-05	5.00 E-07
Ag-108m [a]	1.319 E+10	7.926 E+00	1.008 E-02	1.22 E-04
Cd-109	3.997 E+07	2.592 E+03	1.237 E-04	1.62 E-04
Ag-110m [a]	2.158 E+07	4.756 E+03	1.687 E-02	1.10 E-04
Cd-113m	4.323 E+08	2.311 E+02	1.086 E-03	2.20 E-03
Sn-113 [a]	9.944 E+06	1.005 E+04	2.498 E-03	1.08 E-05
Sn-119m	2.532 E+07	3.748 E+03	5.313 E-04	5.60 E-06
Sn-121m	1.736 E+09	5.376 E+01	2.396 E-04	1.60 E-05
Te-121	1.450 E+06	6.435 E+04	3.471 E-03	4.80 E-06
Te-123	3.154 E+20	2.911 E-10	1.342 E-05	7.80 E-05
Sb-124	5.205 E+06	1.749 E+04	1.331 E-02	2.60 E-05
I-125	5.135 E+06	1.759 E+04	3.655 E-04	1.02 E-04
Sb-125	8.707 E+07	1.037 E+03	3.150 E-03	2.80 E-05
Te-125m	5.011 E+06	1.802 E+04	8.582 E-04	1.02 E-05
Sb-126	1.071 E+06	8.363 E+04	1.847 E-02	2.00 E-05
Sn-126 [a]	3.156 E+12	2.839 E-02	1.056 E-03	2.20 E-04
Te-127m [a]	9.418 E+06	9.440 E+03	1.870 E-03	3.00 E-05
I-129	4.951 E+14	1.768 E-04	4.633 E-04	7.20 E-04
Te-129m [a]	2.920 E+06	2.997 E+04	4.127 E-03	2.60 E-05
Xe-131m	1.028 E+06	8.382 E+04	9.622 E-04	0.00 E+00
Ba-133	3.337 E+08	2.544 E+02	2.705 E-03	3.00 E-05
Cs-134	6.517 E+07	1.293 E+03	1.018 E-02	1.32 E-04
Cs-135	7.574 E+13	1.104 E-03	3.964 E-04	1.38 E-05
Cs-136	1.137 E+06	7.300 E+04	2.326 E-03	2.40 E-05

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
Cs-137 [a]	9.521 E+08	8.655 E+01	4.816 E-03	9.20 E-05
Ba-140 [a]	1.101 E+06	7.326 E+04	2.236 E-02	2.00 E-05
Ce-141	2.808 E+06	2.851 E+04	1.467 E-03	6.40 E-05
Ce-144 [a]	2.462 E+07	3.185 E+03	7.996 E-03	7.20 E-04
Nd-147	9.487 E+05	8.094 E+04	2.432 E-03	4.80 E-05
Pm-147	8.278 E+07	9.277 E+02	3.676 E-04	1.00 E-04
Sm-147	3.343 E+18	2.297 E-08	1.361 E-02	1.92 E-01
Eu-150	1.079 E+09	6.977 E+01	9.532 E-03	3.80 E-06
Sm-151	2.840 E+09	2.632 E+01	1.179 E-04	8.00 E-05
Eu-152	4.267 E+08	1.740 E+02	7.667 E-03	8.40 E-04
Gd-152	3.406 E+21	2.180 E-11	1.303 E-02	3.80 E-01
Gd-153	2.091 E+07	3.528 E+03	8.622 E-04	4.20 E-05
Eu-154	2.712 E+08	2.703 E+02	9.009 E-03	1.06 E-03
Eu-155	1.529 E+08	4.762 E+02	7.749 E-04	1.38 E-04
Tm-170	1.111 E+07	5.975 E+03	1.982 E-03	1.40 E-04
Hf-175	6.048 E+06	1.066 E+04	2.422 E-03	1.44 E-05
Hf-181	3.662 E+06	1.703 E+04	4.357 E-03	2.80 E-05
Ta-182	9.910 E+06	6.257 E+03	8.890 E-03	1.52 E-04
W-185	6.489 E+06	9.401 E+03	7.520 E-04	2.40 E-06
Re-187	1.577 E+18	3.827 E-08	3.913 E-06	4.00 E-08
Au-195	1.608 E+07	3.599 E+03	7.629 E-04	1.32 E-06
Hg-203	4.026 E+06	1.381 E+04	1.997 E-03	1.12 E-05
Tl-204	1.196 E+08	4.624 E+02	1.407 E-03	7.80 E-06
Bi-207	1.002 E+09	5.438 E+01	9.829 E-03	1.12 E-04
Pb-210	7.037 E+08	7.634 E+01	2.661 E-04	1.80 E-02
Po-210	1.196 E+07	4.493 E+03	3.206 E-02	1.22 E-02
Ra-226	5.049 E+10	9.885 E-01	2.888 E-02	7.00 E-02
Ac-227	6.871 E+08	7.232 E+01	5.021 E-04	1.10 E+01
Ra-228	1.815 E+08	2.727 E+02	1.391 E-04	5.20 E-02
Th-228	6.037 E+07	8.195 E+02	3.272 E-02	6.40 E-01
Th-229	2.316 E+11	2.127 E-01	3.055 E-02	2.20 E+00
Th-230	2.379 E+12	2.061 E-02	2.822 E-02	8.60 E-01

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
Pa-231	1.034 E+12	4.723 E-02	3.054 E-02	2.80 E+00
Th-232	4.434 E+17	1.097 E-07	2.426 E-02	9.00 E-01
U-232	2.203 E+09	2.207 E+01	3.210 E-02	7.40 E-01
U-233	5.026 E+12	9.633 E-03	2.912 E-02	1.92 E-01
Th-234	2.082 E+06	2.315 E+04	4.268 E-04	1.32 E-04
U-234	7.754 E+12	6.217 E-03	2.880 E-02	1.88 E-01
U-235	2.221 E+16	2.161 E-06	2.773 E-02	1.70 E-01
Pu-236	9.152 E+07	5.222 E+02	3.478 E-02	4.00 E-01
U-236	7.390 E+14	6.468 E-05	2.712 E-02	1.74 E-01
Np-237	6.753 E+13	7.047 E-04	2.944 E-02	4.60 E-01
Pu-238	2.768 E+09	1.712 E+01	3.315 E-02	9.20 E-01
U-238	1.410 E+17	3.361 E-07	2.532 E-02	1.60 E-01
Pu-239	7.609 E+11	6.202 E-02	3.109 E-02	1.00 E+00
Pu-240	2.071 E+11	2.269 E-01	3.115 E-02	1.00 E+00
Am-241	1.366 E+10	3.427 E+00	3.343 E-02	8.40 E-01
Pu-241	4.544 E+08	1.030 E+02	3.177 E-05	1.80 E-02
Am-242m	4.450 E+09	1.047 E+01	4.288 E-04	7.40 E-01
Cm-242	1.408 E+07	3.311 E+03	3.682 E-02	1.04 E-01
Pu-242	1.179 E+13	3.954 E-03	2.955 E-02	9.60 E-01
Am-243	2.324 E+11	1.997 E-01	3.225 E-02	8.20 E-01
Cm-243	9.467 E+08	4.903 E+01	3.683 E-02	6.20 E-01
Cm-244	5.712 E+08	8.093 E+01	3.499 E-02	5.40 E-01
Pu-244	2.525 E+15	1.831 E-05	2.909 E-02	9.40 E-01
Cm-245	2.682 E+11	1.716 E-01	3.334 E-02	8.40 E-01
Cm-246	1.493 E+11	3.072 E-01	3.282 E-02	8.40 E-01
Bk-247	4.352 E+10	1.049 E+00	3.425 E-02	1.38 E+00
Cm-247	5.049 E+14	9.043 E-05	3.174 E-02	7.80 E-01
Cm-248	1.073 E+13	4.239 E-03	1.244 E-01	3.00 E+00
Cf-249	1.108 E+10	4.089 E+00	3.945 E-02	1.40 E+00
Cf-250	4.128 E+08	1.093 E+02	3.727 E-02	6.80 E-01
Cm-250	2.525 E+11	1.787 E-01	8.263 E-01	1.68 E+01
Cf-251	2.834 E+10	1.586 E+00	3.663 E-02	1.42 E+00

Table F-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (second)	Specific Activity [a] (Ci/g)	Decay Heat [b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor [b,d]
Cf-252	8.347 E+07	5.362 E+02	7.258 E-02	4.00 E-01
Es-254	2.380 E+07	1.865 E+03	5.779 E-02	1.72 E-01

Reference: Table A-1 in HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*.

Note: The conversion factor from seconds to years is 3.155 E+07 s/yr.

a. Firestone et al., 1999, *Table of Isotopes* (Chu et al., 1999, *Lund/LBNL Nuclear Data Search Database*). Specific activity data: DFSNW-ECAL-043, *Calculations for Table A-1 of HNF-EP-0063*.

b. Daughters with half-lives <10 days (8.64×10^5 sec) and with parent radionuclide half-life greater than the daughter are not reportable as separate isotopes. Contributions from nonreportable daughters have been included in the decay heat and dose-equivalence factors.

c. Decay heat: ORIGEN database.

d. ICRP Publication 71, "Age Dependent Doses to Members of the Public from Intake of Radionuclides: Part 4 Inhalation Dose Coefficients." Factor: HNF-14741, *Solid Waste Operations Complex Master Documented Safety Analysis*, as amended.

DE-Ci = dose-equivalent curie

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APPENDIX G

RADIOLOGICAL ACCEPTANCE LIMITS

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APPENDIX G
RADIOLOGICAL ACCEPTANCE LIMITS

G.1 RADIONUCLIDE REPORTING

Reportable radionuclides shall be reported on the Waste Profile (WP) and Onsite Waste Transfer Form (OWTF). Activity concentrations reported on the WP are applied at the waste stream level; activity concentrations reported on the OWTF are applied at the waste package level. Radionuclides reported on the OWTF shall be identified on the WP. Determination of activity concentrations reported on the WP and the OWTF shall be documented and available for review. Verification of calculations used to determine the radionuclide concentrations (data results) shall be conducted and documented. Waste packages exceeding the activity concentration upper limit will not be accepted without approval of a revised WP; waste concentrations less than the lower limit will be accepted without prior approval.

Radiological acceptance limits are developed from the concentration limits established to protect human health and the environment due to normal releases and intruder events in UDQ-IDF-2019-002-SA, *Duration of Intruder Protections Necessary for Increased Strontium-90 Concentrations in Vitrified Waste*, Table 1 (supersedes Table 17 of RPP-RPT-59958, *Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington*).

When one or more requirements or limits were more restrictive than others, the more restrictive acceptance limit was adopted. Radionuclides in the waste shall not exceed the concentrations listed in Table G-1.

G.2 REPORTABLE RADIONUCLIDES

Radionuclides known or reasonably expected to be present in a waste stream ***shall*** be reported as follows:

- The activity concentration of the radionuclides in the final waste form exceeds 1% of the Action Level (Table G-1). These radionuclides require rigorous waste characterization and shall be reported on the OWTF and the waste profile.
- Radionuclides that are alpha-emitting and transuranic with a half-life >20 years that exceed 10 pCi/g shall be reported on the waste profile. Transuranic waste radionuclides with concentrations that exceed 1 nCi/g require rigorous waste characterization methods and shall be reported on the OWTF and the waste profile.
- Activity concentrations in the final waste form that exceed 1% of the total activity concentration shall be reported on the OWTF and the waste profile. The total activity concentration shall include the activity of all radionuclides, except for those that are exempt from the reporting requirements as specified. For these radionuclides and for those present at a level less than the detection limit of industry-accepted characterization methods, process knowledge should be sufficient for characterization.

Table G-1. Radionuclide Concentration Limits

Radionuclide	Limit (Ci/m^3)
^{227}Ac	1,320
^{241}Am	3.67
^{243}Am	1.08
^{14}C	6.15
$^{113}Cd^{m}$	92,200
^{243}Cm	480
^{244}Cm	771
^{60}Co	1.61E+09
^{137}Cs	83.9
^{152}Eu	65,900
^{154}Eu	1.03E+08
^{155}Eu	1.75E+09
^{3}H	2,780
^{129}I	0.120
$^{93}Nb^{m}$	8.73E+07
^{59}Ni	18.3
^{63}Ni	43.4
^{237}Np	0.740
^{221}Pa	0.211
^{210}Pb	448
^{238}Pu	17.4
^{239}Pu	2.11
^{240}Pu	2.16
^{241}Pu	107
^{242}Pu	2.21
^{226}Ra	0.228
^{228}Ra	1.87E+11
^{222}Rn	9.51E+05
^{79}Se	1.12
^{151}Sm	2.97E+04
^{126}Sn	0.0945
^{90}Sr	47.6
^{99}Tc	0.906

Table G-1. Radionuclide Concentration Limits

Radionuclide	Limit (Ci/m^3)
^{229}Th	0.419
^{230}Th	0.467
^{232}Th	0.0267
^{232}U	1.19
^{223}U	2.52
^{234}U	5.04
^{235}U	0.967
^{236}U	5.62
^{238}U	4.03
^{93}Zr	462

Concentrations limits from RPP-CALC-61254, *Inadvertent Intruder Dose Calculation Update for the Integrated Disposal Facility Performance Assessment*, Table 6-5 Year 2278 used in UDQ-IDF-2019-002-SA, *Duration of Intruder Protections Necessary for Increased Strontium-90 Concentrations in Vitrified Waste*, (supersedes RPP-RPT-59958, *Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington*, Table 7-17).

G.3 REFERENCES

RPP-CALC-61254, 2019, *Inadvertent Intruder Dose Calculation Update for the Integrated Disposal Facility Performance Assessment*, Rev. 3, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-RPT-59958, 2018, *Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington*, Rev. 1, Washington River Protection Solutions, LLC, Richland, Washington.

UDQ-IDF-2019-002-SA, 2019, *Duration of Intruder Protections Necessary for Increased Strontium-90 Concentrations in Vitrified Waste*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

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APPENDIX H

CONTAINERS, COATINGS, AND LINERS

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APPENDIX H
CONTAINERS, COATINGS, AND LINERS

H1.0 INTRODUCTION

WAC 173-303-630(4), "Dangerous Waste Regulations," "Use and Management of Containers," requires that containers used for storage of dangerous waste be made of or lined with materials that are compatible with the waste and will not react with the waste, and that the ability of the container to contain the waste is not impaired. Various factors affect the compatibility of a container/liner combination, including the properties of chemical constituents in the waste; the physical form of the waste (e.g., free liquid, absorbed liquid, dry waste); and the anticipated length of storage.

The compatibility of the container/liner and the waste is determined using chemical compatibility charts, manufacturer's compatibility data, and/or other applicable data. Any combination of container(s) and/or liner(s) can be used that is compatible with the waste.

Hanford Site procurement specifications for metal drums (HNF-7403, *Specification for Packaging of Hanford Site Performance-Based Drums*) and boxes (HNF-7656, *Specification for Packaging of Hanford Site Performance-Based Steel Boxes*) identify several options for container coatings, with varying degrees of chemical resistance. WHC-SD-TP-ES-002, *Justification for Packaging Acceptance Criteria*, describes a set of standard packages from the Hanford Site that generally will be compatible with the types of waste generated on the Hanford Site. The Hanford Site specifications are provided for information purposes only. It is not necessary to select packaging according to Hanford Site specifications.

H2.0 REFERENCES

HNF-7403, 2000, *Specification for Packaging of Hanford Site Performance-Based Drums*, Rev. 0, Duratek Federal Services, Inc., Northwest Operations, Richland, Washington.

HNF-7656, 2001, *Specification for Packaging of Hanford Site Performance-Based Steel Boxes*, Rev. 0, Duratek Federal Services, Inc., Northwest Operations, Richland, Washington.

WAC 173-303-630, "Dangerous Waste Regulations," "Use and Management of Containers," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-630.

WHC-SD-TP-ES-002, 1996, *Justification for Packaging Acceptance Criteria*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX I

LABELING OF WASTE CONTAINERS

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APPENDIX I
LABELING OF WASTE CONTAINERS

I1.0 INTRODUCTION

Containers sent to the Integrated Disposal Facility must be labeled for identification and to communicate information needed for proper waste management. Table I-1 lists the standard labeling required on containerized waste except for immobilized low-activity waste glass containers. The following sections provide general requirements for labels and markings.

Table I-1. Required Labeling for Waste Containers [a]

Label	When Required	Location		
		On Drum	On Box	On ILAW Glass Container
Bar code with container identification number	All containers	Bottom third of drum	Short side of box	Pallet placard holder
Gross weight in kg (kg units must appear on label)	All containers	Same side as bar code	Same side as bar code	Pallet placard holder
Applicable DOT labeling	All containers	As specified in 49 CFR	As specified in 49 CFR	Pallet placard holder
Hazardous waste label	Mixed waste containers	Same side as bar code	Same side as bar code	Pallet placard holder
Hazard label(s) [a]	Mixed waste containers	Same side as bar code	Same side as bar code	Pallet placard holder
PCB label [b]	Waste that is regulated for PCB content under 40 CFR 761	Same side as bar code	Same side as bar code	Pallet placard holder
Asbestos label	As required per 40 CFR 61, Subpart M	Same side as bar code	Same side as bar code	Pallet placard holder

Notes: Complete reference citations are provided in Chapter I7.0.
For packages shipped within a Special Packaging Zone as allowed by DOE/RL-2001-36, the minimum marking and labeling requirements are the bar code with container identification number and gross weight in kilograms.

a. Refer to Table I-2 for Washington State hazard labeling of mixed waste. These labels might conflict with DOT hazard labeling and should be covered, removed, or obliterated during transportation. ILAW glass containers will be labelled using the ILAW pallet sign holder, as labels will not be placed directly in the ILAW glass container from the high heat of the cooling glass.

b. Label in accordance with 40 CFR 761.40 and 40 CFR 761.45. The label placed on containers holding PCB items must include the date the item was removed from service.

DOT = U.S. Department of Transportation
ILAW = immobilized low-activity waste
PCB = polychlorinated biphenyl

Table I-2. Selection of Washington State Hazard Labeling

Hazard or Risk	Acceptable Labels and Markings
Dangerous Waste Characteristic – D001 Ignitable (WAC 173-303-090(5))	IGNITABLE
Dangerous Waste Characteristic – D002 Corrosive (WAC 173-303-090(6))	CORROSIVE
Dangerous Waste Characteristic – D003 Reactivity (WAC 173-303-090(7))	REACTIVE
Dangerous Waste Characteristic – D004 - D043 Toxic (WAC 173-303-090(8))	TOXIC
WA State Dangerous Waste Criteria – WT01, WT02 Toxic (WAC 171-303-100)	TOXIC
WA State Dangerous Waste Criteria – WP01, WP02, WP03 Persistent (WAC 171-303-100)	TOXIC
Discarded Chemical Products – (U, P codes) (WAC 173-303-9903)	a. If a listed dangerous waste no longer exhibits a characteristic hazard, then label TOXIC. b. Otherwise, label with appropriate IGNITABLE, CORROSIVE, REACTIVE, OR TOXIC labels.
Dangerous Waste Sources – (F, codes) (WAC 173-303-9904)	a. If a listed dangerous waste no longer exhibits a characteristic hazard, then label TOXIC. b. Otherwise, label with appropriate IGNITABLE, CORROSIVE, REACTIVE, OR TOXIC labels.

References: WAC 173-303, "Dangerous Waste Regulations."
173-303-090, "Dangerous Waste Characteristics."
173-303-100, "Dangerous Waste Criteria."
173-303-9903, "Discarded Chemical Products List."
173-303-9904, "Dangerous Sources List."

I2.0 BAR CODE

Each container shall be labeled with a bar code showing the unique container identification number (CIN). Bar-coded CINs will be assigned as follows:

- For containers purchased through the Hanford Site procurement system, the bar code will be attached to the containers when the containers are received at the Central Stores warehouse. The CIN is a unique seven-digit number.
- For containers not purchased through the Hanford Site procurement system, Hanford Site generators will assign a CIN. The CIN must be a unique number. The suggested format to ensure that the CIN is unique is: "Facility ID-Year-Sequential #," where the Facility ID is the generating facility's unique

four-character (letter and/or number) identifier, "Year" is the last two digits of the year the CIN was assigned, and "Sequential #" is the generator's sequential numbering of containers for that year.

I3.0 DURABILITY

Labels and markings must be durable, fade-resistant, water-resistant paints, vinyl stickers, or another system that is sufficiently durable to remain intact and legible during management of the waste before disposal.

I4.0 PLACEMENT OF LABELS

Labels and markings shall be positioned so that required information is visible on the same side of the container as the bar code. If drums are palletized, the drums must be oriented on the pallet such that a complete set of labels is visible.

I5.0 SIZE OF LABELS

Standard labels defined by regulations (e.g., U.S. Department of Transportation label, hazardous waste label, polychlorinated biphenyl label, and asbestos label) must be legible or as specified by the regulations. Characters on Washington State hazard labels must be legible from a distance of 25 ft or the lettering size is a minimum of 1.27 cm (0.5 in.) in size. Characters on other labels (e.g., gross weight) must be a minimum of 2.54 cm (1 in.) high or as specified by the regulations.

I6.0 LABELING INNER CONTAINERS IN LAB PACKS

Each inner container in a lab pack must be labeled with an identification number or waste name cross-referenced against the contents inventory sheet. These labels must be sufficiently durable to remain legible for 20 years. Hazard labeling requirements are listed in Table I-2.

I7.0 REFERENCES

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*. Available at: https://www.govinfo.gov/content/pkg/CFR-2010-title40-vol8/pdf/CFR-2010-title40-vol8-part61.pdf.

Subpart M, "National Emissions Standard for Asbestos." (61.140–61.157)

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*. Available at: https://www.govinfo.gov/content/pkg/CFR-2018-title40-vol34/pdf/CFR-2018-title40-vol34-part761.pdf.

761.40, "Marking Requirements."

761.45, "Marking Formats."

49 CFR, "Transportation," *Code of Federal Regulations*. Available at:
https://www.govinfo.gov/content/pkg/CFR-2009-title49-vol1/xml/CFR-2009-title49-vol1.xml.
https://www.govinfo.gov/content/pkg/CFR-2009-title49-vol2/xml/CFR-2009-title49-vol2.xml.
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DOE/RL-2001-36, 2017, *Hanford Sitewide Transportation Safety Document*, Rev. 1-E, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-090, "Dangerous Waste Characteristics."

303-100, "Dangerous Waste Criteria."

303-9903, "Discarded Chemical Products List."

303-9904, "Dangerous Sources List."