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Hanford Site Solid Waste Acceptance Criteria

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

CH2MHILL
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Terms

AK	acceptable knowledge
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CH	contact-handled
CHPRC	CH2M HILL Plateau Remediation Company
CWC	Central Waste Complex
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HIC	high-integrity container
LDR	land disposal restrictions
LLBG	Low-Level Burial Grounds
LLW	low-level waste
MLLW	mixed low-level waste
NDA	nondestructive assay
NDE	nondestructive examination
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
QA	quality assurance
QAP	quality assurance program
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RGN	reactivity group number
RH	remote-handled
SWIFT	Solid Waste Integrated Forecast Technical (report)
SWOC	Solid Waste Operations Complex
TRU	transuranic
TRUM	transuranic mixed
TRUPACT	Transuranic Package Transporter

TSCA	*Toxic Substances Control Act of 1976*
TSD	treatment, storage, and/or disposal
WFMP	Waste & Fuels Management Project
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Receiving and Processing
WSRd	waste specification record

Definitions

Acceptable knowledge. 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.

Acid. Acids are chemical agents that release hydrogen ions when added to water. When acids are added, they release more hydrogen ions into the solution, and this causes the pH of the solution to drop. The more hydrogen ions equals a lower pH and a more acidic solution.

Asbestos-containing waste material. Mill tailings or any waste that contains commercial asbestos and is generated by a source subject to 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Subpart M, "National Emission 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").

Base. Bases are chemical agents that have the potential to accept hydrogen ions when added to water. When bases are added, they accept more hydrogen ions from the solution, and this causes the pH of the solution to rise. The less hydrogen ions equals a higher pH and a more caustic solution.

Beryllium-containing waste material. Any waste that contains beryllium and/or beryllium compounds including beryllium-contaminated clothing, equipment, waste scrap, or debris.

Bulk waste. Waste that is not containerized for disposal and contains potentially dispersible radiological contamination, such as soil and rubble.

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, *Radioactive Waste Management Manual*).

Cellulose. Cellulose is a linear macromolecule consisting of monomeric units with the empirical formula $C_6H_{10}O_5$. Cellulosic materials commonly present in the contact-handled transuranic wastes include paper, cloth, wood, and Benelex™, which is composed of wood fiber plus phenolic resin. Other commercial materials that contain cellulosics include cellophane, cellulose acetate (used to manufacture rayon, molded items, paints, coatings), and ethyl cellulose (used to manufacture paints, molded items).

Certifiable form. The waste is in a form capable of being certified for shipment to and disposal at the Waste Isolation Pilot Plant.

Chelating agent. Amine polycarboxylic acids (e.g., ethylenediaminetetraacetic acid and diethylenetriaminepentaacetic acid), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, and glucinic acid) (10 CFR 61.2, "Licensing Requirements for Land Disposal of Radioactive Waste," "Definitions").

™ Benelex is a trademark of the Masonite Corporation, Chicago, Illinois.

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 Fire Code*).

Combustible waste. Any waste 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). TRU/TRUM packaged waste external dose rate cannot exceed 2 mSv/hr (200 mrem/hr).

Container. Any portable device in which a material is stored, transported, treated, disposed, or otherwise handled (WAC 173-303-040, "Dangerous Waste Regulations," "Definitions").

Corrosive material. Class 8 means a liquid or solid that causes full thickness destruction of human skin at the site of contact within a specified period of time. A liquid that has a severe corrosion rate on steel or aluminum based on the criteria in 49 CFR 173.137(c)(2), "Transportation," "Shippers—General Requirements for Shipments and Packagings," "Class 8—Assignment of Packing Group," is also a corrosive material (49 CFR 173.136, "Class 8—Definitions").

Corrosive waste. A dangerous waste that exhibits the characteristic of corrosivity defined in WAC 173-303-090(6), "Dangerous Waste Characteristics."

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

Dangerous waste constituents. Those constituents listed in WAC 173-303-9905, "Dangerous Waste Constituents List," and any other constituents that have caused a waste to be a dangerous waste under WAC 173-303.

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), "Land Disposal Restrictions," "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.

Decontamination. The removal of radioactive material from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

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 (DE-Ci). 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."

U.S. Environmental Protection Agency (EPA) hazardous waste numbers. The number assigned by EPA to each hazardous waste listed in 40 CFR 261, "Identification and Listing of Hazardous Waste," Subpart D, "Lists of Hazardous Wastes," and to each characteristic identified in 40 CFR 261, Subpart C, "Characteristics of Hazardous Waste."

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).

Facility. All contiguous land, structures, other appurtenances, and improvements on the land, used for recycling, reusing, reclaiming, transferring, treating, storing, or disposing of dangerous waste. The Hanford facility consists of several TSD operational units (e.g., one or more landfills, surface impoundments, or combinations of these) (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.

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.

Flammable liquid. A liquid having a flash point of not more than 60°C (140°F), or any material in a liquid phase with a flash point at or above 37.8°C (100°F) that is intentionally heated and offered for transportation at or above its flash point in a bulk packaging (49 CFR 173).

Flammable solid. Any of the following types of materials: wetted explosives, self-reactive materials that are liable to undergo a strongly exothermal decomposition caused by excessively high temperatures or contamination, or readily combustible solids that might cause a fire through friction (49 CFR 173).

Free liquids. Those liquids determined to be present in a waste as defined by the Paint Filter Liquids Test, Method 9095 of SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*.

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. The term generator also includes any person or organization that manages a dangerous waste at the generating site on behalf of the generator.

Gross weight. The tare weight of a container plus the weight of its contents.

Hanford Site treatment, storage, and/or disposal unit (Hanford Site TSD unit). Any one of the operational TSD units having acceptance criteria defined by this document. This specifically excludes all other TSD units identified on the Hanford Site.

Hazardous waste. Solid waste designated by 40 CFR 261 and regulated as a hazardous waste and/or mixed waste by EPA.

High-level waste. The highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation (DOE M 435.1-1).

Ignitable waste. A dangerous waste that exhibits the characteristic of ignitability as described in WAC 173-303-090(5).

Incompatible waste. A dangerous waste that is unsuitable for placement in a particular device or facility because it might corrode or decay the containment materials or is unsuitable for mixing with another waste or material because the mixture might produce heat or pressure, fire or explosion, violent reaction, toxic dusts, fumes, mists, or gases, or flammable fumes or gases (WAC 173-303-040).

Infectious waste. Any waste that contains or is suspected of containing 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.

Inner liner. A continuous layer of material placed inside a tank or container that protects the construction materials of the tank or container from the contained waste or reagents used to treat the waste (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 U.S. Department of Transportation (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, “Land Disposal Restrictions,” and WAC 173-303-140, “Land Disposal Restrictions.” (Refer to definitions for *Resource Conservation and Recovery Act of 1976* [RCRA] land disposal restrictions [LDR] and Washington State LDR.)

Layer of confinement. A confinement layer is any boundary around a volume greater than 4.0 L that restricts, but does not prohibit, the release of hydrogen gas across the boundary. Bags (in a fully expanded condition), containers, or other closed inner packagings that are less than 4.0 L in size are not counted as layers of confinement. Plastic bags containing waste that are twist and tape closed and fold and tape closed are layer of confinement. Filtered bags are a layer of confinement, but have a higher hydrogen diffusivity rate.

Low-level mixed waste. Waste that meets both the definition of low-level waste and mixed waste.

Low-level waste. 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*) (42 USC 2011 et seq.), or naturally occurring radioactive material (DOE M 435.1-1). Contains less than 100 nCi/g of transuranic isotopes.

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 byproduct material subject to the *Atomic Energy Act of 1954* (WAC 173-303-040).

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.

Mobile radionuclides. Radionuclides that tend to migrate readily through Hanford soil and pose the highest risk of impact to groundwater resources: tritium (hydrogen-3), carbon-14, chlorine-36, selenium-79, molybdenum-93, technetium-99, iodine-129, rhenium-187, uranium (all isotopes), and neptunium-237.

Neutralize. Type of chemical reaction when a hydronium ion from an acid reacts with a hydroxide ion from a base to make water and a salt.

Newly generated waste. Waste from ongoing processes including secondary waste or repackaged waste that has not been previously accepted by the Solid Waste Operations Complex and is not retrieved or previously stored waste.

Non-biodegradable sorbent. A sorbent material meeting the requirements of 40 CFR 264.314(e), "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Special Requirements for Bulk and Containerized Liquids."

Noncombustible waste. Containerized waste that shows no evidence of combustion or decomposition on exposure to 538°C (1,000°F) for 10 minutes as specified by NUREG-0782, *Draft Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste" Summary*, or waste that has been stabilized by grouting or disposal in a high-integrity container (HIC).

Organic peroxide. Any organic compound containing oxygen in the bivalent -O-O- structure and that might be considered a derivative of hydrogen peroxide, where one or more of the hydrogen atoms have been replaced by organic radicals.

Onsite. Any property within the Hanford Site boundary. (NOTE: DOT, *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA], and RCRA regulations have varying definitions of onsite; the precise DOT, CERCLA, and RCRA meanings of the term are not implied in the use of the term in this document.)

Operational safety requirements or 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.

Outer packaging. The outermost enclosure of a composite or combination packaging together with any absorbent materials, cushioning, and any other components necessary to contain and protect inner receptacles or inner packagings (49 CFR 171, "General Information, Regulations, and Definitions").

Oxidizer. A substance such as chlorate, permanganate, inorganic peroxide, or a nitrate that yields oxygen readily to stimulate the combustion of organic matter.

Package. The package, together with its contents, as presented for transportation.

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).

Plateau Remediation Company. The current contract with the DOE to operate portions of the Hanford Site, including the facilities described in this document. CH2M HILL is the Plateau Remediation Company contractor.

Plutonium-equivalent curie (PE-Ci). A method of normalizing the radiotoxicity in transuranic waste to plutonium-239 for use in establishing the approved safety limits at the Waste Isolation Pilot Plant (WIPP) located near Carlsbad, New Mexico. The normalization is based on the relative committed effective dose equivalent from inhalation of a radionuclide to that of plutonium-239 using the conversion factors from DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public*, as described in Appendix B of DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*.

Plutonium-239 fissile gram equivalent. A method of normalizing fissile and fissionable isotopes to plutonium-239 for use in establishing criticality safety limits for the Hanford Site Solid Waste Program. This is consistent with the method found in the safety analysis reports for the Transuranic Package Transporter (TRUPACT)-II, TRUPACT-III, HalfPACT, and remote-handled (RH)-TRU 72-B casks for plutonium-239, uranium-233, and uranium-235 and in ANSI/ANS-8.15-2014, *Nuclear Criticality Safety Control of Selected Actinide Nuclides*, for other fissile, fissionable, and special actinide elements.

Polychlorinated biphenyl (PCB). Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances that contains such substance (40 CFR 761.3, “Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions,” “Definitions”).

Process knowledge. Knowledge the 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.

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. Data from waste analysis that is 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, sludges, 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).

RCRA land disposal restrictions. The requirements and restrictions for land disposal of hazardous waste codified in 40 CFR 268.

Reactive waste. A dangerous waste that exhibits the characteristic of reactivity as described in WAC 173-303-090(7).

Reactivity group number. An EPA system for classifying chemicals into one of 41 reactivity groups based on their reactive functional group, chemical structure, or reactivity with other chemical groups. Reactivity group number (RGN) assignments may be obtained through the CBFO-managed

Master RGN List or by contacting the CH2M HILL Plateau Remediation Company Waste & Fuels Management Project TRU Program for assistance.

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

Remote-handled transuranic waste. Packaged transuranic waste whose unshielded payload container external surface dose rate exceeds 2 mSv/hr (200 mrem/hr), unless the shielding is part of a WIPP-approved configuration.

Residue. The hazardous material remaining in a packaging, including a tank car, after its contents have been unloaded to the maximum extent practicable and before the packaging is either refilled or cleaned of hazardous material and purge to remove any hazardous vapors.

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. Any technique that reduces the solubility and mobility of dangerous waste constituents and/or radionuclides by physical means rather than by bonding or chemically reacting with the stabilizing material.

Sorb. To absorb or adsorb.

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

Specific activity. The radiological activity (disintegrations per unit of time) of a radionuclide per unit mass of that radionuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radiological activity per unit mass of the material.

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 M 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).

Spontaneously combustible material. A pyrophoric or self-heating material (49 CFR 171).

Stabilization. Any technique that reduces the solubility and mobility of dangerous waste constituents and/or radionuclides by bonding or chemically reacting with the stabilizing material. The term stabilization to meet LDR is used when the specific definition of 40 CFR 268.42, “Treatment Standards Expressed as Specified Technologies,” Table 1, is implied.

Standard waste box. A payload container authorized for use with TRUPACT-II or HalfPACT transportation packages for packaging of transuranic waste (NRC, 1996, *Safety Analysis Report for the TRUPACT II Shipping Package (SARP)*).

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 radioactive waste for a temporary period, at the end of which the waste is treated, disposed of, or stored elsewhere (DOE M 435.1-1).

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 PCB waste. Any PCB-containing waste that is regulated under the TSCA requirements codified in 40 CFR 761.

Transuranic mixed waste (TRU-mixed waste). Waste that meets both the definitions of transuranic waste and mixed waste.

Transuranic waste (TRU waste). Radioactive waste containing more than 100 nCi (3,700 Bq) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of EPA, does not need the degree of isolation required by the 40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," disposal regulations; or (3) waste that the U.S. Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR 61 (DOE M 435.1-1).

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 173-303-600(3), "Final Facility Standards," (WAC 173-303-040).

Treatment, storage, and/or disposal unit manager or TSD unit manager. The individual, or delegate, having responsibility for the operation of a given TSD unit within the limits of the TSD unit RCRA permit, safety basis, performance assessment, and/or other environmental requirements.

U.S. Department of Energy, Richland Operations Office (DOE-RL). The DOE field element responsible for the storage and disposal facilities listed in this document.

Verification. Refers to the process by which waste container contents are verified by physical inspection (e.g., nondestructive examination and visual examination) or chemical screening as stated in the waste analysis plans for the TSD units.

Washington State land disposal restrictions or Washington State LDR. The land disposal restrictions of WAC 173-303-140(4).

Washington State-only dangerous waste. State-only dangerous waste.

Waste Specification Record. A document that identifies the anticipated TSD methods to be applied to a given class of waste managed at Hanford Site TSD units.

Waste stream. A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties (DOE M 435.1-1).

Water-reactive waste. Waste that meets the definition of WAC 173-303-090(7)(a)(ii), (iii) or (iv).

Waste & Fuels Management Project (WFMP) Waste Acceptance organization. The Waste Acceptance organization within the Waste & Fuels Management Project is responsible for waste acceptance, including approval of waste stream profiles, approval of individual waste packages, shipments, and for coordinating the approval of case-by-case evaluations for specific criteria and exceptions to the acceptance criteria.

1 Introduction

DOE O 435.1, *Radioactive Waste Management*, requires each treatment, storage, and/or disposal facility (referred to in this document as a treatment, storage, and/or disposal [TSD] unit) that manages low-level (LLW) or transuranic (TRU) waste (including mixed waste and *Toxic Substances Control Act of 1976* [TSCA] polychlorinated biphenyl [PCB] waste) to maintain waste acceptance criteria. This requirement is implemented through DOE/RL-2000-25, *Richland Operations Office Implementation Plan for DOE Order 435.1*. The waste acceptance criteria for the U.S. Department of Energy, Richland Operations Office (DOE-RL) TSD units are provided, including criteria for the Low-Level Burial Grounds (LLBG) including the Mixed Waste Trenches (Trench 31 and Trench 34), the Central Waste Complex (CWC), T Plant, and the Waste Receiving and Processing (WRAP) facility.

1.1 Purpose and Scope

The criteria for each TSD unit are established in this document to ensure that newly generated waste accepted can be managed within the operating requirements of the unit, which include environmental regulations, DOE Orders, permits, safety basis documents, fire hazards analyses, waste analysis plans, and performance assessments. The requirements of DOE O 435.1 and DOE M 435.1-1, *Radioactive Waste Management Manual*, are implemented through DOE/RL-2000-25. Revisions to this acceptance criteria document require an Unreviewed Safety Question review to document that the changes are consistent with current applicable safety analyses.

All waste received for acceptance at the Solid Waste Operations Complex (SWOC) facilities will be disposal ready, meeting all applicable federal and state land disposal restrictions (LDR) requirements, radiological stabilization requirements (greater than Category 1 wastes and mobile radionuclides), 90% full requirements, and 50 lb/in^2 compaction criteria for the disposal trenches. It is expected that all LLW and mixed low-level waste (MLLW) with a disposition path will have received treatment, if required, for shipment and final disposition. LLW and MLLW that does not meet the requirements will have an exception per Section 1.6. TRU waste must meet Waste Isolation Pilot Plant (WIPP) requirements as defined in DOE/WIPP/02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, unless an exception is granted. WIPP waste acceptance criteria changes will be communicated via formal notification from the DOE Field Office. Existing SWOC waste profiles will be reviewed and revised based on the WIPP waste acceptance criteria changes, as needed. These acceptance criteria apply to the following DOE-RL TSD units:

- Lined trenches in the LLBG
- CWC
- WRAP facility
- T Plant Complex

Waste from all generators, including Hanford Site and offsite facilities, must comply with these criteria. Exceptions can be granted, as provided in Section 1.6.

Specific waste streams could have additional requirements based on the identified TSD pathway. These requirements are communicated in the waste specification records (WSRds) and/or waste stream profile sheet approvals.

The Hanford Site manages nonradioactive waste through direct shipments to offsite contractors. The waste acceptance requirements of the offsite TSD facility must be met for these nonradioactive wastes. This document does not address the acceptance requirements of these offsite facilities.

Selection of specific storage locations and container movements within a TSD unit are outside the scope of these acceptance criteria.

1.2 Roadmap to the Waste Acceptance Criteria

Chapter 1 provides introductory information and describes general administrative requirements that apply to generators.

Chapter 2 identifies requirements that generally apply to waste sent to any of the TSD units. These criteria relate primarily to overall characterization and segregation methods used by generators. Acceptance criteria that are the same for all units are provided in this chapter.

Chapters 3 through 6 communicate the TSD unit-based criteria for acceptance of waste. Each of the following chapters contains a general description of the TSD unit functions followed by identification of prohibited waste, physical/chemical acceptance criteria, radiological acceptance criteria, and packaging criteria:

- Chapter 3: The lined trench (Trench 31 and Trench 34) portion of the 218-W-5 Burial Ground is a *Resource Conservation and Recovery Act of 1976 (*RCRA) permitted disposal unit for certain MLLW and LLW that meet federal and state LDR. The unit may also dispose of certain types of TSCA PCB waste.
- Chapter 4: CWC is a storage unit for MLLW, low-level TSCA PCB waste, TRU waste, transuranic mixed (TRUM) waste, TRU TSCA PCB waste, and other waste types that must be stored pending treatment and/or disposal.
- Chapter 5: The T Plant Complex is a multipurpose unit for storage, repackaging, treatment, and decontamination of radioactive waste. The T Plant Complex can accept LLW and TRU waste, including mixed and TSCA PCB waste.
- Chapter 6: The WRAP facility is a multipurpose unit for processing and treating LLW and TRU waste, including mixed and TSCA PCB waste. The WRAP facility can perform repackaging nondestructive assay (NDA) and nondestructive examination (NDE) of waste containers. The WRAP facility is the primary unit for repackaging and processing TRU waste for certification and disposal at WIPP.

Chapter 7 lists references for all chapters except the appendices. Each following appendix has its own reference section:

- Appendix A provides radiological calculation methods.
- Appendix B provides fissionable material content limits.
- Appendix C describes the labeling of containers.
- Appendix D describes the selection of containers, coatings, and liners.
- Appendix E describes the selection of sorbents, stabilizing materials, and void fillers.
- Appendix F, “Radiological Release of Waste,” has been retired.
- Appendix G provides contact-handled (CH) TRU waste acceptance criteria and certification requirements.

- Appendix H provides a listing of approved vents.
- Appendix I provides remote-handled (RH) TRU waste acceptance criteria.

1.3 Waste Acceptance Process

The process for obtaining approval to ship waste to the Hanford Site Waste & Fuels Management Project (WFMP) TSD units is described for the Hanford Site Solid Waste Acceptance Program available at: http://www.hanford.gov/?page=577. Use of the waste acceptance process is mandatory. All non-Hanford Site waste generators must receive approval from DOE-RL before acceptance and shipment of waste to Hanford Site TSD units.

1.4 Generator Responsibilities

Generators of radioactive waste have certain general responsibilities under DOE O 435.1-1. Acceptance of waste at Hanford Site TSD units is contingent on effectively fulfilling these responsibilities. The generator is responsible for all costs associated with the storage, treatment, disposition, and associated transportation for disposal-ready waste, as stated in Section 1.1 of these acceptance criteria. Generators are also financially responsible for costs incurred by Hanford Site TSD units resulting from nonconformance with the acceptance criteria.

1.4.1 Waste Certification Program

Generators must implement and maintain a waste certification program to ensure that any waste sent to a Hanford Site TSD unit meets the acceptance criteria of that unit (Section III.J. and Section IV.J of DOE M 435.1-1). All nonconforming containers can be returned to the generator for resolution. There is no obligation for WFMP TSD units to correct generator nonconformances.

1.4.2 Quality Assurance Program

Each generator shall have a quality assurance program (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, *Quality Assurance* (DOE M 435.1-1). The generator QAP shall be subject to evaluation according to the requirements of Section 1.5.

1.4.3 Waste Minimization Program

Generators shall establish and maintain an auditable waste minimization program, including goals, incentives, procedures, and reports, to ensure that the amount of radioactive waste generated and/or shipped for disposal is minimized (DOE M 435.1-1). For Hanford Site generators, the most current version of DOE/RL-91-31, *Hanford Site Waste Minimization and Pollution Prevention Awareness Program Plan*, defines the methods for meeting this requirement.

1.4.4 Waste Forecast

Generators that wish to ship waste to the Hanford Site TSD unit shall provide an annual waste forecast. This input is done through the Solid Waste Integrated Forecast Technical (SWIFT) report forecasting tool. Integration of data is summarized in the SWIFT report, and it provides up-to-date life cycle information about radioactive solid waste that is expected to be managed by the Hanford Site WFMP for onsite and offsite generators. The data contained in this report are the official data for solid waste forecasting. Requests to update this forecast are sent out semiannually in conjunction with the budget cycle.

1.4.5 Defense Determination Guidance

The Hanford Site will accept TRU waste generated by atomic energy defense activities of the United States as defined in the *Nuclear Waste Policy Act of 198*2. Non-defense TRU waste will require an exception per Section 1.6 of this document. DOE and its predecessor agencies were engaged in a broad range of activities that fall under the heading of atomic energy defense activities. TRU waste is considered to be defense related if it has been generated in whole or in part by one or more of the following functions:

- Naval reactors development
- Weapons activities, including defense inertial confinement fusion
- Verification and control technology
- Defense nuclear materials production
- Defense nuclear waste and materials byproducts management
- Defense nuclear materials security and safeguards and security investigations
- Defense research and development

In order to establish the defense pedigree of the waste, a “defense determination” is required for all waste destined for WIPP disposal. The determination may be established as a part of the documentation of process knowledge that demonstrates the origin of the waste. For waste with a less direct tie to one of the listed defense-related activities, contact the TRU program for guidance. The SWIFT report contains two volumes: Volume I provides waste metrics in several forms (e.g., volume, containers, and radionuclides), and Volume II provides detailed history and analyzes any changes to the metrics.

Customized data reports or analyses may be requested by contacting the Transportation and Waste Integration organization.

1.5 Evaluation of Generator Waste Certification Program

Under DOE M 435.1-1, receiving TSD units must evaluate waste to ensure it meets the acceptance criteria of the unit. This requirement is implemented through review of information submitted by the generator and verification and confirmation inspections performed on waste containers. When repeated or serious nonconformances are found, additional evaluations will be performed as defined in the waste analysis plan for that TSD unit. When necessary, an onsite audit of the waste certification program of the generator, including applicable portions of the QAP, will be required.

1.6 Exceptions to the Waste Acceptance Criteria

All exceptions to these acceptance criteria will be approved by DOE-RL. Exceptions to these 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). Exceptions that may pose a regulatory risk to the CH2M HILL Plateau Remediation Company (CHPRC) will require direction from the DOE-RL contracting officer.

A generator can request an exception from one or more of the criteria in this document. The request should be a written letter to the WFMP Waste Acceptance organization that includes the following information:

- Specific requirement(s) in this document for which an exception is desired
- Waste type (e.g., TRU, TRUM, 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)
- Identification of the waste in the SWIFT report
- 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

1.7 Precedence of Requirements

Cases may 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 is less restrictive than others, the more restrictive one must be met.

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2 General Requirements

Certain general requirements apply to acceptance of all waste at Hanford Site TSD units. These requirements are described in the following sections.

2.1 General Radioactive Classes of Waste Managed at Hanford Site Treatment, Storage, and/or Disposal Units

The TSD units covered by these acceptance criteria manage LLW and TRU waste. This generally excludes acceptance of waste classified as high-level waste, spent nuclear fuel, and/or byproduct material.

2.2 Composition of Waste and Containers

For all waste, a detailed record must be kept of the contents, volume, and weight, as well as any added void fillers, sorbents, stabilization agents, or solidification agents (DOE M 435.1-1).

For containerized waste, the container type, weight, internal and external volume, any shielding provided, and the date packaged must be recorded (DOE M 435.1-1). In the case of lab packs, the record shall include the exact number, type, and volume of inner containers.

2.3 Prohibited Waste

The following waste types are not accepted:

- Dangerous waste not having dangerous waste numbers listed on the approved Part A, Form 3, permit application for the TSD unit (*Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* [hereinafter called Hanford Facility RCRA Permit], Unit Name Part A Form)
- Explosive waste (SWSD-STD-EP-53087, *Low-Level Burial Grounds Trenches 31-34-94 Waste Analysis Plan*; HNF-21239, *Solid Waste Operations Complex Fire Hazards Analysis*)
- Shock-sensitive waste (PRC-STD-EP-53090, *Central Waste Complex – Waste Receiving and Processing Facility Waste Analysis Plan*; TPLN-STD-EP-53088, *T Plant Complex Waste Analysis Plan*; HNF-21239)
- Pyrophoric waste (PRC-STD-EP-53090; SWSD-STD-EP-53087; TPLN-STD-EP-53088)
- Class IV oxidizer (see definitions) waste (PRC-STD-EP-53090; SWSD-STD-EP-53087; TPLN-STD-EP-53088; HNF-21239)
- Waste that is readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water; prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable (DOE M 435.1-1, Chapter III and Chapter IV, N.1)
- Containers packaged such that toxic air pollutants exceed *Washington Administrative Code* small quantity emission rates (WAC 173-460, “Controls for New Sources of Toxic Air Pollutants”)
- Infectious waste

2.4 Physical and Chemical Characterization

The waste generator must determine the physical and chemical characteristics of the waste with sufficient accuracy and detail to provide proper designation and management of the waste in accordance with the unit-specific acceptance criteria and all applicable regulations (i.e., knowledge) (e.g., SWSD-STD-EP-53087; TPLN-STD-EP-53088; PRC-STD-EP-53090; 40 CFR 264.13, "General Waste Analysis"; WAC 173-303-300, "Dangerous Waste Regulations," "General Waste Analysis"; 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions").

The following subsections describe the physical/chemical characterization requirements for waste acceptance.

2.4.1 Types of Acceptable and Process 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. Knowledge can be obtained using the following types of information:

- Analytical data from a representative sample of the waste or for a waste generated by a similar process
- Test data from a nonradioactive surrogate sample that is chemically representative of a radioactive waste stream
- Material safety data sheets and/or safety data sheets for commercial chemical products
- Mass balance data for the waste generating process, to the extent that such data provides a sufficient understanding of the characteristics and constituents in the waste stream
- Interview information
- Logbooks
- Procurement records
- Qualified analytical data
- Radiation work packages
- Procedures and/or methods
- Process flowcharts
- Inventory sheets
- Vendor information

The following subsections describe how this information may be used to meet the knowledge requirements and when analysis of a representative sample is required.

2.4.2 General Waste Knowledge Requirements

General waste knowledge must be sufficient to determine the waste stream designation and to manage the waste in accordance with TSD unit-specific 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 40 CFR 261, "Identification and Listing of Hazardous Waste": 40 CFR 761; and/or WAC 173-303 and to assign correct waste numbers. 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." For other waste numbers and classification under 40 CFR 761, analysis of a representative sample must be performed if the available process knowledge is not sufficient to determine whether the waste is regulated and assign waste numbers. The sampling and testing methods outlined in WAC 173-303-110, "Sampling, Testing Methods, and Analyses," must be used for the toxicity characteristics, corrosivity, and free liquids. For other characteristic and state criteria designations, an appropriate method must be used when testing is needed. Appropriate test methods can include SW-846 or any other methods with proper quality assurance (QA) and quality control (QC).

In cases where one or more constituents are input into a process but are not expected to be in the waste in concentrations that would cause the waste to be regulated, and when process knowledge is questionable, sampling and analysis should be performed to demonstrate that the constituents are below regulated limits. This analysis could be met through chemical screening and considered process knowledge. (Note: Sampling and analysis, if performed, would only be needed for initial characterization of a consistent waste stream.)

All waste must be characterized sufficiently to ensure that it can be managed in accordance with the unit-specific waste management requirements set forth in this document. This includes sufficient knowledge to demonstrate that the waste is not prohibited from management at that unit, segregate waste containers for compatibility, ensure compatibility of waste with containers, ensure that the waste can be safely managed, and segregate the waste for TSD in accordance with the WSRds.

2.4.3 Land Disposal Restrictions Waste Knowledge

For waste defined as hazardous waste in 40 CFR 261, waste characterization must be sufficient to establish whether the waste is a restricted waste under the LDR provisions of 40 CFR 268 and, if so, to determine the applicable LDR subcategories and treatment standard(s) for that waste. Testing of a representative sample at a Hanford Site laboratory or another independent laboratory is required when a generator or treatment facility certifies that a waste stream meets a concentration-based treatment standard of 40 CFR 268. To certify that a waste stream meets a specified technology treatment standard in 40 CFR 268, the generator or treatment facility must provide data (i.e., an LDR certification form which demonstrates that the waste was properly treated by that treatment technology).

For waste that is defined as dangerous in WAC 173-303, characterization must be sufficient to establish which, if any, of the Washington State LDR requirements of WAC 173-303-140, "Land Disposal Restrictions," apply.

2.4.4 Exceptions to Physical and Chemical Characterization Requirements

The following exceptions can be made to the physical/chemical characterization requirements stated previously:

- Hazardous debris that is managed in accordance with the alternative treatment standards for hazardous debris (40 CFR 268.45, "Treatment Standards for Hazardous Debris") does not require sampling and analysis for adequate physical/chemical characterization.
- Hanford Site generators can transfer waste for storage at an onsite TSD unit without full characterization for designation and LDR status, provided the characterization is sufficient to

demonstrate that the waste can be managed in accordance with the unit-specific acceptance criteria and provided a representative sample (or samples) has been obtained or will be obtained at the TSD unit for complete characterization of the waste.

- An alternative management path negotiated by DOE-RL with the appropriate regulatory agency can characterize waste that cannot be characterized in accordance with the requirements stated previously because of factors such as unique chemical or radiological hazards of the waste.

2.4.5 Recertification

Physical/chemical characterization data for a waste stream must be recertified annually via the waste stream profile process and whenever the waste generating process changes. Recertification shall identify, at a minimum, 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 waste analysis plan for the receiving TSD unit.

2.5 Radiological Characterization

The major radionuclides in the waste and the concentration of each major radionuclide must be established with sufficient sensitivity and accuracy to classify and manage the waste properly in accordance with the TSD unit-specific radiological limits (DOE M 435.1-1).

2.5.1 Identification of Major Radionuclides

For the purposes of the radiological criteria in this document, major radionuclides are defined as those that meet any of the following conditions (calculation methods for determining these limits are described in Appendix A):

- Any TRU radionuclide present in the waste in a concentration exceeding 1nCi/g.
- Any fissionable radionuclide present in the waste in a quantity exceeding 0.1 fissile gram equivalent per container.
- Any radionuclide present in a concentration exceeding 1% of its respective Category 1 limit (Appendix A, Table A-2). This reporting limit does not apply to TRU waste.
- Any mobile radionuclide present in a concentration exceeding its reporting limit (Appendix A, Table A-2). This reporting limit does not apply to TRU waste.
- For waste that has no detectable radiological activity but cannot be radiologically released, major radionuclides are those radionuclides 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 a concentration less than 1.0 E-6 Ci/m^3, and not otherwise reportable, is exempt from reporting.

- For TRU waste, additional reporting requirements are provided in Appendices G and I.

2.5.2 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., Category 1 and 3 limits for the LLBG and TRU determination). A graded approach (DOE M 435.1-1) should be applied when planning radiological characterization of waste streams. Using the graded 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 an equivalent process), in accordance with DOE M 435.1-1, could help ensure that the radiological characterization data of appropriate type, quantity, and quality are obtained.

Both direct and indirect methods can be used for characterization (DOE M 435.1-1). When indirect methods are used, they 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 a 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. Process knowledge can also be used to eliminate radionuclides from further consideration that are not present in sufficient concentration to be major radionuclides as defined in Section 2.5.1, as long as the basis of this determination is documented.

- **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. Data relating to 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 NDA, 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., are 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 QA 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 radionuclides that are more difficult to measure. Scaling factors must be developed from one of the previous methods and must be corroborated periodically (at a minimum, every 3 years for RH-TRU waste) with radionuclide-specific analysis.

Other methods of radiological characterization could be used, but they must be documented clearly and approved by the WFMP waste acceptance organization. Documentation of the method must include a detailed description of the method, the radionuclides identifiable by the method, and a discussion of precision, accuracy, and QA/QC methods.

2.5.3 Additional Detail on Mobile Radionuclide Characterization

For LLW and MLLW, mobile radionuclide reporting is critical for compliance with the LLBG performance assessments (WHC-EP-0645, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*; WHC-SD-WM-TI-730, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*). Because of the low reporting limits and difficulty of analysis of certain mobile radionuclides, this subsection provides additional detail concerning acceptable knowledge (AK) and characterization.

The concentration of each mobile radionuclide must be established and compared to the Table A-2 (Appendix A) reporting limit using process knowledge and/or analysis. If process knowledge alone is used to determine that a mobile radionuclide is not present in a waste stream at the reporting limit, the basis for this determination must be clearly documented. If available analytical techniques cannot detect a mobile radionuclide at its reporting limit, the concentration could be estimated using a combination of process knowledge, scaling factors, and analytical detection limits.

Mobile radionuclide reporting is intended to measure only the quantity of isotopes that exceeds Hanford Site natural background concentrations. For waste forms that contain uranium originating from natural backgrounds on the Hanford Site, the background concentration of that radionuclide can be subtracted from the total concentration.

2.5.4 Recertification

The radiological characterization of waste streams must be recertified via the waste stream profile process with sufficient frequency to account for changes in the generating process, radiological composition, and radiological decay.

2.5.5 Radioactive Material Shipments Less Than Values Specified in 49 CFR 173.436 or Derived According to 49 CFR 173.433

- All shipments of radioactive materials having activities or activity concentrations less than those listed in 49 CFR 173.436, “Transportation,” “Shippers—General Requirements for Shipments and Packagings,” “Exempt Material Activity Concentrations and Exempt Consignment Activity Limits for Radionuclides,” or derived according to 49 CFR 173.433, “Requirements for Determining A1 and A2 Values for Radionuclides and for the Listing of Radionuclides on Shipping Papers and Labels,” are exempt from U.S. Department of Transportation (DOT) regulations. These materials shall be shipped in a container to ensure that no loss of the radioactive material occurs during loading, inspections, transportation, and unloading.

- The shipping documentation shall have the following statement placed on it: "The following Container(s) _____ Contain Radioactive Material at concentrations that are not regulated for transportation per DOT Regulations in 49 CFR 173.403, "Definitions", but are not releasable per DOE Order 458.1 Admin Chg 3."

- A radiological survey report shall identify the package radiation exposure rates (i.e., contact and 30 cm [11.8 in.] readings), the expected radionuclides, associated activity levels, and package contamination levels. As necessary, contamination surveys shall include an evaluation of hard-to-detect radionuclides (e.g., H-3). The radiological survey report shall be sent with the shipment as part of the shipping documents.

2.6 Waste Segregation and Treatment and/or Disposal Path

The following subsections discuss waste segregation and the treatment and/or disposal path.

2.6.1 Segregation of Uncontaminated Waste from Radioactive Waste

Generators shall segregate uncontaminated waste from radioactive waste to minimize waste volume and the cost of waste treatment and disposal (DOE M 435.1-1).

2.6.2 Radiological Release of Waste

Generators shall attempt to obtain radiological release of dangerous waste and TSCA PCB waste generated from radioactive material areas in accordance with their site/facility radiological release criteria, unless one or more of the following conditions apply (for Hanford Site CHPRC generators, the Hanford Site release criteria are discussed in PRC-PRO-RP-20377, *Determination of the Radiological Status of RCRA/TSCA Waste*, and HNF-13536, *PHMC Radiological Control Procedures*):

- Radiological surface contamination exceeds the values established in CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*, Table 4-1. Materials/equipment with potential radioactivity in volume above the background from DOE operations cannot be released unless DOE has approved an authorized limit or the conditions of PRC-PRO-RP-20377 for TSCA/RCRA waste are satisfied.

- Process knowledge clearly identifies that radiological contamination was introduced into the waste.

- The analytical limit of detection for the waste matrix is above the site/facility radiological release limits (for Hanford Site CHPRC generators, PRC-PRO-RP-20377 and HNF-13536).

- The waste can be treated and directly disposed as radioactive waste at a cost that is lower than the cost of radiological release and disposal as nonradioactive waste.

- The basis for use of these conditions must be documented as part of the radiological characterization record(s) for the waste.

2.6.3 Segregation for Treatment, Storage, and/or Disposal

All waste shall be segregated by the WSRds and waste stream profiles to facilitate proper TSD disposition. The WSRds identify major waste streams, grouped in a manner that defines currently available storage and disposal methods and, for waste requiring treatment, the anticipated treatment and/or disposal methods. When it is not technically feasible or it is cost prohibitive to segregate a given waste stream by WSRd and profile, the generator must document the basis for not segregating the waste. Acceptance of nonsegregated waste is contingent on either (1) the WFMP Waste Acceptance organization

identifying a treatment/disposal pathway, or (2) approval by DOE-RL to receive the waste stream for storage through the exception process.

WSRds will include certain waste stream-specific requirements to facilitate TSD. These criteria must be met in addition to the criteria identified in this document.

The current set of WSRds, along with instructions for selecting the appropriate WSRd, can be obtained from the Hanford Site Solid Waste Acceptance Program.

2.6.4 Waste Streams Having No Established Treatment/Disposal Path

Every effort shall be made to avoid the generation of waste for which no treatment/disposal path has been identified.

Written DOE-RL approval is required for acceptance of any waste stream that has no established treatment/disposal path.

2.6.5 Mixed Low-Level Waste

MLLW from CHPRC and non-CHPRC generators that requires treatment to meet LDR requirements shall be treated, as required, to meet LDR treatment standards prior to delivery to CHPRC disposal units. Non-LDR compliant MLLW presented for storage will be considered on a case-by-case basis when no treatment path is available or for treatment and disposal when treatment at the disposal facility is proposed. See Section 1.6 for the exception for non-LDR compliant waste.

2.7 Management and WIPP Certification of Transuranic Waste

TRU waste has a unique set of management and certification requirements based primarily on DOE/WIPP-02-3122 and DOE/WIPP-02-3214, *Remote-Handled TRU Characterization Program Implementation Plan*. Requirements applicable to generators of CH and RH TRU waste are identified in Appendix G and Appendix I, respectively. If TRU waste does not meet the requirements of Appendix G and Appendix I, an exception to this document will be required for the waste to be accepted at a SWOC facility. For TRU waste that meets general SWOC requirements, but not Appendix G and Appendix I requirements, DOE-RL will be contacted for consultation regarding the exception.

The most recent (October 2018) revision to DOE/WIPP-02-3122 (WIPP waste acceptance criteria) included a series of new or expanded requirements, collectively referred to as enhanced AK. These requirements (DOE/WIPP-02-3122, Appendix H) include development of the following items:

- An Interface Waste Management Documents List that identifies plans, procedures, and reports associated with current waste management and packaging (e.g., waste generation, waste management, waste treatment, waste packaging, waste repackaging waste remediation, waste stream delineation, and waste characterization procedures) and is prepared on a waste stream basis.
- A chemical compatibility evaluation is performed in accordance with EPA-600/2-80-076, *A Method for Determining the Compatibility of Hazardous Wastes*.
- An evaluation of oxidizers in the waste stream.
- An AK assessment is performed once on each waste stream having currently certified containers and a population of unshipped containers. The AK assessment is performed to ensure that the AK documentation relating to the management of potentially reactive, corrosive, ignitable, and incompatible TRU waste materials is adequate, current, and accurately described in existing AK summary reports.

Responsibility for performing certification lies with the WIPP certified program (i.e., Central Characterization Program at the Hanford Site). However, the documentation necessary to formally certify the waste must be provided by the waste generators and the Hanford Site TRU program.

2.8 Records

The generator must retain all record copy material used for waste characterization and designation in accordance with federal and state requirements and DOE orders. These records include process knowledge, sampling information, analytical data, inventory records, and related information. The generator must transfer copies of certain records, as requested by the WFMP Waste Acceptance organization, through the waste acceptance process described for the Hanford Site Solid Waste Acceptance Program.

2.9 Classified and Accountable Nuclear Material

Radioactive waste to which access has been limited for national security reasons and that cannot be declassified shall be managed in accordance with the requirements of DOE M 473.32, *Protection Program Operations*, and DOE O 470.4B, *Safeguards and Security Program* (DOE M 435.1-1).

During the acceptance process, the generator shall notify the WFMP Waste Acceptance organization 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 470.4A).

2.10 Waste Verification

A portion of the waste containers sent to SWOC TSD units must be verified by physical inspection (e.g., NDE and visual examination) or chemical screening as stated in the waste analysis plans for the TSD units (i.e., SWSD-STD-EP-53087; TPLN-STD-EP-53088; PRC-STD-EP-53090). For most waste types, this verification will be performed at the generator's location by physical inspection before or during packaging. In cases where the verification cannot be performed at the generator's location, the generators must notify the Transportation and Waste Integration organization prior to packaging the waste. The Performance Evaluation System Committee will evaluate the individual cases and determine if verification for the waste will be performed at one of the Hanford Site TSD units.

2.11 Physical and Chemical Criteria

The following subsections describe the physical and chemical criteria for acceptance of all waste.

2.11.1 Chemical Compatibility

All waste placed in a given outer container shall be chemically compatible (WAC 173-303-630, "Use and Management of Containers"). To ensure this compatibility, chemical compatibility evaluations are performed using CHPRC procedure PRC-PRO-WM-52507, *Compatibility Review*. Evaluations under this procedure are performed for waste to be stored on site at CWC, the WRAP facility, or T Plant, and for hazardous materials that will be sent to offsite TSD facilities.

A separate chemical compatibility evaluation is performed for TRU and mixed TRU wastes to be sent to WIPP for disposal. This chemical compatibility evaluation is performed as part of the enhanced AK (Section 2.7) process. Refer to Appendices G and I for more information on the documentation required for CH and RH TRU and TRUM waste, respectively.

2.11.2 Asbestos-Containing Waste

Asbestos-containing waste material shall be packaged in accordance with 40 CFR 61.150, "Fabricating, Demolition, Renovation, and Spraying Operations." Wetting with water is allowed as long as the liquid does not exceed applicable free liquid requirements (Section 3.3.1).

2.11.3 Heat Generation

If heat generation from radiological decay in the waste package exceeds 3.5 W/m^3 (0.1 W/ft^3), the package must be evaluated to ensure that the heat does not affect the integrity of the container or surrounding containers in storage. This evaluation must be provided to and approved by the WFMP Waste Acceptance organization.

2.11.4 Gas Generation

Generators shall provide evidence of compliance with DOE M 435.1-1. When vents are required by this section, a certificate of conformance shall be provided, stating the vent model number that has been installed on the waste container and indicating 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 (DOE M 435.1-1, Chapter IV, L.1.b). Unless otherwise specified by the WFMP Waste Acceptance organization, a minimum 5-year time value shall be used to demonstrate compliance when performing gas generation calculations for LLW going directly to disposal.

When a container of newly generated TRU waste is packaged, vents or other mechanisms shall be provided at the time the waste is packaged to prevent pressurization of the container or generation of flammable or explosive concentrations of gases. Containers of currently stored waste shall meet this requirement as soon as practical unless analyses demonstrate that the waste can otherwise be managed safely (DOE M 435.1-1, Chapter III, L.1.b).

If required, the following mitigating measures (or alternative measures approved by the WFMP Waste Acceptance organization) must be used:

- **Control of hydrogen from radiolytic decomposition:** Use an approved vent, as listed in Appendix H, or an approved alternative. All 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 mil 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.
- **Control of hydrogen from biological decomposition:** Waste containing readily biodegradable organic materials (e.g., animal waste and vegetation) must be vented with an approved vent, as listed in Appendix H, or an approved alternative. Slaked lime shall also be added to the waste to reduce biological decomposition if filtering alone is not sufficient to control gas generations.

2.11.5 Liquids and Liquid-Containing Waste

All free liquids must be absorbed or stabilized in accordance with Appendix E, or otherwise removed from the waste, except when specifically allowed as follows: If additional knowledge is needed for the free liquids, testing can be performed to determine if it is organic or aqueous in nature.

- Containerized free liquids are allowed in the following situations, but cannot exceed 1% of the volume of the waste (40 CFR 264.314; TPLN-STD-EP-53088):
  - Free liquids in a very small container, such as an ampule
  - Small articles that contain free liquids required for the article to function (e.g., batteries or capacitors)
- For liquid containing waste condensate inner plastic packaging (e.g., bags) subsequent to packaging, the condensate shall be eliminated to the maximum extent practical by placing sorbents within the inner plastic packaging (TPLN-STD-EP-53088). The type and amount of sorbent required shall be in accordance with Appendix E. In any case, the amount of liquid may not exceed 1% of the volume of the waste or 0.5% of waste processed to a stable form (DOE M 435.1-1).
- Before being absorbed, liquids in TRU waste containers shall be sampled to determine pH. If necessary (i.e., pH is <2 or >12.5), the liquid shall be neutralized to achieve a pH greater than 2 and less than 12.5 before being absorbed. Documentation shall be maintained of the amount of liquid present, the pH before and after neutralization, and the amount of neutralization agent used.
- For waste that could form condensate during storage, sufficient sorbent (refer to Appendix E for absorbent selection criteria) shall be added to the container to sorb any condensate formed.
- Residual liquids in large debris items shall be sorbed or removed. In cases where it is not practical to remove suspected liquids and it is impossible to determine if liquids are present, the liquids shall be removed to the maximum extent possible by draining suspected liquids at low points and placing an adequate amount of sorbent around each item. In any case, the amount of liquid cannot exceed 1% of the volume of the waste (DOE M 435.1-1).

2.12 Radiological Criteria

The following subsections describe the radiological criteria for acceptance of waste.

2.12.1 Criticality Safety Limits

The fissile and fissionable material content limits are provided in Appendix B.

2.12.2 Dose Equivalent Curie Limits

Waste must meet the safety basis limit of 82.5 dose-equivalent curies per container. Radionuclide quantities greater than 82.5 dose-equivalent curies per container may be accepted based on specific container and waste forms but must be evaluated to ensure compliance with safety basis criteria (HNF-15280, *Technical Safety Requirements Solid Waste Operations Complex*).

Unvented drums equal to or greater than 33 dose-equivalent curies without overpack are prohibited (HNF-15280).

Additionally, each facility has inventory limits as described in HNF-15280. Waste receipts are controlled by each facility to maintain the inventory within these limits.

2.12.3 Package Removable Contamination Limits

Removable contamination on accessible surfaces of waste packages shall not exceed the limits of CHPRC-00073, Table 2-2. Removable contamination limits for TRU waste containers must comply with Appendicies G and I. Use of fixatives is not allowed to meet the criteria. For returnable overpacks, the contamination limits and fixative prohibition also applies to the outside of the inner package.

In addition, elevated concentrations of tritium may accumulate when tritium diffuses as tritiated water vapor from containers and concentrate in the cargo area. Shipments that are greater than 100 Ci of tritium should be shipped in open conveyances.

2.13 Packaging Criteria

The following subsections describe the packaging criteria for acceptance of waste.

2.13.1 Container Selection

The packages for waste shall meet applicable 49 CFR container requirements for the hazard class/division of the waste, except that packaging for onsite transfers under an approved Packaging Safety Document might be allowed where cost or technical constraints make the use of a DOT-compliant package unfeasible. If the waste does not meet the definition of any DOT hazard class, a container meeting the general requirements of 49 CFR 173.410, “General Design Requirements,” is adequate.

2.13.2 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. Containers having some pit or scale corrosion could be acceptable for storage, provided the integrity of the container is confirmed. Polyurea-coated containers must have a flame spread rating of 25 or less when tested in accordance with ASTM E-84-16, *Standard Test Method Surface Burning Characteristics of Building Materials*, or similar test as approved by a qualified CHPRC Fire Protection Engineer, for acceptance into CWC.

2.13.3 Securing Waste and Shielding

For newly generated waste, 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. Externally attached shielding is prohibited.

2.13.4 Labeling

Packages shall be labeled according to the instructions in Appendix C.

3 Acceptance Criteria for Disposal in the Low-Level Burial Grounds

This chapter outlines the criteria necessary in order to comply with the regulatory, permitting, safety, environmental, and operational requirements for the LLW and MLLW TSD in the LLBG.

3.1 Facility Description and Function

Trench 31 and Trench 34 of the 218-W-5 Burial Ground are RCRA-compliant units for disposal of certain MLLW. Currently, only LLW and MLLW originally designated with RCRA characteristic numbers D001 through D043, certain listed, discarded chemical product waste numbers (U- and P-listed waste), certain F-listed waste F001 through F012, F019, and F039 (derived from F001 through F012, and F019), and Washington State-only dangerous waste (except waste number WSC2-acid) are accepted in Trenches 31 and 34 (Table 3-1). Waste accepted for disposal at Trench 31 and Trench 34 must be disposal ready and meet the LDR treatment standards of 40 CFR 268, WAC 173-303-140, radiological stabilization, 90% full requirements, and the 50 lb/in^2 compaction criteria for the disposal trenches. There also are safety-based limits on the radionuclide concentrations of waste received. The unit may also dispose of certain types of TSCA PCB waste.

Table 3-1. Low-Level Burial Ground Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
D001–D043	F001	U001–U012	P001–P006	WT01
	F002	U014–U039	P008–P018	WT02
	F003	U041–U053	P020–P024	WP01
	F004	U055–U064	P026–P031	WP02
	F005	U066–U099	P033	WP03
	F006	U101–U103	P034	WSC2*
	F007	U105–U138	P036–P051	WPCB
	F008	U140–U174	P054	
	F009	U176–U194	P056–P060	
	F010	U196	P062–P078	
	F011	U197	P081	
	F012	U200–U211	P082	
	F019	U213–U223	P084	
	F028	U225–U228	P085	
	F039	U231–U240	P087–P089	
		U243–U244	P092–P099	
		U246–U249	P101–P106	
		U271	P108–P116	
		U278–U280	P118–P123	
		U328	P127	
		U353	P128	
		U359	P185	

Table 3-1. Low-Level Burial Ground Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
		U364	P188–P192	
		U367	P194	
		U372	P196–P199	
		U373	P201–P205	
		U375		
		U387		
		U389		
		U394		
		U395		
		U401–U404		
		U407		
		U409–U411		

Note: Acceptable dangerous waste numbers may be added or deleted at any time due to changes in regulations. See the currently approved *Dangerous Waste Permit Application, Part A Form*, Section XIV, "Description of Dangerous Waste," to verify the dangerous waste numbers acceptable at the LLBG.

*See Section 3.2.

3.2 Prohibited Waste

The following types of waste are not disposed in Trench 31 and Trench 34:

- Waste designated with WSC2-acid (Hanford Facility RCRA Permit, Unit Name Part A Form).
- TSCA-regulated PCB waste, except as specifically authorized by 40 CFR 761.
- Waste that does not comply with the requirement of DOE M 435.1-1, Chapter IV, G.1.d.1. LLW 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 (DOE M 435.1-1, Chapter IV, G.1.d.1).
- All free liquids must be absorbed or stabilized in accordance with Section 2.11.5. Waste that does not comply with the requirement of DOE M 435.1-1, Chapter IV, G.1.d.2. Liquid LLW or LLW containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the waste volume when the LLW is in a disposal container, or 0.5% of the waste volume after it is processed to a stable form (DOE M 435.1-1, Chapter IV, G.1.d.2).
- Waste that does not comply with the requirement of DOE M 435.1-1, Chapter IV, G.1.d.3. LLW 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 (DOE M 435.1-1).

- Waste that does not comply with the requirement of DOE M 435.1-1, Chapter IV, G.1.d.4. LLW 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). Additional requirements related to these criteria are listed in Section 2.11.4.
- Waste that does not comply with the requirement of DOE M 435.1-1, Chapter IV, G.1.d.5. LLW 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). Additional requirements related to these criteria are listed in Section 2.11.4.
- Waste that does not meet all applicable treatment standards of 40 CFR 268 and WAC 173-303-140.
- TRU waste and waste that exceeds other radiological limits of Section 3.4.
- Waste that is incompatible with the trench liner, as defined in Section 3.3.3 (40 CFR 264.301, "Design and Operating Requirements"; WAC 173-303-665, "Landfills"; HNF-5841).

3.3 Physical and Chemical Criteria

The following physical and chemical criteria apply to waste acceptance in the LLBG.

3.3.1 Land Disposal Restrictions

All waste subject to RCRA LDR (40 CFR 268) and/or Washington State LDR (WAC 173-303-140) must be demonstrated to meet all applicable treatment standards and requirements. For waste that has concentration-based treatment standards for specific hazardous constituents under 40 CFR 268, the waste must be tested at a Hanford Site laboratory or another independent laboratory in accordance with 40 CFR 268. For waste that has treatment standards that are not concentration-based, the 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 (HNF-5841).

3.3.2 Compatibility of Waste with Liner

All waste disposed in the LLBG must be compatible with the landfill liner system (HNF-5841). A variety of chemical constituents have been evaluated for compatibility with the liner system, and it is believed that waste meeting LDR requirements and the other acceptance criteria of this chapter will be compatible (HNF-5841; WHC-SD-WM-TI-714, *High-Density Polyethylene Liner Chemical Compatibility for Radioactive Mixed Waste Trenches*). An assessment will be performed by the WFMP Waste Acceptance organization 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.

Table 3-2 lists certain chemical constituents, in concentrated form, that have been evaluated and determined to be incompatible with the liner.

Table 3-2. Chemical Constituents Known to be Incompatible with Liner System

Chemical Constituent	Chemical Abstracts Service Number(s)
Aqua Regia	8007-56-5
Bromic Acid	7789-31-3
Bromine (Elemental)	7726-95-6
Bromobenzene	108-86-1
Bromoform	75-25-2
Calcium Bisulfite	13780-03-5
Calcium Sulfide	20548-54-3
Chlorine (Elemental)	7782-50-5
1-Chloropentane (Amyl Chloride)	543-59-9
1,1-Dichloroethylene (Vinylidene Chloride)	75-35-4
1,2-Dichloropropane (Propylene Dichloride)	78-87-5
Diethyl Benzene	105-05-5, 135-01-3, 141-93-5
Diethyl Ether	60-29-7
Chloroethane (Ethyl Chloride)	75-00-3
Fluorine (Elemental)	7782-41-4
Nitrobenzene	98-95-3
Sulfur Trioxide	7446-11-9
Sulfuric Acid, Fuming	8014-95-7
Tetrachloroethylene	127-18-4
Thionyl Chloride	7719-09-7
Trichloroethylene	79-01-6, 52037-46-4

Source: WHC-SD-WM-TI-714, *High-Density Polyethylene Liner Chemical Compatibility for Radioactive Mixed Waste Trenches.*

3.3.3 Gas Generation

Radioactive animal carcasses must be packaged as follows:

- The waste must be packaged in an inner and outer metal package, where the outer package has a capacity at least 40% greater than that of the inner package. The outer package must be a metal container that meets applicable transportation requirements for shipment to the LLBG.
- The inner package shall be lined with a minimum 4 mil plastic liner. The animal carcass(es) in the inner package must be surrounded with slaked lime. The plastic liner and inner package must be sealed.

- A minimum of 7.6 cm (3 in.) of mineral sorbent must be placed in the bottom of the outer package. The inner package must be placed into the outer package, and the void space filled between the two packages with additional mineral sorbent.
- The outer package must be sealed.

3.4 Radiological Criteria

The following radiological criteria apply to waste acceptance in the LLBG.

3.4.1 Radiological Concentration Limits

The methodology for classification of the radionuclide content of waste according to the various limits listed in the following sections is provided in Appendix A. A waste must meet all of the following conditions to be disposed in the LLBG:

- TRU content (as calculated by Method A1.1 of Appendix A) shall not exceed 100 nCi/g (3,700 Bq/g) of waste (DOE M 435.1-1).
- Waste category (as calculated by methods described in Section A1.4 and Section A1.5 of Appendix A) shall not exceed Category 3, except with an analysis coordinated by the WFMP Waste Acceptance organization demonstrating that the LLBG performance assessment conditions are met (WHC-EP-0645; WHC-SD-WM-TI-730).
- Category 3 waste (as calculated by methods described in Section A1.4 and Section A1.5 of Appendix A) can be disposed of only if the waste meets one of the following waste form stability criteria (WHC-EP-0645; WHC-SD-WM-TI-730):
  - Packaging in a high-integrity container (HIC) that is procured through WHC-S-0486, *Specification for High Integrity Container, 300 Year*.
  - Packaging in an HIC approved by the WFMP Waste Acceptance organization.

    NOTE: A list of approved HICs is available from the Hanford Site Solid Waste Acceptance Program.
  - Placement in monoliths in the LLBG using the exception process in Section 1.6.
  - Stabilization in concrete or other stabilization agents. The stabilized waste must meet the leach index and compression strength criteria of NRC, 1991, *Technical Position on Waste Form*, Section C.2, and Appendix A. Several Hanford Site-approved concrete mix formulas have been developed that can be used to meet the stabilization criteria. Contact the WFMP Waste Acceptance organization for information on use of these formulas.
  - Inherently stable waste that meets the stability requirements of 10 CFR 61.56, “Waste Characteristics,” and NRC, 1991.

– Mobile radionuclides. If the concentration of any mobile radionuclide exceeds the Mobile Radionuclide Reporting Limit of Appendix A, Table A-2, stabilization could be required (WHC-EP-0645; WHC-SD-WM-TI-730). The WFMP Waste Acceptance organization will perform a case-by-case evaluation based on the LLBG performance assessment (WHC-EP-0645; WHC-SD-WM-TI-730) to determine whether the waste requires stabilization to meet the groundwater pathway dose criteria. Stabilization normally would consist of placing the waste container in an HIC, but additional stabilization might be required based on a number of factors such as waste form and radionuclide content. The WFMP Waste Acceptance organization will coordinate this evaluation.

3.4.2 Criticality Safety Limits

The fissile and fissionable material limits are provided in Appendix B. Note that fissile waste packages can be accepted only with an approved criticality safety evaluation.

3.4.3 Package Dose Rate Limits

Containers with dose rates less than or equal to 2 mSv/hr (200 mrem/hr) at contact and less than 1 mSv/hr (100 mrem/hr) at 30 cm (1 ft) are acceptable at the LLBG. CH containers (see definitions) exceeding these limits require container-specific review and approval.

RH waste is acceptable at the LLBG if approved through both a waste stream profile sheet and a container-specific shipment. RH waste shall meet the applicable dose rate restrictions of DOT or an approved package-specific safety document. RH waste shall be configured for unloading such that personnel exposures are maintained as low as reasonably achievable.

3.5 Packaging Criteria

The packaging criteria described in the following subsections apply to acceptance in the LLBG.

3.5.1 Package Construction

Containers must meet one of the following criteria to ensure compliance with HNF-21239:

- Containers shall be constructed of metal, concrete, or masonry.
- Containers constructed of wood shall be either (1) pretreated wood having the Underwriters Laboratories FR-S stamp, or (2) painted with a fire-retardant paint that has been approved by Underwriters Laboratories or Factory Mutual.
- Containers constructed of rigid plastic shall have a maximum flame spread rating of 25 when tested by a nationally recognized testing laboratory to the most current version of ASTM E-84-16. These containers will only be accepted if approved by WFMP Fire Protection Engineering.
- Containers shall be constructed of flexible plastic packaging provided the waste matrix is limited to soils, metals, concrete, or masonry. Incidental amounts of organic material such as personal protective equipment are allowed in flexible packaging.
- Other containers as authorized under the LLBG Fire Hazards Analysis and approved by WFMP Fire Protection Engineering.
- Sacrificial rigging shall not contain regulated materials, such as lead.

Containers shall be compatible with the waste and maintain containment during handling and storage before disposal. Where required, an appropriate combination of protective coatings and liners shall be used to prevent loss of container integrity.

3.5.2 Handling of Packages

All packages must be configured for safe unloading by forklift or crane. Alternate means of unloading could be allowed with approval from the TSD unit manager or designee. Packages that must be unloaded by crane shall be equipped with a lifting system designed to lift the fully-loaded package safely. All 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, information must be provided to the WFMP Waste Acceptance organization concerning the methods for unloading before the shipment is scheduled. Sacrificial rigging shall be provided for RH waste packages. Rigging shall not contain regulated materials, such as lead.

3.5.3 Minimization of Subsidence

All waste shall be packaged in a form that minimizes settling and subsidence to the maximum extent feasible (DOE M 435.1-1; WHC-EP-0645; WHC-SD-WM-TI-730; Serne et al., 1992, "Characterization of Grouted Low-Level Waste to Support Performance Assessment"). All waste accepted for disposal in the LLBG must meet one of the following minimization of subsidence criteria at the time of disposal:

- Packaged in an HIC that is procured through WHC-S-0486
- Packaged in an HIC approved by CHPRC WFMP
- Compactable waste that has been compacted to a minimum pressure of 3.52 kg/cm^2 (50 lb/in^2)
- Placed in a Hanford Site-provided in-trench structural monolith meeting the requirements of HNF-1981, *Specification for Concrete Encasement for Contact-Handled Category 3 Waste*, specification for concrete encasements using the exception process in Section 1.6 (non-PRC generators)
- Solid with a minimum "confined" compressive strength of 3.52 kg/cm^2 (50 lb/in^2)
- Containerized waste must be at least 90% full when placed in the disposal unit (WAC 173-303-665)

3.5.4 Labeling

Bulk waste and RH waste containers that are removed from reusable overpacks are exempt from labeling requirements at the LLBG. For unusual waste forms, special labeling provisions can be arranged with the WFMP Waste Acceptance organization.

3.5.5 Bulk Waste (Noncontainerized)

Bulk waste can be disposed in the LLBG, on a case-by-case basis. Waste shall meet the following requirements to be considered:

- Certain types of waste can be disposed in bulk rather than packaging in containers. This includes soil, vegetation, building rubble, and other homogeneous waste having relatively low concentrations of radionuclides and hazardous chemical constituents. To avoid unnecessary conservatism, universally applicable limits have not been developed for the LLBG acceptance criteria. Instead, a case-by-case evaluation will be performed on request to determine whether a given waste stream can be disposed in bulk. Any mitigating measures required to meet the conditions of the safety basis will also 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 rather than the bulk waste requirements.

4 Acceptance Criteria for the Central Waste Complex

This chapter outlines the criteria necessary to comply with the regulatory, permitting, safety, environmental, and operational requirements at CWC.

4.1 Facility Description and Function

CWC is a storage and treatment unit for MLLW, TRU, TRUM, and TSCA PCB waste, and other waste types requiring treatment before disposal. Waste stored at CWC will be treated and repackaged as required for disposal as treatment capabilities become available.

CWC manages waste having characteristic waste numbers D001 through D043, certain listed, discarded chemical product waste numbers (U- and P-listed waste), certain F-listed waste (F001 through F012, F019, F028, and F039), and all Washington State-only waste numbers (Table 4-1). CWC manages TSCA PCB waste from Hanford Site generators in accordance with 40 CFR 761. CWC also can store waste from CERCLA cleanup activities.

Table 4-1. Central Waste Complex Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
D001–D043	F001	U001–U012	P001–P006	WT01
	F002	U014–U039	P008–P018	WT02
	F003	U041–U053	P020–P024	WP01
	F004	U055–U064	P026–P031	WP02
	F005	U066–U099	P033	WP03
	F006	U101–U103	P034	WSC2
	F007	U105–U138	P036–P051	WPCB
	F008	U140–U174	P054	
	F009	U176–U194	P056–P060	
	F010	U196	P062–P078	
	F011	U197	P081	
	F012	U200–U211	P082	
	F019	U213–U223	P084	
	F028	U225–U228	P085	
	F039	U231–U240	P087–P089	
		U243–U244	P092–P099	
		U246–U249	P101–P106	
		U271	P108–P116	
		U278–U280	P118–P123	
		U328	P127	
		U353	P128	
		U359	P185	
		U364	P188–P192	
		U367	P194	

Table 4-1. Central Waste Complex Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
		U372 U373 U387 U389 U394 U395 U401–U404 U407 U409–U411	P196–P199 P201–P205	

Note: Acceptable dangerous waste numbers may be added or deleted at any time due to changes in regulations. See the currently approved *Dangerous Waste Permit Application, Part A Form*, Section XIV, "Description of Dangerous Waste," to verify dangerous waste numbers that are acceptable at the Central Waste Complex.

4.2 Prohibited Waste

The following wastes are not accepted for storage at CWC (see Section 2.3):

- Liquid waste, except if packaged in lab packs or overpacks in quantities less than or equal to 57 L (15 gal) per outer container.
- Compressed gases packaged at pressures in excess of 1.5 atmospheres (152 kilopascals absolute pressure) at 20°C (68°F), except that pressurized aerosol cans can be accepted (DOE M 435.1-1); additional requirements related to these criteria are listed in Section 2.11.4.

4.3 Radiological Criteria

The following subsection describes the radiological criteria specific to the CWC.

4.3.1 Package Dose Rate Limits

Waste packages shall not exceed 1 Sv/hr (100 mrem/hr) at 30 cm (1 ft) from the waste package and 2 mSv/hr (200 mrem/hr) at any point on the surface of the package. Containers exceeding these limits may be acceptable but will require container-specific review and approval by CWC Operations.

4.4 Packaging Criteria

The following subsections describe the packaging criteria for acceptance at CWC.

4.4.1 Container Selection

Outer containers shall be constructed of noncombustible materials. Wood, fiberboard, and plastic outer containers are prohibited (HNF-15280). See Section 1.6 for the exception process if the outer container is combustible.

4.4.2 Protective Coatings and Liners

The packaging for stored waste shall include coatings and/or liners sufficient to maintain the integrity of the containment system during the anticipated storage life of the waste, as follows:

- The exterior coating of containers shall be alkyd enamel, galvanized, or an alternative coating with performance equivalent to or better than alkyd enamel.
- The interior coatings and liners shall be chemically compatible with the waste and protect the containment system from corrosion over the anticipated storage life of the waste (WAC 173-303-630). Unless otherwise specified by the WFMP Waste Acceptance organization, the storage life should be assumed to be 20 years. For containers procured under Hanford Site container procurement specifications, Appendix D defines preferred coating and liner options.

4.4.3 Packaging of Liquid Waste in Lab Packs

The following requirements are for packaging of liquid waste as lab packs and overpacked liquids:

- Up to 57 L (15 gal) of liquid can be packaged in inner glass, metal, or plastic containers. Glass containers shall not exceed 4 L (1.1 gal) capacity each. Sufficient head space must be left in the inner containers to prevent breakage because of expansion in temperatures up to 55°C (131°F) and freezing conditions.
- Inner containers shall be securely closed. The lids of glass containers shall be sealed with Teflon® or equivalent lid seals (gaskets). After closure, glass lids shall be taped.
- All inner containers shall be compatible with the waste contents over the anticipated storage life of the waste.
- Each inner container shall be labeled with its contents.
- A sufficient quantity of suggested sorbent (selected in accordance with Appendix E) shall be packaged around the inner containers to sorb twice the volume of the liquid in the inner containers. The sorbent shall be placed around the inner containers in a manner that prevents shifting and breakage.

4.4.4 Package Size and Weight Limits

The baseline size limits for CWC storage modules are shown in Table 4-2. Larger containers could be accepted into specific storage modules with special loading procedures. Drums smaller than 208 L (55 gal) are not accepted on a routine basis but could be approved on a case-by-case evaluation.

Table 4-2. Central Waste Complex Container Size and Floor Loading Limits

Storage Units	Package Size Limit	Floor Loading Limit
Alkali Metal Modules	321 L (85 gal) drum	1,225 kg/m^2 (250 lb/ft^2)
Low-Flash Point Modules	321 L (85 gal) drum	1,225 kg/m^2 (250 lb/ft^2)

® Teflon is a registered trademark of E.I. DuPont de Nemours & Company, Wilmington, Delaware.

Table 4-2. Central Waste Complex Container Size and Floor Loading Limits

Storage Units	Package Size Limit	Floor Loading Limit
2401-W Building	3.0 m high by 3.4 m wide (10 ft high by 11 ft wide)	2,200 kg/m^2 (450 lb/ft^2)
2402-W Building	3.0 m high by 3.4 m wide (10 ft high by 11 ft wide)	3,430 kg/m^2 (700 lb/ft^2)
2402-WB through WL Buildings, 2403-W and 2404-W Facilities	3.0 m high by 3.4 m wide (10 ft high by 11 ft wide)	9,800 kg/m^2 (2,000 lb/ft^2)

4.4.5 Stacking

Packages must be designed to withstand the weight of two layers of 208 L (55 gal) drums weighing 454 kg (1,000 lb) each stacked on top.

4.4.6 Waste Pallets

Waste shall be stored on metal or wood pallets.

5 Acceptance Criteria for the T Plant Complex

This chapter outlines the criteria necessary in order to comply with the regulatory, permitting, safety, environmental, and operational requirements at the T Plant Complex.

5.1 Facility Description and Function

The T Plant Complex is a treatment and storage unit having a number of functions, including equipment decontamination, waste treatment, storage, sampling, NDE, and repackaging. The sand from the K Basins sandfilter backwash is currently being stored in the 221-T Building. This building can also be used for decontamination, treatment, and storage of equipment and waste. The 2706-T Building is used for the decontamination, treatment, and storage of equipment and waste having relatively low levels of radiological contamination. The 214-T Building is for storage purposes.

Wastes that can be managed at the T Plant Complex include LLW, TRU, TRUM, hazardous/dangerous low-level mixed, and TSCA PCB (40 CFR 761) waste. Table 5-1 lists the dangerous waste number for the T Plant Complex. Waste managed at the T Plant Complex could be sent to other Hanford Site TSD units. The acceptance criteria for these units must be met subsequent to processing at the T Plant Complex.

Table 5-1. T Plant Complex Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
D001–D043	F001	U001–U012	P001–P007	WT01
	F002	U014–U039	P008–P018	WT02
	F003	U041–U053	P020–P024	WP01
	F004	U055–U064	P026–P031	WP02
	F005	U066–U099	P033	WP03
	F006	U101–U103	P034	WSC2
	F007	U105–U138	P036–P051	WPCB
	F008	U140–U174	P054	
	F009	U176–U194	P056–P060	
	F010	U196-U197	P062–P078	
	F011	U200–U211	P081	
	F012	U213–U223	P082	
	F019	U225–U228	P084	
	F028	U234–U240	P085	
	F039	U243	P087-P089	
		U244	P092–P099	
		U246–U249	P101–P106	
		U271	P108–P116	
		U278–U280	P118–P123	
		U328	P127	
		U353	P128	
		U359	P185	

Table 5-1. T Plant Complex Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
		U364 U367 U372 U373 U387 U389 U394 U395 U401-U403 U404 U409–U411	P188–P192 P194 P196–P199 P201–P205	

Note: Acceptable dangerous waste numbers may be added or deleted at any time due to changes in regulations. See the currently approved Dangerous Waste Permit Application, Part A Form, Section XIV, "Description of Dangerous Waste," to verify the dangerous waste numbers acceptable at the T Plant Complex.

5.2 Prohibited Waste

The following waste types are not accepted at the T Plant Complex:

- Compressed gases packaged at pressures in excess of 1.5 atmospheres (152 kilopascals absolute pressure) at 20°C (68°F), except that pressurized aerosol cans can be accepted (DOE M 435.1-1). Additional requirements related to these criteria are listed in Section 2.11.4.
- Prohibited wastes are described in Section 2.3.

5.3 Radiological Criteria

The following subsections describe the radiological acceptance criteria specific to the T Plant Complex.

5.3.1 Package External Dose Rate Limits

Waste packages that exceed 1 mSv/hr (100 mrem/hr) at 30 cm (1 ft) from the waste package or 2 mSv/hr (200 mrem/hr), at any point on the surface of the package, require case-by-case evaluation for acceptance. When these dose rates are exceeded, the generator must provide detailed radiological survey data.

5.3.2 Internal Dose Rate and Contamination Limits for Decontamination and Processing

The contact dose rate for equipment and waste to be decontaminated or processed will be determined on a case-by-case basis during acceptance review. When internal contact dose rates exceed 1 mSv/hr (100 mrem/hr), the generator must provide detailed radiological survey information.

Items with detectable alpha contamination may not be acceptable for decontamination or processing at the 2706-T Building. If the waste contains detectable alpha contamination, the generator must provide detailed radiological survey information to determine whether the waste can be processed.

5.4 Packaging Criteria

The packaging criteria for acceptance of waste at the T Plant Complex are described in the following subsections.

5.4.1 Container Selection

Outer containers shall be constructed of metal or concrete, except that fire-retardant wooden boxes can be used. Wooden boxes shall be constructed of wood that is either (1) pretreated wood having the Underwriters Laboratories FR-S stamp, or (2) painted with a fire-retardant paint that has been approved by Underwriters Laboratories or Factory Mutual. Poly HICs are prohibited at the T Plant Complex.

5.4.2 Protective Coatings and Liners for Stored Waste

The packaging for waste to be stored shall include the following coatings and/or liners sufficient to maintain the integrity of the containment system during the anticipated storage life of the waste:

- The exterior coating of containers shall be alkyd enamel, galvanized, or an alternative coating with performance equivalent to or better than alkyd enamel.
- The interior coatings and liners shall be chemically compatible with the waste and shall protect the containment system from corrosion over the anticipated storage life of the waste (WAC 173-303-630). Unless otherwise specified by the WFMP Waste Acceptance organization, the storage life should be assumed to be 20 years. For containers procured under Hanford Site container procurement specifications, Appendix D defines preferred coating and liner options.

5.4.3 Container Size Limits

Container size limits are as follows:

- **2706-T:** 12.2 m (40 ft) long by 4.3 m (14 ft) high by 3.7 m (12 ft) wide
- **221-T:** 6.7 m (22 ft) long by 4 m (13 ft) high by 5.5 m (18 ft) wide
- **214-T:** 6 m (20 ft) long by 3 m (10 ft) high by 3 m (10 ft) wide

These size limits may be exceeded on a case-by-case basis with approval from facility operations via a waste profile.

5.4.4 Container Weight Limits

Heavier containers can be accepted on a case-by-case basis with T Plant Complex operations approval. General container weight limits are as follows:

- Drums shall not exceed 454 kg (1,000 lb).
- Boxes shall not exceed their rated weight capacity.

Large equipment or packages shall not exceed the following limits:

- **2706-T:** 5,400 kg (11,900 lb) (small vehicles); 9,100 kg (20,000 lb) per axle or 36,000 kg (80,000 lb) gross (heavy equipment). All limits can be exceeded on a case-by-case basis.
- **221-T:** 41,000 kg (90,000 lb).
- **214-T:** 5,400 kg (11,900 lb) (small vehicles); 9,100 kg (20,000 lb) per axle or 36,000 kg (80,000 lb) gross (heavy equipment). All limits can be exceeded on a case-by-case basis.

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6 Acceptance Criteria for the Waste Receiving and Processing Facility

This chapter outlines the criteria necessary in order to comply with the regulatory, permitting, safety, environmental, and operational requirements at the WRAP facility.

The acceptance criteria described in the following subsections apply to newly generated waste sent to the WRAP facility. Newly generated TRU waste shall be managed in accordance with Section 2.7. Acceptance criteria for retrieved waste containers in the LLBG will be established through project-specific acceptance procedures.

6.1 Facility Description and Function

The WRAP facility is a treatment and storage unit. The WRAP facility receives waste containers for verification, sampling, NDA, NDE, treatment, and repackaging.

Wastes that can be managed at the WRAP facility include TRU, TRUM, LLW, MLLW, and TSCA PCB waste. Table 6-1 lists the dangerous waste numbers for the WRAP facility.

Waste managed at the WRAP facility could be sent to other Hanford Site TSD units for TSD. The acceptance criteria for these TSD units must be met subsequent to reprocessing waste at the WRAP facility.

Table 6-1. Waste Receiving and Processing Facility Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
D001–D043	F001	U001–U012	P001–P006	WT01
	F002	U014–U039	P008–P018	WT02
	F003	U041–U053	P020–P024	WP01
	F004	U055–U064	P026–P031	WP02
	F005	U066–U099	P033	WP03
	F006	U101–U103	P034	WPCB
	F007	U105–U138	P036–P051	WSC2
	F008	U140–U174	P054	
	F009	U176–U194	P056–P060	
	F010	U196	P062–P078	
	F011	U197	P081	
	–F012	U200–U211	P082	
	F019	U213–U223	P084	
	F020-F023	U225–U228	P085	
	F026-F028	U231–U240	P087–P089	
	F039	U243–U244	P092–P099	
		U246–U249	P101–P106	
		U271	P108–P116	
		U278–U280	P118–P123	
		U328	P127	

Table 6-1. Waste Receiving and Processing Facility Dangerous Waste Numbers

Characteristic Waste "D" Series	Nonspecific Source "F" Series	Discarded Chemical Product "U" Series	Discarded Chemical Product "P" Series	Washington State-Only "W" Series
		U353	P128	
		U359	P185	
		U364	P188–P192	
		U367	P194	
		U372	P196–P199	
		U373	P201–P205	
		U387		
		U389		
		U394		
		U395		
		U401–U404		
		U407		
		U409–U411		

Note: Acceptable dangerous waste numbers may be added or deleted at any time due to changes in regulations. See the currently approved Dangerous Waste Permit Application, Part B Form, Section XIV, "Description of Dangerous Waste," to verify the dangerous waste numbers acceptable at the WRAP facility.

6.2 Prohibited Waste

The following waste types are not accepted at the WRAP facility (see Section 2.3):

- Compressed gases packaged at pressures in excess of 1.5 Atm (152 kPa absolute pressure) at 20°C (68°F), except for pressurized aerosol cans, which can be accepted (DOE M 435.1-1); additional requirements related to these criteria are listed in Section 2.11.4
- Liquid waste, except if packaged in lab packs or overpacks in quantities less than or equal to 57 L (15 gal) per outer container

6.3 Packaging Criteria

The following subsections describe the packaging criteria for acceptance at the WRAP facility.

6.3.1 Protective Coatings and Liners for Stored Waste

The packaging for mixed waste to be stored shall include the following coatings and/or liners sufficient to maintain the integrity of the containment system during the anticipated storage life of the waste:

- The exterior coating of metal containers shall be alkyd enamel, galvanized, or an alternative coating with performance equivalent to or better than alkyd enamel.
- The interior coatings and liners shall be chemically compatible with the waste and shall protect the containment system from corrosion over the anticipated storage life of the waste (WAC 173-303-630). Unless otherwise specified by the WFMP Waste Acceptance organization, the storage life should be

assumed to be 20 years. For containers procured under Hanford Site container procurement specifications, Appendix D defines preferred coating and liner options.

6.3.2 Noncombustible Containers

Outer containers shall be constructed of metal, except that fire-retardant wooden boxes can be used for LLW only. Wooden boxes shall be constructed of wood that is either pretreated with the Underwriters Laboratories FR-S stamp, or coated with a fire-retardant paint that has been approved by Underwriters Laboratories or Factory Mutual. Wooden boxes must be overpacked in a metal box for NDA at the WRAP facility.

6.3.3 Package Size Limits

The container sizes that can be handled at the WRAP facility are described in the following subsections. These dimensions are absolute and include any attachments such as lifting bails, lid flanges, or pallets if they are necessary to handle the container.

6.3.3.1 Nondestructive Examination

- Drums and other cylindrical containers not exceeding 1.61 m (5 ft 3.5 in.) in diameter and 1.64 m (5 ft 4.75 in.) tall.
- Boxes must be less than 2.90 m (9 ft 6 in.) long; must be less than 1.61 m (5 ft 3.5 in.) wide at bottom; above 0.6 m (2 ft) from bottom must be less than 1.93 m (6 ft 4 in.) wide; and must be less than 1.64 m (5 ft 4.75 in.) high.

6.3.3.2 Nondestructive Assay

- Drums and other cylindrical containers not exceeding 1.39 m (54.7 in.) in diameter and 0.99 m (39 in.) tall.
- Boxes not exceeding 1.83 m (72 in.) long by 1.39 m (54.7 in.) wide and 0.99 m (39 in.) tall.

6.3.4 Package Weight Limits

The maximum weights for containers handled at the WRAP facility are as follows:

- **NDE:** 3,175 kg (7,000 lb)
- **NDA:** 1,814.3 kg (4,000 lb)

6.3.5 Labeling

Packages shall be labeled as described in Appendix C.

6.4 Package Dose Rate Limits

Containers with dose rates less than or equal to 2 mSv/hr (200 mrem/hr) at contact and less than 1 mSv/hr (100 mrem/hr) at 30 cm (1 ft) are acceptable at the WRAP facility. Containers exceeding these limits may be acceptable but will require container-specific review and approval by WRAP facility operations.

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Appendix A

Radiological Calculation Methods

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Contents

Tables

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Terms

DE-Ci	dose equivalent curies
DOE	U.S. Department of Energy
FGE	fissile gram equivalent
NL	no applicable limit
SOF	sum of fractions
TRU	transuranic
TSR	Technical Safety Requirements
TSD	treatment, storage, and/or disposal
WFMP	Waste & Fuels Management Project
WIPP	Waste Isolation Pilot Plant

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A1 Radiological Calculation Methods

Various radiological calculations are required to determine whether a waste can be managed at Hanford Site treatment, storage, and/or disposal (TSD) units. The following sections describe the methodology for performing these calculations. For each calculation, the following assumptions shall be used:

- All major radionuclides in the waste, as defined in Section 2.5.1, must be considered in the calculations. If there is a major radionuclide in the waste that is not listed in Tables A-1 and A-2, the generator must notify the Waste & Fuels Management Project (WFMP) Waste Acceptance organization to calculate the applicable limits and conversion factors.
- If a daughter radionuclide has a half-life less than 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 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 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 TSD unit.

Table A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	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
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

Table A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	Specific Activity[a] (Ci/g)	Decay Heat[b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor[b,d]
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 A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	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

Table A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	Specific Activity[a] (Ci/g)	Decay Heat[b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor[b,d]
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
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

Table A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	Specific Activity[a] (Ci/g)	Decay Heat[b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor[b,d]
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
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

Table A-1. Conversion Factors for General Radiological Calculations

Isotope	Half-Life (sec)	Specific Activity[a] (Ci/g)	Decay Heat[b,c] (W/Ci)	ICRP 71 DE-Ci Correction Factor[b,d]
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
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

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

a. Firestone, 1999, *Table of Isotopes* (Chu et al., 1999, *The Lund/LBNL Data Search*).

Specific activity data: DFSNW-ECAL-043, *Calculations for Table A-1 of HNF-EP-0063.*

b. Daughters with half-life less than 10 days (8.64 × 105 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 Dose Coefficients*, Factor: HNF-14741, *Solid Waste Operations Complex Master Documented Safety Analysis*, as amended.

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
H-3	4.4 E+00	9.9 E+04	NL
Be-7	NL	NL	NL
Be-10	NL	1.1 E+00	2.4 E+02
C-14	1.3 E-04	9.1 E-02	2.1 E+01
C-14 activated metal[a]	NL	9.1 E-01	2.1 E+02
Na-22	NL	NL	NL
P-32	NL	NL	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
Si-32	NL	7.3 E-01	3.6 E+02
P-33	NL	NL	NL
S-35	NL	NL	NL
Cl-36	3.1 E-05	6.4 E-05	1.4 E-01
Ar-39	NL	NL	NL
K-40	NL	1.8 E-03	3.8 E-01
Ca-41	NL	1.9 E-01	4.1 E+01
Ar-42	NL	NL	NL
Ti-44	NL	6.3 E-03	4.7 E+02
Ca-45	NL	NL	NL
Sc-46	NL	NL	NL
V-49	NL	NL	NL
Cr-51	NL	NL	NL
Mn-54	NL	NL	NL
Fe-55	NL	NL	NL
Co-56	NL	NL	NL
Co-57	NL	NL	NL
Co-58	NL	NL	NL
Fe-59	NL	NL	NL
Ni-59	NL	3.9 E+00	8.5 E+02
Fe-60	NL	NL	NL
Ni-59 activated metal[a]	NL	3.9 E+01	8.5 E+03
Co-60	NL	7.5 E+01	NL
Co-60 activated metal[a]	NL	7.5 E+02	NL
Ni-63	NL	5.9 E+00	2.0 E+04
Ni-63 activated metal[a]	NL	5.9 E+01	2.0 E+05
Zn-65	NL	NL	NL
Ge-68	NL	NL	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
Se-75	NL	NL	NL
Se-79	3.4 E-05	5.1 E-01	1.1 E+02
Sr-82	NL	NL	NL
Rb-83	NL	NL	NL
Rb-84	NL	NL	NL
Kr-85	NL	NL	NL
Sr-85	NL	NL	NL
Rb-86	NL	NL	NL
Y-88	NL	NL	NL
Sr-89	NL	NL	NL
Sr-90[c]	NL	1.6 E-02	5.4 E+04
Nb-91	NL	2.0 E+00	6.3 E+02
Mo-93	2.1 E-04	8.7 E-01	2.0 E+02
Nb-93m	NL	NL	NL
Zr-93	NL	2.50 E+00	5.40 E+02
Nb-94	NL	2.2 E-04	4.8 E-02
Nb-94 activated metal[a]	NL	2.2 E-03	4.8 E-01
Nb-95	NL	NL	NL
Zr-95[b]	NL	NL	NL
Tc-99	2.1 E-04	2.3 E-02	5.0 E+00
Ru-103[b]	NL	NL	NL
Ru-106[b]	NL	NL	NL
Pd-107	NL	1.5 E+01	3.3 E+03
Ag-108m	NL	NL	NL
Cd-109	NL	NL	NL
Ag-110m[b]	NL	NL	NL
Cd-113m	NL	7.6 E-01	NL
Sn-113[b]	NL	NL	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
Sn-119m	NL	NL	NL
Sn-121m	NL	6.7 E-01	2.2 E+04
Te-121	NL	NL	NL
Te-123	NL	NL	NL
Sb-124	NL	NL	NL
I-125	NL	NL	NL
Te-125m	NL	NL	NL
Sb-125	NL	NL	NL
Sb-126	NL	NL	NL
Sn-126[b]	NL	1.6 E-04	3.4 E-02
Te-127m[b]	NL	NL	NL
I-129	1.0 E-06	8.5 E-03	1.8 E+00
Te-129m[b]	NL	NL	NL
Xe-131m	NL	NL	NL
Ba-133	NL	7.1 E-01	NL
Cs-134	NL	NL	NL
Cs-135	NL	1.6 E-01	3.5 E+01
Cs-136	NL	NL	NL
Cs-137[b]	NL	5.5 E-03	1.2 E+04
Ba-140[b]	NL	NL	NL
Ce-141	NL	NL	NL
Ce-144[b]	NL	NL	NL
Nd-147	NL	NL	NL
Pm-147	NL	NL	NL
Sm-147	NL	1.7 E-02	3.7 E+00
Eu-150	NL	1.4 E-03	6.7 E+02
Sm-151	NL	4.6 E+01	2.1 E+05
Eu-152	NL	4.8 E-02	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
Gd-152	NL	6.4 E-03	1.4 E+00
Gd-153	NL	NL	NL
Eu-154	NL	7.5 E-01	NL
Eu-155	NL	NL	NL
Tm-170	NL	NL	NL
Hf-175	NL	NL	NL
Hf-181	NL	NL	NL
Ta-182	NL	NL	NL
W-185	NL	NL	NL
Re-187	3.3 E-02	3.6 E+01	7.8 E+03
Au-195	NL	NL	NL
Hg-203	NL	NL	NL
Tl-204	NL	NL	NL
Bi-207	NL	1.7 E-03	1.44 E+03
Pb-210	NL	3.7 E-02	2.1 E+06
Po-210	NL	NL	NL
Ra-226	NL	1.7 E-04	4.3 E-02
Ac-227	NL	4.2 E-03	3.0 E+05
Ra-228	NL	1.7 E+01	NL
Th-228	NL	NL	NL
Th-229	NL	4.4 E-04	9.8 E-02
Th-230	NL	2.1 E-03	1.5 E-01
Pa-231	NL	1.4 E-04	3.0 E-02
Th-232	NL	1.1 E-04	2.3 E-02
Total U	1.4 E-05	NL	NL
U-232	See Total U	4.6 E-04	4.6 E+00
U-233	See Total U	7.4 E-03	9.7 E-01
Th-234	NL	NL	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
U-234	See Total U	8.9 E-03	1.9 E+00
U-235	See Total U	2.8 E-03	5.0 E-01
Pu-236	NL	NL	NL
U-236	See Total U	9.5 E-03	2.0 E+00
Np-237[c]	1.1 E-05	6.8 E-04	1.5 E-01
Pu-238[c]	NL	4.7 E-03	2.4 E+01
U-238	See Total U	5.7 E-03	1.2 E+00
Pu-239[c]	NL	1.9 E-03	4.2 E-01
Pu-240[c]	NL	1.9 E-03	4.3 E-01
Am-241[c]	NL	2.1 E-03	8.5 E-01
Pu-241	NL	6.1 E-02	2.5 E+01
Am-242m[c]	NL	1.9 E-03	1.6 E+00
Cm-242	NL	NL	NL
Pu-242[c]	NL	2.0 E-03	4.3 E-01
Am-243[c]	NL	1.0 E-03	2.3 E-01
Cm-243[c]	NL	1.8 E-02	3.4 E+02
Cm-244	NL	1.4 E-01	1.6 E+02
Pu-244[c]	NL	6.1 E-04	1.3 E-01
Cm-245[c]	NL	1.3 E-03	2.2 E-01
Cm-246[c]	NL	1.8 E-03	4.2 E-01
Bk-247[c]	NL	1.5 E-03	3.8 E-01
Cm-247[c]	NL	5.6 E-04	1.2 E-01
Cm-248[c]	NL	5.1 E-04	1.1 E-01
Cf-249[c]	NL	7.8 E-04	3.6 E-01
Cf-250	NL	3.8 E-01	1.5 E+02
Cm-250[c]	NL	9.3 E-05	2.1 E-02
Cf-251[c]	NL	1.3 E-03	3.8 E-01
Cf-252	NL	NL	NL

Table A-2. Low-Level Burial Grounds Radiological Content Limits

Isotope	Mobile Radionuclide Reporting Limit (Ci/m^3)	Category 1 Waste Limit (Ci/m^3)	Category 3 Waste Limit (Ci/m^3)
Es-254	NL	NL	NL

References: WHC-EP-0645, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*; WHC-SD-WM-TI-730, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*.

a. Limit for isotope in activated metal.

b. Daughters with half-life less than 10 days and with parent radionuclide half-life greater than the daughter are not reportable.

c. Transuranic isotope (half-life >20 years).

NL = no applicable limit

A1.1 Transuranic Waste Determination

To determine whether a waste is transuranic (TRU), compute the sum of the specific activity of the alpha-emitting TRU radionuclides having half-lives greater than 20 years. These radionuclides are identified in Table A-2 with the superscript [c]. If the total alpha activity exceeds 100 nCi/g (3,700 Bq), the waste is TRU (DOE M 435.1-1, *Radioactive Waste Management Manual*). For the mass of the waste matrix used in the TRU 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 DOE G 435.1-1, Chapter IIIA.

A1.2 Calculation of Plutonium-239 Fissile Gram Equivalents

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

- Multiply the grams of each fissionable isotope by the FGE conversion factor (FGE per gram) in Appendix B (Table B-1) to yield the FGE for the isotope.
  - Isotope mass (grams) × isotope conversion factor (FGE per gram) = Isotope FGE
- 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 WFMP facility criticality safety representative could use an alternate method for determining the FGE for uranium-235 in specific cases as discussed in Appendix B. Natural uranium (i.e., 0.72% of uranium-235) and depleted uranium (i.e., <0.72%) are normally exempt for criticality purposes at WFMP TSD units.

A1.3 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 A-1. The thermal power calculation is performed using the

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

Isotope concentration (curies per m^3) × decay heat (watts/curie) = decay heat/thermal power (watts per m^3)

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

A1.4 Category 1 Determination

Classification of waste as Category 1 or greater than Category 1 is a sum of fractions (SOF) calculation. The concentration of each isotope (expressed in curies per m^3) is divided by its respective Category 1 limit from Table A-2. The category is the SOF for all isotopes in the waste package:

- If the SOF is less than or equal to 1, the waste is Category I.
- If the SOF exceeds 1, the waste is greater than Category 1, and the Category 3 determination described in Section A1.5 must be performed to classify the waste package.

A1.5 Category 3 Determination

Category 3 determination is performed in the same way as the Category 1 calculation (using the Category 3 limits from Table A-2). The concentration of each isotope (expressed in curies per m^3) is divided by its respective Category 3 limit from Table A-2. The category is the SOF for all isotopes in the waste:

- If the SOF is less than or equal to 1, the waste is Category 3. If the SOF exceeds 1, the waste is greater than Category 3.

A1.6 Mobile Radionuclide Reporting

The concentration of each mobile isotope (hydrogen-3, carbon-14, chlorine-36, selenium-79, molybdenum-93, technetium-99, iodine-129, rhenium-187, total uranium, and neptunium-237) is compared against its respective reporting value from Table A-2.

A1.7 Calculating Dose Equivalent Curies

Calculating the dose equivalent curies (DE-Ci) of a waste container is performed by multiplying the activity (in curies) of each isotope in a given container by its respective International Commission on Radiological Protection correction factor (ICRP Publication 71), from Table A-1, and summing the results. The '*Effective Waste Container Inventory*' may be reduced based on analysis in Appendix B of HNF-14741, *SWOC Master Documented Safety Analysis (MDSA)*, for the purpose of meeting Source Strength Control Specific Administrative Control limits in HNF-15280, *SWOC Technical Safety Requirements (TSR).*

A1.8 Calculating Plutonium-239 Equivalent Curies

The plutonium equivalent curie calculation is required for TRU waste to be shipped to WIPP. The plutonium equivalent curie calculation is performed as specified in the WIPP waste acceptance criteria (DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*).

A2 References

Chu, S.Y.F., L.P. Ekstrom, and R.B. Firestone, 1999, *The Lund/LBNL Nuclear Data Search*, Version 2.0, Lawrence Berkeley National Laboratory, Berkeley, California. Available at: http://nucleardata.nuclear.lu.se/toi/.

DFSNW-ECAL-043, 2001, *Calculations for Table A-1 of HNF-EP-0063*, Rev. 0, Northwest Operations, Duratek Federal Services, Inc., Richland, Washington.

DOE G 435.1-1, 1999, *Implementation Guide for use with DOE M 435.1-1*, Chapter III, "Transuranic Waste Requirements," U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0435.1-EGuide-1-Chp01.

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Firestone, Richard B., 1999, *Table of Isotopes*, 8th Edition, John Wiley & Sons, Inc., New York, New York.

HNF-14741, 2017, *Solid Waste Operations Complex Master Documented Safety Analysis*, Rev. 12, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.

HNF-15280, 2013, *Technical Safety Requirements for the Solid Waste Operations Complex*, Rev. 10, CH2M HILL Plateau Remediation Company, Richland, Washington.

ICRP Publication 71, 1995, *Age-dependent Doses to Members of the Public from Intake of Radionuclides – Part 4 Dose Coefficients*, International Commission on Radiological Protection, Ottawa, Ontario, Canada.

WHC-EP-0645, 1995, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*, Westinghouse Hanford Company, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/105099.

WHC-SD-WM-TI-730, 1996, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071840H.

Appendix B

Fissionable Material Content Limits

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Contents

Tables

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Terms

AK	acceptable knowledge
CPS	criticality prevention specification
CSER	criticality safety evaluation report
CSR	criticality safety representative
FGE	fissile gram equivalent
LLBG	Low-Level Burial Grounds
NDA	nondestructive assay
SWB	standard waste box
SWOC	Solid Waste Operations Complex
TMU	total measurement uncertainty
TRU	transuranic
TSD	treatment, storage, and/or disposal
WIPP	Waste Isolation Pilot Plant
WFMP	Waste & Fuels Management Project

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B1 Fissionable Material Content Limits

Small changes to criticality safety are described in this appendix. The sections in this chapter describe the limits for fissionable material content in waste packages or bulk waste sent to treatment, storage, and/or disposal (TSD) units covered by the criteria provided in this document. Fissionable material inventories for a given container shall be restricted to ensure that they do not exceed the applicable fissionable material limit, including measurement uncertainty. For some waste packages, the generator must provide distribution of the fissionable material or moderating materials in the container to determine the applicable specification and whether criticality limits are met. Meeting criticality limits does not ensure that the container will be accepted because Waste Isolation Pilot Plant (WIPP) and disposal limits may be more restrictive.

B1.1 Exempt Materials

Waste packages (208 L [55 gal] or larger) or bulk waste shipments are exempt from criticality safety controls and fissile labeling at all TSD units if the fissile gram equivalent (FGE) for the contained fissionable material is less than 15 FGE. Natural uranium (i.e., up to 0.72% uranium-235) and depleted uranium (i.e., <0.72%) is normally exempt for criticality purposes at the TSD units; however, the total mass of uranium-235 is counted for WIPP acceptance.

B1.2 Measurement Uncertainty for Nonexempt Materials

Measured values of operating parameters subject to criticality safety limits (e.g., the mass of a given isotope) shall conservatively account for assessed biases and uncertainties for the measurement methods.

The measurement uncertainty will be accounted for in the following ways.

- For transuranic (TRU) waste destined for WIPP, the sum of the measured mass and the mass corresponding to the 2 sigma total measurement uncertainty (TMU) shall be less than the fissile material quantity limits in Table G-2.
- For measurements of fissionable material under a critical mass limit, where the accuracy of the fissile mass measurement method is determined from nondestructive assay (NDA) measurements performed in accordance with PRC-RD-EN-10484, *Nondestructive Assay Management Program*, or equivalent NDA quality assurance program, the measured FGE plus one TMU shall not exceed the values for a qualified program in Table B-1. The TMU of any measurement system shall not exceed 30% for any container with a measured value (without measurement uncertainty applied) greater than 100 FGE when establishing compliance with the Table B-1 FGE limits.

The acceptance of containers based on methods not equivalent to PRC-RD-EN-10484 may be allowed based on Waste & Fuels Management Project (WFMP) criticality representative review for acceptability under the alternative acceptable knowledge (AK) values specified in Table B-1.

Table B-1. Summary of Fissile Material Limits for Standard Waste Containers

Container	Additional Container or Content Specifications	Maximum FGE Without Handling Restrictions (CPS-SWOC-001)	Maximum FGE with Handling Restrictions (CPS-SWOC-001)	Maximum WIPP FGE
208 L (55 gal) Drum or Larger	FGE Based on Qualified Program *<32 kg Pb, <140 kg drum weight*	250	340	200[a]/100[b]
	FGE Based on AK *<32 kg Pb, <140 kg drum weight*	128	179	Not acceptable
	FGE Based on Qualified Program *>32 kg Pb, <800 kg drum weight*	216	340	200[a]/100[b]
	FGE Based on AK *>32 kg Pb, <800 kg drum weight*	108	179	Not acceptable
	FGE Based on Qualified Program *No Weight Limit*	180	250	Not acceptable
	FGE Based on AK *No Weight Limit*	87	128	Not acceptable
	Liquid Lab Pack with FGE per Qualified Program	170	Non specified	Not acceptable
	Liquid Lab Pack with FGE Based on AK	80	Non specified	Not acceptable
WIPP SWB/SLB2 and Other Boxes (Only SWBs/ SLB2s are Allowed for WIPP)	SWB/SLB2 with Unrestricted Hydrogen to Fissile Atom Ratio and FGE Based on Qualified Program	325-380	325-380	325 (SWB/ SLB2)[c]
	Waste Box with Minimum Dimension of (2.5 ft) and FGE Based on Qualified Program	250	1,000	Not Acceptable
	Waste Box with Minimum Dimension of (2.5 ft) and FGE Based on AK	125	500	Not acceptable

Table B-1. Summary of Fissile Material Limits for Standard Waste Containers

Container	Additional Container or Content Specifications	Maximum FGE Without Handling Restrictions (CPS-SWOC-001)	Maximum FGE with Handling Restrictions (CPS-SWOC-001)	Maximum WIPP FGE
Ten-Drum Overpack	Up to 10 Drums with FGE Based on a Qualified Program	325	325	325

Reference: CPS-SWOC-001, *Criticality Prevention Specification: SWOC Storage, Movement, and Non-Intrusive Operations*.

Notes: Terms used in this table are included in the terms list.

250 FGE for SWB containing machine compacted waste, ≤1% by wt. Be or BeO.

100 FGE for SWB containing greater than 1% by wt. Be or BeO.

All measured FGE limits include uncertainty (2 TMU for WIPP; 1 TMU for SWOC).

SWOC acceptance of SWBs/SLB2over 325 FGE up to 380 FGE is dependent on the Pu-240 content; however, over 325 FGE is no longer accepted at WIPP.

Exceptions for fissile containers:

- Drums over 200 FGE may be acceptable at WIPP when overpacked in an SWB, SLB2, or a 10-drum overpack.
- Nonsteel drums are allowed with WFMP CSR concurrence, but handling restrictions may be required.
- Waste storage drums are assumed to have nominal dimensions of 84.46 cm (33.25 in.) inner height, 88.9 cm (35 in.) outer height, 57.15 cm (22.5 in.) inner diameter, and 60.96 cm (24 in.) outer diameter. Drums smaller than these dimensions may be allowed only if overpacked in a container meeting this assumption.
- Fissile boxes smaller than 1.5 m × 1.2 m × 0.9 m (5 ft × 4 ft × 3 ft) (L × W × H) may be allowed with WFMP CSR concurrence.
- Over 2.2 L (0.58 gal) liquid in a container may be allowed with WFMP CSR concurrence, but FGE limits may be reduced and handling restrictions may be required.
- Other containers may be acceptable at SWOC based on specific criticality safety evaluation reports.
- SWOC normally excludes depleted or natural uranium from FGE calculations, but WIPP does not.

Additional process controls may be required by the applicable criticality prevention specifications.

Additional disposal requirements apply (CPS-SW-008, *Criticality Prevention Specification: Burial of Non-TRU Fissile Material in the Lined Trenches*).

a. 200 FGE for 55, 85, or 100 gal drums containing less than 1% by wt. Be or BeO.

b. 100 FGE for 55, 85, or 100 gal drums containing greater than 1% by wt. Be or BeO.

c. 325 FGE for SWB containing less than 1% by wt. Be or BeO.

d. The WIPP limit includes 2 times the TMU. If a WIPP-compliant TMU has not been developed, the one sigma TMU should be estimated as 30%.

CSR = criticality safety representative

SLB2 = standard large box 2

SWB = standard waste box

SWOC = Solid Waste Operations Complex

B1.3 Nonexempt Materials in Standard Containers

Certain nonexempt materials in standard packaging configurations (Table B-1) are acceptable at the Low-Level Burial Grounds (LLBG), Central Waste Complex, T Plant Complex, and Waste Receiving and Processing facility. The fissionable material limits are expressed as plutonium-239 FGE as defined in

HNF-5134, *CSER 00-005: Fissile Gram Equivalence for Hanford Solid Waste Operations*, and as described in Section A1.2. Table B-2 is used to determine the total FGE of fissionable material in a waste container by multiplying the gram quantity of each listed isotope by the correction factor and summing the results.

Table B-2. Fissile Gram Equivalent Conversion Factors (Fissile Gram Equivalent per Gram)

Isotope	Conversion Factor	Isotope	Conversion Factor
U-233	1.0 E+0*	Am-242m	3.46 E+1
U-235	6.43 E-1	Am-243	1.29 E-2
Np-237	1.5 E-2	Cm-243	5.0 E+0
Pu-238	1.13 E-1	Cm-244	9.0 E-2
Pu-239	1.0 E+0	Cm-245	1.5 E+1
Pu-240	2.25 E-2	Cm-247	5.0 E-1
Pu-241	2.25 E+0	Cf-249	4.5 E+1
Pu-242	7.5 E-3	Cf-251	9.0 E+1
Am-241	1.88 E-2	—	—

Reference: Section 5.0 in HNF-5134, CSER 00-005: *Fissile Gram Equivalence for Hanford Solid Waste Operations*.

*Value used for U-233 when calculating for U-235.

Some of the specific container limits are shown in Table B-1, which addresses the most common containers and criticality prevention specifications (CPSs). Additional requirements are detailed in the CPSs. Other container limits or acceptable configurations may be available. Exceptions can be requested as specified in Section 1.6. If a new criticality safety evaluation report (CSER) is required for a new waste stream, the generator will need to provide funding for performing the evaluation.

Assumptions and controls from the CSER for box receipt and storage, in addition to the total fissile content specified in Table B-2 that must be met, include the following for each box (other containers, which are not technically boxes, may be accepted under the box CSER as long as the containers meet these requirements):

- Box must be of robust construction and resistant to water intrusion.
- Content typically is flushed or drained equipment (e.g., pumps, piping, hoods, and gloveboxes), high-efficiency particulate air filters, drums, or boxes.
- Although additional liquids may be acceptable at the SWOC, box acceptance normally is limited to 1% of the volume and free liquid 2 L (0.53 gal), or less, to limit repackaging.
- Disposal of non-TRU waste in the LLBG containers is limited to 128.5 FGE per drum equivalent volume and 42.4 FGE per ft^2 cross-sectional area (CPS-SW-008, *Criticality Prevention Specification: Burial of Non-TRU Fissile Material in the Lined Trenches*).

B1.4 Nonexempt Materials in Nonstandard Containers or Bulk Waste

Waste packages that have nonexempt quantities of fissionable material but are not in Table B-2 standard containers (e.g., in 114 L [30 gal] drums, concrete or wooden boxes, small boxes, ion exchange modules, or bulk waste shipments) may still be received for storage and disposal. Non-TRU waste packages of this type may be accepted up to a maximum of 128.5 FGE, per 208 L (55 gal) drum equivalent volume and 42.4 FGE per ft^2 cross-sectional area (CPS-SW-008) for disposal. Other transportation limits might apply to the entire shipment.

B1.5 Nonexempt Quantities of Fissionable Radionuclides in Other Configurations

Limits for configurations other than those shown in Sections B1.4 and B1.5 may already be available or may be requested as described in Section 1.6. If a new CSER is required for a new waste stream, the generator will need to provide funding for performing the evaluation.

B1.6 Calculation of Uranium-235 Fissile Gram Equivalent

A detailed method for calculating FGE, that takes into account the poisoning effect of uranium-238 in special cases is provided in CSER 00-005 (HNF-5134). The maximum enrichment, or actual distribution for a mixture of enrichments, is required to perform this calculation. If uranium is not a significant factor, FGE may be calculated as discussed in Section A1.2. The uranium-235 FGE value for the uranium in a waste package provides limits for disposal by one of the following methods:

- The FGE for uranium-235 may be calculated using the conversion factor in Table B-2. Uranium-235 also may be excluded in calculating FGE if it is in natural or depleted uranium (less than or equal to 0.72 weight percent uranium-235 in uranium); however, the FGE from uranium-235 is counted for WIPP acceptance. The WFMP facility criticality safety representative may also exempt homogeneous uranium solutions in solid or liquid form up to 1.0 weight percent enrichment of uranium-235.
- The FGE for uranium-235 may be conservatively calculated by including all uranium-235 present with no exemptions on a 1 g = 1 FGE basis. This conservative method of conversion was typically used for older waste packages.

B2 References

CHPRC-01041, CPS-SWOC-001, 2017, *Criticality Prevention Specification* [CPS-SW-008 Rev G-0]: *Storage, Movement, and Non-Intrusive Operations*, Rev. 5-0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-01063, 2014, *Criticality Prevention Specification* [*CPS-SW-008* Rev B-0]*: Burial of Non-TRU Fissile Material in the Lined Trenches*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-5134, 2010, *CSER 00-005: Fissile Gram Equivalence for Hanford Solid Waste Operations*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-RD-EN-10484, 2015, *Nondestructive Assay Management Program*, Revision 0, Change 3, CH2M HILL Plateau Remediation Company, Richland, Washington.

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Appendix C

Labeling of Waste Containers

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Contents

Tables

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Terms

CIN	container identification number
DOT	U.S. Department of Transportation
FGE	fissile gram equivalence
PCB	polychlorinated biphenyl

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C1 Labeling of Waste Containers

Containers sent to Hanford Site treatment, storage, and/or disposal units must be labeled for identification in order to communicate information needed for proper waste management. Table C-1 shows the standard labeling required on containerized waste. The following sections provide general requirements for labels and markings.

Table C-1. Required Labeling for Waste Containers

Label	When Required	Location on Drum	Location on Box
Bar code with container identification number	All containers	Bottom third of drum	Short side of box
Gross weight in kg (kilogram units must appear on label)	All containers	Same side as bar code	Same side as bar code
Applicable DOT labeling	All containers	As specified in 49 CFR	As specified in 49 CFR
Dangerous waste or hazardous waste label	Dangerous and mixed waste containers	Same side as bar code	Same side as bar code
Hazard label(s)[a]	Dangerous and mixed waste containers	Same side as bar code	Same side as bar code
PCB label[b]	Waste that is regulated for PCB content under 40 CFR 761	Same side as bar code	Same side as bar code
Asbestos label	As required per 40 CFR 61, Subpart M	Same side as bar code	Same side as bar code
Solid Waste Information Tracking System-generated fissile label (printed with a barcode printer) and fissile trefoil label (or symbol)[c]	Containers with 15 FGE or more fissionable material	Same side as bar code	Same side as bar code

References: 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Subpart M, "National Emission Standard for Asbestos."

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions."

49 CFR, "Transportation."

DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*.

Note: 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 the container identification number and the gross weight in kg.

a. Refer to Table C-2 for Washington State hazard labeling of dangerous, and mixed, waste. These labels might conflict with DOT hazard labeling and should be covered, removed, or obliterated during transportation.

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

c. These labels might conflict with the DOT fissile label; for shipments of waste from offsite and many onsite generators, labels should be placed on the containers at the time the waste arrives on the Hanford Site or at the receiving facility.

DOT = U.S. Department of Transportation

FGE = fissile gram equivalent

PCB = polychlorinated biphenyl

Table C-2. Selection of Washington State Hazard Labeling

Based on the waste designation performed in accordance with WAC 173-303-070 (3), choose the label or marking, or combination of labels or markings, that communicates the hazard labels associated with the waste.

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
WA State Characteristic Waste Criteria – WSC2 Corrosive (WAC 173-303-090(6)(a)(iii))	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) IGNITABLE, CORROSIVE, REACTIVE, and/or TOXIC
Dangerous Waste Sources – (F, K* codes) (WAC 173-303-9904)	a) IGNITABLE, CORROSIVE, REACTIVE, and/or TOXIC
WA State Dangerous Waste Sources – WPCB (WAC 173-303-9904)	TOXIC

Reference: WAC 173-303, "Dangerous Waste Regulations."

*K listed hazardous waste is not managed on the Hanford Site.

NOTE: *MARK F, U and P listed dangerous waste codes with the applicable hazard label based on the basis for the listing at WAC 173-303-9903, -9904, and -9905, and whether the waste continues to exhibit that characteristic. As examples, F001 has a hazard code of "(T)" and will have the "Toxic" hazard label; F003 has a hazard code of "(I)" and will have the "Ignitable" hazard label; F005 has the hazard codes of "(I, T)" and will have the "Ignitable" and "Toxic" hazard labels. This is assuming the waste exhibits the characteristics. It is relatively easy to determine if a waste exhibits the characteristics of ignitability, corrosivity or reactivity, but it is not as easy to determine if a waste exhibits the characteristic of toxicity. Unless proven by analysis, the "Toxic" hazard label should apply if a dangerous waste code has the toxic characteristic.*

C1.1 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: (1) "Facility ID-Year-Sequential #," where the Facility ID is the generating facility's unique four-character (letter and/or number) identifier, (2) "Year" is the last two digits of the year the CIN was assigned, and (3) "Sequential #" is the generator's sequential numbering of containers for that year.
- For offsite generators, a bar code will be attached when the container is received on the Hanford Site. The CIN will be the unique container identification number provided by the waste generator. (NOTE: Offsite generators should contact the Waste & Fuels Management Project Waste Acceptance organization for guidance on assigning a unique identification number.)

C1.2 Durability

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

C1.3 Placement of Labels

Labels and markings shall be positioned so that all 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.

C1.4 Size of Labels

Standard labels defined by regulations (e.g., DOT label, hazardous waste label, polychlorinated biphenyl [PCB] 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 one-half inch in size (0.5 in/1.27 cm). 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.

C1.5 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 C-2.

C2 References

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

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*. Available at: https://ecfr.io/Title-40/cfr761_main.

761.40, "Marking Requirements."

761.45, "Marking Formats."

49 CFR, "Transportation," *Code of Federal Regulations*. Available at: https://www.ecfr.gov/cgi-bin/text-idx?&tpl=/ecfrbrowse/Title49/49tab_02.tpl.

DOE/RL-2001-36, 2011, *Hanford Sitewide Transportation Safety Document*, as amended, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://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."

Appendix D

Selection of Compatible Containers, Coatings, and Liners

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Contents

Table

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D1 Selection of Compatible Containers, Coatings, and Liners

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, sorbed liquid, and 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) that is compatible with the waste can be used.

Current revisions of 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. A set of standard packages from the Hanford Site that generally will be compatible with the types of waste generated on the Hanford Site is described in WHC-SD-TP-ES-002, *Justification for Packaging Acceptance Criteria*. Table D-1 provides baseline coating and liner combinations for metal containers based on WHC-SD-TP-ES-002. These container/liner combinations generally provide a compatible container, although compatibility data must demonstrate that the container is compatible with the waste. (NOTE: The Hanford Site specifications and Table D-1 are provided for information purposes only. It is not necessary to select packaging according to Hanford Site specifications or if a container/liner combination meets or exceeds the Hanford Site specifications.)

Table D-1. Standard Container/Liner Combinations

Waste Specification Record Series	Subgroup	Minimum Coatings/Liners
100—Low-level waste	Low-level dry waste for disposal	LPC/no liner
	Low-level absorbed liquids	LPC/10 mil liner
200—TRU waste	Dry debris and soil	LPC/10 mil liner MPC/no liner
	Neutralized sorbed or solidified corrosive (acid or caustic) liquids	LPC/90 mil liner HPC/no liner
	Sorbed or solidified noncorrosive liquids, sludges, and wet soil	LPC/90 mil liner MPC/10 mil liner
400—Mixed waste overpacked and lab-packed liquids	Organic liquids (noncorrosive)	LPC/90 mil liner MPC/10 mil liner
	Corrosive (acidic or caustic) or oxidizing liquids	LPC/90 mil liner HPC/no liner
	Other noncorrosive waste	LPC/90 mil liner MPC/10 mil liner

Table D-1. Standard Container/Liner Combinations

Waste Specification Record Series	Subgroup	Minimum Coatings/Liners
500—Mixed waste solids, sorbed liquids, and soils	Sorbed organic liquids or sludges (noncorrosive)	LPC/90 mil liner MPC/10 mil liner
	Corrosive (acidic or caustic) or oxidizing waste	LPC/90 mil liner HPC/no liner
	Noncorrosive sorbed liquid, sludges, or wet soils	LPC/90 mil liner MPC/10 mil liner
	Noncorrosive dry solids or dry soils	LPC/10 mil liner MPC/no liner
600—Mixed debris waste	Corrosive (acidic or caustic) or oxidizing debris	LPC/90 mil liner HPC/no liner
	Other noncorrosive debris	LPC/10 mil liner MPC/no liner
800—Mixed waste with specific treatment standards	Lead solids, beryllium powder	LPC/no liner
	Elemental mercury	LPC/10 mil (0.6 in.) liner
	Batteries containing acids or caustics	LPC/90 mil liner HPC/no liner
	Other	Case-by-case evaluation
900—State-only mixed waste and LDR-compliant mixed waste	Solid corrosive waste	LPC/90 mil liner HPC/no liner
	Other	LPC/10 mil liner MPC/no liner

Notes: 10 mil liner is 10 mil or thicker nylon reinforced polyethylene liner.

90 mil liner is 90 mil or thicker high-density polyethylene rigid liner.

For mixed hazards, the most protective combination of coatings/liners should be chosen.

HPC = high performance coating
LDR = land disposal restrictions
LPC = low performance coating
MPC = medium performance coating
TRU = transuranic

D2 References

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

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

Appendix E

Selection and Use of Void Fillers, Sorbents, and Stabilizing Materials

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Contents

Tables

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Terms

LDR	land disposal restriction
TRU	transuranic
TRUM	transuranic mixed
WSRd	waste specification record

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E1 Selection and Use of Void Fillers, Sorbents, and Stabilizing Materials

Sorbents and stabilizing materials can be used to meet free liquid requirements or provide a safer waste form for handling and storage. All sorbents and stabilizing materials must be nonhazardous, compatible with the waste being sorbed or stabilized, and nonbiodegradable as defined in 40 CFR 264.314(e) "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Special Requirements for Bulk and Containerized Liquids." Table E-1 lists the general types of sorbents and stabilizing materials that can be used for non-transuranic (TRU) Hanford Site waste streams. Table E-2 lists the specific types of sorbents and stabilizing materials that can be used for TRU and transuranic mixed (TRUM) Hanford Site waste streams. Specific products used must meet the requirements of this appendix listed on an approved Waste Profile Sheet.

Use of these materials to meet radiological stabilization (i.e., to meet Category 3 or mobile radionuclide stabilization requirements) or *Resource Conservation and Recovery Act of 1976* land disposal restriction (LDR) treatment standards is not addressed in this appendix. A more specific evaluation must be performed as specified previously in this document to demonstrate radiological stabilization or LDR compliance.

Table E-1. Sorbent Selection Based on Waste Specification Records

Waste Specification Record Series	Subgroup	Allowable Sorbents/Stabilizing Materials[a]
100—Low-level waste	Low-level liquids for disposal	Mineral sorbents Polymer sorbents Stabilizing materials
	Low-level organic liquids (>1%) and chelating agents (>1%) for disposal	Stabilizing materials
200 – TRU and TRUM		See Table E-2
400—Mixed waste overpacked and lab packed liquids*	All types	Mineral sorbents Polymer sorbents
500—Mixed waste solids, sorbed liquids and soils	Non-thermal treatment WSRds (520 series)	Mineral sorbents Polymer sorbents
	Thermal treatment WSRds (500 series)	Mineral sorbents Polymer sorbents
600—Mixed debris waste	Thermal treatment WSRds (620 series)	Mineral sorbents Polymer sorbents
	Non-thermal treatment WSRds (640 series)	Mineral sorbents Polymer sorbents
800—Other mixed waste with specific treatment standards	All types	Polymer sorbents (or as specified in waste stream profile)

Table E-1. Sorbent Selection Based on Waste Specification Records

Waste Specification Record Series	Subgroup	Allowable Sorbents/Stabilizing Materials[a]
900—State-only mixed waste and LDR-compliant mixed waste	Thermal treatment WSRds (920 series)	Mineral sorbents Polymer sorbents
	Other WSRds	Mineral sorbents Polymer sorbents

*Sorbent for lab packs is placed around containers, not mixed with liquids.

LDR = land disposal restriction

TRU = transuranic

TRUM = transuranic mixed

WSRd = waste specification record

E1.1 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, 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 E1.2.

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.

E1.2 Selection and Use of Sorbents and Stabilizing Materials

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

- Determine from Tables E-1 and E-2 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. Absorbents similar in composition to those listed may also be used for packaging waste. However, Waste Services approval is needed before using any absorbents other than those listed. 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
  - The recommended ratio of sorbent to waste for the liquid being sorbed
  - 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.

E1.3 Hanford Site Requirements for Use of Sorbents

Sorbents used for Hanford Site treatment, storage, and/or disposal units must be used in sufficient quantity. For all Hanford Site applications, at least twice the minimum amount of absorbent shall be used. The minimum ratio of absorbent to liquid is determined based on data from the manufacturer or testing; however, a minimum of twice the minimum amount of sorbent must be used. Table E-2 lists the types of sorbents and stabilizing materials that can be used for Hanford Site TRU waste.

E1.4 Specific TRU and TRUM Waste Requirements for Sorbents

TRU and TRUM waste streams have very specific sorbent requirements to meet acceptance requirements at the Waste Isolation Pilot Plant. Table E-2 lists the allowable sorbents. If the table lists a brand named product, then substitutions with a similar composition must be requested and approved through Waste Services and the TRU program. The third column of Table E-2 shows the maximum allowable amount of an oxidizer weight percent mixed with the listed sorbent. Sorbents with a cellulosic content are not allowed in TRU waste.

Liquids identified as corrosive (i.e. aqueous liquids having a pH <2 or > 12.5) must be neutralized using an appropriate neutralizing agent before being absorbed. Refer to Appendices G and I for documentation requirements for treatment.

The following inorganic sorbents are not acceptable for use in treating oxidizing chemicals in TRU waste:

- Hydromatrix
- Micro-Cel E
- Perlite
- Vermiculite

Polyol organic sorbents that are prohibited include the following:

- Slikwik
- Wheat Scoop
- Carbohydrate sorbents
- Polyols not otherwise specified

Table E-2. TRU Waste Sorbents Acceptable for Use in TRU Waste

Trade Name	Composition	Maximum Weight Percent of Oxidizer Allowed
Engineered Organic Polymer Sorbents		
NoChar N910 and A610	Thermoplastic elastomer (Copolymer of styrene, butadiene, and possibly acrylates and phthalates)	<30 wt%
NoChar N960 and A660	Copolymer of acrylamide	<32 wt%
		≤40 wt% (metal nitrates only)[a]
NoChar N965	Mixture containing 60% N910 and 40% N960	<31 wt%
Universal Polypropylene	Polypropylene	<30 wt%
Inorganic Sorbents		
Absorb-N-Dry	Fuller's Earth 90 to 100% or Bentonite calcined 90 to 100% and quartz <10%	≤ 28
Aquaset	Sodium montmorillonite	≤27
Aquaset II	Sepiolite	≤45
Aquaset II-G	Sepiolite	≤36
Celite S	Kieselguhr (diatomaceous earth)	≤36
ChemOil-Away	Volcanic ash ≥98 Organic material ≤2%	≤13
Drierite	Calcium sulfate	≤29
Floor-Dry	Kieselguhr (diatomaceous earth)	≤36
Oil-Dri	Bentonite 90 to 100%	≤38
Optisorb	Kieselguhr (diatomaceous earth)	≤36
KMI Natural Zeolite (4 to 7 Å pore size)	Clinoptilolite	≤35
Plaster of Paris	Calcium sulfate hemihydrate	≤24
Portland cement (when used as a dry sorbent)	Portland Cement[b]	≤20
Selectsorb	Kieselguhr (diatomaceous earth)	≤36
Spill-X-A	Magnesium oxide 60 to 100% Attapulgite 7 to 13% Sodium carbonate 5 to 10%	≤33
Totalsorb	>99% expanded Amorphous Alumina Silicate	≤36
Zeolite (10 Å pore size)	Zeolite	≤44

Table E-2. TRU Waste Sorbents Acceptable for Use in TRU Waste

Trade Name	Composition	Maximum Weight Percent of Oxidizer Allowed
Zeolite (4 Å pore size)	Zeolite	≤35

Note: Several products listed in table are trademarks or registered trademarks of their respective companies.

a. Excludes silver nitrate (AgNO3) and lithium nitrate (Li NO3).

b. The weight percent of oxidizing chemical allowed for Portland cement does not apply to ion exchange resins with oxidizing chemical and wet mixed and set cement.

E2 References

40 CFR 264.314, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," "Special Requirements for Bulk and Containerized Liquids," *Code of Federal Regulations*. Available at: https://www.gpo.gov/fdsys/granule/CFR-2011-title40-vol26/CFR-2011-title40-vol26-sec264-314.

Resource Conservation and Recovery Act of 1976, 42 USC 6901 et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

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Appendix F

Radiological Release of Waste

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F1 Radiological Release of Waste

Appendix F has been retired. Radiological release information is reflected in the following two documents:

- PRC-PRO-RP-20377, 2013, *Determination of the Radiological Status of RCRA/TSCA Waste*, Revision 0, Change 4 (or current revision), CH2M HILL Plateau Remediation Company, Richland, Washington.
- PRC-PRO-RP-40026, 2016, *Standard Radiological Clearance Surveys for Personal Property*, Revision 3, Change 1 (or current revision), CH2M HILL Plateau Remediation Company, Richland, Washington.

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Appendix G

Contact-Handled Transuranic Waste Acceptance Criteria

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Contents

Tables

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Terms

AK	acceptable knowledge
CCP	Central Characterization Program
CHPRC	CH2M HILL Plateau Remediation Company
CH	contact-handled
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
FGE	fissile gram equivalence
PCB	polychlorinated biphenyl
PE-Ci	plutonium equivalent curie
POC	pipe overpack container
RCRA	*Resource Conservation and Recovery Act of 1976*
RTR	real-time radiography
SLB2	standard large box 2
SWB	standard waste box
SWOC	Solid Waste Operations Complex
TMU	total measurement uncertainty
TRU	transuranic
TRUM	transuranic mixed
TSD	treatment, storage, and/or disposal
WIPP	Waste Isolation Pilot Plant

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G1 Contact-Handled Transuranic Waste Certification Criteria

As a generator of transuranic (TRU) and transuranic mixed (TRUM)[1] waste destined for disposal at the Waste Isolation Pilot Plant (WIPP), the Hanford Site must ensure that its contact-handled (CH) TRU waste meets the requirements of DOE O 435.1, *Radioactive Waste Management*; DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (hereinafter called WIPP waste acceptance criteria); and DOE, 2013, *CH-TRAMPAC,* specific physical, chemical, radiological, and packaging criteria for acceptance of defense CH TRU waste shipments at WIPP.

Although the Hanford Site both generates TRU waste and manages TRU waste from various generators at the Central Waste Complex and other treatment, storage, and/or disposal (TSD) facilities, the Central Characterization Program (CCP) will be responsible for characterizing and certifying the waste for disposal at WIPP. Efforts on the part of the Hanford Site TRU program will focus on supporting CCP in its efforts.

In addition to the Solid Waste Operations Complex (SWOC) TSD requirements identified previously in this document, specific CH TRU waste acceptance criteria are described below.

Robust documentation is required to develop the acceptable knowledge (AK) file in support of TRU waste characterization and eventual CCP certification. As such, all procured items shall meet CH2M HILL Plateau Remediation Company (CHPRC) Quality Level-3 standards. The additional documentation that CH TRU generators must provide includes the following:

- Work packages and procedures, and revisions to those procedures, describing how the waste was generated and packaged.
- Waste stream or container-specific documentation of waste contents, including container data sheets, contents inventory sheets, Waste Planning Checklists, Waste Packaging/Labeling Instructions, Radioactive Waste Disposal Request forms, Radioactive Waste Characterization Worksheets, treatment batch travelers, facility safety and analysis reports, work and test plans, work/field instructions (e.g., field changes, timely orders/standard orders), and site waste management policies/plans (e.g., facility waste acceptance criteria), as applicable.
- Characterization documents prepared by the waste generating organizations, including radioassay results (if available), sampling and analysis plans, and analytical results.
- An evaluation of chemical compatibility of the waste in accordance with EPA-600/02-80-076, *A Method for Determining the Compatibility of Hazardous Waste*. Chemicals evaluated shall be those actually present in the waste, rather than chemical precursors or process inputs. This evaluation must be submitted to the TRU program for review and approved in conjunction with the waste profile approval by the Waste Acceptance organization. The following elements are to be included in the chemical compatibility evaluation:
  - Identification of the chemicals present in the waste
  - Assignment of the reactivity group numbers to each chemical
  - Identification of any potential adverse reactions and documentation that reactions have been adequately dispositioned.

[1] Unless otherwise specified, the term TRU refers to both TRU and TRUM waste.

- An evaluation of oxidizing chemicals in waste streams containing oxidizing chemicals performed in accordance with DOE/WIPP-17-3589, *Basis of Knowledge for Evaluating Oxidizing Chemicals in TRU Waste*. This evaluation must be submitted to the TRU program for review and approved in conjunction with the waste profile approval by the Waste Acceptance organization. If this evaluation indicates that oxidizers are present in the waste, the waste must be treated as appropriate to eliminate the oxidizer properties before the waste is submitted for acceptance. The following elements are to be included in the evaluation:
  - Identification of oxidizers present in the waste
  - Description of the waste, including absorbents used and the chemical form of the oxidizer
  - Description of any treatment performed to eliminate the oxidizing potential
  - Estimation of the oxidizer present
- All correspondence (e.g., emails, memos, phone logs) related to treatment of the waste (such as elementary neutralization, deactivation of pyrophoric and reactive waste, reacting of oxidizers to remove oxidizing potential). This should include details regarding the treatment proposed, inputs to the treatment process, and details regarding the treatment process (e.g., amounts of reagents used, pre- and post-treatment conditions, results of the treatment, final packaging).
- Documentation of any treatment performed to address prohibited items or nonconforming conditions (e.g., if prohibited liquids are identified in the waste, results of any testing or analysis performed to identify the liquid, and for corrosive liquids the pH before treatment, the type and amount of neutralizers added [if any], and the pH after treatment).
- All correspondence related to selection of absorbents used in the waste, including identification (product name) of the absorbent and its material safety data sheet/safety data sheet.
- Measured dose rates and supporting information are required for any items within the waste that have an unshielded contact dose rate in excess of 150 mrem/hr.
- The model number and serial number of each filter vent or combination of filter vents installed on a payload container.
- Documentation demonstrating compliance with the requirements in Tables G-1 through G-6.
- The information provided shall include the document number, revision and date, title/description, generator point-of-contact, verification date, and source document tracking number, if known.

Table G-1. Container Properties

Waste Attribute	Waste Acceptance Criteria	Comments
Payload Container Description	DOT Specification 7A, Type A 55 gal steel drum POC SWB SLB2	POCs, SWBs, and SLB2s are procured through the DOE Carlsbad Field Office Centralized Procurement Program.
Container Weights	1,000 lb/55 gal drum 328 lb/6 in. diameter standard POC 547 lb/12 in. diameter standard POC 550 lb/S100 POC 547 lb/S200 POC 547 lb/S300 POC 4,000 lb/SWB 10,500 lb/SLB2	These weight limits are part of the definition of CH waste at WIPP and cannot be exceeded in CH waste.
Removable Surface Contamination	$\leq$20 dpm/100 cm^2 for alpha $\leq$200 dpm/100 cm^2 for beta-gamma	The fixing of surface contamination to meet these limits is not allowed. For WIPP purposes only – the use of dry swipes for hard-to-detect nuclides is acceptable.
Confinement Requirements	See Table G-3 for the applicable limits. The allowable number of confinement layers are limited by the decay heat and must comply with the limits in Table G-3. Newly generated waste must be packaged with filtered bags or horsetailed.	A smaller number of confinement layers may be required as a waste stream profile condition of approval. Filtered bags are considered layers of confinement.
Filter Vents	All containers to be vented with one or more filter vents that meet the WIPP Hazardous Waste Facility Permit and DOE (2013) (Section 2.5.1) or DOE (2010) (Section 2.4.1) specifications, as appropriate.	WIPP-approved filter vents are listed in Appendix H.

References: 10 CFR 835, "Occupational Radiation Protection."

40 CFR 262.32, Subpart C, "Standards Applicable to Generators of Hazardous Waste, Pre-Transport Requirements, Marking."

40 CFR 761.40, Subpart C, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions, Marking of PCBs and PCB Items, Marking Requirements."

ANSI/AIM BC1-1995, *Uniform Symbology Specification Code 39*.

DOE/WIPP-09-3427, *Waste Data System User's Manual*

CH = contact handled
PCB = polychlorinated biphenyl
POC = pipe overpack container
SLB2 = standard large box 2
SWB = standard waste box
WIPP = Waste Isolation Pilot Plant

Table G-2. Radiological Properties

Waste Attribute	Waste Acceptance Criteria	Comments
Radionuclide Composition	Information on radionuclide composition, with emphasis on the activities and masses of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs. Information also required for radionuclides contributing to the TRU alpha activity concentration, ^{239}Pu FGE, ^{239}Pu equivalent curies, and the decay heat. Other radionuclides contributing to 95% of the radioactive hazard for the payload container shall be reported. If any of the reportable radionuclides are not measureable by NDA, appropriate scaling factors and documentation for the factors shall be provided to quantify the nonmeasureable radionuclide(s) based on a measurable radionuclide.	Measurements of radiological activity to include TMU expressed in terms of one standard deviation.
Fissile Material Quantity (Pu-239 FGE)	≤1% Be/BeO by weight of the waste ≤200 g/55 gal drum (direct fill or configured as a pipe component) ≤325 g/SWB ≤325 g/SLB2 >1% Be/BeO by weight of the waste ≤100 g/55 gal drum (direct fill, up to 100 kg Be/BeO) ≤140 g/55 gal drum (configured as a POC) ≤100 g/SWB	For each container, the sum of ^{239}Pu FGE plus two times the TMU (expressed in terms of one standard deviation) is compared to the limit given. If a WIPP compliant TMU has not been developed, then a value of 30% should be used as the estimated one sigma TMU.
TRU Alpha Activity Concentration	>100 nCi of alpha-emitting TRU isotopes with half-lives greater than 20 years per gram of waste	Alpha activity calculated without regard to TMU.
Pu-239 Equivalent Activity (PE-Ci)	Untreated waste, all waste forms: ≤80 PE-Ci/55 gal drum ≤560 PE-Ci/direct loaded SWB ≤560 PE-Ci/direct loaded SLB2 ≤1,200 PE-Ci/undamaged 55 or 85 gal drum overpacked into a SWB, no single payload container within the SWB can exceed 1,100 PE-Ci* ≤1,800 PE-Ci/55 gal drum containing a POC Solidified/vitrified waste: ≤1,800 PE-Ci/any payload container	Contact the TRU waste program for guidance if a payload container is found to exceed PE-Ci limits. There are no reporting requirements for the associated TMU.

Table G-2. Radiological Properties

Waste Attribute	Waste Acceptance Criteria	Comments
Radiation Dose Rate	≤200 mrem/hr at the surface of the payload (waste) container ≤10 mrem/hr at 2 m Additional POC limits: ≤179 mrem/hr surface dose rate for S100 POCs ≤155 mrem/hr surface dose rate for S300 POCs	Measurements shall be made on each CH TRU waste container with instruments calibrated using sources traceable to a national standard. Internal payload container shielding shall not be used to meet dose rate requirements except for a POC. Contributions to the dose rate from all radiation sources (e.g., gamma, neutron, etc.) shall be included in the comparison to the limits.
Decay Heat	The allowable decay heat for SWBs and drums is limited by the waste material type and the number of confinement layers. See Table G-3 for the applicable limits. Maximum 40 watts per POC Maximum 80 watts per SLB2	Calculated using generator-supplied isotopic and loading data.

NOTE: The Hanford Site does not accept machine-compacted TRU waste.

*When overpacking one or more damaged waste containers, the direct loaded PE-Ci limits apply.

CH = contact handled
FGE = fissile gram equivalence
NDA = nondestructive assay
PE-Ci = plutonium equivalent curie
POC = pipe overpack container
SLB2 = standard large box 2
SWB = standard waste box
TMU = total measurement uncertainty
TRU = transuranic

Table G-3 presents the decay heat limits for several waste types and is derived from Table 5.2-1 of the CH-TRAMPAC (DOE, 2013). Details on determination of the applicable material type are found in Section 4.3 of the CH-TRAMPAC. When there are mixtures of material types, the values for the most restrictive material type (if present at 5 weight percent or greater) will be used.

Table G-3. Decay Heat and Confinement Layer Limits

Container Type	Typical Waste Material Description[a]	Confinement Layers	Decay Heat Limit (watts)[b]
55 gal	Absorbed, adsorbed, or solidified inorganic liquid[c]	0	0.206
55 gal	Absorbed, adsorbed, or solidified inorganic liquid[c]	1	0.1797
55 gal	Absorbed, adsorbed, or solidified inorganic liquid[c]	2	0.1594
55 gal	Absorbed, adsorbed, or solidified inorganic liquid[c]	3	0.0466
55 gal	Concreted inorganic particulate waste	0	0.8241

Table G-3. Decay Heat and Confinement Layer Limits

Container Type	Typical Waste Material Description[a]	Confinement Layers	Decay Heat Limit (watts)[b]
55 gal	Concreted inorganic particulate waste	1	0.7189
55 gal	Concreted inorganic particulate waste	2	0.6375
55 gal	Concreted inorganic particulate waste	3	0.1863
55 gal	Concreted inorganic particulate waste	4	0.1359
55 gal	Soils, solidified particulates, or sludges formed from precipitation	0	0.2536
55 gal	Soils, solidified particulates, or sludges formed from precipitation	1	0.2212
55 gal	Soils, solidified particulates, or sludges formed from precipitation	2	0.1962
55 gal	Soils, solidified particulates, or sludges formed from precipitation	3	0.0573
55 gal	Soils, solidified particulates, or sludges formed from precipitation	4	0.0418
55 gal	Solid inorganic materials in plastic bags	0	0.2251
55 gal	Solid inorganic materials in plastic bags	1	0.1924
55 gal	Solid inorganic materials in plastic bags	2	0.0869
55 gal	Solid inorganic materials in plastic bags	3	0.0561
55 gal	Solid inorganic materials in plastic bags	4	0.0414
55 gal	Solid organic materials	0	0.1126
55 gal	Solid organic materials	1	0.0962
55 gal	Solid organic materials	2	0.0434
55 gal	Solid organic materials	3	0.028
55 gal	Solid organic materials	4	0.0207
SWB	Absorbed, adsorbed, or solidified inorganic liquid	0	0.9132
SWB	Absorbed, adsorbed, or solidified inorganic liquid	2[d]	0.5185
SWB	Concreted inorganic particulate waste	0	3.6528
SWB	Soils, solidified particulates, or sludges formed from precipitation	0	1.124
SWB	Solid inorganic materials in plastic bags	0	1.0206
SWB	Solid inorganic materials in plastic bags	1	0.7029

Table G-3. Decay Heat and Confinement Layer Limits

Container Type	Typical Waste Material Description[a]	Confinement Layers	Decay Heat Limit (watts)[b]
SWB	Solid inorganic materials in plastic bags	2	0.5361
SWB	Solid inorganic materials in plastic bags	3	0.1222
SWB	Solid inorganic materials in plastic bags	4	0.069
SWB	Solid organic materials	0	0.5103
SWB	Solid organic materials	1	0.3515
SWB	Solid organic materials	2	0.268
SWB	Solid organic materials	3	0.0611
SWB	Solid organic materials	4	0.0345
55 gal	Solid inorganic materials in metal cans (no organic materials inside cans and no radioactive material outside of cans)	N/A	40

a. If the waste contains mixtures of waste material types, use the most conservative limits of the material types that are present in the waste at a concentration of 5% or greater.

b. Limits are from Table 5.2-1 of DOE, 2013, *CH-TRAMPAC*.

c. If organic sorbents are used and are present at 5 weight percent or more, the decay heat limits for solid organic materials will be used. The number of confinement layers may not exceed three.

d. There is no limit specified for this waste type with one layer of confinement in the current TRAMPAC document; if one layer is present, use the applicable limit for two layers.

N/A = not applicable

SWB = standard waste box

TRAMPAC = Transuranic Package Transporter

Table G-4. Physical Properties

Waste Attribute	Waste Acceptance Criteria	Compliance Methods
Liquids	Liquid waste is prohibited in payload containers, as follows: All liquids shall be sorbed or stabilized. Corrosive liquids must be neutralized and sorbed or stabilized. Liquids that exhibit the characteristic of corrosivity shall have the pH adjusted to be within the range of >2 to <12.5. (The pH range of 4-10 is suggestion for best practices, but is not a hard requirement. If a liquid is already within the range of >2.0 to <12.5, then no adjustment to the pH is required). Documentation that must be provided includes the following: the pH of the liquid before and after neutralization, the amount of liquid neutralized, the amount and type of neutralization agent used, and the amount and type of sorbent used. Residual oxidizers shall comply with the limits listed in Table E-2.	RCRA empty containers that held strong corrosive liquids or oxidizers should be rinsed; the rinsate should be added to the treatment batch for the neutralization. Add inorganic sorbent to RCRA empty containers in TRU waste to eliminate residual liquids.
Internal Containers	No sealed containers greater than 4 L, except for Waste Material Type II.2 (solid, inorganic waste) packaged in metal cans. Containers greater than 4 L, including rigid liners, shall be vented or punctured. Vents or punctures must be visible by radiography. Heat sealed, filtered bags may be used to package Waste Material Types I.3 (concreted inorganic particulate waste), II.1 (solid inorganic waste), III.1 (solid organic materials), and III.3 (homogeneous mixed inorganic waste) and must have at least one filter vent.	See Section 4.3 of DOE, 2013 for Waste Material Type definitions. For containers >4L vented with a hole, a toggle bolt should be inserted into the hole to aid during NDE/RTR.
Compressed Gases (Pressurized Containers)	Compressed gases in pressurized containers (e.g., aerosol cans) are prohibited.	Venting methods of the pressurized container must be observable by RTR.
Sharp/Heavy Objects	Sharp/heavy objects must be blocked, braced, or suitably packaged to provide puncture protection for the payload container.	
Dense Objects Impenetrable by Standard RTR	Dense objects that cannot be penetrated by standard RTR should not be packaged into CH TRU waste. Examples are small lead pigs, or lead sheeting.	

Table G-4. Physical Properties

Waste Attribute	Waste Acceptance Criteria	Compliance Methods

Reference: DOE, 2013, *CH-TRAMPAC*.

CH = contact handled

NDE = nondestructive examination

RCRA = *Resource Conservation and Recovery Act of 1976*

RTR = real-time radiography

TRU = transuranic

Table G-5. Chemical Properties

Waste Attribute	Waste Acceptance Criteria	Compliance Methods
Hazardous Waste	Limited to EPA hazardous waste numbers identified as allowable in the WIPP Hazardous Waste Facility Permit. Hazardous waste not occurring as co-contaminants with TRU wastes are not acceptable at WIPP.	WIPP allowable hazardous waste numbers are listed in Table G-6. Washington State dangerous waste codes are allowable at WIPP.
Ignitable (D001), Corrosives (D002), Reactive (D003) and Compressed Gases	Wastes assigned EPA waste numbers D001 (ignitable), D002 (corrosive), and D003 (reactive), and compressed gases (pressurized containers) are prohibited.	
Polychlorinated Biphenyls	Information from the generator must include the earliest date of waste generation (i.e., the date of removal from service for disposal), the estimated weight of PCBs in kg, and a description of the type of PCB waste (e.g., PCB remediation waste, PCB articles, PCB bulk product waste).	

EPA = U.S. Environmental Protection Agency

PCB = polychlorinated biphenyl

TRU = transuranic

WIPP = Waste Isolation Pilot Plant

Table G-6. Acceptable RCRA Hazardous Waste Numbers for the Waste Isolation Pilot Plant

"D" Series	"F" Series	"P" Series	"U" Series
D004	F001	P015	U002*
D005	F002	P030	U003*
D006	F003	P098	U019*
D007	F004	P099	U037
D008	F005	P106	U043
D009	F006	P120	U044
D010	F007		U052
D011	F009		U070
D018			U072
D019			U078
D021			U079
D022			U103
D026			U105
D027			U108
D028			U122
D029			U133*
D030			U134*
D032			U151
D033			U154*
D034			U159*
D035			U196
D036			U209
D037			U210
D038			U220
D039			U226
D040			U228
D043			U239*

*Acceptance of U numbered wastes listed for reactivity, ignitability, or corrosivity is contingent upon a demonstration that the wastes no longer exhibit those characteristics.

RCRA = *Resource Conservation and Recovery Act of 1976*

Beyond the documentation requirements, CH TRU/TRUM must meet the waste acceptance criteria presented in Tables G-1 through G-6 and the following requirements:

CHPRC approval is required for any procured (i.e., chemicals, absorbents fixatives, internal packaging) item(s) added to a package other than its original waste contents (e.g. fixatives, neutralizers, sorbents). The generator shall provide documentation, prior to use, of the procured item(s) to meet CHPRC Quality Level 3 (QL-3) standards. QL-3 is assigned to items and services that are important to the project mission and represent sufficient risk that controls beyond standard commercial practices are considered necessary to ensure the item or service is suitable for its intended purpose.

Note: QL-3 is a graded approach to determine what quality level is desired for documentation, evidence of compliance, qualifications, inspections, etc., on the part of CHPRC to have a documented basis that the service provided will meet its intended function. Examples where a need for a documented basis would influence the designation as being QL-3 or above include, but not limited to, the following:

- Certified Material Test Reports
- Material Pedigree
- Certificates of Conformance
- Inspection Reports
- Test Reports

Additional notes for TRU waste include the following:

- The TRU alpha activity concentration of the waste is based on the weight of the waste. Calculation of the waste weight must be consistent with DOE O 435.1, the waste weight is typically determined by subtracting the tare weight of the waste container (including the weight of the liner and any shielding, if applicable) from the gross weight of the container.
- Waste that cannot be verified using radiography must be packaged using visual examination. This requirement, if applicable, will be communicated to the generator as a waste stream profile condition of approval. Waste Acceptance personnel are available to conduct visual examinations (i.e., waste verification) at the generator location.
- Unusually heavy or dense items that are not penetrable by standard real-time radiography (RTR) systems should not be packaged as CH TRU waste. These objects cause waste packages to fail during the WIPP certification process.
- Packaging requirements will be established and communicated to the generator on the waste stream profile sheet. Generators must obtain waste stream profile approval prior to generating and/or packaging their CH TRU waste.
- Small amounts of shielding may be used for as low as reasonably achievable purposes only, but it must not interfere with waste characterization or certification. If shielding is present, the generator must provide the type of shielding, thickness, and number of layers present. The dose rates of the items being shielded, before and after shielding, must also be provided.
- Waste that has been shielded to CH dose levels due to items within the waste that exceed the 200 mrem/hr dose rate limit are still considered remote-handled waste if the unshielded dose rate of the container would exceed 200 mrem/hr.
- The CHPRC Waste & Fuels Management Project must be consulted before any waste containing plutonium in excess of 20% by weight is submitted for storage or disposal.

- Waste must be segregated by the profile and waste specification record, including segregation of defense from nondefense waste. Nondefense TRU waste is prohibited from shipment to WIPP but may be shipped to a SWOC facility for storage using the exception process in Section 1.6 of the main text.

The generator must supply sufficient information for CCP to prepare, document, and obtain approval for an appropriate defense determination. Defense TRU waste is waste generated (in whole or in part) by the U.S. Department of Energy (DOE), and predecessor agencies, while carrying out any of the following: naval reactors development; weapons activities, including defense inertial confinement fusion; verification and control technology; defense nuclear material production; defense nuclear waste and materials byproduct management; defense nuclear materials security investigations; and defense research and development.

G2 References

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*. Available at: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title10/10cfr835_main_02.tpl.

40 CFR 262.32, "Standards Applicable to Generators of Hazardous Waste," "Marking," Subpart C, "Pre-Transport Requirements," *Code of Federal Regulations*. Available at: https://ecfr.io/Title-40/pt40.27.262#se40.28.262_132.

40 CFR 761.40, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," "Applicability," Subpart C, "Marking of PCBs and PCB Items, Marking Requirements," *Code of Federal Regulations*. Available at: https://ecfr.io/Title-40/pt40.27.761#se40.34.761_140.

49 CFR 173, "Transportation," "Shippers—General Requirements for Shipments and Packagings," *Code of Federal Regulations*. Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=000ee20ca9d4544d4908fb1ef43f45ad&mc=true&tpl=/ecfrbrowse/Title49/49cfr173_main_02.tpl.

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EPA-600/2-80-076, 1980, *A Method for Determining the Compatibility of Hazardous Waste*, Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=91018H00.TXT.

Resource Conservation and Recovery Act of 1976, 42 USC 6901 et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

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Appendix H

Approved Vents

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Contents

Table

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H1 Approved Vents

Containers requiring a vent will have a vent installed (HNF-14741, *Solid Waste Operations Complex Master Documented Safety Analysis*). Containers of transuranic (TRU) and transuranic mixed wastes will have a vent (or multiple vents) installed to meet the venting requirements contained in DOE, 2013, *CH-TRAMPAC*; DOE, 2007, *TRUPACT-III TRAMPAC*; and DOE, 2010, *RH-TRAMPAC*. Table H-1 provides a list of the approved vents. The NucFil™-019 DS is the preferred vent for newly generated transuranic waste packages; other vents will be approved on a case-by-case basis in the waste profile.

Table H-1. Approved Vents

Manufacturer	Model Number	H_2 Diffusivity (mole/sec/mol fraction)
Fairey	99421	1.85E-05
Nuclear Filter Technology	NucFil-007	3.70E-06
Nuclear Filter Technology	NucFil-007LS	3.70E-06
Nuclear Filter Technology	NucFil-007LW	3.70E-06
Nuclear Filter Technology	NucFil-007S	3.70E-06
Nuclear Filter Technology	NucFil-007W	3.70E-06
Nuclear Filter Technology	NucFil-007WS	3.70E-06
Nuclear Filter Technology	NucFil-012	1.90E-06
Nuclear Filter Technology	NucFil-013	3.70E-06
Nuclear Filter Technology	NucFil-013 GorTex	7.70E-06
Nuclear Filter Technology	NucFil-013 SS	3.70E-06
Nuclear Filter Technology	NucFil-015 D S	1.48E-05
Nuclear Filter Technology	NucFil-016	1.85E-05
Nuclear Filter Technology	NucFil-016LPDS	3.70E-06
Nuclear Filter Technology	NucFil-016 SS HP	1.65E-04
Nuclear Filter Technology	NucFil-019	1.85E-05
Nuclear Filter Technology	NucFil-019 DS	7.40E-06
Nuclear Filter Technology	NucFil-019-EPD	7.40E-06
Nuclear Filter Technology	NucFil-019-EPDDS	7.40E-06
Nuclear Filter Technology	NucFil-019S DS	1.85E-05
Nuclear Filter Technology	NucFil-020	1.90E-06
Nuclear Filter Technology	NucFil-020DS	1.90E-06

™ NucFil is a trademark of Nuclear Filter Technology Inc., Golden, Colorado.

Table H-1. Approved Vents

Manufacturer	Model Number	H_2 Diffusivity (mole/sec/mol fraction)
Nuclear Filter Technology	NucFil-020S	1.90E-06
Nuclear Filter Technology	NucFil-049	3.70E-06
Nuclear Filter Technology	NucFil-049S	3.70E-06
Nuclear Filter Technology	NucFil-051	1.90E-06
Nuclear Filter Technology	NucFil-072	3.70E-06
Nuclear Filter Technology	NucFil-072SSS	3.70E-06
Nuclear Filter Technology	NucFil-073	3.70E-06
Nuclear Filter Technology	NucFil-075	3.70E-06
Nuclear Filter Technology	NucFil-08DS	3.70E-06
Nuclear Filter Technology	NucFil-307DS	3.70E-06
Nuclear Filter Technology	NucFil-347DS	3.70E-06
Nuclear Filter Technology	NucFil-357DS	3.70E-06
Nuclear Filter Technology	NucFil-357S	3.70E-06
Nuclear Filter Technology	NucFil-407DS	3.70E-06
Nuclear Filter Technology	NucFil-7DS	3.70E-06
Nuclear Filter Technology	NucFil-DVS3	3.70E-06
Nuclear Filter Technology	NucFil-DVS3A	3.70E-06
Nuclear Filter Technology	NucFil-DVS307	3.07E-06
Nuclear Filter Technology	NucFil-NFS7A	3.70E-06
UltraTech	9400	3.70E-06
UltraTech	9402	1.90E-06
UltraTech	9408	1.85E-05
UltraTech	9412	3.70E-06
UltraTech	9412L	3.70E-06
UltraTech	9412LX	3.70E-06
UltraTech	9416	1.85E-05
UltraTech	9416T	1.85E-05
UltraTech	9423	1.85E-05
UltraTech	9423T	1.85E-05

Table H-1. Approved Vents

Manufacturer	Model Number	H_2 Diffusivity (mole/sec/mol fraction)
UltraTech	9424	1.85E-05
UltraTech	9424X	1.85E-05
UltraTech	9450	3.70E-06
UltraTech	9460	9.25E-05
UltraTech	9500	1.85E-05
UltraTech	9550	1.85E-05
UltraTech	9810	7.4E-06
UltraTech	9812	7.4E-06
UltraTech	9815	7.4E-06
UltraTech	9817	7.4E-06

Notes: NucFil is a trademark of Nuclear Filter Technology Inc., Golden, Colorado.

Install all filters in accordance with DOE/WIPP 11-3384, Rev. 16, *CBFO Approved Filter Vents*, or contact the TRU program for assistance.

H2 References

DOE, 2010, *TRUPACT-III TRAMPAC*, Rev. 2, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

DOE, 2013, *CH-TRAMPAC*, Rev. 4, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

DOE, 2015, *RH-TRAMPAC*, Rev. 3, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

DOE/WIPP 11-3384, 2018, *CBFO Approved Filter Vents*, Rev. 16, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

HNF-14741, 2017, *Solid Waste Operations Complex Master Documented Safety Analysis*, Rev. 12, CH2M HILL Plateau Remediation Company, Richland, Washington.

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Appendix I

Remote-Handled Transuranic Waste Acceptance Criteria

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Contents

Tables

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Terms

AK	acceptable knowledge
CCP	Central Characterization Program
CHPRC	CH2M HILL Plateau Remediation Company
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FGE	fissile gram equivalence
PCB	polychlorinated biphenyl
PE-Ci	plutonium equivalent curie
RCRA	*Resource Conservation and Recovery Act of 1976*
RH	remote-handled
SC	shielded container
SWOC	Solid Waste Operations Complex
TMU	total measurement uncertainty
TRU	transuranic
TRUM	transuranic mixed
TSD	treatment, storage, and/or disposal
WIPP	Waste Isolation Pilot Plant

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I1 Remote-Handled Transuranic Waste Certification Criteria

As a generator of transuranic (TRU) and transuranic mixed (TRUM)[1] waste destined for disposal at the Waste Isolation Pilot Plant (WIPP), the Hanford Site must ensure that its remote-handled (RH) TRU waste meets the requirements of DOE O 435.1, *Radioactive Waste Management*; DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (hereinafter called WIPP waste acceptance criteria); and DOE, 2013, *CH-TRAMPAC*, specific physical, chemical, radiological, and packaging criteria for acceptance of defense RH TRU waste shipments at WIPP.

Although the Hanford Site both generates TRU waste and manages TRU waste from various generators at the Central Waste Complex and other treatment, storage, and/or disposal (TSD) facilities, the Central Characterization Program (CCP) will be responsible for characterizing and certifying the waste for disposal at WIPP. Efforts on the part of the Hanford Site TRU program will focus on supporting CCP in its efforts.

In addition to the Solid Waste Operations Complex (SWOC) TSD requirements identified previously in this document, specific RH TRU waste acceptance criteria are described below:

- RH TRU waste must be packaged in 30 gal drums in shielded containers (SCs) or in temporary overpack containers shielded to <200 mrem/hr for storage in the appropriate facility within SWOC.

  Note: RH TRU/TRUM will be transported to WIPP using WIPP SCs. These containers are a WIPP-specific design incorporating lead shielding and internal space for a single 30 gal container of waste. The SC is packaged for transport to WIPP into a HalfPACT shipping package in accordance with DOE, 2013, *CH-TRAMPAC*.

- RH TRU waste must be visually examined by Waste Acceptance personnel during packaging.

Robust documentation is required to develop the acceptable knowledge (AK) file in support of TRU waste characterization and eventual CCP certification. As such, all procured items shall be meet CH2M HILL Plateau Remediation Company (CHPRC) Quality Level-3 standards. The additional documentation that RH TRU generators must provide includes the following:

- Work packages and procedures, and revisions to those procedures, describing how the waste was generated and packaged.

- Waste stream or container-specific documentation of waste contents, including container data sheets, contents inventory sheets, Waste Planning Checklists, Waste Packaging/Labeling Instructions, Radioactive Waste Disposal Request forms, Radioactive Waste Characterization Worksheets, treatment batch travelers, facility safety and analysis reports, work and test plans, work/field instructions (e.g., field changes, timely orders/standard orders), and site waste management policies/plans (e.g., facility waste acceptance criteria), as applicable

- Characterization documents prepared by the waste generating organizations, including radioassay results (if available), sampling and analysis plans, and analytical results

[1] Unless otherwise specified, the term TRU refers to both TRU and TRUM waste.

- Documentation of the derivation of any scaling factors that are used for radiological characterization. This should be a document that explains how the scaling factors were determined and should reference all testing and analysis, or computer modeling that was done to obtain the factors. Analytical results used for the development of scaling factors shall be updated based on changes to throughput in the waste generating process to reflect changes in the waste. Scaling factors must be checked periodically and updated as needed.

- An evaluation of chemical compatibility of the waste in accordance with EPA-600/02-80-076, *A Method for Determining the Compatibility of Hazardous Waste*. Chemicals evaluated shall be those actually present in the waste, rather than chemical precursors or process inputs. This evaluation must be submitted to the TRU program for review and approved in conjunction with the waste profile approval by the Waste Acceptance organization. The following elements are to be included in the chemical compatibility evaluation:

  – Identification of the chemicals present in the waste
  – Assignment of the reactivity group numbers to each chemical
  – Identification of any potential adverse reactions and documentation that reactions have been adequately dispositioned.

- An evaluation of oxidizing chemicals in waste streams containing oxidizing chemicals performed in accordance with DOE/WIPP-17-3589, *Basis of Knowledge For Evaluating Oxidizing Chemicals in TRU Waste*. This evaluation must be submitted to the TRU program for review and approved in conjunction with the waste profile approval by the Waste Acceptance organization. If this evaluation indicates that oxidizers are present in the waste, the waste must be treated as appropriate to eliminate the oxidizer properties before the waste is submitted for acceptance. The following elements are to be included in the evaluation:

  – Identification of oxidizers present in the waste
  – Description of the waste, including absorbents used and the chemical form of the oxidizer
  – Description of any treatment performed to eliminate the oxidizing potential
  – Estimation of the oxidizer present

- All correspondence (e.g., emails, memos, phone logs) related to treatment of the waste (such as elementary neutralization, deactivation of pyrophoric and reactive waste, reacting of oxidizers to remove oxidizing potential). This should include details regarding the treatment proposed, inputs to the treatment process, and details regarding the treatment process (e.g., amounts of reagents used, pre- and post-treatment conditions, results of the treatment, final packaging).

- Documentation of any treatment performed to address prohibited items or nonconforming conditions (e.g., if prohibited liquids are identified in the waste, results of any testing or analysis performed to identify the liquid, and for corrosive liquids the pH before treatment, the type and amount of neutralizers added [if any], and the pH after treatment).

- All correspondence related to selection of absorbents used in the waste, including identification (product name) of the absorbent and its material safety data sheet/safety data sheet.

- For shielded items, include the measured dose rates before and after shielding, the type(s) of shielding used, the thickness of each layer, and the number of layers used. If engineered shielded containers are used, a drawing must be provided in the waste profile for each type of container used.

- The model number and serial number of each filter vent or combination of filter vents installed on a payload container.
- Documentation demonstrating compliance with the requirements in Tables I-1 through I-5.
- The information provided shall include the document number, revision and date, title/description, generator point-of-contact, verification date, and source document tracking number, if known.

Beyond the documentation requirements, RH TRU/TRUM must meet the waste acceptance criteria presented in Tables I-1 through I-5 and the following requirements:

CHPRC approval is required for any procured (i.e., chemicals, absorbents fixatives, internal packaging, etc.) item(s) added to a package other than its original waste contents (e.g. fixatives, neutralizers, sorbents). The generator shall provide documentation, prior to use, of the procured item(s) to meet CHPRC Quality Level 3 (QL-3) standards. QL-3 is assigned to items and services that are important to the project mission and represent sufficient risk that controls beyond standard commercial practices are considered necessary to ensure the item or service is suitable for its intended purpose.

Note: QL-3 is a graded approach to determine what quality level is desired for documentation, evidence of compliance, qualifications, inspections, etc., on the part of CHPRC to have a documented basis that the service provided will meet its intended function. Examples where a need for a documented basis would influence the designation as being QL-3 or above include, but not limited to, the following:

- Certified Material Test Reports
- Material Pedigree
- Certificates of Conformance
- Inspection Reports
- Test Reports

Additional notes for TRU waste include the following:

- The TRU alpha activity concentration of the waste is based on the weight of the waste. The waste weight is typically determined by subtracting the tare weight of the waste containers (including the weight of the rigid liner and any shielding external from the waste, if applicable) from the gross weight of the container.
- Waste that cannot be verified using radiography must be packaged using visual examination. This requirement, if applicable, will be communicated to the generator as a waste stream profile condition of approval. Waste Acceptance personnel are available to conduct visual examinations (i.e., waste verification) at the generator location.
- Packaging requirements will be established and communicated to the generator on the waste stream profile sheet. Generators must obtain waste stream profile approval prior to generating and/or packaging their RH TRU waste.
- The CHPRC Waste & Fuels Management Project must be consulted before any waste containing plutonium in excess of 20% by weight is submitted for storage or disposal.
- Waste must be segregated by the profile and waste specification record, including segregation of defense from nondefense waste. Nondefense TRU waste is prohibited from shipment to WIPP but may be shipped to a SWOC facility for storage using the exception process in Section 1.6 of the main text.

- The generator must supply sufficient information for the CCP to prepare, document, and obtain approval for an appropriate defense determination. Defense TRU waste is waste generated (in whole or in part) by the U.S. Department of Energy (DOE), and predecessor agencies, while carrying out any of the following: naval reactors development; weapons activities, including defense inertial confinement fusion; verification and control technology; defense nuclear material production; defense nuclear waste and materials byproduct management; defense nuclear materials security investigations; and defense research and development.

Table I-1. Container Properties

Waste Attribute	Waste Acceptance Criteria	Comments
Payload Container Description	30 gal drum overpacked in a WIPP SC	WIPP SCs are procured through the DOE Carlsbad Field Office Centralized Procurement Program.
Container Weights	2,260 lb per loaded SC 524 lb per loaded 30 gal drum	SC weight limit based on currently approved container design. Additional designs are being considered.
Removable Surface Contamination	$\leq$20 dpm/100 cm^2 for alpha $\leq$200 dpm/100 cm^2 for beta-gamma	The fixing of surface contamination to meet these limits is not allowed. For WIPP purposes only – the use of dry swipes for hard-to-detect nuclides is acceptable.
Confinement Requirements	Maximum layers of confinement allowed is four, including the liners. Newly generated waste must be packaged with filtered bags or horsetailed.	A smaller number of confinement layers may be required as a waste stream profile condition of approval. Filtered bags are considered layers of confinement.
Filter Vents	All containers to be vented with one or more filter vents that meet the WIPP Hazardous Waste Facility Permit and DOE (201) (Section 2.5.1) or DOE (2010) (Section 2.4.1) specifications, as appropriate.	WIPP-approved filter vents are listed in Appendix H.

References: 10 CFR 835, "Occupational Radiation Protection."

40 CFR 262.32, Subpart C, "Standards Applicable to Generators of Hazardous Waste, Pre-Transport Requirements, Marking."

40 CFR 761.40, Subpart C, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions, Marking of PCBs and PCB Items, Marking Requirements."

DOE, 2010, *TRUPACT-III TRAMPAC*.

DOE/WIPP-09-3427, *Waste Data System User's Manual.*

DOE	=	U.S. Department of Energy	TRU	=	transuranic
PCB	=	polychlorinated biphenyl	WIPP	=	Waste Isolation Pilot Plant
SC	=	shielded container			

Table I-2. Radiological Properties

Waste Attribute	Waste Acceptance Criteria	Comments
Radionuclide Composition	Information on radionuclide composition, with emphasis on the activities and masses of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs. Information also required for radionuclides contributing to the TRU alpha activity concentration, ^{239}Pu FGE, ^{239}Pu equivalent curies, and the decay heat. Other radionuclides contributing to 95% of the radioactive hazard for the payload container shall be reported.	Measurements of radiological activity to include TMU expressed in terms of one standard deviation. Note: DE-Ci are limited to 82.5 per container for acceptance at SWOC facilities.
Fissile Material Quantity (Pu-239 FGE)	≤1% Be/BeO by weight of the waste ≤200 g/30 gal drum >1% Be/BeO by weight of the waste Not authorized for shipment	For each container, the sum of ^{239}Pu FGE plus two times the TMU (expressed in terms of one standard deviation) is compared to the limit given.
TRU Alpha Activity Concentration	>100 nCi of alpha-emitting TRU isotopes with half-lives greater than 20 years per gram of waste	Alpha activity calculated without regard to TMU.
Pu-239 Equivalent Activity (PE-Ci)	≤80 PE-Ci	Contact the TRU waste program for guidance if a payload container is found to exceed PE-Ci limits. There are no reporting requirements for the associated TMU.
Radiation Dose Rate	≤200 mrem/hr at the surface of the SC ≤10 mrem/hr at 2 m	Measurements shall be made on each RH TRU waste container with instruments calibrated using sources traceable to a national standard.
Decay Heat	Maximum 30 watts per drum.	Calculated using generator-supplied isotopic and loading data.
Total Activity	≤23 Ci/L	RH TRU waste shall not exceed 23 Ci/L maximum activity level averaged over the volume of the payload container.

Note: The Hanford Site does not accept machine-compacted TRU waste.

FGE = fissile gram equivalence
PE-Ci = plutonium equivalent curie
RH = remote handled
SC = shielded container
SWOC = Solid Waste Operations Complex
TMU = total measurement uncertainty
TRU = transuranic

Table I-3. Physical Properties

Waste Attribute	Waste Acceptance Criteria	Compliance Methods
Liquids	Liquid waste is prohibited in payload containers, as follows: All liquids shall be sorbed or stabilized. Corrosive liquids must be neutralized and sorbed or stabilized. Liquids that exhibit the characteristic of corrosivity shall have the pH adjusted to be within the range of >2 to <12.5. (The pH range of 4-10 is a suggestion for best practices, but is not a hard requirement. If a liquid is already within the range of >2.0 to <12.5, then no adjustment to the pH is required). Documentation must be provided includes the following: the pH of the liquid before and after neutralization, the amount of liquid neutralized, the amount and type of neutralization agent used, and the amount and type of sorbent used. Residual oxidizers shall comply with the limits listed in Table E-2.	RCRA empty containers that held strong corrosive liquids or oxidizers should be rinsed; the rinsate should be added to the treatment batch for the neutralization. Add inorganic sorbent to RCRA empty containers in TRU waste to eliminate residual liquids.
Internal Containers	No sealed containers greater than 4 L, except for Waste Material Type II.2 (solid, inorganic waste) packaged in metal cans. Containers greater than 4 L, including rigid liners, shall be vented or punctured. Vents or punctures must be visible by radiography. Heat sealed, filtered bags may be used to package Waste Material Types I.3 (concreted inorganic particulate waste), II.1 (solid inorganic waste), III.1 (solid organic materials), and III.3 (homogeneous mixed inorganic waste) and must have at least one filter vent.	See DOE (201) (Section 2.8) for Waste Material Type definitions.
Compressed Gases (Pressurized Containers)	Compressed gases in pressurized containers (e.g., aerosol cans) are prohibited.	Venting methods of the pressurized container must be observable.
Sharp/Heavy Objects	Sharp/heavy objects must be blocked, braced, or suitably packaged to provide puncture protection for the payload container.	
Volume Utilization	The volume utilization percentage (as percent full) of the 30 gal drum must be reported.	Information required to implement dose-to-curie calculations.

Reference: DOE, 2012, *CH-TRAMPAC*.

CH = contact handled

RCRA = *Resource Conservation and Recovery Act of 1976*

RTR = real-time radiography

TRU = transuranic

Table I-4. Chemical Properties

Waste Attribute	Waste Acceptance Criteria	Compliance Methods
Hazardous Waste	Limited to EPA hazardous waste numbers identified as allowable in the WIPP Hazardous Waste Facility Permit. Hazardous waste not occurring as co-contaminants with TRU wastes are not acceptable at WIPP.	WIPP allowable hazardous waste numbers are listed in Table I-5. Washington State dangerous waste codes are allowable at WIPP.
Ignitable (D001), Corrosives (D002), Reactive (D003) and Compressed Gases	Wastes assigned EPA waste numbers D001 (ignitable), D002 (corrosive), and D003 (reactive), and compressed gases (pressurized containers) are prohibited.	
Polychlorinated Biphenyls	Information from the generator must include the earliest date of waste generation (i.e., the date of removal from service for disposal), the estimated weight of PCBs in kg, and a description of the type of PCB waste (e.g., PCB remediation waste, PCB articles, PCB bulk product waste).	

EPA = U.S. Environmental Protection Agency
PCB = polychlorinated biphenyl
TRU = transuranic
WIPP = Waste Isolation Pilot Plant

Table I-5. Acceptable RCRA Hazardous Waste Numbers for the Waste Isolation Pilot Plant

"D" Series	"F" Series	"P" Series	"U" Series
D004	F001	P015	U002*
D005	F002	P030	U003*
D006	F003	P098	U019*
D007	F004	P099	U037
D008	F005	P106	U043
D009	F006	P120	U044
D010	F007		U052
D011	F009		U070
D018			U072
D019			U078
D021			U079
D022			U103

Table I-5. Acceptable RCRA Hazardous Waste Numbers for the Waste Isolation Pilot Plant

"D" Series	"F" Series	"P" Series	"U" Series
D026			U105
D027			U108
D028			U122
D029			U133*
D030			U134*
D032			U151
D033			U154*
D034			U159*
D035			U196
D036			U209
D037			U210
D038			U220
D039			U226
D040			U228
D043			U239*

*Acceptance of U numbered wastes listed for reactivity, ignitability, or corrosivity is contingent upon a demonstration that the wastes no longer exhibit those characteristics.

RCRA = *Resource Conservation and Recovery Act of 1976*

I2 References

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40 CFR 761.40, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," "Applicability," Subpart C, "Marking of PCBs and PCB Items, Marking Requirements," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol30/xml/CFR-2010-title40-vol30-sec761-40.xml.

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