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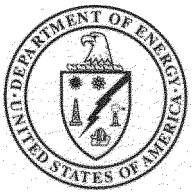
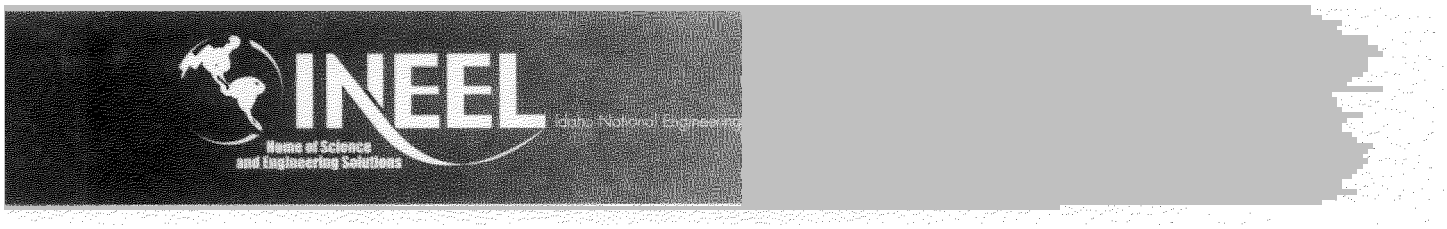


U.S. Department of Energy
Idaho Operations Office

Waste Acceptance Criteria for ICDF Landfill



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Revision 5
Project No. 23350

Waste Acceptance Criteria for ICDF Landfill

March 2004

Prepared for the
U.S. Department of Energy
Idaho Operations Office

ABSTRACT

The INEEL CERCLA Disposal Facility landfill will accept Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste generated within the Idaho National Engineering and Environmental Laboratory (INEEL). Hazardous, mixed, low-level, and Toxic Substance Control Act waste will be accepted for disposal at the INEEL CERCLA Disposal Facility landfill. The purpose of this document is to provide the basis for the quantities of radioactive and nonradioactive waste allowable in waste designated for disposal in the INEEL CERCLA Disposal Facility landfill.

The *ICDF Complex Waste Acceptance Criteria* document contains the overall waste acceptance criteria. As such, the compliance details that are the same for all areas of the INEEL CERCLA Disposal Facility Complex are referenced to that document.

This document specifies the chemical and radiological waste acceptance criteria for waste that will be disposed of at the landfill. Compliance with the requirements of this document will ensure protection of human health and the environment, including the Snake River Plain Aquifer. Waste placed in the INEEL CERCLA Disposal Facility landfill must not cause groundwater in the Snake River Plain Aquifer to exceed maximum contaminant levels, a hazard index of 1, or 10^{-4} cumulative risk levels.

The defined waste acceptance criteria concentrations are compared to the design inventory concentrations. The purpose of this comparison is to show that there is an acceptable uncertainty margin based on the actual constituent concentrations anticipated for disposal at the INEEL CERCLA Disposal Facility.

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FIGURES

TABLES

ACRONYMS

AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
GCL	geosynthetic clay liner
HI	hazard index
ICDF	INEEL CERCLA Disposal Facility
IDAPA	Idaho Administrative Procedures Act
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LDR	land disposal restriction
MCL	maximum contaminant level
NA	not applicable
NE-ID	U.S. Department of Energy Idaho Operations Office
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRC	Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act

RDX	Royal Demolition Explosive
ROD	Record of Decision
SRPA	Snake River Plain Aquifer
SSSTF	Staging, Storage, Sizing, and Treatment Facility
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TRU	transuranic
TSCA	Toxic Substances Control Act
USC	United States Code
UTS	universal treatment standard
WAG	waste area group

NOMENCLATURE

The following definitions are presented as an aid to the reader for understanding the technical and scientific terms used within this document.

Analytical residue and sample preservative residue: Aqueous and organic solutions from sample preservatives and analytical residue generated from field preparation and laboratory analyses.

CERCLA-derived remediation and removal waste: Waste from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities that may include, but are not limited to, the following: soil, water, debris, contaminated personal protective equipment (PPE), filters, and other support equipment that cannot be decontaminated.

Construction waste: Waste generated during the on-Site construction of CERCLA activities.

Contaminated equipment: Contaminated equipment becomes a waste stream if it cannot be properly decontaminated or reused.

Debris: Solid material exceeding a 60-mm particle size that is a manufactured object, plant, or animal matter, or natural geologic material intended for disposal. However, the following materials are not considered to be debris:

- Any material for which a specific treatment standard is provided in 40 *Code of Federal Regulations* (CFR) 268, Subpart D (such as lead acid batteries, cadmium batteries, and radioactive lead solids)
- Process residuals, such as smelter slag and residues from the treatment of waste, wastewater, sludge, or air emission residues
- Intact containers of hazardous waste that retain at least 75% of their original volume.

A mixture of debris and other material that has not been treated to the standards provided by 40 CFR 268.45 is subject to regulation as debris, if the mixture is composed primarily of debris, by volume based on visual inspection.

Drill cuttings: Soil generated from boring and drilling activities. Perched water and Snake River Plain Aquifer (SRPA) water well installation is expected to generate a substantial volume of drill cuttings.

Free liquids: Liquids that can be readily separated from the solid portion of a waste under ambient temperature and pressure (DOE Order 435.1), as demonstrated by "Environmental Protection Agency Paint Filter Liquids Test Method 9095."

Hazardous debris: Debris that contains a hazardous waste listed in 40 CFR 261, Subpart D or that exhibits a characteristic of hazardous waste identified in 40 CFR 261, Subpart C.

Hazard index: The sum of more than one hazard quotient where the U.S. Environmental Protection Agency (EPA) goal is a value not to exceed 1.

Hazard quotient: The ratio of a single substance exposure level, over a given time period, to a reference exposure level at which no adverse effects are likely to occur.

Hazardous substances: Any material designated as such pursuant to CERCLA, including all Resource Conservation and Recovery Act (RCRA) hazardous waste, radionuclides, a variety of other chemical substances, and any material identified as a hazardous substance (such as petroleum, petroleum products, and all hazardous waste).

Hazardous waste: Waste designated as hazardous by EPA regulations (40 CFR 261.3) and regulated under RCRA.

High-level waste: Highly radioactive waste material. High-level waste results from the reprocessing of spent nuclear fuel, including the liquid waste produced directly during reprocessing. In accordance with DOE Order 435.1, the term refers to any solid material derived from such liquid waste that contains fission products in sufficient concentrations and to other highly radioactive material that is determined, consistent with existing law, to require permanent isolation. (Adapted from *Nuclear Waste Policy Act of 1982*, as amended.)

Hydraulic spills: Unintentional releases of hydraulic fluid. Spills that occur when hydraulic fluid leaks from equipment seals or through ruptured hoses.

Investigation-derived waste: Materials that are generated from CERCLA investigations, such as drill cuttings, purge water, development water, overburden, interstitial and underburden soil, and waste (debris, sludge, etc.).

Infectious waste: Waste containing living organisms that could endanger human health or the health of domestic animals or wildlife by extending the range of biological pests, viruses, pathogenic microorganisms, or other agents capable of infesting, infecting, or extensively and permanently altering the normal populations of organisms.

Low-level radioactive waste: Waste that cannot be defined as high-level radioactive waste, spent nuclear fuel, transuranic (TRU) waste, by-product material (as defined in Section 11e [2] of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material (DOE Order 435.1).

Miscellaneous waste: Non-recyclable, unwanted material (such as trash, labels, rags, and other debris).

Mixed waste: Waste containing both radioactive components as defined by the *Atomic Energy Act of 1954* (as amended) and hazardous components as defined by 40 CFR 262.

Personal protective equipment: Items worn or used during waste-handling activities such as coveralls, shoe covers, boots, gloves, glove liners, hoods, and duct tape. Coveralls and hoods are generally made of cloth, paper, or synthetic material. Gloves are generally latex or nitrile, and glove liners are made of disposable cloth material. Shoe covers and boots are generally rubber.

Purge/development water: Water generated from well development or during sampling that is removed from a well before samples are collected.

Radioactive waste: Solid, liquid, or gaseous material that contains radionuclides regulated under the *Atomic Energy Act of 1954* (as amended), which is of negligible economic value considering costs of recovery.

RCRA Facility means:

1. All contiguous land, structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).

2. For the purpose of implementing corrective action under 40 CFR 264.101, all contiguous property under the control of the owner or operator seeking a permit under Subtitle C of RCRA. This definition also applies to facilities implementing corrective action under RCRA Section 30008(h).

3. Notwithstanding paragraph (2) of this definition, a remediation waste management site is not a facility that is subject to 40 CFR 264.101, but is subject to corrective action requirements if the site is located within such a facility.

Sample containers: Vessels composed of steel, aluminum, Teflon, brass, glass, or plastic used to contain samples of water, soil, or other media. Once used, these containers become a waste stream if they cannot be decontaminated for reuse.

Secondary waste: A generic category of waste that is generated from support activities (including operations and maintenance activities) related to retrieving, processing, and packaging the investigation-derived materials. Examples of secondary waste include waste associated with routine decontamination activities (excluding facility closure), PPE, administrative area and support services waste, used equipment and filters, and other similar waste generated during operations and maintenance activities.

Soil waste: Soil excavated as part of a project that may be contaminated as a result of spill and pipeline leaks or radioactive liquids from plant liquid transfer operations.

Solidification: A technique that limits the solubility and mobility of hazardous waste constituents through physical means. This process changes the physical state from liquid or semisolid to a solid.

Spent nuclear fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation and that has not yet been reprocessed to remove its constituent elements.

Stabilization: A technique that limits the solubility and mobility of hazardous waste constituents by causing the constituents to bond or chemically react with the stabilizing material.

Structural stability: A waste form that will generally maintain its physical dimensions and its form under the expected disposal conditions, such as weight of overburden and compaction equipment, the presence of moisture and microbial activity, and internal factors such as radiation effects and chemical changes. The waste form itself can provide structural stability by processing the waste to a stable form or by placing the waste in a disposal container or structure that provides stability after disposal.

Toxic Substances Control Act waste: Waste managed strictly under Toxic Substances Control Act (TSCA) regulations. Currently, only polychlorinated biphenyls (PCBs) and asbestos are regulated under TSCA as waste.

Transuranic waste: In accordance with DOE Order 435.1, radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting transuranic (TRU) isotopes per gram of waste, with half-lives greater than 20 years, except for (1) high-level radioactive waste; (2) waste that the U.S. 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 disposal regulations; or (3) waste that the Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR 61. (Source: *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended.)

Unused and unaltered sample material: Material that may include excess soil cores from the interbeds, underlying basalt, and groundwater.

Void space: *Compressible void space*: Space that is compressible through the application of load or settlement over time (e.g., interstitial space in soil, empty space in wooden boxes of soil). *Incompressible void space*: Percent of voids in waste that is encased in a cement enclosure (e.g., void space within a container that has been filled with concrete).

Waste Acceptance Criteria for the ICDF Landfill

1. INTRODUCTION

The U.S. Department of Energy Idaho Operations Office (NE-ID)[a] authorized a remedial design/construction work plan for the Idaho Nuclear Technology and Engineering Center (INTEC) in accordance with the *Final Record of Decision Idaho Nuclear Technology and Engineering Center* (DOE-ID 1999). The Record of Decision (ROD) requires the removal and on-Site disposal of some of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq.) remediation waste generated within the Idaho National Engineering and Environmental Laboratory (INEEL).

The ROD requirements necessitate the construction of the INEEL CERCLA Disposal Facility (ICDF), which will be the disposal facility for the ROD-identified waste streams. The ICDF landfill will be an on-Site, engineered facility (located south of INTEC and adjacent to the existing percolation ponds) that meets the substantive requirements of the Resource Conservation and Recovery Act (RCRA) Subtitle C (42 USC § 6901 et seq.); Idaho Hazardous Waste Management Act (Idaho Code § 39-4401 et seq.); U.S. Department of Energy (DOE) Order 435.1, "Radioactive Waste Management"; and Toxic Substances Control Act (TSCA) (15 USC § 2601 et seq.) polychlorinated biphenyl (PCB) landfill design and construction requirements. Designed and authorized to accept not only Waste Area Group (WAG) 3 waste, but also waste from other INEEL CERCLA actions, the ICDF Complex will include the necessary subsystems and support facilities to provide a complete waste disposal system.

The major components of the ICDF Complex include the following:

- The disposal cells (landfill)
- An evaporation pond comprised of two cells
- The Staging, Storage, Sizing, and Treatment Facility (SSSTF).

The ICDF Complex, including a buffer zone, will cover approximately 40 acres with a landfill disposal capacity of approximately 510,000 yd^3. The evaporation pond, designated as equivalent to a RCRA Corrective Action Management Unit in the ROD (DOE-ID 1999), will receive ICDF leachate and other aqueous waste generated as a result of operations. The evaporation pond will accept those waste streams listed in Table 2-1 of the *Waste Acceptance Criteria for ICDF Evaporation Pond* (DOE-ID 2004). The ICDF leachate will be pumped directly to the evaporation pond, and the pump system will track the volume and flow of leachate sent to the pond.

The ICDF Complex is designed to provide the centralized receipt, inspection, treatment, and segregation areas necessary to stage and store incoming waste from the other INEEL CERCLA remediation sites before disposal to the ICDF landfill or shipment off-Site. All ICDF Complex activities shall take place within the WAG 3 area of contamination (AOC) to allow flexibility in managing the consolidation and remediation of waste without triggering land disposal restrictions (LDRs) and other RCRA requirements, in accordance with the ROD (DOE-ID 1999); however, LDRs will apply to waste generated outside the WAG 3 AOC or to the waste that has triggered placement. Figure 1-1 illustrates the WAG 3 AOC.

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a. The abbreviation NE-ID signifies that the U.S. Department of Energy Idaho Operations Office (which was abbreviated DOE-ID before October 1, 2003) reports to the U.S. Department of Energy Office of Nuclear Energy, Science, and Technology.

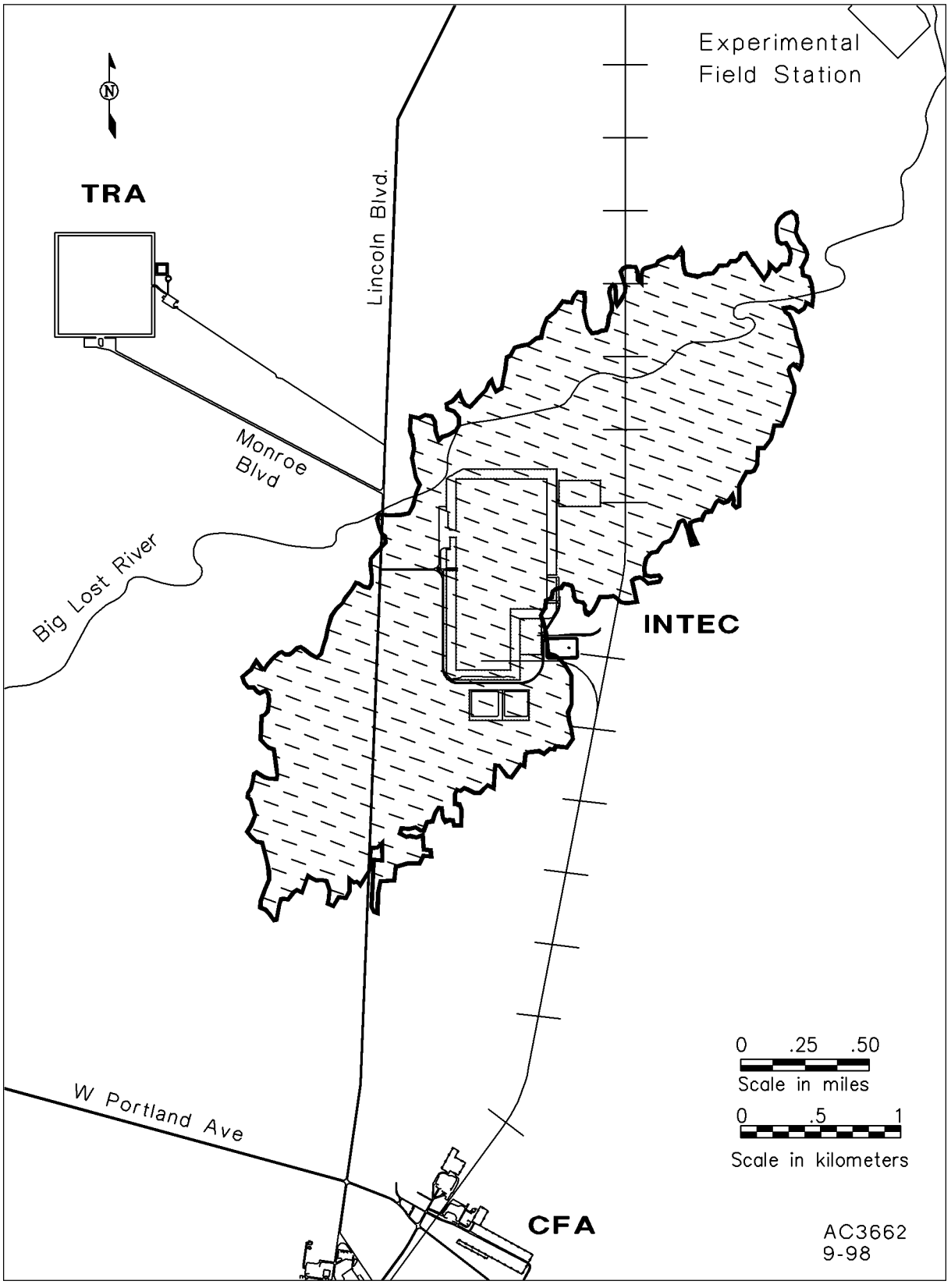

Figure 1-1. Waste Area Group 3 area of contamination.

A short-term storage area, the Staging and Storage Annex, is already located within the INTEC fenced area to serve as a temporary storage area for INEEL CERCLA waste designated for:

- Direct disposal to the ICDF landfill
- Packaging in preparation for off-Site disposal
- Other INEEL on-Site disposal.

Waste from WAG 3 and other CERCLA remediation sites will be stored at the Staging and Storage Annex during the design and construction phases of the ICDF Complex, including construction of the SSSTF.

The ICDF landfill will accept only low-level, mixed low-level, hazardous, and TSCA waste generated from INEEL CERCLA activities for disposal. Current projections of Sitewide CERCLA waste volumes total about 510,000 yd^3. Most of the waste will be contaminated soil, but debris and CERCLA investigation-derived waste also are included in the waste inventory.

This document details the criteria that must be satisfied prior to the ICDF landfill acceptance of waste for disposal. Compliance with the ICDF landfill waste acceptance criteria will ensure protection of human health and the environment, including the Snake River Plain Aquifer (SRPA). Waste placed in the ICDF landfill must not cause groundwater in the SRPA to exceed Idaho maximum contaminant levels (MCLs), 10^{-4} cumulative risk levels, or a hazard index (HI) of 1. Exposure to members of the public has been evaluated for two scenarios: (1) as visitors to the ICDF Complex who have had appropriate health and safety training and on-Site briefing and (2) as visitors to the Central Facilities Area (e.g., delivery services with no special training).

Three waste acceptance criteria documents have been developed for the ICDF Complex: the *ICDF Complex Waste Acceptance Criteria* document (which is the main waste acceptance criteria document for the complex) and two secondary waste acceptance criteria documents for the ICDF landfill and ICDF evaporation pond, as described in the following paragraphs.

The *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a) is the master waste acceptance criteria document for all the waste entering the ICDF Complex for treatment, storage, disposal, or packaging for off-Site shipment. All incoming waste must have adequate documentation to demonstrate that the waste meets the appropriate waste acceptance criteria for units within the ICDF Complex. If the waste is to be shipped off-Site and is brought into the ICDF for repackaging, the waste should meet the waste acceptance criteria for the final disposal facility. This ICDF Complex waste acceptance criteria will allow the waste to enter the ICDF Complex; however, if the waste is destined for the landfill or evaporation pond, then the waste acceptance criteria delineated in the corresponding secondary waste acceptance criteria documents must also be met.

The ICDF landfill waste acceptance criteria are secondary waste acceptance criteria specific to waste that will be disposed of in the ICDF landfill. Landfill-specific acceptance criteria (e.g., numerical chemical and radiological concentrations) have been developed for the landfill and are included in this document. Development of the chemical and radiological acceptance criteria for the landfill included calculations to determine concentrations in the ICDF landfill leachate that are protective of the evaporation pond liner system, SRPA, and human health and the environment. Generic criteria that must be met by all waste entering the ICDF Complex gates are referenced to specific sections of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

The *Waste Acceptance Criteria for the ICDF Evaporation Pond* document (DOE-ID 2004) is a secondary waste acceptance criteria document specific to waste that will be disposed of at the ICDF evaporation pond. Evaporation pond-specific acceptance criteria (e.g., numerical chemical and radiological concentrations) have been developed for the pond and are included in the evaporation pond waste acceptance criteria. Development of the chemical and radiological acceptance criteria for the landfill included calculations to determine concentrations in the ICDF landfill leachate that are protective of the evaporation pond liner system, human health, and potential ecological receptors. Generic criteria that must be met by all waste entering the ICDF Complex gates are referenced in specific sections of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

1.1 Purpose and Objectives

The purpose of this document is to provide the limits for quantities of radioactive and nonradioactive constituents that may be accepted for disposal at the ICDF landfill. The objectives of the ICDF landfill waste acceptance criteria are to ensure the following:

- Waste placed within the ICDF landfill will not exceed the allowable limits for protection of the SRPA in accordance with the ROD requirements (DOE-ID 1999).
- The commitments in the ROD (DOE-ID 1999) to meet the remedial action objectives (RAOs) are met and maintained.
- The waste received at the ICDF landfill contains only the radionuclides and hazardous constituents that the facility can safely manage to protect human health (workers and the public) and the environment.
- The concentrations and/or total activities of the waste received at the ICDF landfill are compatible with the ICDF landfill design and operations.
- The waste received at the ICDF landfill is in a form or container that will maintain its integrity and retain acceptable configuration under the conditions expected to be encountered during ICDF Complex operations and closure.
- Waste received at the ICDF landfill does not contain materials that will compromise the safety or integrity of the facility under the expected operating conditions. For example, waste with significant voids could compromise the cover integrity due to subsidence, reactive waste could compromise worker safety, and liner-incompatible waste could compromise liner integrity.

1.2 Scope

Landfill-specific acceptance criteria (e.g., numerical chemical and radiological concentrations) have been developed for the landfill and are included in this document. Development of the chemical and radiological acceptance criteria for the landfill included calculations to determine concentrations in the ICDF landfill leachate that are protective of the evaporation pond liner system, SRPA, and human health and the environment. Generic criteria that must be met by all waste entering the ICDF Complex gates are referenced to specific sections of the *ICDF Complex Waste Acceptance Criteria* document (DOE-ID 2003a).

The ICDF Complex, including the ICDF landfill cells, will be designed to meet the substantive requirements of DOE Order 435.1, RCRA Subtitle C minimum technology requirements (40 CFR 264,

Subpart N requirements), and the applicable sections of TSCA PCB design and construction specifications. The ICDF landfill is designed and managed to meet the National Contingency Plan requirement of maximum 15 mrem/yr exposure to the public. The ICDF landfill will be authorized to accept waste generated within the INEEL from CERCLA removal/remedial and investigative activities at the INEEL WAGs.

The ICDF landfill is designed and designated to accept ICDF CERCLA remediation waste generated within the ICDF Complex and from CERCLA removal/remedial and investigative activities at the INEEL WAGs that meet the ICDF landfill waste acceptance criteria for disposal.

The ICDF Complex users must specify and obtain approval from the ICDF Complex Operations Manager prior to shipment. Waste that can be accepted at the ICDF landfill include the following:

- WAG 3 CERCLA remediation waste, including soil, drill cuttings, building debris, boxed soil, and secondary remediation waste, such as personal protective equipment (PPE).
- Waste generated in the ICDF Complex and from CERCLA investigative, remedial, and removal activities at the INEEL WAGs. The waste will include soil, drill cuttings, building debris, stabilized waste, and secondary remediation and investigation waste.
- Secondary CERCLA waste from waste processing and decontamination activities in the SSSTF and INEEL WAGs.

1.3 Roadmap to ICDF Landfill Waste Acceptance Criteria

Primary elements of the ICDF landfill waste acceptance criteria that are common to the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a) are cross-referenced in Table 1-1. Requirements that apply only to the ICDF landfill are included in this document and are not repeated in the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

Table 1-1. Cross-reference of ICDF Complex waste acceptance criteria and ICDF evaporation pond waste acceptance criteria.

Function	*ICDF Complex Waste Acceptance Criteria* Section[a]
Responsibilities	1.5
General requirements of the waste profile process	2.1
Exceptions to waste acceptance criteria requirements (case-by-case acceptance)	2.2.1
General classes of waste	2.2
Waste form requirements	2.2
Composition and waste containers	2.3
Physical and chemical characterization requirements	2.4
Type of acceptable knowledge	2.4.1
Radiological characterization	2.5
Waste acceptance process	3
Waste acceptance scheduling requirements	3.2
Waste tracking system	3.3

Table 1-1. (continued).

Function	*ICDF Complex Waste Acceptance Criteria* Section[a]
Data quality objectives	3.4
Waste profile	3.5
Waste certification process	3.6
Verification as packaged	3.7
Receipt verification	3.8
Nonconforming waste	3.9
Records	3.10
Packaging and shipping	3.11
Prohibitions	5.2
Criticality safety limits	5.4.3
Package external concentration limits	5.4.4
Package dose rate limits	5.4.5
Packaging criteria	5.5
Outer package criteria	5.5.1
Container requirements	5.5
Condition of containers	5.5.2
Container compatibility and segregation	5.5.3
Securing waste and shielding	5.5.4
Handling packages	5.5.5
Package labeling and marking	5.5.6

a. *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a)
ICDF = INEEL CERCLA Disposal Facility

1.4 Relationship to Other Documents

This document is based on and integrated with several related documents, as discussed in the following sections.

1.4.1 Operable Unit 3-13 Record of Decision

The ROD (DOE-ID 1999) is the regulatory authorization for the ICDF Complex. This document includes the regulatory basis for the ICDF landfill and the applicable or relevant and appropriate requirements (ARARs) that the ICDF Complex must meet. The ROD also describes the AOC for WAG 3. Because the ICDF Complex will receive waste from both inside and outside of the AOC, this document has different requirements for mixed waste from inside and outside of the AOC. These AOC issues are addressed in more detail in the waste acceptance criteria basis (Section 4.1).

1.4.2 Related ICDF Complex Waste Acceptance Criteria

When the ICDF Complex becomes operational, the three integrated waste acceptance criteria documents will actively govern the requirements of the acceptance and disposal process. The waste acceptance criteria are briefly described below:

- **ICDF Complex Waste Acceptance Criteria:** The ICDF Complex waste acceptance criteria will encompass all waste entering the ICDF Complex, including waste for landfill disposal, evaporation pond disposal, or for storage or off-Site shipment. Waste meeting the ICDF Complex waste acceptance criteria must demonstrate that the waste meets the ICDF Landfill waste acceptance criteria to be accepted for disposal in the ICDF landfill. In addition, the waste must meet the evaporation pond waste acceptance criteria to be accepted for disposal to the pond, and it must meet the SSSTF waste acceptance criteria to be accepted for treatment. The *ICDF Complex Waste Acceptance Criteria* document contains the waste acceptance criteria components that apply to all waste, regardless of the intended final disposal.

- **ICDF Landfill Waste Acceptance Criteria:** The waste acceptance criteria for the ICDF landfill specify the chemical and radiological requirements for disposal of waste in the ICDF landfill.

- **ICDF Evaporation Pond Waste Acceptance Criteria:** The ICDF evaporation pond waste acceptance criteria specify the chemical and radiological requirements for disposal of waste in the ICDF evaporation pond.

Integration among the various waste acceptance criteria documents will be achieved by use of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a) as the master document and by use of the same waste profile for all waste entering the complex. The waste profile will help provide consistent documentation of the waste during shipment or transfer and will be the same no matter the waste destination.

1.5 Responsibilities

Responsibilities for use of the ICDF Complex are described in Section 1.5 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

2. WASTE PROFILE PROCESS

The waste profile process is described in Section 2 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

3. WASTE ACCEPTANCE PROCESS

The waste acceptance process is described in Section 3 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

4. WASTE ACCEPTANCE BASIS

4.1 Criteria Basis

The ICDF landfill is authorized to accept CERCLA waste from INEEL activities consistent with the ROD (DOE-ID 1999). This section develops the basis for the ICDF Complex waste acceptance criteria numerical criteria. The actual numerical criteria are presented in Section 5. The basis for acceptance criteria includes protection of human health, including worker health and safety and the environment; protection of the ICDF landfill liner system; control of waste form; and compliance with environmental regulations' ARARs as authorized by the ROD (DOE-ID 1999). These criteria have provided the basis for developing chemical, radiological, and physical waste acceptance criteria.

4.1.1 Remedial Design Analysis

The waste acceptance criteria are based on the constituents identified in the "INEEL CERCLA Disposal Facility Design Inventory" (EDF-ER-264), and the results of the studies are summarized in Table 4-1.

Table 4-1. Summary of ICDF study results influencing the ICDF waste acceptance criteria.

Document	Summary of Results
"Leachate Contaminant Reduction Time Study" (EDF-ER-274)	This study provides the content of a hypothetical ICDF leachate based on the "INEEL CERCLA Disposal Facility Design Inventory" (EDF-ER-264). It provides the modeled composition of the leachate during the operations period—taking into account solubility, soil-water partitioning, and radioactive decay—using a combination of K_ds and geochemistry modeling. An operational period of 15 years was assumed for the ICDF landfill, followed by a 30-year postclosure period.
"Fate and Transport Modeling Results and Summary Report" (EDF-ER-275)	This study estimated contaminant fate and transport (1,000,000-year simulations) through the vadose zone to a monitoring well located 20 m downgradient of the ICDF landfill in the SRPA.
"Waste-Soil Design Ratio Calculations" (EDF-ER-277)	These calculations were performed for various types of solid debris varying from rubble to cement monoliths. The soil/waste ratio depends on the size and shape of the nonsoil waste and varies from 2:1 to 42:1.
"Hydrologic Modeling of Final Cover" (EDF-ER-279)	The model was used to evaluate long-term infiltration rates through the landfill cover section for the ICDF landfill.
"Liner/Leachate Compatibility Study" (EDF-ER-278)	This study develops the maximum concentrations allowable in the waste in terms of impact to the landfill liner. These are compared to the design inventory. The study indicates that the main chemical threat to the ICDF landfill liner would be organic constituents. Organic constituents would have to be present at concentrations several orders of magnitude higher than the "INEEL CERCLA Disposal Facility Design Inventory" (EDF-ER-264) organic constituents before they would impact liner compatibility.
"IDAPA Preliminary Air Screening Results" (EDF-ER-315)	This study calculates preliminary air compliance results based on IDAPA 58.01.01.585/586. These calculated concentrations are compared with the regulatory values to determine if further detailed modeling is required to establish operational controls. The study assumes that the maximum input for 1 year is approximately 36% of the design inventory and compares both the anticipated design inventory waste concentrations and the waste acceptance criteria concentration guideline waste concentrations to the regulatory limits. Results show that for design inventory waste concentrations, only benzo(a)pyrene exceeded regulatory limits. Results show that for waste acceptance criteria guidance

Table 4-1. (continued).

Document	Summary of Results
	concentrations, 80 chemicals exceed regulatory limits. The operational limits for air emissions will be set in the remedial action work plan.

EDF = engineering design file
ER = environmental restoration
ICDF = INEEL CERCLA Disposal Facility
IDAPA = Idaho Administrative Procedures Act
SRPA = Snake River Plain Aquifer

4.1.2 Protection of Human Health and the Environment

Worker protection shall be provided by compliance with the requirements of the *Health and Safety Plan for INEEL CERCLA Disposal Facility Operations* (INEEL 2003).

The waste handling at the ICDF landfill shall maintain worker exposure as low as reasonably achievable in accordance with DOE Order 5400.5, "Radiation Protection of the Public and the Environment." Therefore, risks to workers have not limited allowable waste acceptance criteria concentrations, but standard DOE protocol will limit worker exposures to ensure worker protection. The primary long-term routes of exposure to hazardous constituents and the radionuclides that are of concern after placement of waste in the ICDF landfill include the ingestion of contaminated groundwater or intrusion into the waste. This is discussed in more detail in "INEEL CERCLA Disposal Facility Short-Term Risk Assessment" (EDF-ER-327). The SRPA RAOs relating to the ICDF landfill, as stated in the ROD (DOE-ID 1999, page 8-2) are defined as follows:

> Maintain caps placed over contaminated soil or debris areas that are contained in place and the closed ICDF-complex, to prevent the release of leachate to underlying groundwater which would result in exceeding a cumulative carcinogenic risk of 1×10^{-4}, a total HI of 1, or applicable State of Idaho groundwater quality standards (e.g., MCLs) in the SRPA.

The RAOs for the ICDF Complex relating to intrusion (DOE-ID 1999, page 8-3) are defined as follows: "Maintain the closed and capped ICDF Complex to prevent exposure to the public to a cumulative carcinogenic risk of 1×10^{-4} and a total HI of 1."

Appendix A summarizes the development of the waste acceptance criteria for specific radionuclide and chemical constituents, which was based on evaluation of risk via the groundwater ingestion pathway.

4.1.3 Protection of the ICDF Landfill Liner System

The expected leachate concentrations are compatible with the earthen and synthetic materials proposed for the ICDF landfill and evaporation liner systems based on U.S. Environmental Protection Agency (EPA) Method 9090 compatibility tests performed at similar facilities and manufacturers' recommendations. The manufacturers' compatibility data and published compatibility tests were reviewed to suggest ICDF maximum leachate limits for liner compatibility. The Method 9090 tests and manufacturers' recommendations were established at levels that had no impact to earthen and synthetic materials. These leachate limits were used to determine the maximum allowable waste soil concentrations of organic and inorganic constituents that, if placed in the ICDF landfill, would not cause significant degradation of the liner system. Based on the results of the study, hazardous constituent concentration limits necessary to ensure liner integrity are listed in "Liner/Leachate Compatibility Study" (EDF-ER-278) and are included as Appendix B of this document.

The constituents used in the published studies are in similar chemical groups as the constituents in the ICDF design inventory and, therefore, would react similarly with the liner materials. Moreover, the use of general chemical categories rather than individual constituents provides a worst-case scenario because of possible synergistic effects of mixed compounds. As such, the liner compatibility evaluations have adequately addressed the wide range of constituents anticipated for disposal at the landfill.

Table 4-2 provides the recommended maximum concentration of chemical categories that, if in the landfill leachate, might be incompatible with the polymeric or earthen material comprising the ICDF liner system. These limits are based on review of the published liner compatibility studies and manufacturers' recommendations. Where available, the recommended maximum allowable concentrations with regard to liner compatibility for individual constituents are provided in Appendix B. For comparison, a category has been included in Table 4-2 to present the projected maximum concentrations in leachate generated from the design inventory. To the extent possible, incompatible types of waste will not be placed close to each other in the landfill.

Table 4-2. Maximum allowable concentrations in leachate by chemical category for liner compatibility.

Chemical Category	Compatible Concentration for High-Density Polyethylene	Compatible Concentration for GCL and Clay	Recommended ICDF Maximum Concentration	Design Inventory Concentrations
Organics	500,000[a] mg/L	500,000[b] mg/L	500,000 mg/L	47 mg/L
Acids and bases	750,000[a] mg/L	500,000[b] mg/L	500,000 mg/L	0[c]
Inorganic	500,000[a] mg/L	500,000[b] mg/L	500,000 mg/L	46,000 mg/L
Dissolved salts	No limit	35,000 mg/L	35,000 mg/L	8,000 mg/L
Strong oxidizers	1,000 mg/L	62,500 mg/L	1,000 mg/L	0[c]
Radionuclides	1,000,000[b] rads	No limit[d]	1,000,000 rads	17,000 rads
pH	0.5–13.0[a]	0.5–13.0	0.5–13.0	8.0

a. Based on the manufacturers' maximum concentration of the list of constituents tested by the manufacturers. The manufacturers' recommendations are provided in Appendix B.
b. Based on reported literature values.
c. Strong acids, bases, or oxidizing compounds were not reported in the design inventory.
d. "No limit" indicates a capacity for pure product that will not adversely affect the liner.
GCL = geosynthetic clay liner
ICDF = INEEL CERCLA Disposal Facility

The concentration and exposure limits in Table 4-2 provide waste acceptance criteria for chemical categories with regard to liner compatibility. These values can be used as a general guide to determine the waste acceptance criteria if individual constituents in the leachate are lower than the limits provided in Appendix B. Based on the design inventory, there are no liner compatibility issues for waste identified to be disposed of in the landfill.

If necessary during operations, the ICDF landfill management and operations team will evaluate waste with chemical constituents not in Table 4-2 on a case-by-case basis. The evaluation will consist of a paper study showing that the new waste constituents are chemically equivalent to an approved constituent. If chemical equivalency cannot be determined through a paper study, EPA Method 9090 (EPA 2002) may be required to show that leachate from the proposed waste is compatible with the liner material. The results of the case-by-case analysis will be documented and retained at the ICDF Complex. This evaluation will be sent to the Agencies as information before the waste stream is deposited in the

landfill. If a waste stream cannot be demonstrated as being compatible with the liner, it will not be allowed into the landfill for disposal.

The manufacturer for the ICDF geomembrane recommends that leachate have a pH between 0.5 and 13 pH units. Recommended manufacturers' limits for strong oxidizers are 1,000 to 500,000 mg/L and are 500,000 mg/L for metals, salts, and nutrients. The permeability of the bentonite used in the geosynthetic clay liner (GCL) and soil bentonite liner could increase if permeated with leachate having a salt ion concentration. Therefore, a maximum inorganic salt concentration of 35,000 mg/L is recommended as a conservative upper limit. These limits are far above the concentrations expected in the leachate from the ICDF landfill and were used to determine the maximum allowable concentrations in the waste soil that, if placed in the ICDF landfill, would not cause significant degradation of the liner system.

4.1.4 Compliance with Applicable or Relevant and Appropriate Requirements

The ICDF Complex is a part of a CERCLA remedial action, and the ARARs are clearly identified in the ROD (DOE-ID 1999). Compliance with these ARARs is documented in the *INEEL CERCLA Disposal Facility Remedial Design/Construction Work Plan*, (DOE-ID 2002). Specific prohibited waste types are discussed in Section 5.1 of this document. The ARARs that affect the waste acceptance criteria are those that limit the types of waste and concentrations/activities that are allowed to enter the landfill. The specific ARARs that affect the waste acceptance criteria for various constituents are in the following sections.

4.1.4.1 Hazardous Waste. Waste not subject to LDRs and originating inside the WAG 3 AOC (that has not triggered placement) is acceptable for direct disposal in the ICDF landfill without the need to meet the RCRA LDRs specified in the ROD (DOE-ID 1999), provided that the waste meets the appropriate waste acceptance criteria.

Hazardous waste from outside the WAG 3 AOC, or hazardous waste from inside the WAG 3 AOC that has triggered placement, is prohibited from disposal at the ICDF landfill unless it meets RCRA LDRs of 40 *Code of Federal Regulations* (CFR) 268, "Land Disposal Restrictions"; 40 CFR 268.45, "Treatment Standards for Hazardous Debris"; or 40 CFR 268.49, "Alternative LDR Treatment Standards for Contaminated Soil." These limits are given in Table 4-3. Hazardous waste is defined in 40 CFR 261 Subparts C and D, "Characteristics of Hazardous Waste," and "List of Hazardous Wastes," respectively. The ICDF landfill cannot accept D-code characteristic waste, F-listed waste, and most P-code and U-code waste from outside the WAG 3 AOC or waste that is above LDR requirements that has triggered placement.

4.1.4.2 Outside of Area of Contamination Waste and Area of Contamination Waste that Have Triggered Placement. Waste originating from outside the AOC or that has triggered placement must comply with RCRA ARARs for land disposal. The ICDF Complex users shall determine whether waste is subject to RCRA LDRs by completing a hazardous waste determination. If the waste is determined to be hazardous, the user will be responsible for evaluating concentrations for the constituents of concern against the applicable treatment standards or prohibition levels. The federal treatment standards and prohibition levels that apply to LDR waste are published in 40 CFR 268.48, "Universal Treatment Standards," and 40 CFR 264.49, "Alternative LDR Treatment Standards for Contaminated Soil," and a limited list of treatment standards is provided in Table 4-3. For waste codes or constituents that are not found in Table 4-3, refer to 40 CFR 268.40, 268.48, and 268.49 for applicable LDRs. The 1999 edition of the CFR shall be used for consistency with the ARARs cited in the ROD (DOE-ID 1999). For waste that is hazardous by characteristic, the underlying hazardous constituents specified in

Table 4-3. Land disposal restriction limits for selected hazardous waste.

Waste Code	Waste Description	Regulated Hazardous Constituent	Regulatory Standard (mg/kg Total, Unless Noted Otherwise)	40 CFR 268.49, "Alternative LDR Treatment Standards for Contaminated Soil"[a]
D001	Ignitable characteristic waste for high TOC subcategory	NA	Deactivate and meet UTS	NA
D001	High TOC ignitable characteristic waste (>10% TOC)	NA	Prohibited from disposal in the ICDF	NA
D002	Corrosive characteristic waste	NA	Deactivate and meet UTS	NA
D003	Reactive wastewater reactive subcategory	NA	Deactivate and meet UTS	NA
D003	Reactive cyanides subcategory	Cyanides (total) Cyanides (amenable)	590 30	5,900 300
D004	Waste that is toxic for arsenic based on TCLP	Arsenic	5.0 mg/L TCLP and meet UTS	50 mg/L TCLP
D005	Waste that is toxic for barium based on TCLP	Barium	21 mg/L TCLP and meet UTS	210 mg/L TCLP
D006	Waste that is toxic for cadmium based on TCLP	Cadmium	0.11 mg/L TCLP and meet UTS	1.1 mg/L TCLP
D007	Waste that is toxic for chromium based on TCLP	Chromium (total)	0.60 mg/L TCLP and meet UTS	6.0 mg/L TCLP
D008	Waste that is toxic for lead based on TCLP	Lead	0.75 mg/L TCLP and meet UTS	0.75 mg/L TCLP
D008	Radioactive lead solids (e.g., lead shielding and elemental lead)	Lead	Macroencapsulation	NA
D009	Waste that is toxic for mercury based on TCLP and that contains less than 260 mg/kg total mercury	Mercury	0.20 mg/L TCLP and meet UTS	0.25 mg/L TCLP
D009	Elemental mercury contaminated with radioactive materials	Mercury	Amalgamation	NA
D010	Waste that is toxic for selenium based on TCLP	Selenium	5.7 mg/L TCLP and meet UTS	57 mg/L TCLP
D011	Waste that is toxic for silver based on TCLP	Silver	0.14 mg/L TCLP and meet UTS	1.4 mg/L TCLP
D012	Waste that is toxic for endrin based on TCLP	Endrin Endrin aldehyde	0.13 and meet UTS	1.3 mg/kg
D013	Waste that is toxic for lindane based on TCLP	Alpha-BHC Beta-BHC Delta-BHC Gamma-BHC (lindane)	0.066 and meet UTS	NA

Table 4-3. (continued).

Waste Code	Waste Description	Regulated Hazardous Constituent	Regulatory Standard (mg/kg Total, Unless Noted Otherwise)	40 CFR 268.49, "Alternative LDR Treatment Standards for Contaminated Soil"[a]
D014	Waste that is toxic for methoxychlor based on TCLP	Methoxychlor	0.18 and meet UTS	1.8 mg/kg
D015	Waste that is toxic for toxaphene based on TCLP	Toxaphene	2.6 and meet UTS	26 mg/kg
D016	Waste that is toxic for 2,4-D based on TCLP	2,4-D	10 and meet UTS	100 mg/kg
D017	Waste that is toxic for 2,4,5-TP (silvex) based on TCLP	2,4,5-TP (silvex)	7.9 and meet UTS	79 mg/kg
D018	Waste that is toxic for benzene based on TCLP	Benzene	10 and meet UTS	100 mg/kg
D019	Waste that is toxic for carbon tetrachloride based on TCLP	Carbon tetrachloride	6.0 and meet UTS	60 mg/kg
D020	Waste that is toxic for chlordane based on TCLP	Chlordane	0.26 and meet UTS	2.6 mg/kg
D021	Waste that is toxic for chlorobenzene based on TCLP	Chlorobenzene	6.0 and meet UTS	60 mg/kg
D022	Waste that is toxic for chloroform based on TCLP	Chloroform	6.0 and meet UTS	60 mg/kg
D023	Waste that is toxic for o-cresol based on TCLP	o-Cresol	5.6 and meet UTS	56 mg/kg
D024	Waste that is toxic for m-cresol based on TCLP	m-Cresol	5.6 and meet UTS	56 mg/kg
D025	Waste that is toxic for p-cresol based on TCLP	p-Cresol	5.6 and meet UTS	56 mg/kg
D026	Waste that is toxic for cresols (total) based on TCLP	Cresols	11.2 and meet UTS	NA
D027	Waste that is toxic for 1,4-dichlorobenzene based on TCLP	1,4-Dichlorobenzene	6.0 and meet UTS	60 mg/kg
D028	Waste that is toxic for 1,2-dichloroethane based on TCLP	1,2-Dichloroethane	6.0 and meet UTS	60 mg/kg
D029	Waste that is toxic for 1,1-dichloroethylene based on TCLP	1,1-Dichloroethylene	6.0 and meet UTS	60 mg/kg
D030	Waste that is toxic for 2,4-dinitrotoluene based on TCLP	2,4-Dinitrotoluene	140 and meet UTS	1,400 mg/kg
D031	Waste that is toxic for heptachlor based on TCLP	Heptachlor Heptachlor epoxide	0.066 and meet UTS	0.66 mg/kg

Table 4-3. (continued).

Waste Code	Waste Description	Regulated Hazardous Constituent	Regulatory Standard (mg/kg Total, Unless Noted Otherwise)	40 CFR 268.49, "Alternative LDR Treatment Standards for Contaminated Soil"[a]
D032	Waste that is toxic for hexachlorobenzene based on TCLP	Hexachlorobenzene	10 and meet UTS	100 mg/kg
D033	Waste that is toxic for hexachlorobutadiene based on TCLP	Hexachlorobutadiene	5.6 and meet UTS	56 mg/kg
D034	Waste that is toxic for hexachloroethane based on TCLP	Hexachloroethane	30 and meet UTS	300 mg/kg
D035	Waste that is toxic for methyl ethyl ketone based on TCLP	Methyl ethyl ketone	36 and meet UTS	330 mg/kg
D036	Waste that is toxic for nitrobenzene based on TCLP	Nitrobenzene	14 and meet UTS	140 mg/kg
D037	Waste that is toxic for pentachlorophenol based on TCLP	Pentachlorophenol	7.4 and meet UTS	74 mg/kg
D038	Wastes that is toxic for pyradine based on TCLP	Pyradine	16 and meet UTS	160 mg/kg
D039	Waste that is toxic for tetrachloroethylene based on TCLP	Tetrachloroethylene	6.0 and meet UTS	60 mg/kg
D040	Waste that is toxic for trichloroethylene based on TCLP	Trichloroethylene	6.0 and meet UTS	60 mg/kg
D041	Waste that is toxic for 2,4,5-trichlorophenol based on TCLP	2,4,5-Trichlorophenol	7.4 and meet UTS	74 mg/kg
D042	Waste that is toxic for 2,4,6-trichlorophenol based on TCLP	2,4,6-Trichlorophenol	7.4 and meet UTS	74 mg/kg
D043	Waste that is toxic for vinyl chloride based on TCLP	Vinyl chloride	6.0 and meet UTS	60 mg/kg
F001	Listed spent solvent waste	Acetone	160	1,600 mg/kg
F002		Benzene	10	100 mg/kg
F003		n-Butyl alcohol	2.6	26 mg/kg
F004		Carbon disulfide	(see 40 CFR 268)	480 mg/L TCLP
F005		Carbon tetrachloride	6.0	60 mg/kg
		o-Cresol	5.6	56 mg/kg
		m-Cresol	5.6	56 mg/kg
		p-Cresol	5.6	56 mg/kg
		Cresol mixtures	11.2	NA

Table 4-3. (continued).

Waste Code	Waste Description	Regulated Hazardous Constituent	Regulatory Standard (mg/kg Total, Unless Noted Otherwise)	40 CFR 268.49, "Alternative LDR Treatment Standards for Contaminated Soil"[a]
		Cyclohexanone	(see 40 CFR 268)	7.5 mg/L TCLP
		o-Dichlorobenzene	6.0	60 mg/kg
		Ethyl acetate	33	330 mg/kg
		Ethyl benzene	10	100 mg/kg
		Ethyl ether	160	1,600 mg/kg
		Isobutyl alcohol	170	1,700 mg/kg
		Methanol	(see 40 CFR 268)	7.5 mg/L TCLP
		Methylene chloride	30	300 mg/kg
		Methyl ethyl ketone	36	360 mg/kg
		Methyl isobutyl ketone	33	330 mg/kg
		Nitrobenzene	14	140 mg/kg
		Pyridine	16	160 mg/kg
		Tetrachloroethylene	6.0	60 mg/kg
		Toluene	10	100 mg/kg
		1,1,1-Trichloroethane	6.0	60 mg/kg
		1,1,2-Trichloroethane	6.0	60 mg/kg
		1,1,2-Trichloro-1,2,2-trifluoroethane	30	300 mg/kg
		Trichloroethylene	6.0	60 mg/kg
		Trichloromonofluoro methane	30	300 mg/kg
		Xylenes	30	300 mg/kg
		Chlorobenzene	6.0	60 mg/kg
U134	Hydrogen fluoride	Fluoride (measured in wastewater only)	NA	NA

a. When treatment of any constituent subject to treatment to a 90% reduction standard would result in concentrations less than 10 times the UTS for that constituent, treatment to achieve constituent concentrations less than 10 times is not required (40 CFR 268.49 [c][1][c]).
b. Note: Table represents a partial list of waste codes most likely to be encountered during remediation activities at the INEEL; 40 CFR 268 will be consulted to ensure that the applicable standard is used.
CFR = Code of Federal Regulations
ICDF = INEEL CERCLA Disposal Facility
INEEL = Idaho National Engineering and Environmental Laboratory
LDR = land disposal restriction
NA = not applicable
TCLP = toxicity characteristic leaching procedure
TOC = total organic carbon
UTS = universal treatment standard

40 CFR 268.48 that reasonably can be expected to be present at the point of generation of the hazardous waste also shall be evaluated. Soil waste will be treated to the alternative LDR treatment standards for contaminated soil (40 CFR 268.49).

Waste profile documentation for all hazardous waste shipped to the ICDF Complex shall include information similar to that found in 40 CFR 268.7, "Testing, Tracking, and Recordkeeping Requirements for Generators, Treaters, and Disposal Facilities," including waste code and applicable treatment standard, subcategory, and underlying hazardous constituents. If the treatment standard is expressed in terms of a concentration limit, the actual concentration of the restricted constituent also shall be reported. If the waste has no listed waste codes and no longer exhibits the characteristic of a hazardous waste because it has been treated, then the waste certification form shall include a statement describing the treatment technology that was used and the reason the waste is no longer hazardous.

Waste from within the AOC may be staged or stored in a manner that triggers placement. If waste from within the AOC triggers placement, then the waste must comply with LDRs. Waste that has been treated to meet the LDR for characteristic waste also must meet the universal treatment standard (UTS) for underlying hazardous constituents for those constituents that are reasonably expected to be present. The generator must determine whether a waste is listed or characteristic and must document the determination.

The determination of a characteristic waste may be based on comparison to the toxicity characteristic leaching procedure (TCLP) regulatory levels. If the total metals' concentrations exceed the associated TCLP regulatory levels for characteristic waste by more than 20 times, then TCLP analysis might be necessary to determine if the waste is RCRA characteristic. For waste containing organic constituents that would cause the waste to be characteristic by TCLP, the constituent must be present below the applicable LDR and UTS levels for the waste to be accepted into the ICDF landfill. In the case of organic constituents, concentrations below the 20 times rule can be used to show that a TCLP analysis is not required. For concentrations over 20 times, if other information is not available to quantitatively show the waste is not hazardous, then a TCLP analysis will be performed.

4.1.4.3 Organic Constituents. Waste containing PCBs in concentrations greater than 500 ppm cannot be placed in the ICDF landfill, because the waste must be incinerated (40 CFR 761, "Polychlorinated Biphenyls [PCBs] Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions").

Waste containing organic concentrations of at least 10% by weight cannot be placed in the ICDF landfill (40 CFR 264, Subpart BB, "Air Emission Standards for Equipment Leaks"). This applies to the leachate collection and removal system, including pumps, compressors, and pressure relief valves.

Waste containing volatile organic concentrations >500 ppm will not be accepted (40 CFR 264.1082[c][i]). By meeting this requirement, the ICDF will be exempt from the standards in 40 CFR 264.1084 through 264.1087.

Waste containing greater than 1% chelating compounds cannot be placed in the ICDF landfill (DOE Order 435.1, "Radioactive Waste Management").

4.1.4.4 Inorganics/Other. There are no ARAR-based limitations on inorganic contents in the waste from inside the AOC (LDRs do not apply).

4.1.4.5 Radionuclides. The ROD (DOE-ID 1999) and DOE Order 435.1 invoke regulatory limits on radionuclide activity that can be disposed of at the ICDF landfill, as discussed below.

Appendix A, "Response to Public Comment," to the ROD (DOE-ID 1999) states in response to comments #28, 226, and 230 that waste containing greater than 10 nCi/g of transuranic (TRU) radionuclides is prohibited from disposal at the ICDF landfill (DOE-ID 1999).

In DOE Order 435.1, TRU waste is defined as follows:

> TRU waste is radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting TRU 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 the EPA, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations
>
> 3. Waste that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Because the ROD restriction is based on TRU isotopes, the 10 nCi/g for the waste acceptance criteria was calculated as follows. The alpha-emitting TRU isotopes with half-lives greater than 20 years are Np-237, Pu-238, Pu-239, Pu-240, Pu-242, Pu-244, Am-241, Am-243, Cm-243, Cm-245, Cm-246, Cm-248, Cm-250, Bk-247, Cf-249, and Cf-251. These isotopes may be present in unequal amounts; the sum of all TRU isotopes must total less than 10 nCi/g for the entire waste stream.

The Nuclear Regulatory Commission (NRC) performance-based disposal requirement (10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste") is invoked by DOE Order 435.1 and includes radiological waste classification. Waste greater than Class C waste cannot be disposed of at the ICDF landfill. The exact regulatory text for determining waste classification is provided in Appendix C.

4.1.5 Compliance with National Emission Standards for Hazardous Air Pollutants

Compliance with National Emission Standards for Hazardous Air Pollutants (NESHAP) limits will be conducted in conjunction with the INEEL on a Sitewide basis. The ICDF Complex will not contribute more than 10 mrem/yr (the federal allowable limit) to the maximally exposed individual at the site boundary. To ensure that the ICDF Complex is not a major factor in changing INEEL NESHAP status, an operational goal for the complex will be set at 1 mrem/yr. This will be met through operational constraints outlined in the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), developed prior to start up of the facility. The emissions from the ICDF Complex will be calculated on an annual basis and will be included with the INEEL annual NESHAP report. If the operational goal of 1 mrem/yr is exceeded, then the Agencies will be notified.

4.2 Development of Numerical Waste Acceptance Criteria

For waste within the AOC, the waste acceptance criteria for each hazardous constituent and radionuclide were calculated based on the RAOs identified in the ROD (DOE-ID 1999), the logic for determining the allowable waste acceptance criteria concentration for each constituent from inside the AOC is shown in Figure 4-1. Comparison of all the criteria is done in Appendix D. Specific numerical waste acceptance criteria are found in Section 5.

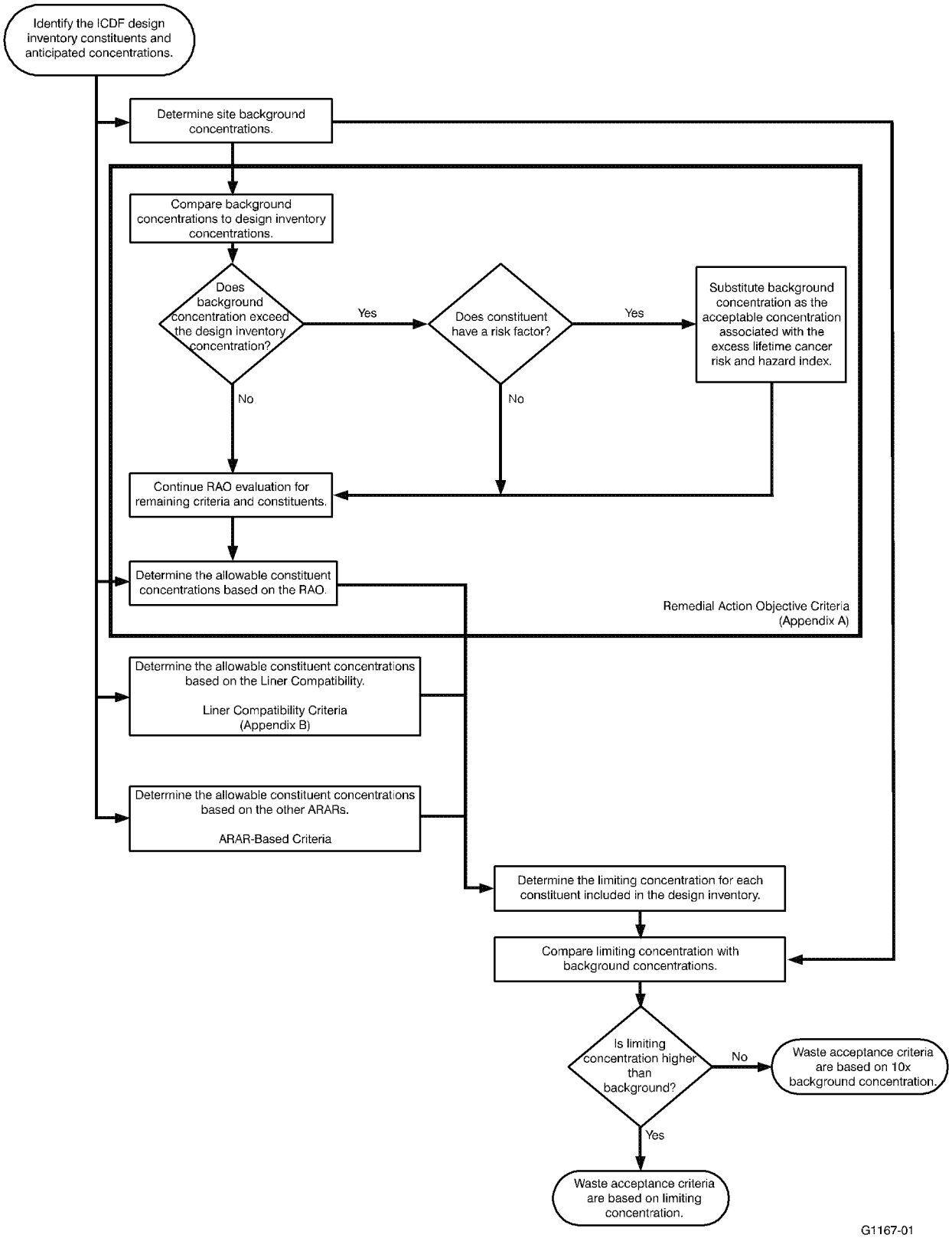

Figure 4-1. Waste acceptance criteria development logic.

Contaminant fate and transport modeling provides the basis for developing groundwater RAO-based waste soil contaminant concentrations. The groundwater RAOs for this activity are the MCL promulgated under the "Safe Drinking Water Act" (42 USC § 300f to 300j-26), risk-based concentrations derived from a cumulative 1×10^{-4} excess lifetime cancer risk, and risk-based concentrations derived from an HI of 1 for noncarcinogens. The use of groundwater RAO-based concentrations provides the basis for ensuring that waste soil disposed of in the landfill will not cause the RAOs to be exceeded at the downgradient groundwater assessment point. The RAO-based waste soil concentration limits were developed, where appropriate, on a cumulative basis. Because the inventory of actual waste received into the facility can be controlled administratively, the individual constituent RAO-based limits can be combined and adjusted to produce a disposed waste stream that exhibits an acceptable overall cumulative value for the RAO limits. The inventory of radionuclides and other constituents will be tracked by the waste tracking system described in Section 3.3 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a). The tracking system will be able to continually update estimates of radiological and other contaminant of concern inventory.

The allowable concentrations of constituents in the waste soil that will be placed in the ICDF are calculated to be protective of groundwater. These concentrations are the lowest of the carcinogenic and noncarcinogenic risk-based concentrations and MCLs. The MCL calculations are performed separate from the risk-based calculations. The total risk allowable at the ICDF is 10^{-4} carcinogenic risk and an HI of 1. Development of the calculated RAO-based waste soil concentrations is discussed in Appendix A, and RAO-based criteria are given in the spreadsheet in Appendix A.

For a few constituents, the background concentration is greater than the design inventory concentration. As such, these constituents will not be included in the cumulative excess lifetime cancer risk or HI evaluation. These constituents are based on the presence of "risk factors" (Appendix A). For those constituents that do have a risk factor, the numerical waste acceptance criteria associated with the risk-based criteria are set at 10 times the background concentration. Defaulting to the background concentrations enables the ICDF to monitor those constituents should actual waste shipments differ from the design inventory.

There are no numerical criteria limits for some constituents that do not present a risk, that are not specifically addressed by ARARs, and that do not present a liner compatibility issue in leachate.

4.3 Tracking Waste Acceptance Criteria during Operations

The waste acceptance criteria presented herein have been developed based on data regarding the proposed design inventory, achieving RAOs, liner compatibility, and regulatory requirements. On a RAO basis, the waste acceptance criteria have been developed by assuming that all contaminants are present in the entire volume of the landfill (510,000 yd^3). The liner compatibility criteria are based on individual constituent limits and/or on a total maximum concentration by chemical category (i.e., 500,000 ppm for total organics). Actual waste entering the landfill will have different contaminant concentrations from the assumptions made in the waste acceptance criteria and periodic evaluation will be necessary to track the actual contaminants entering the landfill for comparison against RAO, liner compatibility, or other regulatory limits.

The following methodology is provided as one method of tracking receipt of actual waste contaminants and contaminant masses versus the proposed waste acceptance criteria:

1. Each waste load or container will have a waste container profile identifying the substances and concentrations contained in the waste. This waste container profile may be the same as the waste profile, but will not exceed the concentrations in the waste profile.

2. The mass of each constituent placed in the landfill will be calculated for each waste load or container using the information from the waste container profile (weight × concentration for each constituent).

3. A database or spreadsheet will be kept identifying each constituent and the cumulative mass of each constituent placed in the landfill.

4. A running inventory will be maintained of the total mass of each constituent received at the facility. The total mass received for each substance will be compared to the total mass limit of the substance identified in the waste acceptance criteria. This comparison for each substance will provide an indication of how much of the waste acceptance criteria limit has been used by the actual substances in the waste. In addition, average concentrations of the constituents in each container or waste load will be checked against concentration-based criteria.

As the waste is placed in the landfill, the tracking system will record the cumulative total of each substance mass. If waste concentrations are significantly lower than the waste acceptance criteria limits, then the concentration guidelines can be increased without affecting the total mass limits in the waste acceptance criteria. Any changes in the waste acceptance criteria concentration guidelines will be recorded in a revision to this document and will follow the requirements for revisions to a *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1999) primary document. The waste tracking system will be described in the remedial action work plan.

5. ACCEPTANCE CRITERIA FOR THE ICDF LANDFILL

5.1 Prohibited Waste

The types of waste that are prohibited from disposal in the ICDF landfill are described in this section. The quality assurance program will include a determination that no prohibited waste is accepted for disposal at the ICDF landfill.

5.1.1 Waste with >10 nCi/g Transuranic Constituents

Waste containing greater than 10 nCi/g of TRU radionuclides is prohibited from disposal at the ICDF landfill in accordance with the ROD (Appendix A, "Operable Unit 3-13 Responsiveness Summary, Public Comments and Responses on the OU 3-13 Proposed Plan," responses to comments #28, 226, and 230 [DOE-ID 1999]).

5.1.2 Toxic Substances Control Act Waste Containing >500 ppm Polychlorinated Biphenyls

The TSCA waste containing greater than 500 ppm of PCBs is prohibited from disposal at the ICDF landfill in accordance with 40 CFR 761.60, "Disposal Requirements." No waste greater than 500 ppm of PCBs is expected, based on the inventory described in "INEEL CERCLA Disposal Facility Design Inventory" (EDF-ER-264).

5.1.3 Free Liquids

Waste containing free liquids is prohibited from disposal at the ICDF landfill, unless the liquids have been stabilized. If necessary, the presence of free liquids shall be determined by EPA Method 9095 ("Paint Filter Liquids Test") (EPA 2002) or the free liquid procedure in the operations and maintenance plan before shipment to the ICDF Complex.

5.1.4 Waste Capable of Detonation, Explosive Decomposition, or Reaction

Waste capable of detonation or explosive decomposition is prohibited. This includes ordnance and explosive materials that could be encountered during excavation of waste. Generally, process knowledge will be used to make the determination that a waste is or is not capable of detonation or explosive decomposition, based on unexploded observable ordnance. If it is not clear based on process knowledge, specific testing of the waste could be required.

5.1.5 Waste Capable of Generating Toxic Gases, Vapors, or Fumes

Waste capable of generating toxic gases, vapors, or fumes harmful to persons transporting, handling, and disposing of the waste (DOE Manual 435.1, "Radioactive Waste Management Manual") is prohibited. The only allowable types of degradable waste are wood, building demolition debris, PPE, and metals. Toxic gases are not formed from the degradation of these materials.

5.1.6 Gaseous Waste

All gaseous waste containers must be empty and flattened.

5.1.7 Waste Exceeding the Class C Limit

Waste exceeding the Class C radioactive waste limit is prohibited, as defined in 10 CFR 61.55, "Waste Classification."

5.1.8 Waste Containing Greater than 1% Chelating Compounds by Weight

Waste containing greater than 1% chelating compounds by weight is prohibited. Chelating compounds can mobilize constituents and cause the RAOs to be exceeded. Examples of chelating compounds are glycinate, salicylate, chelidamic acid, and phthalic acid.

5.1.9 Spent Nuclear Fuel and High-Level Waste

Spent nuclear fuel and high-level waste (DOE Manual 435.1) are prohibited.

5.1.10 Volatile Organic Waste >500 ppm

Volatile organic waste >500 ppm is prohibited (40 CFR 1082 [c][I]).

5.1.11 Organic Waste >10%

Organic waste >10 % by weight total organic content is prohibited (40 CFR 264.1050[b]).

5.2 Restricted Types of Waste Requiring Treatment

Table 5-1 lists the materials restricted from disposal at the ICDF landfill until specific conditions are met.

Table 5-1. Materials restricted from disposal at the ICDF landfill until the listed conditions have been met.

Restricted Material	Condition to be Met
Hazardous waste outside the AOC	Hazardous waste from outside the AOC must be treated to meet UTSs for those constituents reasonably expected to be present.
Bulk disposal of waste containing free liquids	Free liquids must be eliminated by stabilization (adding materials to chemically immobilize the free liquids in the waste). If necessary, the presence of free liquids shall be determined by EPA Method 9095 ("Paint Filter Liquids Test") (EPA 2002) before shipment to the ICDF Complex.
Containerized waste holding free liquids, unless one of the following conditions has been met:	All freestanding liquid has been decanted, solidified with nonbiodegradable sorbent materials, stabilized, or otherwise eliminated.[a] The waste has been converted into a form that contains as little freestanding and noncorrosive liquid as is reasonably achievable. In no case shall the liquid exceed 1% of the waste volume in a disposal container or 0.5% of the waste volume processed to a stable form.[a]
LDR—Restricted waste	Must meet LDR requirements for 40 CFR 268.
Refrigerant-bearing equipment containing CFCs	The CFC removal has been completed (40 CFR 82).

Table 5-1. (continued).

Restricted Material	Condition to be Met
Pyrophoric waste	The waste must be treated, prepared, and packaged to be nonflammable prior to being disposed of.
Infectious waste, as defined in 10 CFR 61 (including "any substance that may harbor or transmit pathogenic organisms," which may apply to septic tank sludge)	Special handling procedures will be developed.
pH <2 or >12.5	Neutralized
Waste containing >500 ppm volatile organics	Must be treated to reduce volatile organics to <500 ppm (40 CFR 264.1082 [c][1]).
Waste >10% by weight	Must be treated to reduce organic content to <10% by weight (40 CFR 264.1050 [b]).
Trinitrotoluene RDX	The waste must not be capable of detonation, explosive decomposition, or reaction at normal pressures and temperature, or explosive reaction with water.

a. The procedure for determining free liquids is provided in the *ICDF Complex Operations and Maintenance Plan* (DOE-ID 2003b).
AOC = area of contamination
CFC = chlorofluorocarbon
CFR = *Code of Federal Regulations*
EPA = U.S. Environmental Protection Agency
ICDF = INEEL CERCLA Disposal Facility
LDR = land disposal restriction
RDX = Royal Demolition Explosive
TNT = trinitrotoluene
UTS = universal treatment standard

5.3 Physical and Chemical Criteria

The logic for developing the maximum allowable risk-based chemical and radiological concentrations in the waste acceptance criteria is shown in Figure 4-1. The chemical limits for waste from within the WAG 3 AOC that have not triggered placement and radiological waste acceptance criteria limits are shown in Table 5-2. A comparison of these waste acceptance criteria limits to the design inventory concentrations is provided in Appendix F. This comparison indicates that the maximum ratio of the design inventory concentrations to the waste acceptance criteria concentrations is approximately 42% with the majority of the constituents at approximately 0.1%. This indicates that all of the design inventory constituents are a minimum of 58% less than the waste acceptance criteria limit. This also assumes that the entire landfill volume is filled with waste having the maximum concentration. In different terminology, the safety margin between the design inventory concentration and the waste acceptance criteria concentration is a minimum of 2.38 and typically 1,000.

The objective of this safety margin is to provide flexibility in the waste acceptance process in case actual waste concentrations are higher than the design inventory. Waste concentrations coming into the ICDF are anticipated to be indicative of the design inventory concentrations rather than the waste acceptance criteria concentrations. However, if waste characterization identifies waste concentrations that approach a waste acceptance criteria limit, then the waste acceptance process will ensure protection of human health and the environment based on analysis of actual waste concentrations. These safety margins should adequately cover the uncertainty of concentrations that may be disposed of at the landfill.

Table 5-2. The ICDF landfill waste acceptance criteria.

Constituent[a]	Selected Waste Acceptance Criteria Concentration Guideline (mg/kg or pCi/kg)	Landfill Waste Acceptance Criteria Maximum Mass (kg or Ci)	Source of Waste Acceptance Criteria Concentration Guideline
Organics			
1,1,1-Trichloroethane	1.6E+01	1.2E+04	RAO
1,1,2,2-Tetrachloroethane	5.0E-02	3.8E+01	RAO
1,1,2-Trichloroethane	2.4E-01	1.8E+02	RAO
1,1-Dichloroethane	2.3E+00	1.8E+03	RAO
1,1-Dichloroethene	1.5E+00	1.1E+03	RAO
1,2,4-Trichlorobenzene	1.1E+01	8.7E+03	RAO
1,2-Dichlorobenzene	1.1E+01	8.7E+03	RAO
1,2-Dichloroethane	5.4E-03	4.1E+00	RAO
1,2-Dichloroethene (total)	3.2E-01	2.5E+02	RAO
1,3-Dichlorobenzene	1.1E+01	8.7E+03	RAO
1,4-Dichlorobenzene	4.4E+01	3.2E+04	Regulatory limit
1,4-Dioxane	1.9E-02	1.4E+01	RAO
2,4,5-Trichlorophenol	4.5E+01	3.4E+04	RAO
2,4,6-Trichlorophenol	1.8E+01	1.4E+04	RAO
2,4-Dichlorophenol	2.2E+01	1.6E+04	RAO
2,4-Dimethylphenol	1.8E+01	1.4E+04	RAO
2,4-Dinitrophenol	5.1E+01	3.9E+04	RAO
2,4-Dinitrotoluene	1.1E+01	8.7E+03	RAO
2,6-Dinitrotoluene	2.1E+01	1.6E+04	RAO
2-Butanone	2.5E+01	1.9E+04	RAO
2-Chloronaphthalene	1.1E+01	8.7E+03	RAO
2-Chlorophenol	1.8E+01	1.4E+04	RAO
2-Hexanone	2.7E+00	2.0E+03	RAO
2-Methylnaphthalene	5.1E+02	3.9E+05	RAO
2-Methylphenol	2.1E+01	1.6E+04	RAO
2-Nitroaniline	1.0E-01	7.7E+01	RAO
2-Nitrophenol	1.8E+01	1.4E+04	RAO
3,3-Dichlorobenzidine	1.1E+01	8.7E+03	RAO
3-Methyl butanal	3.3E+04	2.5E+07	Liner compatibility
3-Nitroaniline	1.0E-01	7.7E+01	RAO
4,6-Dinitro-2-methylphenol	4.5E+01	3.4E+04	RAO
4-Bromophenyl-phenylether	8.5E+04	6.5E+07	Liner compatibility
4-Chloro-3-methylphenol	9.6E+04	7.3E+07	Liner compatibility
4-Chloroaniline	4.1E+01	3.1E+04	RAO
4-Chlorophenyl-phenylether	1.0E+05	7.6E+07	Regulatory limit
4-Methyl-2-pentanone	3.0E+01	2.2E+04	RAO
4-Methylphenol	3.9E+01	2.9E+04	RAO
4-Nitroaniline	1.0E-01	7.7E+01	RAO
4-Nitrophenol	5.2E+01	3.9E+04	RAO
Acenaphthene	2.0E+02	1.5E+05	RAO
Acenaphthylene	2.1E+01	1.6E+04	RAO
Acetone	4.9E+01	3.7E+04	Regulatory limit
Acetonitrile	1.2E+00	8.8E+02	RAO

Table 5-2. (continued).

Constituent[a]	Selected Waste Acceptance Criteria Concentration Guideline (mg/kg or pCi/kg)	Landfill Waste Acceptance Criteria Maximum Mass (kg or Ci)	Source of Waste Acceptance Criteria Concentration Guideline
Acrolein	5.5E-01	4.2E+02	RAO
Acrylonitrile	5.8E-01	4.4E+02	RAO
Anthracene	3.2E+02	2.4E+05	RAO
Aramite	6.7E+00	5.1E+03	RAO
Aroclor-1016	7.7E+00	5.8E+03	RAO
Aroclor-1254	1.3E+02	9.7E+04	RAO
Aroclor-1260	5.0E+02	3.8E+05	Regulatory limit
Aroclor-1268	6.2E+01	4.7E+04	RAO
Benzene	2.2E+02	1.7E+05	Regulatory limit
Benzidine	1.7E+01	1.3E+04	RAO
Benzo(a)anthracene	2.5E+02	1.9E+05	RAO
Benzo(a)pyrene	1.1E+02	8.0E+04	RAO
Benzo(b)fluoranthene	1.8E+02	1.4E+05	RAO
Benzo(g,h,i)perylene	1.1E+01	8.7E+03	RAO
Benzo(k)fluoranthene	1.9E+01	1.4E+04	RAO
Benzoic acid	8.6E+00	6.5E+03	RAO
bis(2-Chloroethoxy)methane	1.6E+02	1.2E+05	Liner compatibility
bis(2-Chloroethyl)ether	1.1E+01	8.7E+03	RAO
bis(2-Chloroisopropyl)ether	1.1E+01	8.7E+03	RAO
bis(2-Ethylhexyl)phthalate	1.5E+02	1.1E+05	RAO
Butane,1,1,3,4-tetrachloro	1.0E+05	7.6E+07	Regulatory limit
Butylbenzylphthalate	6.8E+01	5.2E+04	RAO
Carbazole	3.2E+01	2.5E+04	RAO
Carbon disulfide	4.6E+01	3.5E+04	RAO
Chlorobenzene	6.6E+00	5.0E+03	RAO
Chloroethane	1.5E-01	1.1E+02	RAO
Chloromethane	3.5E-01	2.7E+02	RAO
Chrysene	2.7E+02	2.0E+05	RAO
Decane, 3,4-dimethyl	3.3E+04	2.5E+07	Liner compatibility
Diacetone alcohol	1.0E+05	7.6E+07	Regulatory limit
Dibenz(a,h)anthracene	1.1E+01	8.7E+03	RAO
Dibenzofuran	3.2E+02	2.5E+05	RAO
Diethylphthalate	1.1E+01	8.7E+03	RAO
Dimethyl disulfide	3.3E+04	2.5E+07	Liner compatibility
Dimethylphthalate	1.1E+01	8.7E+03	RAO
Di-n-butylphthalate	2.4E+01	1.8E+04	RAO
Di-n-octylphthalate	2.6E+01	2.0E+04	RAO
Eicosane	1.0E+05	7.6E+07	Regulatory limit
Ethyl cyanide	3.3E+04	2.5E+07	Liner compatibility
Ethylbenzene	7.8E+01	5.9E+04	RAO
Famphur	1.0E+05	7.6E+07	Regulatory limit
Fluoranthene	7.6E+02	5.8E+05	RAO
Fluorine	1.8E+02	1.4E+05	RAO
Heptadecane, 2,6,10,15-tetra	3.3E+04	2.5E+07	Liner compatibility

Table 5-2. (continued).

Constituent[a]	Selected Waste Acceptance Criteria Concentration Guideline (mg/kg or pCi/kg)	Landfill Waste Acceptance Criteria Maximum Mass (kg or Ci)	Source of Waste Acceptance Criteria Concentration Guideline
Hexachlorobenzene	1.1E+01	8.7E+03	RAO
Hexachlorobutadiene	2.1E+01	1.6E+04	RAO
Hexachlorocyclopentadiene	1.1E+01	8.7E+03	RAO
Hexachloroethane	1.1E+01	8.7E+03	RAO
Indeno(1,2,3-cd)pyrene	1.1E+01	8.7E+03	RAO
Isobutyl alcohol	1.2E+00	8.8E+02	RAO
Isophorone	1.1E+01	8.7E+03	RAO
Isopropyl alcohol/2-propanol	1.0E+05	7.6E+07	Regulatory limit
Kepone	9.9E+01	7.5E+04	RAO
Mesityl oxide	1.0E+05	7.6E+07	Regulatory limit
Methyl acetate	4.8E-01	3.7E+02	RAO
Methylene chloride	2.7E+01	2.1E+04	Liner compatibility
Naphthalene	4.3E+02	3.2E+05	RAO
Nitrobenzene	1.1E+01	8.7E+03	RAO
N-Nitroso-di-n-propylamine	1.1E+01	8.7E+03	RAO
N-Nitrosodiphenylamine	1.1E+01	8.7E+03	RAO
Octane,2,3,7-trimethyl	3.3E+04	2.5E+07	Liner compatibility
o-Toluenesulfonamide	3.3E+04	2.5E+07	Liner compatibility
Pentachlorophenol	5.6E+01	4.2E+04	RAO
Phenanthrene	1.2E+03	8.9E+05	RAO
Phenol	8.0E+01	6.1E+04	RAO
Phenol,2,6-bis(1,1-dimethyl)	1.0E+05	7.6E+07	Regulatory limit
p-Toluenesulfonamide	3.3E+04	2.5E+07	Liner compatibility
Pyrene	2.5E+02	1.9E+05	RAO
RDX	1.0E+01	7.9E+03	RAO
Styrene	6.1E-02	4.6E+01	RAO
Tetrachloroethene	9.6E+00	7.3E+03	RAO
Toluene	3.0E+01	2.2E+04	Regulatory limit
Tributylphosphate	4.8E+02	3.6E+05	Liner compatibility
Trichloroethene	3.1E+01	2.3E+04	Regulatory limit
Trinitrotoluene	1.1E+01	8.4E+03	RAO
Undecane, 4,6-dimethyl	3.3E+02	2.5E+05	Liner compatibility
Xylene (ortho)	3.9E+00	2.9E+03	RAO
Xylene (total)	2.8E+02	2.1E+05	Regulatory limit
Inorganics			
Aluminum	1.6E+05	1.2E+08	10 × background
Antimony	5.8E+03	4.4E+06	RAO
Arsenic	5.8E+01	4.4E+04	RAO
Barium	3.0E+03	2.3E+06	RAO
Beryllium	1.8E+01	1.4E+04	RAO
Boron	3.3E+03	2.5E+06	RAO
Cadmium	3.6E+03	2.7E+06	RAO
Calcium	No limit	No limit	Liner compatibility
Chloride	3.3E+04	2.5E+07	Liner compatibility

Table 5-2. (continued).

Constituent[a]	Selected Waste Acceptance Criteria Concentration Guideline (mg/kg or pCi/kg)	Landfill Waste Acceptance Criteria Maximum Mass (kg or Ci)	Source of Waste Acceptance Criteria Concentration Guideline
Chromium	4.1E+04	3.1E+07	RAO
Cobalt	1.1E+02	8.3E+04	RAO
Copper	3.0E+04	2.3E+07	RAO
Cyanide	3.4E+02	2.6E+05	RAO
Dysprosium	5.9E+04	4.5E+07	RAO
Fluoride	3.9E+03	2.9E+06	RAO
Iron	2.4E+05	1.8E+08	10 × background
Lead	5.8E+04	4.4E+07	RAO
Magnesium	1.2E+05	9.1E+07	10 × background
Manganese	4.9E+03	3.7E+06	RAO
Mercury	9.5E+03	7.2E+06	RAO
Molybdenum	1.0E+04	7.7E+06	RAO
Nickel	3.5E+02	2.7E+05	RAO
Nitrate	3.9E+03	3.0E+06	RAO
Nitrate/Nitrite-N	3.3E+04	2.5E+07	Liner compatibility
Nitrite	8.5E+00	6.4E+03	RAO
Phosphorus	No limit	No limit	Liner compatibility
Potassium	4.3E+04	3.3E+07	10 × background
Selenium	8.5E+02	6.4E+05	RAO
Silver	9.8E+03	7.5E+06	RAO
Sodium	3.2E+03	2.4E+06	10 × background
Strontium	1.8E+04	1.4E+07	RAO
Sulfate	3.3E+04	2.5E+07	Liner compatibility
Sulfide	3.3E+04	2.5E+07	Liner compatibility
Terbium	No limit	No limit	Liner compatibility
Thallium	4.3E+00	3.3E+03	RAO
Vanadium	4.5E+02	3.4E+05	RAO
Ytterbium	No limit	No limit	Liner compatibility
Zinc	2.1E+05	1.6E+08	RAO
Zirconium	No limit	No limit	Liner compatibility
Radionuclides			
Ag-108m	8.0E+05	6.1E+02	RAO
Am-241	1.0E+07	7.6E+03	Regulatory limit
Am-243	3.3E+02	2.5E–01	RAO
Ba-137m	No limit	No limit	Liner compatibility
C-14	3.0E+03	2.3E–00	RAO
Cd-113m	1.6E+06	1.2E+03	RAO
Ce-144	1.8E+03	1.4E+00	RAO
Co-57	3.7E+03	2.8E+00	RAO
Co-60	1.9E+08	1.5E+05	RAO
Cs-134	1.1E+07	8.5E+03	RAO
Cs-137	2.3E+12	1.7E+09	Regulatory limit
Eu-152	9.7E+08	7.3E+05	RAO
Eu-154	8.2E+08	6.2E+05	RAO

Table 5-2. (continued).

Constituent[a]	Selected Waste Acceptance Criteria Concentration Guideline (mg/kg or pCi/kg)	Landfill Waste Acceptance Criteria Maximum Mass (kg or Ci)	Source of Waste Acceptance Criteria Concentration Guideline
Eu-155	1.8E+08	1.3E+05	RAO
Fe-55	2.0E+12	1.5E+09	RAO
H-3	5.0E+07	3.8E+04	RAO
I-129	3.1E+03	2.4E+00	RAO
K-40	2.4E+05	1.8E+02	RAO
Kr-85	No limit	—	RAO
Ni-59	9.5E+09	7.2E+06	RAO
Ni-63	6.0E+10	4.6E+07	RAO
Np-237	6.4E+05	4.9E+02	RAO
Pm-147	3.8E+08	2.9E+05	RAO
Pu-238	1.0E+07	7.6E+03	Regulatory limit
Pu-239	6.7E+06	5.1E+03	RAO
Pu-240	1.5E+06	1.1E+03	RAO
Pu-241	6.4E+07	4.9E+04	RAO
Ra-226	4.7E+05	3.6E+02	RAO
Ru-106	1.2E+04	9.2E+00	RAO
Sb-125	9.3E+06	7.0E+03	RAO
Sm-151	3.4E+08	2.6E+05	RAO
Sr-90	3.5E+12	2.7E+09	Regulatory limit
Tc-99	5.8E+06	4.4E+03	RAO
Te-125m	2.3E+06	1.7E+03	RAO
Th-228	1.6E+04	1.2E+01	RAO
Th-230	1.4E+04	1.1E+01	RAO
Th-232	1.7E+04	1.3E+01	RAO
U-233	2.6E+01	1.9E-02	RAO
U-234	6.0E+06	2.6E+03	RAO
U-235	1.1E+05	8.3E+01	RAO
U-236	2.0E+05	1.5E+02	RAO
U-238	2.0E+06	1.5E+03	RAO
Y-90	2.3E+10	1.7E+07	RAO

a. The mass values are maximum masses that cannot be exceeded.
RAO = remedial action objective

5.3.1 Liquid and Liquid-Containing Waste

For liquid-containing waste where condensate could form in 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. In any case, the amount of liquid may not exceed 1% of the waste volume or 0.5% of waste processed to a stable form.

Residual liquids in large debris items shall be sorbed or removed. In cases where removing suspected liquids is not practical and sampling to determine if liquids are present is impossible, 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 waste volume.

5.3.2 Land Disposal Restrictions

The application of LDRs for waste that is either a listed waste and/or characteristic waste depends on whether a waste originates from inside the WAG 3 AOC or has triggered placement. The discussion of what triggers LDRs is found in Section 4.

Waste originating inside the WAG 3 AOC (that has not triggered placement) is acceptable for direct disposal in the ICDF landfill without the need to meet the RCRA LDRs specified in the ROD (DOE-ID 1999), provided that the waste meets the appropriate waste acceptance criteria.

The numerical waste acceptance criteria for organic and inorganic constituents for waste not subject to LDRs were based on the logic described in Section 4. Each of the numerical criteria is shown in Appendix D with the lowest number selected as the landfill waste acceptance criteria.

5.3.3 Solidification or Stabilization of Organic Liquids and Chelating Compounds

Organic liquids and chelating compounds exceeding 1% of the waste by weight must be solidified or stabilized to a form that immobilizes the organic and chelating compounds.

5.3.4 Asbestos-Containing Waste

Asbestos-containing waste should be sent to the Central Facilities Area bulk landfill unless the radionuclide content of the waste prevents this disposal. If the waste is radioactive, asbestos-containing waste material shall be packaged in accordance with 40 CFR 61.150, "National Emission Standard for Asbestos." Wetting with water is allowed as long as it does not exceed applicable free liquid requirements. Asbestos waste will be disposed of in accordance with applicable state and federal regulations.

5.3.5 Heat Generation

If heat generation from radiological decay in the waste package exceeds 3.5 watts per m^3 (0.1 watt per ft^3), then the package must be evaluated using the conversion factors in Appendix E to ensure that the heat does not affect the integrity of the container or surrounding containers in the ICDF landfill. This evaluation must be provided to and approved by the ICDF Complex operations manager.

5.3.6 Gas Generation

Gas generation from radiolytic or biological decomposition of containerized waste must be controlled to prevent pressurization exceeding 1.5 atmospheres (152 kilopascals absolute pressure) and combustible gas (e.g., hydrogen and methane) concentrations exceeding the lower explosive limit during handling before disposal. Field methods for determining presence and amount of combustible gas can be used to demonstrate compliance with these criteria.

5.3.7 Physical Limits

Physical requirements may influence the disposal of certain waste types to the ICDF landfill, even when the waste satisfies other ICDF landfill waste acceptance criteria. Physical waste characteristics such as weight, volume, dimensions, or length might require adjustment before the waste is accepted for disposal. Table 5-3 identifies the physical limits and restrictions that must be met before the waste types will be considered for disposal at the ICDF landfill.

Table 5-3. Physical limits for waste proposed for disposal at the ICDF landfill.

Waste Type	Limits and Restrictions
Steel boxes	Steel boxes are assumed to be completely filled and, therefore, incompressible. Steel boxes with greater than 5% void space will not be accepted.
Concrete debris	Concrete may be sent to the ICDF in one of two different forms. Reduced to rubble with a maximum dimension of approximately 1 ft. It is preferred that this rubble be mixed with other waste soil so that it can be handled as soil at the ICDF. Large blocks or slabs may be shipped under the following criteria: Containerized: It must not exceed the gross weight limit for the container. It must not extend above the side walls of the container. It shall not exceed 20 ft in length unless specifically approved by ICDF operations and must be loaded toward the rear of the box. All rebar must be cut flush with the surface. Noncontainerized: It shall not exceed 20 ft in length unless specifically approved by ICDF operations. If greater than 8 ft or a large amount of large rubble is provided, consideration shall be given to grouting in place to ensure that compaction is achieved. All rebar must be cut flush with the surface of slabs and rubble.
Steel plate	Steel plate shall not exceed 4 ft in width or 8 ft in length unless specifically approved by ICDF operations. To minimize voids, steel plate shall not be bent or folded.
Rebar	Rebar should be cut to lengths of approximately 4 ft and mixed with soil to the extent practical. Rebar pieces where soil is not common can be placed in bulk roll-off containers with other hard debris.
Other debris-like material	Other debris-like material that exceeds the dimensions above may be disposed of subject to approval of a placement plan that addresses compliance with placement and compaction requirements (e.g., grout in place, fill voids with grout).

ICDF = INEEL CERCLA Disposal Facility

5.4 Radiological Criteria

5.4.1 Radiological Concentration Limits

Restrictions on the activity of radionuclides that can be placed in the ICDF landfill were determined in an iterative process that is discussed in Section 4.2. In anticipation that waste not currently in the inventory will be discovered, the waste acceptance criteria are based on a combination of the total allowable inventory of radionuclides that could impact groundwater and the protection to worker health and safety. Waste acceptance criteria for radionuclides that were not evaluated in development of these waste acceptance criteria will be developed using the same process as was described in Section 4.2 of this document. The radiological concentration (activity limits) given in Table 5-2 were derived from the waste acceptance criteria and logic discussed in Section 4 of this document.

5.4.2 Radiological Inventory Limits

The radiological inventory limits for the ICDF landfill will be maintained to stay within the facility safety envelope and authorization basis. These inventory limits are to be less than a Hazard Category 3 Nuclear Facility.

5.4.3 Criticality Safety Limits

Criticality safety limits are described in Section 5.4.3 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.4.4 Package External Concentration Limits

Package external concentration limits are described in Section 5.4.4 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.4.5 Package Dose Rate Limits

Package dose rate limits are described in Section 5.4.5 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.4.6 Non-Contact-Handled Waste

Non-contact-handled waste shall meet the applicable dose rate restrictions of the U.S. Department of Transportation or an approved packaging safety analysis. Remote-handled waste shall be configured for unloading such that personnel exposures are maintained as low as reasonably achievable.

5.5 Packaging Criteria

Packaging criteria are described in Section 5.5 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), see Table 1-1, except as specifically called out in the following sections.

5.5.1 Outer Packages

Criteria for outer packages are described in Section 5.5.1 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.5.2 Condition of Containers

Condition of containers is described in Section 5.5.2 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.5.3 Container Compatibility and Segregation

Container compatibility and segregation are described in Section 5.5.3 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.5.4 Securing Waste and Shielding

Securing waste and shielding are described in Section 5.5.4 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.5.5 Handling Packages

Handling packages are described in Section 5.5.5 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a), Table 1-1.

5.5.6 Minimizing Subsidence

All waste shall be packaged in a form that minimizes settling and subsidence of the ICDF landfill to the maximum extent feasible. The following forms will be considered to meet these criteria.

- Inherently stable waste that will not subside in the disposal environment.
- Waste stabilized by grouting or packaging.
- Containerized soil and soil-like solids and sorbed liquids that fill at least 95% of the volume of the container.
- Other containerized waste that fills at least 95% of the internal volume of the container; void space should be kept to a minimum.
- Any void fillers must be selected and used in accordance with the requirements of these waste acceptance criteria.

5.5.7 Package Labeling and Marking

Package labeling and marking are described in Section 5.5.5 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

5.5.8 Vehicle Placarding

Vehicle placarding is described in Section 5.5.7 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

5.5.9 Bulk (Noncontainerized) Waste

Labeling of bulk noncontainerized waste is described in Section 5.5.8 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

5.5.10 Radiological Contamination Limits

Radiological container limits for waste containers are described in Section 5.5.9 of the *ICDF Complex Waste Acceptance Criteria* (DOE-ID 2003a).

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Appendix A

Remedial Action Objective Criteria

Appendix A

Remedial Action Objective Criteria

A.1 PURPOSE

The purpose of this appendix is to define the allowable waste soil constituent concentrations (i.e., criteria) based on the Remedial Action Objectives (RAOs) defined in the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE—ID 1999) hereinafter referred to as the ROD. These criteria will be compared with other concentration-based criteria to support the ultimate waste acceptance criteria (WAC) definition.

A.2 REQUIREMENTS OR GIVENS

A.2.1 Design Inventory

The design inventory constituents and associated site-specific concentrations are published in the *INEEL CERCLA Disposal Facility Design Inventory* (EDF-ER-264). All constituents identified in the design inventory will be considered in this evaluation. The design inventory concentrations (C_{DI}) provide the starting point for evaluating the RAOs and determining acceptable concentrations.

A.2.2 Remedial Action Objective

The RAO provides the basis for calculating the required concentrationbased criteria. The RAOs specific to the INEEL CERCLA Disposal Facility is stated in the Operable Unit 3-13 ROD (DOE-ID 1999, page 8-2) as:

> *"Maintain caps placed over contaminated soil or debris areas that are contained in place and the closed ICDF-complex, to prevent the release of leachate to underlying groundwater which would result in exceeding a cumulative carcinogenic risk of 1E-4, a total HI of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs) in the SRPA."*

This RAO provides the basis for developing three criteria:

- Cumulative excess lifetime carcinogenic risk (ELCR) in groundwater of 1E-4,
- Total non-carcinogenic hazard index (HI) in groundwater of 1, and
- Achieving the maximum contaminant levels (MCLs) in groundwater (e.g., individual constituents, total alpha of 15 pCi/L).

A.2.3 Design Inventory Evaluation

The analysis of the design inventory constituents and concentrations over time is performed in conjunction with the fate and transport modeling. The results of this evaluation indicate that the RAOs are not exceeded in the 1.0E + 06 year simulation period. A detailed discussion of the method and approach of this evaluation is provided in the modeling document (EDF-ER-274).

A.3 METHODOLOGY & IMPLEMENTATION

Since the fate and transport modeling indicates that the C_{DI} is well within acceptable limits, constituent concentrations are adjusted to maximize WAC limits. The purpose of these adjustments is to increase the concentrations such that the RAOs are approached, but not exceeded. The initial concentration adjustments are based on an overall increase in C_{DI} concentrations. These concentration adjustments were to add a margin of safety between the design inventory and WAC limits. Appendix F presents a table summarizing the actual comparison between the design inventory and WAC limits.

The initial adjustments are based on the following rationale, in order of the application:

- Initially, all constituents are reviewed to determine if there are risk factors or MCL elements that warrant setting a RAO limit. If none are identified, the criteria adjusted value is set to "No Limit" and the basis is explained as "No Limits."

- Background is included in the evaluation for constituents with background concentrations. When the background concentration exceeds the C_{DI}, the value is adjusted to 10 × Background and the basis is explained as "10 × Background." The existing background concentrations in the SRPA were also reviewed and combined with predicted peak groundwater concentrations (at the design infiltration rate of 0.0001 m/yr) and compared to the MCL.

- The 10 × value is consistent with the Remedial Investigation/Baseline Risk Assessment for WAG 3 at the INEEL. This approach eliminates contaminants as a concern if the exposure point concentration was less than 10 X the background value.

- Constituents with a C_{DI} less than 1.0E-10, including those with a concentration of zero, are assigned a minimum adjusted concentration of 1.0E-10 irrespective of units and basis is explained as "Minimum Concentration."

- All other C_{DI}s are increased by three orders of magnitude (i.e., a factor of 1,000) and basis is explained as "Cumulative Groundwater RBC."

- All constituents that are less than the maximum concentration detected in historical data are modified to exceed the concentration and basis is explained as "Adjusted to exceed maximum concentrations."

These initial concentration adjustments result in three specific types of exceedence. These specific areas, and the primary contributor(s), include the following:

- An unacceptable HI due to 2-, 3-, and 4-Nitroanilines.

- An unacceptable ELCR due to I-129.

- An unacceptable MCL comparison, specific to the beta particles and photon emitters criterion, due to I129.

The constituent concentrations for the primary contributors are adjusted downward until all RAOs reach acceptable limits. The resultant evaluation provides RAO-based criteria that are protective. Representative adjusted RAO curves are provided in Figures A-1 through A-3.

The existing background concentrations in the SRPA were reviewed and combined with predicted peak groundwater concentrations (at the design infiltration rate of .0001 m/yr). The combined concentration was then compared against the primary MCL to verify that no exceedence of MCL would occur. Results indicate that combined concentrations do not exceed the primary MCL values, as shown in Table A-1.

Table A-1. Comparison of ICDF contribution to SRPA at design recharge rate (0.0001 m/yr).

	SRPA Background Mean Concentration in Groundwater[a]		MCL Concentration[b]	Background as Fraction of	WAC Guide Soil Concentration [c]	Predicted Peak Groundwater Concentration[d]	Combined Concentration [e]	Combine Concentrat as Fraction
Constituent	µg/L	mg/L	mg/L	MCL	mg/kg	mg/L	mg/L	MCL[f]
Arsenic	1.9	1.9E-03	5.0E-02	0.04	5.8E+01	4.1E-03	6.0E-03	0.12
Barium	66	6.6E-02	2.0E+00	0.03	3.0E+03	2.4E-03	6.8E-02	0.03
Cadmium	<1	1.0E-03	5.0E-03	0.20	3.6E+03	3.4E-03	4.4E-03	0.88
Chromium	12	1.2E-02	1.0E-01	0.12	4.1E+04	3.6E-02	4.8E-02	0.48
Lead	<5	5.0E-03	1.5E-02	0.33	5.8E+04	3.5E-03	8.5E-03	0.57
Mercury	<0.1	1.0E-04	2.0E-03	0.05	9.5E+03	4.6E-04	5.6E-04	0.28
Selenium	1.1	1.1E-03	5.0E-02	0.02	8.5E+02	8.0E-04	1.9E-03	0.04
Silver	1	1.0E-03	NL	NL	9.8E+03	8.0E-04	1.8E-03	NL
Fluoride	0.3	3.0E-04	4.0E+00	0.00	3.9E+03	5.3E-01	5.3E-01	0.13
Nitrate (as NO_3^-)[g]	8.1	8.1E-03	4.4E+01	0.00	3.9E+03	5.3E-01	5.4E-01	0.01

a. Based on existing INEEL background groundwater data (DOE/ID-22094); < (less than) values are converted to mg/L assuming th value stated.

b. MCL Concentration from EPA at www.epa.gov/safewater/mcl.html. NL indicates no primary MCL established. Secondary MCL were not assessed.

c. From Table A-2

d. Peak groundwater concentration using WAC Guide Soil concentration as modeled in this Appendix.

e. Combined value adds the predicted peak groundwater concentration at WAC Guide waste soil concentration and SRPA Backgrou Mean Concentrations.

f. Comparison of the combined value against the MCL value. Presented as a fraction of the applicable MCL value.

g. The nitrate (measured as Nitrogen) background value is 1.86 µg/L. This is converted to Nitrate (as Nitrate), based on previous calculations, as follows:
Nitrate (as N) / % Nitrogen in Nitrate = Nitrate (as Nitrate) – or – 1.86 µg/L / .23 = 8.1 µg/L

A final check is made against the detection limit for the radionuclides. Because the radionuclides in the design inventory were calculated based on a Cesium 137 level, very small concentrations are calculated which are well below typical laboratory detection limits. The detection limit value used for screening all constituents was 1 pCi/g. When the 1pCi/g detection limit exceeds the adjusted value, the value is eliminated from the WAC limits and is explained as "Below Detection Limit." However, if a constituent was detected in the historical data, the constituent was retained. All of these constituents were used in determining the cumulative risk values, but these constituents will be tracked in the WAC by the Cesium-137 concentration. If Cs-137 is below the WAC limit, then all of these radionuclides with very small concentrations will also be within their respective limits. A list of these constituents with very small concentrations are included in Table A-1.

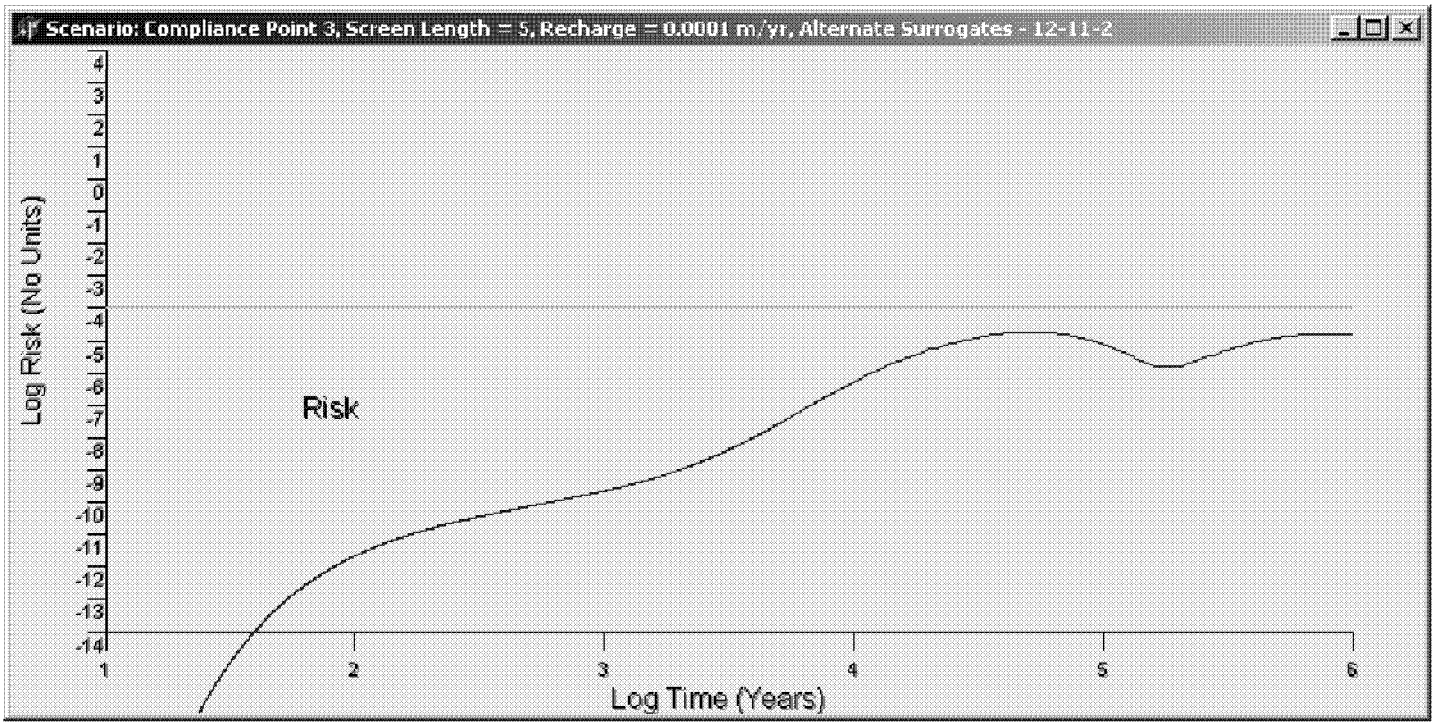

Figure A-1. Adjusted excess lifetime cancer risk curve.

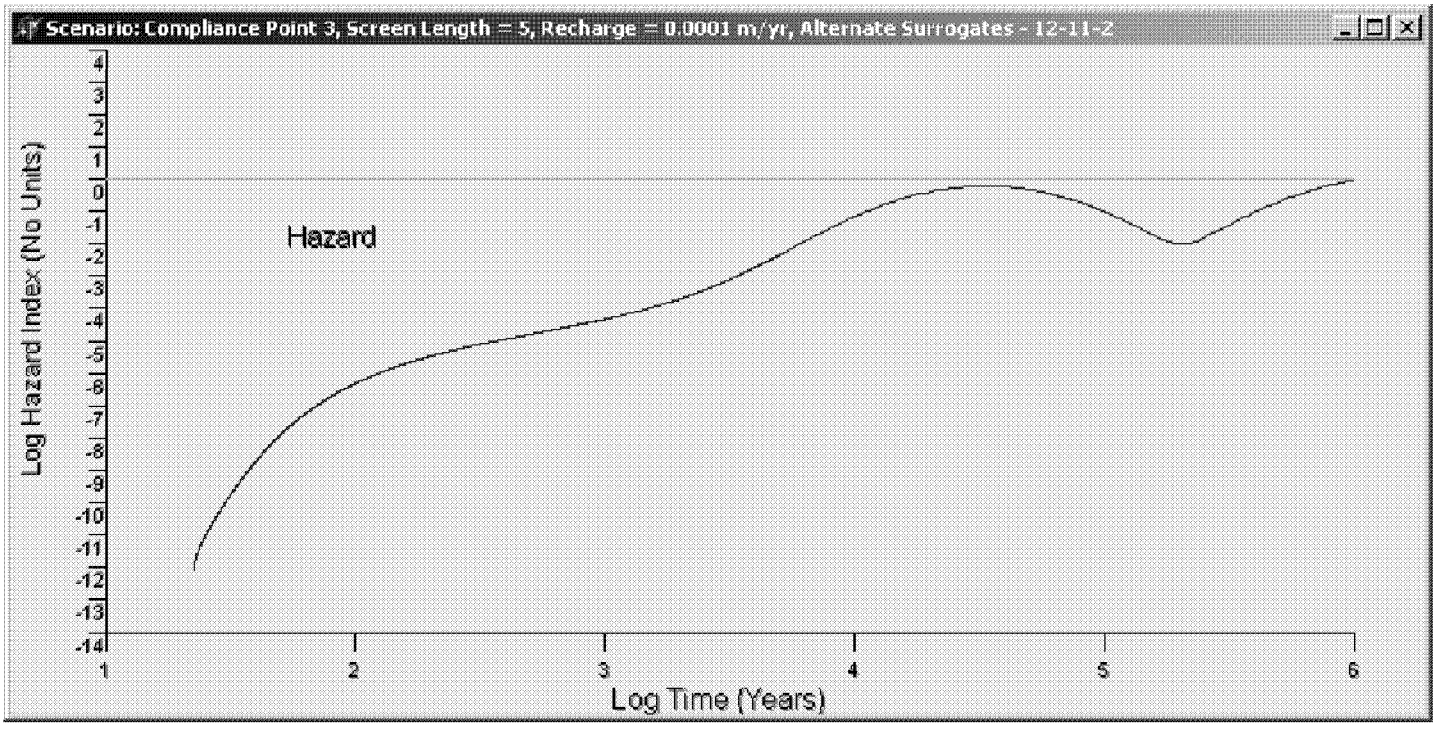

Figure A-2. Adjusted hazard index curve.

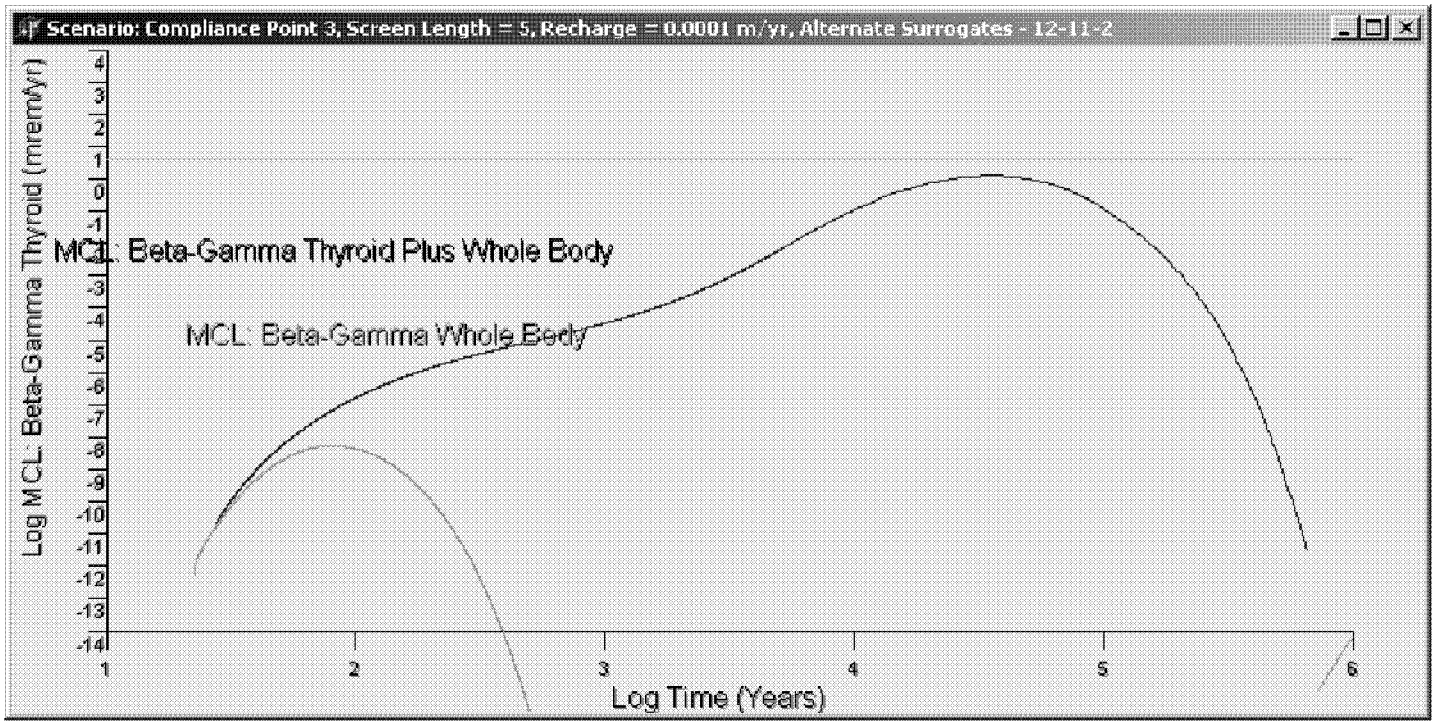

Figure A-3. Adjusted maximum contaminant level—beta and photon emitter curve for thyroid and total body.

A.4 CONCLUSIONS

The allowable concentrations of constituents in the waste soil that will be placed in the INEEL CERCLA Disposal Facility (ICDF) were calculated in order to be protective of groundwater. These selected allowable waste soil concentrations are shown in Table A-1. The C_{DI} and basis for adjustment are included in the table.

Table A-2. Selected allowable waste soil concentrations based on RAOs.

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Ac225	Rad	5.12E-05	5.12E-02	Below Detection Limit
Ac227	Rad	2.04E-02	2.04E+01	Below Detection Limit
Ac228	Rad	1.52E-07	1.52E-04	Below Detection Limit
Ag106	Rad	0.00E+00	1.00E-10	Below Detection Limit
Ag108	Rad	3.69E-06	No Limit	Below Detection Limit
Ag108m	Rad	8.00E+02	8.00E+05	Cumulative Groundwater
Ag109m	Rad	4.92E-09	No Limit	Below Detection Limit
Ag110	Rad	5.18E-08	No Limit	Below Detection Limit
Ag110m	Rad	5.55E-06	5.55E-03	Below Detection Limit
Ag111	Rad	0.00E+00	1.00E-10	Below Detection Limit
Am241	Rad	2.38E+04	2.38E+07	Cumulative Groundwater

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Am242	Rad	4.53E-02	4.53E+01	Below Detection Limit
Am242m	Rad	4.52E-02	4.52E+01	Below Detection Limit
Am243	Rad	3.34E-01	3.34E+02	Cumulative Groundwater
Am245	Rad	0.00E+00	1.00E-10	Below Detection Limit
Am246	Rad	1.38E-22	1.00E-10	Below Detection Limit
At217	Rad	5.12E-05	5.12E-02	Below Detection Limit
Ba136m	Rad	0.00E+00	No Limit	Below Detection Limit
Ba137m	Rad	2.31E+07	No Limit	Cumulative Groundwater
Ba140	Rad	0.00E+00	1.00E-10	Below Detection Limit
Be 10	Rad	1.14E-03	1.14E+00	Below Detection Limit
Bi210	Rad	1.09E-03	1.09E+00	Below Detection Limit
Bi211	Rad	1.83E-02	1.83E+01	Below Detection Limit
Bi212	Rad	5.53E-01	5.53E+02	Below Detection Limit
Bi213	Rad	0.00E+00	1.00E-10	Below Detection Limit
Bi214	Rad	5.62E-03	5.62E+00	Below Detection Limit
Bk249	Rad	2.16E-18	1.00E-10	Below Detection Limit
Bk250	Rad	7.75E-23	1.00E-10	Below Detection Limit
C 14	Rad	4.61E-02	3.00E+03	Cumulative Groundwater
Cd109	Rad	4.92E-09	4.92E-06	Below Detection Limit
Cd113m	Rad	1.62E+03	1.62E+06	Cumulative Groundwater
Cd115m	Rad	4.25E-51	1.00E-10	Below Detection Limit
Ce141	Rad	1.80E-68	1.00E-10	Below Detection Limit
Ce142	Rad	0.00E+00	No Limit	Below Detection Limit
Ce144	Rad	1.81E+00	1.81E+03	Cumulative Groundwater
Cf249	Rad	4.12E-13	1.00E-10	Below Detection Limit
Cf250	Rad	2.11E-13	1.00E-10	Below Detection Limit
Cf251	Rad	9.52E-16	1.00E-10	Below Detection Limit
Cf252	Rad	2.24E-17	1.00E-10	Below Detection Limit
Cm241	Rad	1.30E-77	1.00E-10	Below Detection Limit
Cm242	Rad	5.39E-14	5.00E+01	Below Detection Limit
Cm243	Rad	3.55E-03	3.55E+00	Below Detection Limit
Cm244	Rad	1.80E+00	1.80E+03	Below Detection Limit
Cm245	Rad	8.02E-05	8.02E-02	Below Detection Limit
Cm246	Rad	1.79E-06	1.79E-03	Below Detection Limit

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Cm247	Rad	6.39E-13	1.00E-10	Below Detection Limit
Cm248	Rad	1.95E-13	1.00E-10	Below Detection Limit
Cm250	Rad	5.53E-22	1.00E-10	Below Detection Limit
Co-57	Rad	3.69E+00	3.69E+03	Cumulative Groundwater
Co-58	Rad	5.88E-14	1.00E-10	Below Detection Limit
Co-60	Rad	1.93E+05	1.93E+08	Cumulative Groundwater
Cr-51	Rad	2.30E-51	1.00E-10	Below Detection Limit
Cs132	Rad	0.00E+00	1.00E-10	Below Detection Limit
Cs134	Rad	1.12E+04	1.12E+07	Cumulative Groundwater
Cs135	Rad	3.58E+01	3.58E+04	Below Detection Limit
Cs136	Rad	0.00E+00	1.00E-10	Below Detection Limit
Cs137	Rad	2.44E+07	2.44E+10	Cumulative Groundwater
Er169	Rad	0.00E+00	1.00E-10	Below Detection Limit
Eu150	Rad	1.73E-05	1.73E-02	Below Detection Limit
Eu152	Rad	9.68E+05	9.68E+08	Cumulative Groundwater
Eu154	Rad	8.21E+05	8.21E+08	Cumulative Groundwater
Eu155	Rad	1.76E+05	1.76E+08	Cumulative Groundwater
Eu156	Rad	0.00E+00	1.00E-10	Below Detection Limit
Fe55	Rad	2.00E+09	2.00E+12	Cumulative Groundwater
Fe-59	Rad	4.51E-32	1.00E-10	Below Detection Limit
Fr221	Rad	5.12E-05	5.12E-02	Below Detection Limit
Fr223	Rad	2.82E-04	2.82E-01	Below Detection Limit
Gd152	Rad	2.72E-11	1.00E-10	Below Detection Limit
Gd153	Rad	2.01E-08	2.01E-05	Below Detection Limit
H 3	Rad	4.96E+04	4.96E+07	Cumulative Groundwater
Hf-181	Rad	7.80E-34	1.00E-10	Below Detection Limit
Ho166m	Rad	2.70E-03	2.70E+00	Below Detection Limit
I129	Rad	1.30E+03	3.11E+03	Cumulative Groundwater
I131	Rad	0.00E+00	1.00E-10	Below Detection Limit
In114	Rad	1.89E-51	No Limit	Below Detection Limit
In114m	Rad	1.97E-51	1.00E-10	Below Detection Limit
In115	Rad	5.78E-09	5.78E-06	Below Detection Limit
In115m	Rad	0.00E+00	1.00E-10	Below Detection Limit
K-40	Rad	1.92E+03	2.40E+05	Cumulative Groundwater
Kr81	Rad	5.30E-06	No Limit	Below Detection Limit

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Kr85	Rad	1.16E+06	No Limit	Cumulative Groundwater
La138	Rad	0.00E+00	1.00E-10	Below Detection Limit
La140	Rad	2.65E-102	1.00E-10	Below Detection Limit
Mn-54	Rad	1.93E-05	1.00E+02	Below Detection Limit
Nb92	Rad	6.35E-16	No Limit	Below Detection Limit
Nb93m	Rad	1.35E+01	1.35E+04	Below Detection Limit
Nb94	Rad	8.83E-03	No Limit	Below Detection Limit
Nb95	Rad	4.80E-30	1.00E-10	Below Detection Limit
Nb95m	Rad	1.84E-32	1.00E-10	Below Detection Limit
Nd144	Rad	3.27E-07	3.27E-04	Below Detection Limit
Nd147	Rad	0.00E+00	1.00E-10	Below Detection Limit
Ni59	Rad	9.50E+06	9.50E+09	Cumulative Groundwater
Ni63	Rad	6.00E+07	6.00E+10	Cumulative Groundwater
Nd147	Rad	0.00E+00	1.00E-10	Below Detection Limit
Np235	Rad	6.80E-08	6.80E-05	Below Detection Limit
Np236	Rad	6.93E-05	6.93E-02	Below Detection Limit
Np237	Rad	6.43E+02	6.43E+05	Cumulative Groundwater
Np238	Rad	2.18E-04	2.18E-01	Below Detection Limit
Np239	Rad	3.34E-01	3.34E+02	Below Detection Limit
Np240	Rad	2.79E-11	1.00E-10	Below Detection Limit
Np240m	Rad	2.54E-08	No Limit	Below Detection Limit
Pa231	Rad	6.98E-02	6.98E+01	Below Detection Limit
Pa233	Rad	4.36E+01	4.36E+04	Below Detection Limit
Pa234	Rad	2.74E-03	No Limit	Below Detection Limit
Pa234m	Rad	1.71E+00	1.71E+03	Below Detection Limit
Pb209	Rad	4.85E-05	4.85E-02	Below Detection Limit
Pb210	Rad	1.09E-03	1.09E+00	Below Detection Limit
Pb211	Rad	1.83E-02	1.83E+01	Below Detection Limit
Pb212	Rad	5.53E-01	5.53E+02	Below Detection Limit
Pb214	Rad	5.62E-03	5.62E+00	Below Detection Limit
Pd107	Rad	6.12E+00	6.12E+03	Below Detection Limit
Pm146	Rad	5.81E+00	5.81E+03	Below Detection Limit
Pm147	Rad	3.82E+05	3.82E+08	Cumulative Groundwater
Pm148	Rad	3.97E-56	1.00E-10	Below Detection Limit
Pm148m	Rad	8.23E-55	1.00E-10	Below Detection Limit
Po210	Rad	1.02E-03	1.02E+00	Below Detection Limit
Po211	Rad	6.84E-07	6.84E-04	Below Detection Limit

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Po212	Rad	3.28E-01	3.28E+02	Below Detection Limit
Po213	Rad	4.34E-05	4.34E-02	Below Detection Limit
Po214	Rad	5.62E-03	5.62E+00	Below Detection Limit
Po215	Rad	1.83E-02	1.83E+01	Below Detection Limit
Po216	Rad	5.53E-01	5.53E+02	Below Detection Limit
Po218	Rad	5.62E-03	5.62E+00	Below Detection Limit
Pr143	Rad	0.00E+00	1.00E-10	Below Detection Limit
Pr144	Rad	1.77E+00	No Limit	Below Detection Limit
Pr144m	Rad	2.53E-02	2.53E+01	Below Detection Limit
Pu236	Rad	5.53E-03	5.53E+00	Below Detection Limit
Pu237	Rad	1.21E-55	1.00E-10	Below Detection Limit
Pu238	Rad	2.33E+05	2.33E+08	Cumulative Groundwater
Pu239	Rad	6.66E+03	6.66E+06	Cumulative Groundwater
Pu240	Rad	1.50E+03	1.50E+06	Cumulative Groundwater
Pu241	Rad	6.39E+04	6.39E+07	Cumulative Groundwater
Pu242	Rad	2.41E-01	2.41E+02	Below Detection Limit
Pu243	Rad	6.39E-13	1.00E-10	Below Detection Limit
Pu244	Rad	2.54E-08	2.54E-05	Below Detection Limit
Pu246	Rad	1.38E-22	1.00E-10	Below Detection Limit
Ra222	Rad	1.17E-113	1.00E-10	Below Detection Limit
Ra223	Rad	2.03E-02	2.03E+01	Below Detection Limit
Ra224	Rad	5.53E-01	5.53E+02	Below Detection Limit
Ra225	Rad	5.12E-05	5.12E-02	Below Detection Limit
Ra226	Rad	4.74E+02	4.74E+05	Cumulative Groundwater
Ra228	Rad	1.52E-07	2.70E+03	Below Detection Limit
Rb86	Rad	0.00E+00	1.00E-10	Below Detection Limit
Rb87	Rad	1.11E-02	1.11E+01	Below Detection Limit
Rh102	Rad	2.97E-02	2.97E+01	Below Detection Limit
Rh103m	Rad	2.83E-55	1.00E-10	Below Detection Limit
Rh106	Rad	1.14E+01	No Limit	Below Detection Limit
Rn218	Rad	1.26E-113	1.00E-10	Below Detection Limit
Rn219	Rad	2.03E-02	2.03E+01	Below Detection Limit
Rn220	Rad	5.53E-01	5.53E+02	Below Detection Limit
Rn222	Rad	6.21E-03	6.21E+00	Below Detection Limit

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Ru103	Rad	2.01E-26	1.00E-10	Below Detection Limit
Ru106	Rad	1.21E+01	1.21E+04	Cumulative Groundwater
Sb124	Rad	2.07E-37	1.00E-10	Below Detection Limit
Sb125	Rad	9.27E+03	9.27E+06	Cumulative Groundwater
Sb126	Rad	2.06E+01	2.06E+04	Below Detection Limit
Sb126m	Rad	1.47E+02	1.47E+05	Below Detection Limit
Sc-46	Rad	2.85E-17	1.00E-10	Below Detection Limit
Se 79	Rad	1.66E+02	1.66E+05	Below Detection Limit
Sm146	Rad	4.26E-07	4.26E-04	Below Detection Limit
Sm147	Rad	4.10E-03	4.10E+00	Below Detection Limit
Sm148	Rad	1.01E-09	1.01E-06	Below Detection Limit
Sm149	Rad	5.12E-09	5.12E-06	Below Detection Limit
Sm151	Rad	3.38E+05	3.38E+08	Cumulative Groundwater
Sn117m	Rad	0.00E+00	1.00E-10	Below Detection Limit
Sn119m	Rad	1.48E-04	1.48E-01	Below Detection Limit
Sn121m	Rad	2.69E+01	2.69E+04	Below Detection Limit
Sn123	Rad	8.42E-14	1.00E-10	Below Detection Limit
Sn125	Rad	0.00E+00	1.00E-10	Below Detection Limit
Sn126	Rad	1.47E+02	1.47E+05	Below Detection Limit
Sr89	Rad	5.99E-41	5.00E+02	Below Detection Limit
Sr90	Rad	2.29E+07	2.29E+10	Cumulative Groundwater
Tb160	Rad	3.18E-31	1.00E-10	Below Detection Limit
Tb161	Rad	0.00E+00	1.00E-10	Below Detection Limit
Tc 98	Rad	1.77E-04	1.77E-01	Below Detection Limit
Tc 99	Rad	5.76E+03	5.76E+06	Cumulative Groundwater
Te123	Rad	4.52E-12	1.00E-10	Below Detection Limit
Te123m	Rad	2.95E-20	1.00E-10	Below Detection Limit
Te125m	Rad	2.27E+03	2.27E+06	Cumulative Groundwater
Te127	Rad	9.36E-17	1.00E-10	Below Detection Limit
Te127m	Rad	9.50E-17	1.00E-10	Below Detection Limit
Te129	Rad	6.75E-68	1.00E-10	Below Detection Limit
Te129m	Rad	1.07E-67	1.00E-10	Below Detection Limit
Th226	Rad	2.18E-114	1.00E-10	Below Detection Limit
Th227	Rad	1.82E-02	1.82E+01	Below Detection Limit

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Th228	Rad	3.29E+01	1.60E+04	Cumulative Groundwater
Th229	Rad	5.12E-05	5.12E-02	Below Detection Limit
Th230	Rad	1.73E+02	1.40E+04	Cumulative Groundwater
Th231	Rad	1.61E+02	1.61E+05	Below Detection Limit
Th232	Rad	1.56E+02	1.68E+04	Cumulative Groundwater
Th234	Rad	1.71E+00	1.71E+03	Below Detection Limit
Tl207	Rad	1.83E-02	No Limit	Below Detection Limit
Tl208	Rad	1.98E-01	No Limit	Below Detection Limit
Tl209	Rad	1.05E-06	No Limit	Below Detection Limit
Tm170	Rad	6.38E-23	1.00E-10	Below Detection Limit
Tm171	Rad	1.59E-09	1.59E-06	Below Detection Limit
U230	Rad	0.00E+00	1.00E-10	Below Detection Limit
U232	Rad	5.35E-01	5.35E+02	Below Detection Limit
U233	Rad	2.56E-02	2.56E+01	Cumulative Groundwater
U234	Rad	6.03E+03	6.03E+06	Cumulative Groundwater
U235	Rad	1.10E+02	1.10E+05	Cumulative Groundwater
U236	Rad	2.02E+02	2.02E+05	Cumulative Groundwater
U237	Rad	0.00E+00	1.00E-10	Below Detection Limit
U238	Rad	1.95E+03	1.95E+06	Cumulative Groundwater
U240	Rad	2.54E-08	2.54E-05	Below Detection Limit
Xe127	Rad	1.58E-69	No Limit	Below Detection Limit
Xe129m	Rad	0.00E+00	No Limit	Below Detection Limit
Xe131m	Rad	2.69E-109	No Limit	Below Detection Limit
Xe133	Rad	0.00E+00	No Limit	Below Detection Limit
Y90	Rad	2.29E+07	2.29E+10	Cumulative Groundwater
Y91	Rad	4.14E-34	1.00E-10	Below Detection Limit
Zn65	Rad	2.70E-06	1.00E+02	Below Detection Limit
Zr93	Rad	8.57E+02	8.57E+05	Below Detection Limit
Zr95	Rad	2.93E-22	1.00E-10	Below Detection Limit
1,1,1-Trichloroethane	Organic	1.57E-02	1.57E+01	Design Inventory x 1000
1,1,2,2-Tetrachloroethane	Organic	4.95E-05	4.95E-02	Design Inventory x 1000
1,1,2-Trichloroethane	Organic	2.42E-04	2.42E-01	Design Inventory x 1000
1,1-Dichloroethane	Organic	2.34E-03	2.34E+00	Design Inventory x 1000
1,1-Dichloroethene	Organic	1.48E-03	1.48E+00	Design Inventory x 1000

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
1,2,4-Trichlorobenzene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
1,2-Dichlorobenzene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
1,2-Dichloroethane	Organic	5.38E-06	5.38E-03	Design Inventory x 1000
1,2-Dichloroethene (total)	Organic	3.24E-04	3.24E-01	Design Inventory x 1000
1,3-Dichlorobenzene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
1,4-Dichlorobenzene	Organic	4.50E-01	4.50E+02	Design Inventory x 1000
1,4-Dioxane	Organic	1.88E-05	1.88E-02	Design Inventory x 1000
2,4,5-Trichlorophenol	Organic	4.46E-02	4.46E+01	Design Inventory x 1000
2,4,6-Trichlorophenol	Organic	1.83E-02	1.83E+01	Design Inventory x 1000
2,4-Dichlorophenol	Organic	2.16E-02	2.16E+01	Design Inventory x 1000
2,4-Dimethylphenol	Organic	1.83E-02	1.83E+01	Design Inventory x 1000
2,4-Dinitrophenol	Organic	5.09E-02	5.09E+01	Design Inventory x 1000
2,4-Dinitrotoluene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
2,6-Dinitrotoluene	Organic	2.07E-02	2.07E+01	Design Inventory x 1000
2-Butanone	Organic	2.47E-02	2.47E+01	Design Inventory x 1000
2-Chloronaphthalene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
2-Chlorophenol	Organic	1.83E-02	1.83E+01	Design Inventory x 1000
2-Hexanone	Organic	2.70E-03	2.70E+00	Design Inventory x 1000
2-Methylnaphthalene	Organic	5.12E-01	5.12E+02	Design Inventory x 1000
2-Methylphenol	Organic	2.06E-02	2.06E+01	Design Inventory x 1000
2-Nitroaniline	Organic	2.72E-02	1.01E-01	Adjusted to Not Exceed Hazard Index
2-Nitrophenol	Organic	1.83E-02	1.83E+01	Design Inventory x 1000
3,3'-Dichlorobenzidine	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
3-Methyl Butanal	Organic	2.23E-04	No Limit	No RAO limits
3-Nitroaniline	Organic	2.72E-02	1.01E-01	Adjusted to Not Exceed Hazard Index
4,6-Dinitro-2-methylphenol	Organic	4.46E-02	4.46E+01	Design Inventory x 1000
4-Bromophenyl-phenylether	Organic	1.14E-02	No Limit	No RAO limits
4-Chloro-3-methylphenol	Organic	1.83E-02	No Limit	No RAO limits
4-Chloroaniline	Organic	4.08E-02	4.12E+01	Design Inventory x 1000
4-Chlorophenyl-	Organic	1.14E-02	No Limit	No RAO limits

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
phenylether				
4-Methyl-2-Pentanone	Organic	2.96E-02	2.96E+01	Design Inventory x 1000
4-Methylphenol	Organic	3.86E-02	3.86E+01	Design Inventory x 1000
4-Nitroaniline	Organic	2.72E-02	1.01E-01	Adjusted to Not Exceed Hazard Index
4-Nitrophenol	Organic	5.16E-02	5.16E+01	Design Inventory x 1000
Acenaphthene	Organic	2.02E-01	2.02E+02	Design Inventory x 1000
Acenaphthylene	Organic	2.07E-02	2.07E+01	Design Inventory x 1000
Acetone	Organic	6.20E-01	6.20E+02	Design Inventory x 1000
Acetonitrile	Organic	1.88E-05	1.16E+00	Adjusted to Exceed Maximum Concentration
Acrolein	Organic	9.06E-06	5.47E-01	Adjusted to Exceed Maximum Concentration
Acrylonitrile	Organic	9.06E-06	5.83E-01	Adjusted to Exceed Maximum Concentration
Anthracene	Organic	3.20E-01	3.20E+02	Design Inventory x 1000
Aramite	Organic	1.15E-04	6.71E+00	Adjusted to Exceed Maximum Concentration
Aroclor-1016	Organic	7.69E-03	7.69E+00	Design Inventory x 1000
Aroclor-1254	Organic	1.28E-01	1.28E+02	Design Inventory x 1000
Aroclor-1260	Organic	7.21E-01	7.21E+02	Design Inventory x 1000
Aroclor-1268	Organic	6.22E-02	6.22E+01	Design Inventory x 1000
Benzene	Organic	6.03E-01	6.03E+02	Design Inventory x 1000
Benzidine	Organic	2.91E-04	1.72E+01	Adjusted to Exceed Maximum Concentration
Benzo(a)anthracene	Organic	2.53E-01	2.53E+02	Design Inventory x 1000
Benzo(a)pyrene	Organic	1.05E-01	1.05E+02	Design Inventory x 1000
Benzo(b)fluoranthene	Organic	1.79E-01	1.79E+02	Design Inventory x 1000
Benzo(g,h,i)perylene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Benzo(k)fluoranthene	Organic	1.86E-02	1.86E+01	Design Inventory x 1000
Benzoic acid	Organic	8.56E-03	8.56E+00	Design Inventory x 1000
bis(2-Chloroethoxy)methane	Organic	1.14E-02	No Limit	No RAO limits
bis(2-Chloroethyl)ether	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
bis(2-Chloroisopropyl)ether	Organic	1.14E-02	1.14E+01	Design Inventory x 1000

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
bis(2-Ethylhexyl)phthalate	Organic	1.47E-01	1.47E+02	Design Inventory x 1000
Butane,1,1,3,4-Tetrachloro-	Organic	7.89E-03	No Limit	No RAO limits
Butylbenzylphthalate	Organic	6.79E-02	6.79E+01	Design Inventory x 1000
Carbazole	Organic	3.23E-02	3.23E+01	Design Inventory x 1000
Carbon Disulfide	Organic	4.55E-02	4.55E+01	Design Inventory x 1000
Chlorobenzene	Organic	6.57E-03	6.57E+00	Design Inventory x 1000
Chloroethane	Organic	3.02E-06	1.47E-01	Adjusted to Exceed Maximum Concentration
Chloromethane	Organic	3.53E-04	3.53E-01	Design Inventory x 1000
Chrysene	Organic	2.65E-01	2.65E+02	Design Inventory x 1000
Decane, 3,4-Dimethyl	Organic	1.61E-04	No Limit	No RAO limits
Diacetone alcohol	Organic	4.32E+00	No Limit	No RAO limits
Dibenz(a,h)anthracene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Dibenzofuran	Organic	3.24E-01	3.24E+02	Design Inventory x 1000
Diethylphthalate	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Dimethyl Disulfide	Organic	2.96E-03	No Limit	No RAO limits
Dimethylphthalate	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Di-n-butylphthalate	Organic	2.39E-02	2.39E+01	Design Inventory x 1000
Di-n-octylphthalate	Organic	2.62E-02	2.62E+01	Design Inventory x 1000
Eicosane	Organic	2.83E-03	No Limit	No RAO limits
Ethyl cyanide	Organic	1.88E-05	No Limit	No RAO limits
Ethylbenzene	Organic	7.81E-02	7.81E+01	Design Inventory x 1000
Famphur	Organic	5.81E-05	No Limit	No RAO limits
Fluoranthene	Organic	7.62E-01	7.62E+02	Design Inventory x 1000
Fluorene	Organic	1.84E-01	1.84E+02	Design Inventory x 1000
Heptadecane, 2,6,10,15-Tetra	Organic	3.44E-03	No Limit	No RAO limits
Hexachlorobenzene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Hexachlorobutadiene	Organic	2.07E-02	2.07E+01	Design Inventory x 1000
Hexachlorocyclopentadiene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Hexachloroethane	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Indeno(1,2,3-cd)pyrene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Isobutyl alcohol	Organic	1.88E-05	1.16E+00	Adjusted to Exceed Maximum Concentration
Isophorone	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Isopropyl Alcohol/2-propanol	Organic	2.12E-03	No Limit	No RAO limits
Kepone	Organic	9.92E-02	9.92E+01	Design Inventory x 1000
Mesityl oxide	Organic	8.48E-02	No Limit	No RAO limits
Methyl Acetate	Organic	4.84E-04	4.84E-01	Design Inventory x 1000
Methylene Chloride	Organic	8.36E-02	8.36E+01	Design Inventory x 1000
Naphthalene	Organic	4.25E-01	4.25E+02	Design Inventory x 1000
Nitrobenzene	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
N-Nitroso-di-n-propylamine	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
N-Nitrosodiphenylamine	Organic	1.14E-02	1.14E+01	Design Inventory x 1000
Octane,2,3,7-Trimethyl	Organic	1.61E-04	No Limit	No RAO limits
o-Toluenesulfonamide	Organic	5.06E-03	No Limit	No RAO limits
Pentachlorophenol	Organic	5.59E-02	5.59E+01	Design Inventory x 1000
Phenanthrene	Organic	1.17E+00	1.17E+03	Design Inventory x 1000
Phenol	Organic	7.98E-02	7.98E+01	Design Inventory x 1000
Phenol,2,6-Bis(1,1-Dimethyl)	Organic	4.05E-03	No Limit	No RAO limits
p-Toluenesulfonamide	Organic	5.06E-03	No Limit	No RAO limits
Pyrene	Organic	2.53E-01	2.53E+02	Design Inventory x 1000
RDX	Organic	0.00E+00	1.04E+01	Adjusted based on anticipated concentrations
Styrene	Organic	1.03E-06	6.11E-02	Adjusted to Exceed Maximum Concentration
Tetrachloroethene	Organic	9.64E-03	9.64E+00	Design Inventory x 1000
Toluene	Organic	9.82E-01	9.82E+02	Design Inventory x 1000
Tributylphosphate	Organic	3.64E-01	No Limit	No RAO limits
Trichloroethene	Organic	7.20E-02	7.20E+01	Design Inventory x 1000
Trinitrotoluene	Organic	0.00E+00	1.11E+01	Adjusted based on anticipated concentrations
Undecane,4,6-Dimethyl-	Organic	1.61E-04	No Limit	No RAO limits

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Xylene (ortho)	Organic	3.88E-03	3.88E+00	Design Inventory x 1000
Xylene (total)	Organic	3.45E+00	3.45E+03	Design Inventory x 1000
Aluminum	Inorganic	7.08E+03	1.61E+05	10 X Background
Antimony	Inorganic	5.83E+00	5.83E+03	Design Inventory x 1000
Arsenic	Inorganic	5.65E+00	5.80E+01	10 X Background
Barium	Inorganic	1.79E+02	3.00E+03	10 X Background
Beryllium	Inorganic	2.87E-01	1.80E+01	10 X Background
Boron	Inorganic	1.85E+02	3.31E+03	Adjusted to Not Exceed Hazard Index
Cadmium	Inorganic	3.59E+00	3.59E+03	Design Inventory x 1000
Calcium	Inorganic	2.04E+04	No Limit	No RAO limits
Chloride	Inorganic	1.87E+00	No Limit	No RAO limits
Chromium	Inorganic	4.12E+01	4.12E+04	Design Inventory x 1000
Cobalt	Inorganic	6.04E+00	1.10E+02	10 X Background
Copper	Inorganic	2.99E+01	2.99E+04	Design Inventory x 1000
Cyanide	Inorganic	3.37E-01	3.37E+02	Design Inventory x 1000
Dysprosium	Inorganic	5.93E+01	5.93E+04	Design Inventory x 1000
Fluoride	Inorganic	3.87E+00	3.87E+03	Design Inventory x 1000
Iron	Inorganic	1.02E+04	2.50E+05	10 X Background
Lead	Inorganic	5.76E+01	5.76E+04	Design Inventory x 1000
Magnesium	Inorganic	4.47E+03	No Limit	No RAO limits
Manganese	Inorganic	2.07E+02	4.90E+03	10 X Background
Mercury	Inorganic	9.45E+00	9.45E+03	Design Inventory x 1000
Molybdenum	Inorganic	1.02E+01	1.02E+04	Design Inventory x 1000
Nickel	Inorganic	1.97E+01	3.50E+02	10 X Background
Nitrate	Inorganic	3.93E+00	3.93E+03	Design Inventory x 1000
Nitrate/Nitrite-N	Inorganic	2.22E-01	No Limit	No RAO limits
Nitrite	Inorganic	8.49E-03	8.49E+00	Design Inventory x 1000
Phosphorus	Inorganic	9.74E+01	No Limit	No RAO limits
Potassium	Inorganic	1.13E+03	No Limit	No RAO limits
Selenium	Inorganic	8.46E-01	8.46E+02	Design Inventory x 1000
Silver	Inorganic	9.84E+00	9.84E+03	Design Inventory x 1000
Sodium	Inorganic	2.11E+02	No Limit	No RAO limits
Strontium	Inorganic	1.82E+01	1.82E+04	Design Inventory x 1000
Sulfate	Inorganic	2.05E+01	No Limit	No RAO limits

Table A-2. (continued).

Constituent Name	Constituent Type	Design Inventory Concentration [a] (pCi/Kg or mg/Kg)	Adjusted Maximum Inventory to Not Exceed Groundwater RAOs in 1 E+06 yrs (pCi/Kg or mg/Kg)	Basis for Adjusted Concentration
Sulfide	Inorganic	7.59E+02	No Limit	No RAO limits
Terbium	Inorganic	5.73E+02	No Limit	No RAO limits
Thallium	Inorganic	3.70E-01	4.30E+00	10 X Background
Vanadium	Inorganic	2.12E+01	4.50E+02	10 X Background
Ytterbium	Inorganic	1.95E+02	No Limit	No RAO limits
Zinc	Inorganic	2.08E+02	2.08E+05	Design Inventory x 1000
Zirconium	Inorganic	6.91E+01	No Limit	No RAO limits

a. Design inventory concentrations for radionuclides were calculated using the design inventory activity for January 1, 2002, averaged over the entire landfill volume at a density of 1500kg/cubic meter. Design inventory concentrations for organics and inorganics were calculated using the constitutent mass from the design inventory averaged over the entire landfill volume at a density of 1500kg/cubic meter.

A.5 REFERENCES

DOE-ID, 1999, *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13,* DOE/ID-10660, Rev. 0, Department of Energy Idaho Operations Office, Idaho Falls, Idaho, U.S. Environmental Protection Agency Region 10, and State of Idaho Department of Health and Welfare.

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EDF-ER-264, 2001, "INEEL CERCLA Disposal Facility Design Inventory," Rev. A, Environmental Restoration Program, Idaho National Engineering and Environmental Laboratory, March 2001.

EDF-ER-275, 2002, "Fate and Transport Modeling Results," Rev. 2, Environmental Restoration Program, Idaho National Engineering and Environmental Laboratory, May 2002.

Appendix B

Recommended Maximum Waste Concentrations Based on Liner Compatibility

Appendix B

Allowable Concentrations in Soil For Liner Compatibility Calculation

Purpose: Convert maximum leachate concentrations for liner compatibility to waste soil concentrations.

Methodology: Convert $C_{Leachate}$ to $C_{Waste\ Soil}$, factoring in decay, DAFs

Calculations: $C_{Waste\ Soil} = (C_{Leachate})$ (Leachate to Waste Soil Ratio)

Leachate to Waste Soil Ratio = $(C_{Soil}) / (C_{Liquid}) = 1 / (DAF_T/1000)\ (e^{-LamdaT})$

Based on: $C_{Liquid} = (C_{Soil})\ (DAF_T/1000)\ (e^{-LamdaT})$

The "Leachate to Waste Soil Ratio" can be determined using the EDF-274, operations evaluation, leachate concentrations as compared to the design inventory concentrations. This is identified on the following table under Step 5.

$C_{Leachate}$ maximum leachate concentrations for liner compatibility (Appendix D - EDF 278)

Notes:
1. Constituent reported in the "INEEL CERCLA Disposal Facility Design Inventory (EDF-ER-264).
2. Where a constituent did not have a specific compatibility concentration, the maximum allowable concentrations in leachate are based on chemical category as shown in Table 4-2 of the main text.
3. The suggested maximum activity concentration selected for the ICDF liner system is based on a total absorbed dose of 1,000,000 rads for the individual radionuclides and a maximum 4 cm leachate depth

Table B-1. Maximum Allowable Concentration in Soil For Compatability.

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
ORGANICS					
1,1,1-Trichloroethane	1.1645E-02	1.6E-02	1.3E+00	2.0E+01	2.7E+01
1,1,2,2-Tetrachloroethane	1.2139E-05	4.9E-05	4.1E+00	5.0E+05	2.0E+06
1,1,2-Trichloroethane	8.9945E-04	2.4E-04	2.7E-01	5.0E+05	1.3E+05
1,1-Dichloroethane	8.3284E-04	2.3E-03	2.8E+00	5.0E+05	1.4E+06
1,1-Dichloroethene	4.4863E-04	1.5E-03	3.3E+00	5.0E+05	1.6E+06
1,2,4-Trichlorobenzene	2.4163E-04	1.1E-02	4.7E+01	5.0E+05	2.4E+07
1,2-Dichlorobenzene	7.0576E-04	1.1E-02	1.6E+01	5.0E+05	8.1E+06
1,2-Dichloroethane	3.2675E-06	5.4E-06	1.6E+00	5.0E+05	8.2E+05
1,2-Dichloroethene (total)	2.8947E-04	3.2E-04	1.1E+00	5.0E+05	5.6E+05
1,3-Dichlorobenzene	1.0090E-03	1.1E-02	1.1E+01	2.0E+03	2.3E+04
1,4-Dichlorobenzene	2.5133E-02	4.5E-01	1.8E+01	5.0E+05	9.0E+06
1,4-Dioxane	1.4684E-05	1.9E-05	1.3E+00	5.0E+05	6.4E+05
2,4,5-Trichlorophenol	1.3509E-03	4.5E-02	3.3E+01	5.0E+05	1.7E+07
2,4,6-Trichlorophenol	4.6178E-03	1.8E-02	4.0E+00	5.0E+05	2.0E+06
2,4-Dichlorophenol	1.3442E-03	2.2E-02	1.6E+01	5.0E+05	8.0E+06
2,4-Dimethylphenol	1.9586E-03	1.8E-02	9.3E+00	5.0E+05	4.7E+06
2,4-Dinitrophenol	5.3031E-02	5.1E-02	9.6E-01	5.0E+05	4.8E+05
2,4-Dinitrotoluene	3.1807E-03	1.1E-02	3.6E+00	5.0E+05	1.8E+06
2,6-Dinitrotoluene	7.4130E-03	2.1E-02	2.8E+00	5.0E+05	1.4E+06
2-Butanone	3.1899E-01	2.5E-02	7.7E-02	2.0E+05	1.5E+04
2-Chloronaphthalene	1.8544E-04	1.1E-02	6.1E+01	2.0E+03	1.2E+05
2-Chlorophenol	1.0814E-03	1.8E-02	1.7E+01	2.0E+03	3.4E+04
2-Hexanone	2.5941E-02	2.7E-03	1.0E-01	5.0E+05	5.2E+04
2-Methylnaphthalene	9.0259E-02	5.1E-01	5.7E+00	5.0E+05	2.8E+06
2-Methylphenol	4.4781E-03	2.1E-02	4.6E+00	5.0E+05	2.3E+06
2-Nitroaniline	2.5044E-01	2.7E-02	1.1E-01	5.0E+05	5.4E+04
2-Nitrophenol	7.2451E-03	1.8E-02	2.5E+00	5.0E+05	1.3E+06

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
3,3'-Dichlorobenzidine	5.1019E-04	1.1E-02	2.2E+01	5.0E+05	1.1E+07
3-Methyl Butanal	3.3689E-03	2.2E-04	6.6E-02	5.0E+05	3.3E+04
3-Nitroaniline	2.5044E-01	2.7E-02	1.1E-01	5.0E+05	5.4E+04
4,6-Dinitro-2-methylphenol	1.6991E-03	4.5E-02	2.6E+01	5.0E+05	1.3E+07
4-Bromophenyl-phenylether	2.6728E-04	1.1E-02	4.3E+01	2.0E+03	8.5E+04
4-Chloro-3-methylphenol	9.5508E-02	1.8E-02	1.9E-01	5.0E+05	9.6E+04
4-Chloroaniline	1.7631E-01	4.1E-02	2.3E-01	5.0E+05	1.2E+05
4-Chlorophenyl-phenylether	1.4533E-03	1.1E-02	7.8E+00	5.0E+05	3.9E+06
4-Methyl-2-Pentanone	4.6888E-03	3.0E-02	6.3E+00	5.0E+05	3.2E+06
4-Methylphenol	9.2045E-03	3.9E-02	4.2E+00	5.0E+05	2.1E+06
4-Nitroaniline	2.5044E-01	2.7E-02	1.1E-01	5.0E+05	5.4E+04
4-Nitrophenol	2.0462E-02	5.2E-02	2.5E+00	5.0E+05	1.3E+06
Acenaphthene	7.9944E-04	2.0E-01	2.5E+02	2.0E+03	5.1E+05
Acenaphthylene	2.7884E-04	2.1E-02	7.4E+01	2.0E+03	1.5E+05
Acetone	6.3120E-01	6.2E-01	9.8E-01	2.0E+05	2.0E+05
Acetonitrile	1.1869E-05	1.9E-05	1.6E+00	5.0E+05	7.9E+05
Acrolein	5.0103E-06	9.1E-06	1.8E+00	2.0E+05	3.6E+05
Acrylonitrile	9.1136E-06	9.1E-06	9.9E-01	2.0E+05	2.0E+05
Anthracene	6.8926E-04	3.2E-01	4.6E+02	2.0E+03	9.3E+05
Aramite	2.9502E-06	1.1E-04	3.9E+01	5.0E+05	1.9E+07
Aroclor-1016	4.9059E-05	7.7E-03	1.6E+02	5.0E+05	7.8E+07

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
Aroclor-1254	8.1934E-04	1.3E-01	1.6E+02	5.0E+05	7.8E+07
Aroclor-1260	4.5996E-03	7.2E-01	1.6E+02	5.0E+05	7.8E+07
Aroclor-1268	3.9679E-04	6.2E-02	1.6E+02	5.0E+05	7.8E+07
Benzene	2.2188E-01	6.0E-01	2.7E+00	2.0E+03	5.4E+03
Benzidine	4.0608E-05	2.9E-04	7.2E+00	2.0E+05	1.4E+06
Benzo(a)anthracene	5.7216E-05	2.5E-01	4.4E+03	2.0E+03	8.8E+06
Benzo(a)pyrene	7.3239E-06	1.0E-01	1.4E+04	2.0E+03	2.9E+07
Benzo(b)fluoranthene	1.5631E-05	1.8E-01	1.1E+04	2.0E+03	2.3E+07
Benzo(g,h,i)perylene	3.8440E-07	1.1E-02	3.0E+04	5.0E+05	1.5E+10
Benzo(k)fluoranthene	3.4878E-06	1.9E-02	5.3E+03	5.0E+05	2.7E+09
Benzoic acid	8.6965E-03	8.6E-03	9.8E-01	5.0E+05	4.9E+05
bis(2-Chloroethoxy)methane	1.4241E-01	1.1E-02	8.0E-02	2.0E+03	1.6E+02
bis(2-Chloroethyl)ether	4.0649E-03	1.1E-02	2.8E+00	2.0E+03	5.6E+03
bis(2-Chloroisopropyl)ether	3.8576E-03	1.1E-02	2.9E+00	2.0E+03	5.9E+03
bis(2-Ethylhexyl)phthalate	3.3897E-07	1.5E-01	4.3E+05	2.0E+03	8.7E+08
Butane,1,1,3,4-Tetrachloro-	1.9359E-03	7.9E-03	4.1E+00	5.0E+05	2.0E+06
Butylbenzylphthalate	3.1464E-05	6.8E-02	2.2E+03	2.0E+05	4.3E+08
Carbazole	3.7871E-03	3.2E-02	8.5E+00	5.0E+05	4.3E+06
Carbon Disulfide	1.6330E-02	4.6E-02	2.8E+00	5.0E+05	1.4E+06
Chlorobenzene	7.6794E-04	6.6E-03	8.6E+00	2.0E+03	1.7E+04
Chloroethane	1.9486E-06	3.0E-06	1.5E+00	5.0E+05	7.7E+05
Chloromethane	2.2959E-03	3.5E-04	1.5E-01	2.0E+03	3.1E+02

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
Chrysene	9.3760E-05	2.7E-01	2.8E+03	2.0E+03	5.7E+06
Decane, 3,4-Dimethyl	2.4354E-03	1.6E-04	6.6E-02	5.0E+05	3.3E+04
Diacetone alcohol	6.8362E-01	4.3E+00	6.3E+00	5.0E+05	3.2E+06
Dibenz(a,h)anthracene	4.0472E-07	1.1E-02	2.8E+04	2.0E+03	5.6E+07
Dibenzofuran	1.0411E-03	3.2E-01	3.1E+02	5.0E+05	1.6E+08
Diethylphthalate	9.2474E-04	1.1E-02	1.2E+01	1.0E+05	1.2E+06
Dimethyl Disulfide	4.4649E-02	3.0E-03	6.6E-02	5.0E+05	3.3E+04
Dimethylphthalate	3.0602E-03	1.1E-02	3.7E+00	1.0E+05	3.7E+05
Di-n-butylphthalate	2.3435E-05	2.4E-02	1.0E+03	1.0E+05	1.0E+08
Di-n-octylphthalate	1.0692E-08	2.6E-02	2.5E+06	5.0E+05	1.2E+12
Eicosane	2.9500E-03	2.8E-03	9.6E-01	5.0E+05	4.8E+05
Ethyl cyanide	2.8373E-04	1.9E-05	6.6E-02	5.0E+05	3.3E+04
Ethylbenzene	8.8938E-03	7.8E-02	8.8E+00	2.0E+03	1.8E+04
Famphur	3.6881E-06	5.8E-05	1.6E+01	5.0E+05	7.9E+06
Fluoranthene	5.0608E-04	7.6E-01	1.5E+03	2.0E+03	3.0E+06
Fluorene	3.5464E-04	1.8E-01	5.2E+02	2.0E+03	1.0E+06
Heptadecane, 2,6,10,15-Tetra	5.1892E-02	3.4E-03	6.6E-02	5.0E+05	3.3E+04
Hexachlorobenzene	4.7695E-05	1.1E-02	2.4E+02	2.0E+03	4.8E+05
Hexachlorobutadiene	1.3242E-05	2.1E-02	1.6E+03	2.0E+03	3.1E+06
Hexachlorocyclopentadiene	1.6242E-06	1.1E-02	7.0E+03	2.0E+03	1.4E+07
Hexachloroethane	1.7398E-04	1.1E-02	6.5E+01	2.0E+03	1.3E+05
Indeno(1,2,3-cd)pyrene	8.1993E-08	1.1E-02	1.4E+05	2.0E+03	2.8E+08

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
Isobutyl alcohol	1.6376E-05	1.9E-05	1.1E+00	5.0E+05	5.7E+05
Isophorone	5.7423E-03	1.1E-02	2.0E+00	2.0E+03	4.0E+03
Isopropyl Alcohol/2-propanol	2.1584E-03	2.1E-03	9.8E-01	5.0E+05	4.9E+05
Kepone	1.1625E-04	9.9E-02	8.5E+02	5.0E+05	4.3E+08
Mesityl oxide	1.3410E-02	8.5E-02	6.3E+00	5.0E+05	3.2E+06
Methyl Acetate	6.7478E-03	4.8E-04	7.2E-02	5.0E+05	3.6E+04
Methylene Chloride	6.1482E-02	8.4E-02	1.4E+00	2.0E+01	2.7E+01
Naphthalene	5.2556E-03	4.3E-01	8.1E+01	2.0E+03	1.6E+05
Nitrobenzene	4.4494E-03	1.1E-02	2.6E+00	1.0E+05	2.6E+05
N-Nitroso-di-n-propylamine	8.3201E-03	1.1E-02	1.4E+00	1.0E+05	1.4E+05
N-Nitrosodiphenylamine	2.1715E-04	1.1E-02	5.2E+01	1.0E+05	5.2E+06
Octane,2,3,7-Trimethyl	2.4354E-03	1.6E-04	6.6E-02	5.0E+05	3.3E+04
o-Toluenesulfonamide	7.6311E-02	5.1E-03	6.6E-02	5.0E+05	3.3E+04
Pentachlorophenol	4.8512E-03	5.6E-02	1.2E+01	1.0E+05	1.2E+06
Phenanthrene	8.7835E-03	1.2E+00	1.3E+02	2.0E+03	2.7E+05
Phenol	3.7775E-02	8.0E-02	2.1E+00	1.0E+05	2.1E+05
Phenol,2,6-Bis(1,1-Dimethyl)	4.3406E-04	4.0E-03	9.3E+00	5.0E+05	4.7E+06
p-Toluenesulfonamide	7.6311E-02	5.1E-03	6.6E-02	5.0E+05	3.3E+04
Pyrene	4.5491E-04	2.5E-01	5.6E+02	2.0E+03	1.1E+06
RDX	0.0000E+00	0.0E+00	Not in inventory	5.0E+03	Not in inventory
Styrene	3.0608E-08	1.0E-06	3.4E+01	2.0E+03	6.7E+04

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
Tetrachloroethene	1.3971E-03	9.6E-03	6.9E+00	2.0E+01	1.4E+02
Toluene	1.4969E-01	9.8E-01	6.6E+00	5.0E+05	3.3E+06
Tributylphosphate	8.3321E-01	3.6E-01	4.4E-01	1.1E+03	4.8E+02
Trichloroethene	2.4672E-02	7.2E-02	2.9E+00	5.0E+05	1.5E+06
Trinitrotoluene	0.0000E+00	0.0E+00	Not in inventory	5.0E+05	Not in inventory
Undecane,4,6-Dimethyl-	2.4354E-03	1.6E-04	6.6E-02	5.0E+03	3.3E+02
Xylene (ortho)	4.4125E-04	3.9E-03	8.8E+00	5.0E+05	4.4E+06
Xylene (total)	3.9255E-01	3.5E+00	8.8E+00	5.0E+05	4.4E+06
INORGANICS					
Aluminum	2.8302E+01	7.1E+03	2.5E+02	5.0E+05	1.3E+08
Antimony	1.1645E-01	5.8E+00	5.0E+01	5.0E+05	2.5E+07
Arsenic	1.8E+00	5.7E+00	3.1E+00	5.0E+05	1.5E+06
Barium	3.6E+00	1.8E+02	5.0E+01	5.0E+05	2.5E+07
Beryllium	1.1E-03	2.9E-01	2.5E+02	5.0E+05	1.3E+08
Boron	3.6E+01	1.8E+02	5.1E+00	5.0E+05	2.5E+06
Cadmium	5.9E-01	3.6E+00	6.1E+00	5.0E+05	3.0E+06
Calcium	4.0E+03	2.0E+04	5.1E+00	5.0E+05	2.5E+06
Chloride	2.8E+01	1.9E+00	6.6E-02	5.0E+05	3.3E+04
Chromium	1.4E+00	4.1E+01	3.0E+01	5.0E+05	1.5E+07
Cobalt	6.0E-01	6.0E+00	1.0E+01	5.0E+05	5.0E+06
Copper	1.5E+00	3.0E+01	2.0E+01	5.0E+05	1.0E+07
Cyanide	3.8E+00	3.4E-01	8.8E-02	5.0E+05	4.4E+04

Constituents	Average Leachate Concentration (C_{Liquid})a mg/l	Design Inventory Concentrationin Soil (C_{Soil})b mg/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatability ($C_{Leachate}$)c mg/l	Maximum Allowable Concentration in Soil For Compatability mg/kg
Dysprosium	2.5E-01	5.9E+01	2.4E+02	5.0E+05	1.2E+08
Fluoride	5.8E+01	3.9E+00	6.6E-02	5.0E+05	3.3E+04
Iron	4.7E+01	1.0E+04	2.2E+02	5.0E+05	1.1E+08
Lead	5.8E-01	5.8E+01	1.0E+02	5.0E+05	5.0E+07
Magnesium	8.8E+02	4.5E+03	5.1E+00	5.0E+05	2.5E+06
Manganese	4.1E+00	2.1E+02	5.0E+01	5.0E+05	2.5E+07
Mercury	9.4E-02	9.4E+00	1.0E+02	5.0E+05	5.0E+07
Molybdenum	1.0E+00	1.0E+01	1.0E+01	5.0E+05	5.0E+06
Nickel	2.0E-01	2.0E+01	1.0E+02	5.0E+05	5.0E+07
Nitrate	5.9E+01	3.9E+00	6.6E-02	5.0E+05	3.3E+04
Nitrate/Nitrite-N	3.3E+00	2.2E-01	6.6E-02	5.0E+05	3.3E+04
Nitrite	1.3E-01	8.5E-03	6.6E-02	5.0E+05	3.3E+04
Phosphorus	1.9E+01	9.7E+01	5.1E+00	5.0E+05	2.5E+06
Potassium	7.5E+01	1.1E+03	1.5E+01	5.0E+05	7.5E+06
Selenium	2.1E-01	8.5E-01	4.1E+00	5.0E+05	2.0E+06
Silver	1.1E-01	9.8E+00	9.0E+01	5.0E+05	4.5E+07
Sodium	2.8E+00	2.1E+02	7.6E+01	5.0E+05	3.8E+07
Strontium	1.5E+00	1.8E+01	1.2E+01	5.0E+05	6.0E+06
Sulfate	3.1E+02	2.1E+01	6.6E-02	5.0E+05	3.3E+04
Sulfide	1.1E+04	7.6E+02	6.6E-02	5.0E+05	3.3E+04
Terbium	2.4E+00	5.7E+02	2.4E+02	5.0E+05	1.2E+08
Thallium	3.7E-03	3.7E-01	1.0E+02	5.0E+05	5.0E+07
Vanadium	3.5E+00	2.1E+01	6.1E+00	5.0E+05	3.0E+06
Ytterbium	8.1E-01	2.0E+02	2.4E+02	5.0E+05	1.2E+08
Zinc	1.3E+01	2.1E+02	1.6E+01	5.0E+05	8.0E+06
Zirconium	1.1508E-01	6.9E+01	6.0E+02	5.0E+05	3.0E+08

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
RADIONUCLIDES					
Ac225	1.2254E-22	5.1E-05	4.2E+17	2.2E+07	9.2E+24
Ac227	5.0026E-16	2.0E-02	4.1E+13	1.6E+09	6.6E+22
Ac228	9.4312E-27	1.5E-07	1.6E+19	9.4E+07	1.5E+27
Ag106	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Ag108	3.4865E-27	3.7E-06	1.1E+21	2.0E+08	2.1E+29
Ag108m	3.2648E-10	8.0E+02	2.4E+12	7.8E+07	1.9E+20
Ag109m	1.3042E-30	4.9E-09	3.8E+21	1.5E+09	5.5E+30
Ag110	8.6089E-30	5.2E-08	6.0E+21	1.1E+08	6.3E+29
Ag110m	1.2722E-21	5.5E-06	4.4E+15	4.6E+07	2.0E+23
Ag111	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Am241	2.0154E-08	2.4E+04	1.2E+12	2.3E+07	2.7E+19
Am242	1.0293E-20	4.5E-02	4.4E+18	6.7E+08	2.9E+27
Am242m	1.3207E-14	4.5E-02	3.4E+12	1.9E+09	6.7E+21
Am243	4.9209E-12	3.3E-01	6.8E+10	2.4E+07	1.6E+18
Am245	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Am246	1.2965E-42	1.4E-22	1.1E+20	1.0E+08	1.1E+28
At217	3.3139E-26	5.1E-05	1.5E+21	1.8E+07	2.8E+28
Ba136m	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Ba137m	5.3572E-14	2.3E+07	4.3E+20	1.9E+08	8.3E+28
Ba140	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Be 10	1.9429E-13	1.1E-03	5.9E+09	6.3E+08	3.7E+18
Bi210	5.4959E-21	1.1E-03	2.0E+17	3.3E+08	6.5E+25
Bi211	2.7459E-23	1.8E-02	6.7E+20	1.9E+07	1.3E+28
Bi212	2.3593E-20	5.5E-01	2.3E+19	4.5E+07	1.1E+27
Bi213	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Bi214	7.9491E-23	5.6E-03	7.1E+19	5.9E+07	4.2E+27
Bk249	3.7647E-35	2.2E-18	5.7E+16	3.9E+09	2.2E+26

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Bk250	3.1111E-43	7.8E-23	2.5E+20	1.1E+08	2.7E+28
C 14	2.0391E-12	4.6E-02	2.3E+10	2.6E+09	5.8E+19
Cd109	4.6671E-23	4.9E-09	1.1E+14	6.5E+09	6.9E+23
Cd113m	8.0411E-10	1.6E+03	2.0E+12	6.9E+08	1.4E+21
Cd115m	1.7276E-66	4.3E-51	2.5E+15	2.0E+08	5.0E+23
Ce141	7.9135E-86	1.8E-68	2.3E+17	5.2E+08	1.2E+26
Ce142	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Ce144	1.1981E-16	1.8E+00	1.5E+16	1.1E+09	1.7E+25
Cf249	1.9467E-25	4.1E-13	2.1E+12	2.1E+07	4.4E+19
Cf250	2.6202E-27	2.1E-13	8.0E+13	2.1E+07	1.7E+21
Cf251	1.1691E-27	9.5E-16	8.1E+11	2.2E+07	1.8E+19
Cf252	2.1811E-32	2.2E-17	1.0E+15	1.2E+10	1.3E+25
Cm241	1.2267E-95	1.3E-77	1.1E+18	7.5E+08	7.9E+26
Cm242	3.2300E-31	5.4E-14	1.7E+17	2.1E+07	3.5E+24
Cm243	1.4421E-17	3.6E-03	2.5E+14	2.1E+07	5.2E+21
Cm244	4.2430E-15	1.8E+00	4.3E+14	2.2E+07	9.4E+21
Cm245	1.1668E-16	8.0E-05	6.9E+11	2.3E+07	1.6E+19
Cm246	1.4542E-18	1.8E-06	1.2E+12	2.4E+07	2.9E+19
Cm247	1.7209E-21	6.4E-13	3.7E+08	2.4E+07	9.0E+15
Cm248	1.1478E-23	2.0E-13	1.7E+10	2.7E+07	4.7E+17
Cm250	9.3665E-34	5.5E-22	5.9E+11	9.8E+07	5.8E+19

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Co-57	4.4657E-15	3.7E+00	8.3E+14	8.9E+08	7.4E+23
Co-58	1.1801E-29	5.9E-14	5.0E+15	1.3E+08	6.5E+23
Co-60	7.5535E-09	1.9E+05	2.6E+13	4.9E+07	1.3E+21
Cr-51	5.1738E-68	2.3E-51	4.5E+16	3.5E+09	1.6E+26
Cs132	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Cs134	3.7642E-12	1.1E+04	3.0E+15	7.4E+07	2.2E+23
Cs135	6.2106E-08	3.6E+01	5.8E+08	2.3E+09	1.3E+18
Cs136	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Cs137	4.7432E-07	2.4E+07	5.2E+13	7.5E+08	3.9E+22
Er169	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Eu150	1.9164E-24	1.7E-05	9.0E+18	4.4E+08	4.0E+27
Eu152	1.1185E-08	9.7E+05	8.7E+13	1.0E+08	8.7E+21
Eu154	5.4018E-09	8.2E+05	1.5E+14	8.4E+07	1.3E+22
Eu155	4.7686E-10	1.8E+05	3.7E+14	1.0E+09	3.9E+23
Eu156	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Fe55	2.5E+06	2.0E+09	8.1E+02	2.3E+10	1.9E+13
Fe-59	2.5813E-49	4.5E-32	1.7E+17	9.8E+07	1.7E+25
Fr221	3.6109E-26	5.1E-05	1.4E+21	2.0E+07	2.8E+28
Fr223	9.1235E-25	2.8E-04	3.1E+20	2.9E+08	9.1E+28
Gd152	5.1942E-12	2.7E-11	5.2E+00	5.9E+07	3.1E+08
Gd153	2.2887E-24	2.0E-08	8.8E+15	8.4E+08	7.4E+24
H 3	5.4072E-08	5.0E+04	9.2E+11	2.2E+10	2.1E+22

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Hf-181	6.3798E-51	7.8E-34	1.2E+17	1.7E+08	2.1E+25
Ho166m	9.5753E-22	2.7E-03	2.8E+18	7.3E+07	2.1E+26
I129	1.1080E-01	1.3E+03	1.2E+04	1.6E+09	1.9E+13
I131	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
In114	2.1932E-73	1.9E-51	8.6E+21	1.6E+08	1.4E+30
In114m	1.3743E-68	2.0E-51	1.4E+17	5.3E+08	7.7E+25
In115	2.4263E-08	5.8E-09	2.4E-01	8.4E+08	2.0E+08
In115m	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
K-40	1.8191E-02	1.9E+03	1.1E+05	2.1E+08	2.2E+13
Kr81e	0.0000E+00	5.3E-06	Not in Leachate	Not in Leachate	Not in Leachate
Kr85e	0.0000E+00	1.2E+06	Not in Leachate	Not in Leachate	Not in Leachate
La138	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
La140	2.4808E-121	2.6E-102	1.1E+19	4.5E+07	4.8E+26
Mn-54	5.6208E-21	1.9E-05	3.4E+15	1.5E+08	5.2E+23
Nb92	6.0265E-23	6.3E-16	1.1E+07	8.5E+07	8.9E+14
Nb93m	3.3422E-13	1.4E+01	4.0E+13	4.2E+09	1.7E+23
Nb94	4.7008E-13	8.8E-03	1.9E+10	7.4E+07	1.4E+18
Nb95	7.6761E-47	4.8E-30	6.3E+16	1.6E+08	9.9E+24
Nb95m	3.0154E-50	1.8E-32	6.1E+17	5.2E+08	3.2E+26
Nd144	1.1499E-06	3.3E-07	2.8E-01	6.7E+07	1.9E+07
Nd147	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Ni59	9.5E+04	9.5E+06	1.0E+02	1.9E+10	1.9E+12
Ni63	5.7E+04	6.0E+07	1.1E+02	7.3E+09	7.7E+11
Np235	7.9572E-22	6.8E-08	8.5E+13	1.3E+10	1.1E+24
Np236	6.5219E-13	6.9E-05	1.1E+08	3.7E+08	4.0E+16
Np237	1.1303E-04	6.4E+02	5.7E+06	2.6E+07	1.5E+14
Np238	6.5324E-21	2.2E-04	3.3E+16	1.6E+08	5.3E+24
Np239	1.1189E-17	3.3E-01	3.0E+16	3.1E+08	9.2E+24
Np240	1.7962E-29	2.8E-11	1.6E+18	8.0E+07	1.2E+26
Np240m	1.8591E-27	2.5E-08	1.4E+19	1.3E+08	1.8E+27
Pa231	2.6870E-12	7.0E-02	2.6E+10	2.3E+07	6.1E+17
Pa233	2.3845E-16	4.4E+01	1.8E+17	3.1E+08	5.7E+25
Pa234	1.5587E-22	2.7E-03	1.8E+19	5.2E+07	9.1E+26
Pa234m	2.8344E-22	1.7E+00	6.0E+21	1.5E+08	9.3E+29
Pb209	6.5639E-24	4.8E-05	7.4E+18	6.5E+08	4.8E+27
Pb210	1.1431E-16	1.1E-03	9.6E+12	3.3E+09	3.1E+22
Pb211	4.6321E-22	1.8E-02	4.0E+19	2.5E+08	1.0E+28
Pb212	2.4761E-19	5.5E-01	2.2E+18	4.0E+08	8.9E+26
Pb214	1.0705E-22	5.6E-03	5.2E+19	2.4E+08	1.2E+28
Pd107	2.1579E-07	6.1E+00	2.8E+07	3.9E+09	1.1E+17
Pm146	2.5092E-14	5.8E+00	2.3E+14	1.5E+08	3.5E+22
Pm147	4.5314E-10	3.8E+05	8.4E+14	2.1E+09	1.7E+24
Pm148	6.2917E-74	4.0E-56	6.3E+17	9.8E+07	6.2E+25
Pm148m	1.0045E-71	8.2E-55	8.2E+16	5.9E+07	4.9E+24

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Po210	1.1168E-19	1.0E-03	9.1E+15	2.4E+07	2.2E+23
Po211	2.7502E-30	6.8E-07	2.5E+23	1.7E+07	4.3E+30
Po212	7.8312E-31	3.3E-01	4.2E+29	1.5E+07	6.1E+36
Po213	1.4337E-33	4.3E-05	3.0E+28	1.5E+07	4.6E+35
Po214	7.2803E-30	5.6E-03	7.7E+26	1.7E+07	1.3E+34
Po215	2.5865E-28	1.8E-02	7.1E+25	1.7E+07	1.2E+33
Po216	6.6128E-25	5.5E-01	8.4E+23	1.9E+07	1.6E+31
Po218	8.2761E-24	5.6E-03	6.8E+20	2.1E+07	1.4E+28
Pr143	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Pr144	6.1071E-21	1.8E+00	2.9E+20	1.0E+08	2.9E+28
Pr144m	3.6345E-23	2.5E-02	7.0E+20	1.1E+10	7.5E+30
Pu236	2.1049E-17	5.5E-03	2.6E+14	2.2E+07	5.8E+21
Pu237	4.4568E-72	1.2E-55	2.7E+16	2.1E+09	5.6E+25
Pu238	9.1694E-08	2.3E+05	2.5E+12	2.3E+07	5.9E+19
Pu239	7.6571E-07	6.7E+03	8.7E+09	2.5E+07	2.2E+17
Pu240	4.6958E-08	1.5E+03	3.2E+10	2.5E+07	7.9E+17
Pu241	3.1615E-09	6.4E+04	2.0E+13	2.4E+10	4.9E+23
Pu242	4.3705E-10	2.4E-01	5.5E+08	2.6E+07	1.4E+16
Pu243	1.0969E-31	6.4E-13	5.8E+18	6.6E+08	3.8E+27
Pu244	1.0228E-14	2.5E-08	2.5E+06	2.8E+07	6.9E+13
Pu246	1.2669E-39	1.4E-22	1.1E+17	8.3E+08	9.0E+25

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Ra222	5.4610E-135	1.2E-113	2.1E+21	2.0E+07	4.2E+28
Ra223	2.4635E-19	2.0E-02	8.2E+16	2.2E+07	1.8E+24
Ra224	2.1683E-18	5.5E-01	2.6E+17	2.2E+07	5.7E+24
Ra225	8.1576E-22	5.1E-05	6.3E+16	1.1E+09	6.7E+25
Ra226	4.7699E-09	4.7E+02	9.9E+10	2.7E+07	2.7E+18
Ra228	2.6232E-21	1.5E-07	5.8E+13	1.1E+10	6.4E+23
Rb86	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Rb87	2.3115E-06	1.1E-02	4.8E+03	1.6E+09	7.8E+12
Rh102	1.3562E-16	3.0E-02	2.2E+14	1.6E+09	3.5E+23
Rh103m	1.0414E-74	2.8E-55	2.7E+19	3.3E+09	8.9E+28
Rh106	3.8311E-21	1.1E+01	3.0E+21	7.9E+07	2.3E+29
Rn218	8.8751E-135	1.3E-113	1.4E+21	1.8E+07	2.5E+28
Rn219	1.6220E-21	2.0E-02	1.2E+19	1.9E+07	2.3E+26
Rn220	6.2441E-19	5.5E-01	8.9E+17	2.0E+07	1.8E+25
Rn222	4.2003E-17	6.2E-03	1.5E+14	2.3E+07	3.4E+21
Ru103	7.0663E-43	2.0E-26	2.8E+16	2.3E+08	6.6E+24
Ru106	8.2725E-15	1.2E+01	1.5E+15	3.2E+09	4.8E+24
Sb124	1.5012E-53	2.1E-37	1.4E+16	5.7E+07	7.9E+23
Sb125	4.9644E-11	9.3E+03	1.9E+14	2.4E+08	4.5E+22
Sb126	3.0774E-16	2.1E+01	6.7E+16	4.2E+07	2.8E+24
Sb126m	2.3390E-18	1.5E+02	6.3E+19	5.9E+07	3.7E+27

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Sc-46	1.7783E-34	2.8E-17	1.6E+17	6.0E+07	9.6E+24
Se 79	5.8469E-07	1.7E+02	2.8E+08	2.4E+09	6.9E+17
Sm146	7.4486E-14	4.3E-07	5.7E+06	5.1E+07	2.9E+14
Sm147	7.4416E-07	4.1E-03	5.5E+03	5.7E+07	3.1E+11
Sm148	1.2161E-08	1.0E-09	8.3E-02	6.4E+07	5.3E+06
Sm149	8.8790E-08	5.1E-09	5.8E-02	Not in Leachate	Not in Leachate
Sm151	5.0410E-08	3.4E+05	6.7E+12	6.5E+09	4.3E+22
Sn117m	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Sn119m	3.2878E-20	1.5E-04	4.5E+15	6.5E+09	2.9E+25
Sn121m	3.4980E-12	2.7E+01	7.7E+12	1.5E+09	1.1E+22
Sn123	5.7152E-30	8.4E-14	1.5E+16	4.2E+10	6.2E+26
Sn125	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Sn126	3.9880E-08	1.5E+02	3.7E+09	2.4E+08	9.0E+17
Sr89	1.0737E-56	6.0E-41	5.6E+15	3.6E+08	2.0E+24
Sr90	1.1664E-05	2.3E+07	2.0E+12	2.2E+08	4.3E+20
Tb160	7.5505E-48	3.2E-31	4.2E+16	2.3E+08	9.9E+24
Tb161	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Tc 98	7.6338E-10	1.8E-04	2.3E+05	9.5E+07	2.2E+13
Tc 99	1.2734E-03	5.8E+03	4.5E+06	8.4E+07	3.8E+14
Te123	1.2422E-13	4.5E-12	3.6E+01	1.5E+09	5.5E+10
Te123m	1.8932E-36	2.9E-20	1.6E+16	7.5E+09	1.2E+26

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
Te125m	6.3652E-14	2.3E+03	3.6E+16	5.2E+08	1.9E+25
Te127	1.7707E-35	9.4E-17	5.3E+18	8.0E+08	4.2E+27
Te127m	5.5758E-33	9.5E-17	1.7E+16	5.6E+08	9.6E+24
Te129	1.6092E-87	6.7E-68	4.2E+19	1.4E+09	5.9E+28
Te129m	1.7769E-84	1.1E-67	6.0E+16	2.1E+08	1.3E+25
Th226	5.0570E-134	2.2E-114	4.3E+19	4.1E+08	1.8E+28
Th227	3.6903E-19	1.8E-02	4.9E+16	2.0E+07	9.9E+23
Th228	8.1923E-14	3.3E+01	4.0E+14	2.1E+07	8.5E+21
Th229	2.4030E-15	5.1E-05	2.1E+10	2.4E+07	5.0E+17
Th230	8.5819E-08	1.7E+02	2.0E+09	2.5E+07	5.1E+16
Th231	1.8890E-16	1.6E+02	8.5E+17	2.7E+07	2.3E+25
Th232	1.4238E-02	1.6E+02	1.1E+04	7.2E+08	7.8E+12
Th234	4.6218E-17	1.7E+00	3.7E+16	3.2E+07	1.2E+24
Tl207	5.9894E-23	1.8E-02	3.0E+20	1.9E+09	5.9E+29
Tl208	4.2003E-22	2.0E-01	4.7E+20	2.6E+08	1.2E+29
Tl209	1.6057E-27	1.1E-06	6.5E+20	3.2E+07	2.1E+28
Tm170	3.2435E-39	6.4E-23	2.0E+16	3.2E+07	6.3E+23
Tm171	1.2527E-24	1.6E-09	1.3E+15	3.8E+08	4.9E+23
U230	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
U232	3.8337E-12	5.3E-01	1.4E+11	4.9E+09	6.8E+20
U233	4.3714E-10	2.6E-02	5.9E+07	2.4E+07	1.4E+15

Constituents	Average Leachate Concentration (C_{Liquid})a pCi/l	Design Inventory Concentration Soil (C_{Soil})b pCi/kg	Leachate to Waste Soil Ratio (C_{Soil}/S_{Liquid}) l/kg	Maximum Concentration Allowed in Leachate For Compatibility ($C_{Leachate}$)c pCi/l	Maximum Allowable Concentration in Soil For Compatibility d pCi/kg
U234	1.5924E-04	6.0E+03	3.8E+07	2.7E+07	1.0E+15
U235	8.4040E-03	1.1E+02	1.3E+04	2.7E+07	3.5E+11
U236	5.1441E-04	2.0E+02	3.9E+05	2.8E+07	1.1E+13
U237	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
U238	9.5710E-01	2.0E+03	2.0E+03	2.8E+07	5.8E+10
U240	2.8268E-25	2.5E-08	9.0E+16	3.0E+07	2.7E+24
Xe127	5.8291E-83	1.6E-69	2.7E+13	8.0E+08	2.2E+22
Xe129m	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Xe131m	3.3438E-123	2.7E-109	8.0E+13	4.1E+08	3.3E+22
Xe133	0.0000E+00	0.0E+00	Not in Leachate	Not in Leachate	Not in Leachate
Y90	1.5435E-11	2.3E+07	1.5E+18	7.9E+08	1.2E+27
Y91	6.2855E-51	4.1E-34	6.6E+16	1.3E+08	8.7E+24
Zn65	1.9732E-21	2.7E-06	1.4E+15	2.1E+08	2.9E+23
Zr93	5.6711E-07	8.6E+02	1.5E+09	2.2E+08	3.3E+17
Zr95	1.4447E-39	2.9E-22	2.0E+17	6.6E+09	1.3E+27

Notes:

a. Average leachate concentration based on 15 year operations period (2001_ EDF-274).

b. Predicted concentrations of constituents in waste soil (2000, EDF-264).

c. Maximum concentration allowed in leachate for liner capability (2001__, EDF 278)

d. Maximum allowable concentration in soil is the leachate to waste soil ratio multiplied by the maximum allowable concentration in leachate for compatibility.

Appendix C

Class C Waste Calculations

Appendix C

Class C Waste Calculation

C.1. DISCUSSION

The Nuclear Regulatory Commission performance-based disposal requirement (10 CFR Part 61) is invoked by DOE Order 435.1 and includes radiological waste classification. Waste greater than Class C wastes can not be disposed to the ICDF landfill. The exact regulatory text for determining waste classification is provided. The radiological activities have been converted into pCi/g for comparison to other values calculated for the ICDF landfill WAC. Waste is classified either according to long-lived radionuclides (Table C-1) short-lived radionuclides (Table C-2) or both. The appropriate numbers for comparison have been put into bold font in each table. If the waste contains more than one radionuclide from one table, the sum of fractions is used to determine waste classification. If both long-and short-lived radionuclides are present, then a combination of the tables and the sum of fractions is used, as explained in the regulatory text below, which is taken directly from the regulations.

Because each waste stream will have a different mixture of isotopes, a separate Class C determination must be made for each waste stream. For simple waste streams that contain only one isotope from one table or the other the Class C limitations is given in the WAC, and matches the bold values in Table C-1 or Table C-2 below. For more complicated waste streams, the procedure outlined below must be followed.

10 CFR 61.7(b)(5) Waste that will not decay to levels which present an acceptable hazard to an intruder within 100 years is designated as Class C waste.

10 CFR 61.55 Waste Classification. (a)(2)(iv)

(3) Classification determined by long-lived radionuclides. If radioactive waste contains only radionuclides listed in Table C-1, classification shall be determined as follows:

(i) If the concentration does not exceed 0.1 times the value in Table C-1, the waste is Class A.

(ii) If the concentration exceeds 0.1 times the value in Table C-1 but does not exceed the value in Table C-1, the waste is Class C.

(iii) If the concentration exceeds the value in Table C-1, the waste is not generally acceptable for near-surface disposal.

(iv) For wastes containing mixtures of radionuclides listed in Table C-1, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

Table C-1. Long-lived radionuclides.

Radionuclide	0.1 × Class C Radionuclide Concentration pCi/g[a]	**Class C Radionuclide Concentration pCi/g[a]**	Concentration curies per cubic meter
C-14	4.0×10^5	**4.0×10^6**	8
C-14 in activated metal	4.0×10^6	**4.0×10^7**	80
Ni-59 in activated metal	1.10×10^7	**1.10×10^8**	220
Nb-94 in activated metal	1.00×10^4	**1.00×10^5**	0.2
Tc-99	1.5×10^5	**1.5×10^6**	3
I-129	4.0×10^3	**4.0×10^4**	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	1.0×10^4	**1.0×10^5**	100[b]
Pu-241	3.5×10^5	**3.5×10^6**	3,500[b]
Cm-242	2.0×10^6	**2.0×10^7**	20,000[b]

a. Assumes a waste density of 2.0 gm/cc, the regulation lists activities as seen in the third column of this table. Columns 1 and 2 have been converted to pCi/g for ease of use.

b. Units are nanocuries per gram.

(4) Classification determined by short-lived radionuclides. If radioactive waste does not contain any of the radionuclides listed in Table C-1, classification shall be determined based on the concentrations shown in Table C-2. However, as specified in paragraph (a)(6) of this section, if radioactive waste does not contain any nuclides listed in either Table C-1 or C-2, it is Class A.

(i) If the concentration does not exceed the value in Column 1, the waste is Class A.

(ii) If the concentration exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

(iii) If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

(iv) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(v) For wastes containing mixtures of the nuclides listed in Table C-2, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

Table C-2. Short-lived Radionuclides.

Radionuclide	Concentration, pCi/g[a]		
	Col. 1	Col. 2	Col. 3
Total of all nuclides with less than 5 year half-life	3.5×10^8	[b]	[b]
H-3	2.0×10^7	[b]	[b]
Co-60	3.5×10^8	[b]	[b]
Ni-63	1.75×10^6	3.5×10^7	3.5×10^8
Ni-63 in activated metal	1.75×10^7	3.5×10^8	3.5×10^9
Sr-90	2.0×10^4	7.5×10^7	3.5×10^9
Cs-137	5.00×10^5	2.2×10^7	2.3×10^9

a. The regulation gives the activities in curies per cubic meter. These have been converted to pCi/g using an assumed mass of 2 gm/cc.

b. No limits are established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table C-2 determine the waste to be Class C independent of these nuclides.

(5) Classification determined by both long- and short-lived radionuclides. If radioactive waste contains a mixture of radionuclides, some of which are listed in Table C-1, and some of which are listed in Table C-2, classification shall be determined as follows:

(i) If the concentration of a nuclide listed in Table C-1 does not exceed 0.1 times the value listed in Table C-1, the class shall be that determined by the concentration of nuclides listed in Table C-2.

(ii) If the concentration of a nuclide listed in Table C-1 exceeds 0.1 times the value listed in Table C-1 but does not exceed the value in Table C-1, the waste shall be Class C, provided the concentration of nuclides listed in Table C-2 does not exceed the value shown in Column 3 of Table C-2.

(6) Classification of wastes with radionuclides other than those listed in Tables 1 and 2. If radioactive waste does not contain any nuclides listed in either Table C-1 or 2, it is Class A.

(7) The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m3 and Cs-137 in a concentration of 22 Ci/m3. Since the concentrations both exceed the values in Column 1, Table C-2, they must be compared to Column 2 values. For Sr-90 fraction 50/150=0.33; for Cs-137 fraction, 22/44=0.5; the sum of the fractions=0.83. Since the sum is less than 1.0, the waste is Class B.

C.2. REFERENCES

10 CFR 61,1999, "Licensing Requirements for Land Disposal of Radioactive Waste", *Code of Federal Regulations*, Office of the Federal Register, July 1, 1999.

C.3. BIBLIOGRAPHY

40 CFR 264, 1999, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart BB, "Air emission standards for equipment leaks," *Code of Federal Regulations,* Office of the Federal Register, July 1, 1999.

40 CFR 761, 1999, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, Office of the Federal Register, July 1, 1999.

DOE-ID, 1999, *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13,* DOE/ID-10660, Rev. 0, Department of Energy Idaho Operations Office, Idaho Falls, Idaho, U.S. Environmental Protection Agency Region 10, and State of Idaho Department of Health and Welfare.

Appendix D

Master Landfill Waste Acceptance Criteria Table

Appendix D

Master Landfill Allowable Concentration Criteria Development Calculation

Purpose:	Compare the concentrations of waste constituents allowable in the waste mass to determine the maximum concentration in the waste mass. The maximum concentration will be used to compute a maximum mass of each design inventory constituent that can be used for the waste acceptance criteria
Methodology:	Copy the design inventory constituent list and concentrations allowed in the landfill based on the following criterian: 1. Groundwater remedial action objectives (RAO) based concentrations 2. Maximum allowable concentrations of waste soil that if placed in the landfill would have a leachate chemical make-up compatable with the liner materials (HDPE geomembrane, geosynthetic clay liner, and soil bentonite liner) 3. Regulatory limitations (ARARs) 4. Background concentrations
Calculations:	1. Input the allowable concentration for each design inventory consitutent based on the 4 criterian listed above. 2. Compare the concentration based on each criteria and determine the the criteria that provides the minimum or most conservative allowable concentration in the soil mass. 3. Compare the concentration determined in step 2 with background concentrations and select the maximum concentration between the 2 values for the landfill waste acceptance criteria maximum allowable concentration. 4. If background is selected for the limiting value, the associated concentration will be set at 10 X background
Notes:	See Figure 4-1 in the text for WAC development logic

Table D-1. WAC Concentration Selection

Constituent[a]	Concentration Based on Criterion mg/kg or pCi/kg: Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
Organics						
1,1,1-Trichloroethane	1.6E+01	2.7E+01	5.0E+02	NA	1.6E+01	RAO
1,1,2,2-Tetrachloroethane	5.0E-02	2.0E+06	5.0E+02	NA	5.0E-02	RAO
1,1,2-Trichloroethane	2.4E-01	1.3E+05	5.0E+02	NA	2.4E-01	RAO
1,1-Dichloroethane	2.3E+00	1.4E+06	5.0E+02	NA	2.3E+00	RAO
1,1-Dichloroethene	1.5E+00	1.6E+06	5.0E+02	NA	1.5E+00	RAO
1,2,4-Trichlorobenzene	1.1E+01	2.4E+07	5.0E+02	NA	1.1E+01	RAO
1,2-Dichlorobenzene	1.1E+01	8.1E+06	5.0E+02	NA	1.1E+01	RAO
1,2-Dichloroethane	5.4E-03	8.2E+05	5.0E+02	NA	5.4E-03	RAO
1,2-Dichloroethene (total)	3.2E-01	5.6E+05	5.0E+02	NA	3.2E-01	RAO
1,3-Dichlorobenzene	1.1E+01	2.3E+04	5.0E+02	NA	1.1E+01	RAO
1,4-Dichlorobenzene	4.5E+02	9.0E+06	4.4E+01	NA	4.5E+02	RAO
1,4-Dioxane	1.9E-02	6.4E+05	5.0E+02	NA	1.9E-02	RAO
2,4,5-Trichlorophenol	4.5E+01	1.7E+07	1.0E+05	NA	4.5E+01	RAO
2,4,6-Trichlorophenol	1.8E+01	2.0E+06	1.0E+05	NA	1.8E+01	RAO
2,4-Dichlorophenol	2.2E+01	8.0E+06	1.0E+05	NA	2.2E+01	RAO
2,4-Dimethylphenol	1.8E+01	4.7E+06	1.0E+05	NA	1.8E+01	RAO
2,4-Dinitrophenol	5.1E+01	4.8E+05	1.0E+05	NA	5.1E+01	RAO
2,4-Dinitrotoluene	1.1E+01	1.8E+06	1.0E+05	NA	1.1E+01	RAO
2,6-Dinitrotoluene	2.1E+01	1.4E+06	1.0E+05	NA	2.1E+01	RAO
2-Butanone	2.5E+01	1.5E+04	5.0E+02	NA	2.5E+01	RAO
2-Chloronaphthalene	1.1E+01	1.2E+05	1.0E+05	NA	1.1E+01	RAO
2-Chlorophenol	1.8E+01	3.4E+04	1.0E+05	NA	1.8E+01	RAO
2-Hexanone	2.7E+00	5.2E+04	5.0E+02	NA	2.7E+00	RAO
2-Methylnaphthalene	5.1E+02	2.8E+06	1.0E+05	NA	5.1E+02	RAO
2-Methylphenol	2.1E+01	2.3E+06	1.0E+05	NA	2.1E+01	RAO
2-Nitroaniline	1.0E-01	5.4E+04	1.0E+05	NA	1.0E-01	RAO
2-Nitrophenol	1.8E+01	1.3E+06	1.0E+05	NA	1.8E+01	RAO
3,3'-Dichlorobenzidine	1.1E+01	1.1E+07	1.0E+05	NA	1.1E+01	RAO
3-Methyl Butanal	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
3-Nitroaniline	1.0E-01	5.4E+04	1.0E+05	NA	1.0E-01	RAO
4,6-Dinitro-2-methylphenol	4.5E+01	1.3E+07	1.0E+05	NA	4.5E+01	RAO
4-Bromophenyl-phenylether	No Limit	8.5E+04	1.0E+05	NA	8.5E+04	Liner Compatibility
4-Chloro-3-methylphenol	No Limit	9.6E+04	1.0E+05	NA	9.6E+04	Liner Compatibility
4-Chloroaniline	4.1E+01	1.2E+05	1.0E+05	NA	4.1E+01	RAO
4-Chlorophenyl-phenylether	No Limit	3.9E+06	1.0E+05	NA	1.0E+05	Regulatory Limit
4-Methyl-2-Pentanone	3.0E+01	3.2E+06	5.0E+02	NA	3.0E+01	RAO
4-Methylphenol	3.9E+01	2.1E+06	1.0E+05	NA	3.9E+01	RAO
4-Nitroaniline	1.0E-01	5.4E+04	1.0E+05	NA	1.0E-01	RAO

	Concentration Based on Criterion mg/kg or pCi/kg					
Constituent[a]	Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
4-Nitrophenol	5.2E+01	1.3E+06	1.0E+05	NA	5.2E+01	RAO
Acenaphthene	2.0E+02	5.1E+05	1.0E+05	NA	2.0E+02	RAO
Acenaphthylene	2.1E+01	1.5E+05	1.0E+05	NA	2.1E+01	RAO
Acetone	6.2E+02	2.0E+05	4.9E+01	NA	5.0E+02	Regulatory Limit
Acetonitrile	1.2E+00	7.9E+05	5.0E+02	NA	1.2E+00	RAO
Acrolein	5.5E-01	3.6E+05	5.0E+02	NA	5.5E-01	RAO
Acrylonitrile	5.8E-01	2.0E+05	5.0E+02	NA	5.8E-01	RAO
Anthracene	3.2E+02	9.3E+05	1.0E+05	NA	3.2E+02	RAO
Aramite	6.7E+00	1.9E+07	1.0E+05	NA	6.7E+00	RAO
Aroclor-1016	7.7E+00	7.8E+07	5.0E+02	NA	7.7E+00	RAO
Aroclor-1254	1.3E+02	7.8E+07	5.0E+02	NA	1.3E+02	RAO
Aroclor-1260	7.2E+02	7.8E+07	5.0E+02	NA	5.0E+02	Regulatory Limit
Aroclor-1268	6.2E+01	7.8E+07	5.0E+02	NA	6.2E+01	RAO
Benzene	6.0E+02	5.4E+03	2.2E+02	NA	5.0E+02	Regulatory Limit
Benzidine	1.7E+01	1.4E+06	1.0E+05	NA	1.7E+01	RAO
Benzo(a)anthracene	2.5E+02	8.8E+06	1.0E+05	NA	2.5E+02	RAO
Benzo(a)pyrene	1.1E+02	2.9E+07	1.0E+05	NA	1.1E+02	RAO
Benzo(b)fluoranthene	1.8E+02	2.3E+07	1.0E+05	NA	1.8E+02	RAO
Benzo(g,h,i)perylene	1.1E+01	1.5E+10	1.0E+05	NA	1.1E+01	RAO
Benzo(k)fluoranthene	1.9E+01	2.7E+09	1.0E+05	NA	1.9E+01	RAO
Benzoic acid	8.6E+00	4.9E+05	1.0E+05	NA	8.6E+00	RAO
bis(2-Chloroethoxy)methane	No Limit	1.6E+02	1.0E+05	NA	1.6E+02	Liner Compatibility
bis(2-Chloroethyl)ether	1.1E+01	5.6E+03	1.0E+05	NA	1.1E+01	RAO
bis(2-Chloroisopropyl)ether	1.1E+01	5.9E+03	1.0E+05	NA	1.1E+01	RAO
bis(2-Ethylhexyl)phthalate	1.5E+02	8.7E+08	1.0E+05	NA	1.5E+02	RAO
Butane,1,1,3,4-Tetrachloro-	No Limit	2.0E+06	1.0E+05	NA	1.0E+05	Regulatory Limit
Butylbenzylphthalate	6.8E+01	4.3E+08	1.0E+05	NA	6.8E+01	RAO
Carbazole	3.2E+01	4.3E+06	1.0E+05	NA	3.2E+01	RAO
Carbon Disulfide	4.6E+01	1.4E+06	5.0E+02	NA	4.6E+01	RAO
Chlorobenzene	6.6E+00	1.7E+04	5.0E+02	NA	6.6E+00	RAO
Chloroethane	1.5E-01	7.7E+05	5.0E+02	NA	1.5E-01	RAO
Chloromethane	3.5E-01	3.1E+02	5.0E+02	NA	3.5E-01	RAO
Chrysene	2.7E+02	5.7E+06	1.0E+05	NA	2.7E+02	RAO
Decane, 3,4-Dimethyl	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
Diacetone alcohol	No Limit	3.2E+06	1.0E+05	NA	1.0E+05	Regulatory Limit

Table D-1. (continued).

Constituent[a]	Concentration Based on Criterion mg/kg or pCi/kg: Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
Dibenz(a,h)anthracene	1.1E+01	5.6E+07	1.0E+05	NA	1.1E+01	RAO
Dibenzofuran	3.2E+02	1.6E+08	1.0E+05	NA	3.2E+02	RAO
Diethylphthalate	1.1E+01	1.2E+06	1.0E+05	NA	1.1E+01	RAO
Dimethyl Disulfide	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
Dimethylphthalate	1.1E+01	3.7E+05	1.0E+05	NA	1.1E+01	RAO
Di-n-butylphthalate	2.4E+01	1.0E+08	1.0E+05	NA	2.4E+01	RAO
Di-n-octylphthalate	2.6E+01	1.2E+12	1.0E+05	NA	2.6E+01	RAO
Eicosane	No Limit	4.8E+05	1.0E+05	NA	1.0E+05	Regulatory Limit
Ethyl cyanide	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
Ethylbenzene	7.8E+01	1.8E+04	5.0E+02	NA	7.8E+01	RAO
Famphur	No Limit	7.9E+06	1.0E+05	NA	1.0E+05	Regulatory Limit
Fluoranthene	7.6E+02	3.0E+06	1.0E+05	NA	7.6E+02	RAO
Fluorene	1.8E+02	1.0E+06	1.0E+05	NA	1.8E+02	RAO
Heptadecane, 2,6,10,15-Tetra	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
Hexachlorobenzene	1.1E+01	4.8E+05	1.0E+05	NA	1.1E+01	RAO
Hexachlorobutadiene	2.1E+01	3.1E+06	5.0E+02	NA	2.1E+01	RAO
Hexachlorocyclopentadiene	1.1E+01	1.4E+07	1.0E+05	NA	1.1E+01	RAO
Hexachloroethane	1.1E+01	1.3E+05	5.0E+02	NA	1.1E+01	RAO
Indeno(1,2,3-cd)pyrene	1.1E+01	2.8E+08	1.0E+05	NA	1.1E+01	RAO
Isobutyl alcohol	1.2E+00	5.7E+05	5.0E+02	NA	1.2E+00	RAO
Isophorone	1.1E+01	4.0E+03	1.0E+05	NA	1.1E+01	RAO
Isopropyl Alcohol/2-propanol	No Limit	4.9E+05	1.0E+05	NA	1.0E+05	Regulatory Limit
Kepone	9.9E+01	4.3E+08	1.0E+05	NA	9.9E+01	RAO
Mesityl oxide	No Limit	3.2E+06	1.0E+05	NA	1.0E+05	Regulatory Limit
Methyl Acetate	4.8E-01	3.6E+04	1.0E+05	NA	4.8E-01	RAO
Methylene Chloride	8.4E+01	2.7E+01	5.0E+02	NA	2.7E+01	Liner Compatibility
Naphthalene	4.3E+02	1.6E+05	1.0E+05	NA	4.3E+02	RAO
Nitrobenzene	1.1E+01	2.6E+05	5.0E+02	NA	1.1E+01	RAO
N-Nitroso-di-n-propylamine	1.1E+01	1.4E+05	1.0E+05	NA	1.1E+01	RAO
N-Nitrosodiphenylamine	1.1E+01	5.2E+06	1.0E+05	NA	1.1E+01	RAO
Octane,2,3,7-Trimethyl	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
o-Toluenesulfonamide	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility
Pentachlorophenol	5.6E+01	1.2E+06	1.0E+05	NA	5.6E+01	RAO
Phenanthrene	1.2E+03	2.7E+05	1.0E+05	NA	1.2E+03	RAO
Phenol	8.0E+01	2.1E+05	1.0E+05	NA	8.0E+01	RAO
Phenol,2,6-Bis(1,1-Dimethyl)	No Limit	4.7E+06	1.0E+05	NA	1.0E+05	Regulatory Limit
p-Toluenesulfonamide	No Limit	3.3E+04	1.0E+05	NA	3.3E+04	Liner Compatibility

Table D-1. (continued).

Constituent[a]	Concentration Based on Criterion mg/kg or pCi/kg: Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
Pyrene	2.5E+02	1.1E+06	1.0E+05	NA	2.5E+02	RAO
RDX	1.0E+01	Not in inventory	1.0E+05	NA	1.0E+01	RAO
Styrene	6.1E-02	6.7E+04	1.0E+05	NA	6.1E-02	RAO
Tetrachloroethene	9.6E+00	1.4E+02	5.0E+02	NA	9.6E+00	RAO
Toluene	9.8E+02	3.3E+06	3.0E+01	NA	5.0E+02	Regulatory Limit
Tributylphosphate	No Limit	4.8E+02	1.0E+05	NA	4.8E+02	Liner Compatibility
Trichloroethene	7.2E+01	1.5E+06	3.1E+01	NA	7.2E+01	RAO
Trinitrotoluene	1.1E+01	Not in inventory	1.0E+05	NA	1.1E+01	RAO
Undecane,4,6-Dimethyl-	No Limit	3.3E+02	1.0E+05	NA	3.3E+02	Liner Compatibility
Xylene (ortho)	3.9E+00	4.4E+06	5.0E+02	NA	3.9E+00	RAO
Xylene (total)	3.5E+03	4.4E+06	2.8E+02	NA	5.0E+02	Regulatory Limit
Inorganics						
Aluminum	1.6E+05	1.3E+08	NA	1.60E+04	1.6E+05	10 X Background
Antimony	5.8E+03	2.5E+07	NA	4.80E+00	5.8E+03	RAO
Arsenic	5.8E+01	1.5E+06	NA	5.80E+00	5.8E+01	RAO
Barium	3.0E+03	2.5E+07	NA	3.00E+02	3.0E+03	RAO
Beryllium	1.8E+01	1.3E+08	NA	1.80E+00	1.8E+01	RAO
Boron	3.3E+03	2.5E+06	NA	NA	3.3E+03	RAO
Cadmium	3.6E+03	3.0E+06	NA	2.20E+00	3.6E+03	RAO
Calcium	No Limit	NA[h]	NA	2.40E+04	No Limit	Liner Compatibility
Chloride	No Limit	3.3E+04	NA	NA	3.3E+04	Liner Compatibility
Chromium	4.1E+04	1.5E+07	NA	3.30E+01	4.1E+04	RAO
Cobalt	1.1E+02	5.0E+06	NA	1.10E+01	1.1E+02	RAO
Copper	3.0E+04	1.0E+07	NA	2.20E+01	3.0E+04	RAO
Cyanide	3.4E+02	4.4E+04	NA	NA	3.4E+02	RAO
Dysprosium	5.9E+04	1.2E+08	NA	NA	5.9E+04	RAO
Fluoride	3.9E+03	3.3E+04	NA	NA	3.9E+03	RAO
Iron	2.5E+05	1.1E+08	NA	2.40E+04	2.4E+05	10 X Background
Lead	5.8E+04	5.0E+07	NA	1.70E+01	5.8E+04	RAO
Magnesium	No Limit	2.5E+06	NA	1.20E+04	1.2E+05	10 X Background
Manganese	4.9E+03	2.5E+07	NA	4.90E+02	4.9E+03	RAO
Mercury	9.5E+03	5.0E+07	NA	5.00E-02	9.5E+03	RAO
Molybdenum	1.0E+04	5.0E+06	NA	NA	1.0E+04	RAO
Nickel	3.5E+02	5.0E+07	NA	3.50E+01	3.5E+02	RAO
Nitrate	3.9E+03	3.3E+04	NA	NA	3.9E+03	RAO
Nitrate/Nitrite-N	No Limit	3.3E+04	NA	NA	3.3E+04	Liner Compatibility
Nitrite	8.5E+00	3.3E+04	NA	NA	8.5E+00	RAO
Phosphorus	No Limit	NA[h]	NA	NA	No Limit	Liner Compatibility
Potassium	No Limit	7.5E+06	NA	4.30E+03	4.3E+04	10 X Background
Selenium	8.5E+02	2.0E+06	NA	2.20E-01	8.5E+02	RAO
Silver	9.8E+03	4.5E+07	NA	0.00E+00	9.8E+03	RAO

Table D-1. (continued).

Constituent[a]	Concentration Based on Criterion mg/kg or pCi/kg: Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
Sodium	No Limit	3.8E+07	NA	3.20E+02	3.2E+03	10 X Background
Strontium	1.8E+04	6.0E+06	NA	NA	1.8E+04	RAO
Sulfate	No Limit	3.3E+04	NA	NA	3.3E+04	Liner Compatibility
Sulfide	No Limit	3.3E+04	NA	NA	3.3E+04	Liner Compatibility
Terbium	No Limit	NA[h]	NA	NA	No Limit	Liner Compatibility
Thallium	4.3E+00	5.0E+07	NA	4.30E-01	4.3E+00	RAO
Vanadium	4.5E+02	3.0E+06	NA	4.50E+01	4.5E+02	RAO
Ytterbium	No Limit	NA[h]	NA	NA	No Limit	Liner Compatibility
Zinc	2.1E+05	8.0E+06	NA	1.50E+02	2.1E+05	RAO
Zirconium	No Limit	NA[h]	NA	NA	No Limit	Liner Compatibility
Radionuclides						
Ag108m	8.0E+05	1.9E+20	NA	NA	8.0E+05	RAO
Am241	2.4E+07	2.7E+19	1.0E+07	NA	1.0E+07	Regulatory Limit
Am243	3.3E+02	1.6E+18	1.0E+07	NA	3.3E+02	RAO
Ba137m	No Limit	NA[h]	NA	NA	No Limit	Liner Compatibility
C14	3.0E+03	5.8E+19	4.0E+09	NA	3.0E+03	RAO
Cd113m	1.6E+06	1.4E+21	NA	NA	1.6E+06	RAO
Ce144	1.8E+03	1.7E+25	NA	NA	1.8E+03	RAO
Co57	3.7E+03	7.4E+23	NA	NA	3.7E+03	RAO
Co60	1.9E+08	1.3E+21	NA	NA	1.9E+08	RAO
Cs134	1.1E+07	2.2E+23	NA	NA	1.1E+07	RAO
Cs137	No Limit	3.9E+22	2.3E+12	NA	2.3E+12	Regulatory Limit
Eu152	9.7E+08	8.7E+21	NA	NA	9.7E+08	RAO
Eu154	8.2E+08	1.3E+22	NA	NA	8.2E+08	RAO
Eu155	1.8E+08	3.9E+23	NA	NA	1.8E+08	RAO
Fe55	2.0E+12	1.9E+13	NA	NA	2.0E+12	RAO
H3	5.0E+07	2.1E+22	NA	NA	5.0E+07	RAO
I129	3.1E+03	1.9E+13	4.0E+07	NA	3.1E+03	RAO
K40	2.4E+05	2.2E+13	NA	NA	2.4E+05	RAO
Kr85	No Limit	No Limit	NA	NA	No Limit	RAO
Ni59	9.5E+09	1.9E+12	1.1E+11	NA	9.5E+09	RAO
Ni63	6.0E+10	7.7E+11	3.5E+11	NA	6.0E+10	RAO
Np237	6.4E+05	1.5E+14	1.0E+07	NA	6.4E+05	RAO
Pm147	3.8E+08	1.7E+24	NA	NA	3.8E+08	RAO
Pu238	2.3E+08	5.9E+19	1.0E+07	NA	1.0E+07	Regulatory Limit
Pu239	6.7E+06	2.2E+17	1.0E+07	NA	6.7E+06	RAO
Pu240	1.5E+06	7.9E+17	1.0E+07	1.00E-01	1.5E+06	RAO
Pu241	6.4E+07	4.9E+23	3.5E+09	1.00E-01	6.4E+07	RAO
Ra226	4.7E+05	2.7E+18	NA	NA	4.7E+05	RAO
Ru106	1.2E+04	4.8E+24	NA	NA	1.2E+04	RAO
Sb125	9.3E+06	4.5E+22	NA	NA	9.3E+06	RAO
Sm151	3.4E+08	4.3E+22	NA	NA	3.4E+08	RAO
Sr90	No Limit	4.3E+20	3.5E+12	NA	3.5E+12	Regulatory Limit
Tc99	5.8E+06	3.8E+14	1.5E+09	NA	5.8E+06	RAO
Te125m	2.3E+06	1.9E+25	NA	NA	2.3E+06	RAO
Th228	1.6E+04	8.5E+21	NA	NA	1.6E+04	RAO
Th230	1.4E+04	5.1E+16	NA	NA	1.4E+04	RAO
Th232	1.7E+04	7.8E+12	NA	NA	1.7E+04	RAO
U233	2.6E+01	1.4E+15	NA	NA	2.6E+01	RAO

Table D-1. (continued).

Constituent[a]	Concentration Based on Criterion mg/kg or pCi/kg: Groundwater RAO Guidance Concentration mg/kg or pCi/kg	Liner Compatability[b] mg/kg or pCi/kg	Regulatory Limitation[c,d,e,f,g] mg/kg or pCi/kg	Background mg/kg or pCi/kg	Selected WAC Concentration mg/kg or pCi/kg	Source of WAC Concentration
U234	6.0E+06	1.0E+15	NA	NA	6.0E+06	RAO
U235	1.1E+05	3.5E+11	NA	NA	1.1E+05	RAO
U236	2.0E+05	1.1E+13	NA	NA	2.0E+05	RAO
U238	2.0E+06	5.8E+10	NA	NA	2.0E+06	RAO
Y90	2.3E+10	1.2E+27	NA	NA	2.3E+10	RAO

[a] All constituents' design inventory concentrations where compared against background to determine if they should be included in the excess lifetime cancer risk and hazard index evalutions. No limit was used as the default if the constituent was less than background and does not have a risk factor, otherwise the concentration was defaulted to the background concentration. MCL

[b] For all constituents where liner compatability data was available, these numbers are given. For constituents without specific compatibility, the maximum allowable leachate concentration by chemical class was used as per Table 4-2 in the main text.

[c] < 10nCi/g total Transuranic isotopes. If more than one transuranic isotope is present the sum must not exceed 10 nCi/g (liquid 10nCi/ml, or 1E7 pCi/L)*These limits are shown in italics*. This is calculated for alpha-emitting TRU isotopes, with half-lives greater than 20 years: NP-237, Pu-238, Pu-239, Pu-240, Pu-244, Pu-244, Am-241, Am-243, Cm-245, cm-248, Cm-250, Bk-247, Cf-249, and Cf-251.

[d] Class C waste, assuming only a single isotope is present. For wastes containing more than one of these isotopes, use the formula in 10 CFR 61.55 to determine waste classification. This is shown in Appendix D to the ICDF Landfill WAC.

[e] Total organic constituents cannot exceede 10% by weight (100,000 mg/kg) 40 CFR 1082(c)(1), total volatile organic constituents cannot exceed 500 ppm.

[f] Total PCBs cannot exceed 500 mg/kg (40 CFR 761.60).

[g] Based on 40 CFR 264 Section BB, exemption provided if organics are less than 10% by weight

[h] Calculated concentration exceeds unity therefore "No Limit" applies to the specific evaluation criterion.

Appendix E

Thermal Power Calculation Methods

Appendix E

E.1 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 E-1. The thermal power calculation is performed in the following steps. The information provided is an excerpt from the Appendix A: Radiological Calculation Methods (DOE/RL 1998)

1. The concentration of each radionuclide (expressed in curies per cubic meter) is multiplied by the heat of decay for that nuclide from Table E-1, yielding the heat of decay for each in units of watts per cubic meter.

2. To determine the thermal power add the heat of decay for each radionuclide in the waste to provide a total "heat of decay" for the waste stream.

E.2 References

DOE/RL 1998, "Hanford Site Solid Waste Acceptance Criteria," HNF-EP-0063, Rev. 5, U. S. Department of Energy Richland Field Office, Richland, Washington, June 29, 1998.

Table E-1. Conversion factors for general radiological calculations.

Isotope	Half-life (days)	Specific Activity (curies per gram)	Heat of Decay (watts per curie)	Dose Equivalent Curie Correction Factor
^{3}H	4.5034 E+03	9.66 E+03	3.38 E-05	1.49 E-07
^{7}Be	5.3920 E+01	3.50 E+05	2.94 E-04	7.47 E-07
^{10}Be	5.8439 E+08	2.23 E-02	1.20 E-03	8.25 E-04
^{14}C	2.0928 E+06	4.46 E+00	2.93 E-04	4.86 E-06
^{22}Na	9.5032 E+02	6.25 E+03	8.71 E-03	1.78 E-05
^{32}P	1.4262 E+01	2.86 E+05	4.12 E-03	3.61 E-05
^{35}S	8.7510 E+01	4.26 E+04	2.88 E-04	5.76 E-06
^{36}Cl	1.0994 E+08	3.30 E-02	1.43 E-03	5.11 E-05
^{40}K	4.6641 E+11	7.00 E-06	3.33 E-03	2.87 E-05
^{45}Ca	1.6380 E+02	1.77 E+04	4.56 E-04	1.54 E-05
^{46}Sc	8.3790 E+01	3.39 E+04	1.26 E-02	6.90 E-05
^{49}V	3.3000 E+02	8.08 E+03	5.16 E-06	8.04 E-07
^{51}Cr	2.7702 E+01	9.24 E+04	1.93 E-04	7.78 E-07
^{54}Mn	3.1210 E+02	7.75 E+03	4.96 E-03	1.56 E-05
^{55}Fe	9.97 E+02	2.38 E+03	9.66 E-06	6.25 E-06
^{56}Co	7.7270 E+01	3.02 E+04	2.02 E-02	9.22 E-05
^{57}Co	2.7179 E+02	8.43 E+03	7.42 E-04	2.11 E-05
^{58}Co	7.0820 E+01	3.12 E+04	4.91 E-03	2.53 E-05
^{59}Fe	4.4503 E+01	4.97 E+04	7.74 E-03	3.44 E-05
^{59}Ni	2.77 E+07	7.97 E-02	1.36 E-05	3.44 E-5
^{60}Co	1.9253 E+03	1.13 E+03	1.54 E-02	5.09 E-04
^{63}Ni	3.65 E+04	5.67 E+01	1.01 E-04	7.23 E-06
^{65}Zn	2.4426 E+02	8.22 E+03	3.38 E-03	4.75 E-05
^{68}Ge	2.7082 E+02	7.09 E+03	2.44 E-05	1.20 E-04
^{75}Se	1.1978 E+02	1.45 E+04	2.32 E-03	1.97 E-05
^{79}Se	2.3741 E+07	6.96 E-02	3.14 E-04	2.29 E-05
^{82}Sr	2.5550 E+01	6.23 E+04	4.65 E-05	1.43 E-04
^{85}Kr	3.9285 E+03	3.91 E+02	1.50 E-03	1.64 E-14
^{85}Sr	6.4840 E+01	2.37 E+04	3.07 E-03	1.17 E-05
^{86}Rb	1.8631 E+01	8.15 E+04	4.51 E-03	1.54 E-05
^{88}Y	1.0665 E+02	1.39 E+04	1.59 E-02	6.54 E-05
^{89}Sr	5.0530 E+01	2.90 E+04	3.46 E-03	9.65 E-05
$^{90}Sr - {}^{90}Y^{*}$	1.0512 E+04	2.76 E+02	5.54 E-03	3.04 E-03
^{93}Mo	1.4610 E+06	9.61 E-01	7.41 E-05	6.62 E-05
^{93m}Nb	5.8914 E+03	2.38 E+02	1.09 E-05	6.81 E-05

Table E-1. (continued).

Isotope	Half-life (days)	Specific Activity (curies per gram)	Heat of Decay (watts per curie)	Dose Equivalent Curie Correction Factor
^{93}Zr	5.5882 E+08	2.51 E-03	1.24 E-04	7.74 E-04
^{94}Nb	7.4144 E+06	1.87 E-01	1.02 E-02	9.65 E-04
^{95}Nb	3.4975 E+01	3.93 E+05	4.68 E-03	1.35 E-05
^{95}Zr–^{95m}Nb*	6.4020 E+01	4.42 E+04	4.24 E-04	6.09 E-05
^{99}Tc	7.7103 E+07	1.71 E-02	5.04 E-04	1.93 E-05
^{103}Ru–^{103m}Rh*	3.6260 E+01	7.00 E+04	3.36 E-03	2.08 E-05
^{106}Ru–^{106}Rh*	3.7359 E+02	6.59 E+03	3.99 E-04	1.11 E-03
^{107}Pd	2.3741 E+09	5.14 E-04	5.51 E-05	2.97 E-05
^{108m}Ag	4.6386 E+04	2.61 E+01	9.96 E-03	6.60 E-04
^{109}Cd	4.6260 E+02	2.59 E+03	1.54 E-04	2.66 E-04
^{110m}Ag–^{110}Ag*	2.4979 E+02	9.50 E+03	7.19 E-03	1.87 E-04
^{113m}Cd	5.1499 E+03	2.24 E+02	1.08 E-03	3.56 E-03
^{113}Sn	1.1509 E+02	1.00 E+04	1.66 E-03	2.48 E-05
^{119m}Sn	2.9310 E+02	3.74 E+03	6.78 E-05	1.45 E-05
^{121m}Sn	2.0088 E+04	5.37 E+01	6.59 E-05	2.68 E-05
^{121}Te	1.6780 E+01	6.43 E+04	3.42 E-03	4.43 E-06
^{123}Te	3.6524 E+15	2.91 E-10	1.29 E-03	2.45 E-05
^{124}Sb	6.0200 E+01	1.75 E+04	1.33 E-02	5.86 E-05
^{125}I	5.9408 E+01	1.76 E+04	2.51 E-04	5.62 E-05
^{125}Sb	1.0074 E+03	1.04 E+03	3.14 E-03	2.84 E-05
^{125m}Te	5.7400 E+01	1.82 E+04	2.13 E-04	1.69 E-05
^{126}Sb	1.2460 E+01	8.32 E+04	1.83 E-02	2.73 E-05
^{126}Sn–^{126m}Sb*	3.6524 E+07	5.68 E-02	1.23 E-02	2.31 E-04
^{127m}Te–^{127}Te*	1.0900 E+02	1.89 E+04	1.36 E-03	5.07 E-05
^{129}I	5.7343 E+09	1.77 E-04	3.93 E-04	4.04 E-04
^{129m}Te	3.3600 E+01	3.01 E+04	1.44 E-03	5.57 E-05
^{131m}Xe	1.1840 E+01	8.42 E+04	1.19 E-04	6.07 E-12
^{133}Ba	3.8423 E+03	2.56 E+02	2.39 E-03	1.81 E-05
^{134}Cs	7.5313 E+02	1.29 E+03	1.02 E-02	1.08 E-04
^{135}Cs	8.4006 E+08	1.15 E-03	3.32 E-04	1.06 E-05
^{137}Cs–^{137m}Ba*	1.0983 E+04	1.69 E+02	3.36 E-03	7.44 E-05
^{140}Ba	1.2752 E+01	7.31 E+04	2.72 E-03	8.70 E-06
^{141}Ce	3.2501 E+01	2.85 E+04	8.60 E-04	2.80 E-05
^{144}Ce–^{144}Pr*	2.8489 E+02	6.37 E+03	7.34 E-03	8.70 E-04
^{147}Nd	1.0980 E+01	8.09 E+04	2.22 E-03	1.59 E-05

Table E-1. (continued).

Isotope	Half-life (days)	Specific Activity (curies per gram)	Heat of Decay (watts per curie)	Dose Equivalent Curie Correction Factor
^{147}Pm	9.5818 E+02	9.27 E+02	3.68 E-04	9.13 E-05
^{147}Sm	3.8716 E+13	2.29 E-08	1.37 E-02	1.74 E-01
^{150}Eu	1.3076 E+04	6.66 E+01	8.90 E-03	6.25 E-04
^{151}Sm	3.2872 E+04	2.63 E+01	7.41 E-04	6.98 E-05
^{152}Eu	4.9461 E+03	1.74 E+02	7.03 E-03	5.14 E-04
^{152}Gd	3.9446 E+16	2.18 E-11	1.31 E-02	5.67 E-01
^{153}Gd	2.4160 E+02	3.53 E+03	6.02 E-04	5.54 E-05
^{154}Eu	3.1385 E+03	2.70 E+02	8.77 E-03	6.66 E-04
^{155}Eu	1.7390 E+03	4.84 E+02	6.53 E-04	9.65 E-05
^{170}Tm	1.2860 E+02	5.97 E+03	1.90 E-03	6.12 E-05
^{175}Hf	7.0000 E+01	1.07 E+04	2.16 E-03	1.30 E-05
^{181}Hf	4.2390 E+01	1.70 E+04	3.85 E-03	3.59 E-05
^{182}Ta	1.1443 E+02	6.27 E+03	8.46 E-03	1.04 E-04
^{185}W	7.5100 E+01	9.40 E+03	7.53 E-04	1.75 E-06
^{187}Re	1.5888 E+13	4.39 E+08	3.91 E-06	1.26 E-07
^{195}Au	1.8609 E+02	3.60 E+03	5.10 E-04	3.01 E-05
^{203}Hg	4.6612 E+01	1.38 E+04	1.75 E-03	1.70 E-05
^{204}Tl	1.3806 E+03	4.64 E+02	1.38 E-03	5.60 E-06
^{207}Bi	1.1523 E+04	5.47 E+01	9.12 E-03	4.66 E-05
^{210}Pb	8.1449 E+03	7.63 E+01	6.62 E-05	3.16 E-02
^{210}Po	1.3838 E+02	4.49 E+03	3.26 E-02	2.18 E-02
^{226}Ra	5.8439 E+05	9.89 E+01	2.89 E-02	2.00 E-02
^{227}Ac	7.9524 E+03	7.23 E+01	1.46 E-03	4.00 E+00
^{228}Ra	2.1001 E+03	2.73 E+02	2.71 E-04	1.11 E-02
^{228Th}	6.9874 E+02	8.20 E+02	3.27 E-02	7.95 E-01
^{229Th}	2.6809 E+06	2.13 E-01	3.08 E-02	5.00 E+00
^{230Th}	2.7532 E+07	2.06 E-02	2.83 E-02	7.58 E-01
^{231}Pa	1.1965 E+07	4.72 E-02	3.08 E-02	2.99 E+00
^{232}Th	5.1317 E+12	1.10 E-07	2.42 E-02	3.81 E+00
^{232}U	2.5165 E+04	2.24 E+01	3.21 E-02	1.53 E+00
^{233}U	5.8147 E+07	9.64 E-03	2.91 E-02	3.15 E-01
^{234Th}	2.4100 E+01	2.32 E+04	1.49 E-04	8.16 E-05
^{234}U	8.9667 E+07	6.26 E-03	2.88 E-02	3.08 E-01
^{235}U	2.5706 E+11	2.16 E-06	2.86 E-02	2.86 E-01
^{236}Pu	1.0439 E+03	5.30 E+02	3.48 E-02	3.37 E-01

Table E-1. (continued).

Isotope	Half-life (days)	Specific Activity (curies per gram)	Heat of Decay (watts per curie)	Dose Equivalent Curie Correction Factor
^{236}U	8.5540 E+09	6.47 E-05	2.71 E-02	2.92 E-01
^{237}Np	7.8162 E+08	7.05 E-04	2.96 E-02	1.25 E+00
^{238}Pu	3.2032 E+04	1.71 E+01	3.31 E-02	9.13 E-01
^{238}U	1.6319 E+12	3.36 E-07	2.53 E-02	2.75 E-01
^{239}Pu	8.8060 E+06	6.21 E-02	3.11 E-02	1.00 E+00
^{240}Pu	2.3971 E+06	2.28 E-01	3.10 E-02	1.00 E+00
^{241}Am	1.5786 E+05	3.44 E+00	3.33 E-02	1.03 E+00
^{241}Pu	5.2412 E+03	1.03 E+02	3.30 E-05	1.92 E-02
^{242m}Am	5.1499 E+04	1.05 E+01	2.37 E-04	9.91 E-01
^{242}Cm	1.6280 E+02	3.31 E+03	3.68 E-02	4.02 E-02
^{242}Pu	1.3634 E+08	3.96 E-03	2.93 E-02	9.56 E-01
^{243}Am	2.6918 E+06	2.00 E-01	3.22 E-02	1.02 E+00
^{243}Cm	1.0629 E+04	5.16 E+01	3.73 E-02	7.15 E-01
^{244}Cm	6.6109 E+03	8.09 E+01	3.50 E-02	5.77 E-01
^{244}Pu	2.9512 E+10	1.83 E-05	2.77 E-02	9.39 E-01
^{245}Cm	3.1046 E+06	1.72 E-01	3.40 E-02	1.06 E+00
^{246}Cm	1.7276 E+06	3.07 E-01	3.25 E-02	1.05 E+00
^{247}Bk	5.0403 E+05	1.05 E+00	3.56 E-02	1.34 E+00
^{247}Cm	5.6978 E+09	9.29 E-05	3.36 E-02	9.65 E-01
^{248}Cm	1.2418 E+08	4.24 E-03	3.06 E-02	3.85 E+00
^{249}Cf	1.2820 E+05	4.09 E+00	3.93 E-02	1.34 E+00
^{250}Cf	4.7774 E+03	1.09 E+02	3.63 E-02	6.10 E-01
^{250}Cm	3.2872 E+06	2.07 E-01	2.19 E-04	2.18 E+01
^{251}Cf	3.2799 E+05	1.59 E+00	3.74 E-02	1.37 E+00
^{252}Cf	9.6607 E+02	5.38 E+02	3.69 E-02	3.65 E-01
^{254}Es	2.7570 E+02	1.86 E+03	3.92 E-02	9.56 E-02

* When this parent-daughter pair are in secular equilibrium, only the activity of the parent nuclide should be considered in performing the calculations. E.g., if ^{90}Sr–^{90}Y are in secular equilibrium in the waste, the thermal power for both nuclides would be determined by multiplying the ^{90}Sr activity by the heat of the decay for the ^{90}Sr–^{90}Y pair.

Appendix F

Comparison of Design Inventory and Waste Acceptance Criteria Concentrations

Table F-1. Comparison of Design Inventory and Waste Acceptance Criteria Concentrations

Constituents	Design Inventory (DI) Mass or Activity kg or Ci	Waste Acceptance Criteria (WAC) Mass or Activity kg or Ci	Mass or Activity Comparison (DI / WAC) %
Organic			
1,1,1-Trichloroethane	7.4E+00	1.2E+04	<0.1%
1,1,2,2-Tetrachloroethane	2.3E-02	3.8E+01	<0.1%
1,1,2-Trichloroethane	1.1E-01	1.8E+02	<0.1%
1,1-Dichloroethane	1.1E+00	1.8E+03	<0.1%
1,1-Dichloroethene	7.0E-01	1.1E+03	<0.1%
1,2,4-Trichlorobenzene	5.4E+00	8.7E+03	<0.1%
1,2-Dichlorobenzene	5.4E+00	8.7E+03	<0.1%
1,2-Dichloroethane	2.5E-03	4.1E+00	<0.1%
1,2-Dichloroethene (total)	1.5E-01	2.5E+02	<0.1%
1,3-Dichlorobenzene	5.4E+00	8.7E+03	<0.1%
1,4-Dichlorobenzene	2.1E+02	3.2E+04	0.67%
1,4-Dioxane	8.9E-03	1.4E+01	<0.1%
2,4,5-Trichlorophenol	2.1E+01	3.4E+04	<0.1%
2,4,6-Trichlorophenol	8.6E+00	1.4E+04	<0.1%
2,4-Dichlorophenol	1.0E+01	1.6E+04	<0.1%
2,4-Dimethylphenol	8.6E+00	1.4E+04	<0.1%
2,4-Dinitrophenol	2.4E+01	3.9E+04	<0.1%
2,4-Dinitrotoluene	5.4E+00	8.7E+03	<0.1%
2,6-Dinitrotoluene	9.8E+00	1.6E+04	<0.1%
2-Butanone	1.2E+01	1.9E+04	<0.1%
2-Chloronaphthalene	5.4E+00	8.7E+03	<0.1%
2-Chlorophenol	8.6E+00	1.4E+04	<0.1%
2-Hexanone	1.3E+00	2.0E+03	<0.1%
2-Methylnaphthalene	2.4E+02	3.9E+05	<0.1%
2-Methylphenol	9.8E+00	1.6E+04	<0.1%
2-Nitroaniline	1.3E+01	7.7E+01	16.81%
2-Nitrophenol	8.6E+00	1.4E+04	<0.1%
3,3'-Dichlorobenzidine	5.4E+00	8.7E+03	<0.1%
3-Methyl Butanal	1.1E-01	2.5E+07	<0.1%
3-Nitroaniline	1.3E+01	7.7E+01	16.81%
4,6-Dinitro-2-methylphenol	2.1E+01	3.4E+04	<0.1%
4-Bromophenyl-phenylether	5.4E+00	6.5E+07	<0.1%
4-Chloro-3-methylphenol	8.6E+00	7.3E+07	<0.1%
4-Chloroaniline	1.9E+01	3.1E+04	<0.1%
4-Chlorophenyl-phenylether	5.4E+00	7.6E+07	<0.1%
4-Methyl-2-Pentanone	1.4E+01	2.2E+04	<0.1%
4-Methylphenol	1.8E+01	2.9E+04	<0.1%
4-Nitroaniline	1.3E+01	7.7E+01	16.81%
4-Nitrophenol	2.4E+01	3.9E+04	<0.1%
Acetonitrile	8.9E-03	8.8E+02	<0.1%
Acrolein	4.3E-03	4.2E+02	<0.1%
Acrylonitrile	4.3E-03	4.4E+02	<0.1%
Anthracene	1.5E+02	2.4E+05	<0.1%
Aramite	5.4E-02	5.1E+03	<0.1%
Aroclor-1016	3.6E+00	5.8E+03	<0.1%

Table F-1. (continued).

Aroclor-1254	6.1E+01	9.7E+04	<0.1%
Aroclor-1260	3.4E+02	3.8E+05	<0.1%
Aroclor-1268	2.9E+01	4.7E+04	<0.1%
Benzene	2.9E+02	1.7E+05	0.17%
Benzidine	1.4E-01	1.3E+04	<0.1%
Benzo(a)anthracene	1.2E+02	1.9E+05	<0.1%
Benzo(a)pyrene	5.0E+01	8.0E+04	<0.1%
Benzo(b)fluoranthene	8.5E+01	1.4E+05	<0.1%
Benzo(g,h,i)perylene	5.4E+00	8.7E+03	<0.1%
Benzo(k)fluoranthene	8.8E+00	1.4E+04	<0.1%
Benzoic acid	4.1E+00	6.5E+03	<0.1%
bis(2-Chloroethoxy)methane	5.4E+00	1.2E+05	<0.1%
bis(2-Chloroethyl)ether	5.4E+00	8.7E+03	<0.1%
bis(2-Chloroisopropyl)ether	5.4E+00	8.7E+03	<0.1%
bis(2-Ethylhexyl)phthalate	7.0E+01	1.1E+05	<0.1%
Butane,1,1,3,4-Tetrachloro-	3.7E+00	7.6E+07	<0.1%
Butylbenzylphthalate	3.2E+01	5.2E+04	<0.1%
Carbazole	1.5E+01	2.5E+04	<0.1%
Carbon Disulfide	2.2E+01	3.5E+04	<0.1%
Chlorobenzene	3.1E+00	5.0E+03	<0.1%
Chloroethane	1.4E-03	1.1E+02	<0.1%
Chloromethane	1.7E-01	2.7E+02	<0.1%
Chrysene	1.3E+02	2.0E+05	<0.1%
Decane, 3,4-Dimethyl	7.6E-02	2.5E+07	<0.1%
Diacetone alcohol	2.0E+03	7.6E+07	<0.1%
Dibenz(a,h)anthracene	5.4E+00	8.7E+03	<0.1%
Dibenzofuran	1.5E+02	2.5E+05	<0.1%
Diethylphthalate	5.4E+00	8.7E+03	<0.1%
Dimethyl Disulfide	1.4E+00	2.5E+07	<0.1%
Dimethylphthalate	5.4E+00	8.7E+03	<0.1%
Di-n-butylphthalate	1.1E+01	1.8E+04	<0.1%
Di-n-octylphthalate	1.2E+01	2.0E+04	<0.1%
Eicosane	1.3E+00	7.6E+07	<0.1%
Ethyl cyanide	8.9E-03	2.5E+07	<0.1%
Ethylbenzene	3.7E+01	5.9E+04	<0.1%
Famphur	2.8E-02	7.6E+07	<0.1%
Fluoranthene	3.6E+02	5.8E+05	<0.1%
Fluorene	8.7E+01	1.4E+05	<0.1%
Heptadecane, 2,6,10,15-Tetra	1.6E+00	2.5E+07	<0.1%
Hexachlorobenzene	5.4E+00	8.7E+03	<0.1%
Hexachlorobutadiene	9.8E+00	1.6E+04	<0.1%
Hexachlorocyclopentadiene	5.4E+00	8.7E+03	<0.1%
Hexachloroethane	5.4E+00	8.7E+03	<0.1%
Indeno(1,2,3-cd)pyrene	5.4E+00	8.7E+03	<0.1%
Isobutyl alcohol	8.9E-03	8.8E+02	<0.1%
Isophorone	5.4E+00	8.7E+03	<0.1%
Isopropyl Alcohol/2-propanol	1.0E+00	7.6E+07	<0.1%
Kepone	4.7E+01	7.5E+04	<0.1%
Mesityl oxide	4.0E+01	7.6E+07	<0.1%
Methyl Acetate	2.3E-01	3.7E+02	<0.1%
Methylene Chloride	4.0E+01	2.1E+04	0.19%
Aroclor-1254	4.3E+01	2.1E+07	<0.1%

Table F-1. (continued).

Nitrobenzene	5.4E+00	8.7E+03	<0.1%
N-Nitroso-di-n-propylamine	5.4E+00	8.7E+03	<0.1%
N-Nitrosodiphenylamine	5.4E+00	8.7E+03	<0.1%
Octane,2,3,7-Trimethyl	7.6E-02	2.5E+07	<0.1%
o-Toluenesulfonamide	2.4E+00	2.5E+07	<0.1%
Pentachlorophenol	2.6E+01	4.2E+04	<0.1%
Phenanthrene	5.5E+02	8.9E+05	<0.1%
Phenol	3.8E+01	6.1E+04	<0.1%
Phenol,2,6-Bis(1,1-Dimethyl)	1.9E+00	7.6E+07	<0.1%
p-Toluenesulfonamide	2.4E+00	2.5E+07	<0.1%
Pyrene	1.2E+02	1.9E+05	<0.1%
RDX	-	7.9E+03	-
Styrene	4.9E-04	4.6E+01	<0.1%
Tetrachloroethene	4.6E+00	7.3E+03	<0.1%
Toluene	4.7E+02	2.2E+04	2.11%
Tributylphosphate	1.7E+02	3.6E+05	<0.1%
Trichloroethene	3.4E+01	2.3E+04	0.15%
Trinitrotoluene	-	8.4E+03	-
Undecane,4,6-Dimethyl-	7.6E-02	2.5E+05	<0.1%
Xylene (ortho)	1.8E+00	2.9E+03	<0.1%
Xylene (total)	1.6E+03	2.1E+05	0.78%
Inorganics			
Aluminum	3.4E+06	1.2E+08	2.76%
Antimony	2.8E+03	4.4E+06	<0.1%
Arsenic	2.7E+03	4.4E+04	6.08%
Barium	8.5E+04	2.3E+06	3.73%
Beryllium	1.4E+02	1.4E+04	1.00%
Boron	8.7E+04	2.5E+06	3.48%
Cadmium	1.7E+03	2.7E+06	<0.1%
Calcium	9.7E+06	-	-
Chloride	8.8E+02	2.5E+07	<0.1%
Chromium	1.9E+04	3.1E+07	<0.1%
Cobalt	2.9E+03	8.3E+04	3.42%
Copper	1.4E+04	2.3E+07	<0.1%
Cyanide	1.6E+02	2.6E+05	<0.1%
Dysprosium	2.8E+04	4.5E+07	<0.1%
Fluoride	1.8E+03	2.9E+06	<0.1%
Iron	4.9E+06	1.8E+08	2.66%
Lead	2.7E+04	4.4E+07	<0.1%
Magnesium	2.1E+06	9.1E+07	2.33%
Manganese	9.8E+04	3.7E+06	2.63%
Mercury	4.5E+03	7.2E+06	<0.1%
Molybdenum	4.8E+03	7.7E+06	<0.1%
Nickel	9.3E+03	2.7E+05	3.50%
Nitrate	1.9E+03	3.0E+06	<0.1%
Nitrate/Nitrite-N	1.1E+02	2.5E+07	<0.1%
Nitrite	4.0E+00	6.4E+03	<0.1%
Phosphorus	4.6E+04	-	-
Potassium	5.3E+05	3.3E+07	1.64%
Selenium	4.0E+02	6.4E+05	<0.1%
Silver	4.7E+03	7.5E+06	<0.1%
Nitrobenzene	1.3E+02	1.1E+07	<0.1%

Table F-1. (continued).

Strontium	8.6E+03	1.4E+07	<0.1%
Sulfate	9.7E+03	2.5E+07	<0.1%
Sulfide	3.6E+05	2.5E+07	1.43%
Terbium	2.7E+05	-	-
Thallium	1.8E+02	3.3E+03	5.37%
Vanadium	1.0E+04	3.4E+05	2.95%
Ytterbium	9.2E+04	-	-
Zinc	9.9E+04	1.6E+08	<0.1%
Zirconium	3.3E+04	-	-
Radionuclide			
Ac225	2.4E-08	-	-
Ac227	9.7E-06	-	-
Ac228	7.2E-11	-	-
Ag106	0.0E+00	-	-
Ag108	1.8E-09	-	-
Ag108m	3.8E-01	6.1E+02	<0.1%
Ag109m	2.3E-12	-	-
Ag110	2.5E-11	-	-
Ag110m	2.6E-09	-	-
Ag111	0.0E+00	-	-
Am241	1.1E+01	7.6E+03	0.15%
Am242	2.1E-05	-	-
Am242m	2.1E-05	-	-
Am243	1.6E-04	2.5E-01	<0.1%
Am245	0.0E+00	-	-
Am246	6.5E-26	-	-
At217	2.4E-08	-	-
Ba136m	0.0E+00	-	-
Ba137m	1.1E+04	-	-
Ba140	0.0E+00	-	-
Be10	5.4E-07	-	-
Bi210	5.2E-07	-	-
Bi211	8.7E-06	-	-
Bi212	2.6E-04	-	-
Bi213	0.0E+00	-	-
Bi214	2.7E-06	-	-
Bk249	1.0E-21	-	-
Bk250	3.7E-26	-	-
C14	2.2E-05	2.3E+00	<0.1%
Cd109	2.3E-12	-	-
Cd113m	7.7E-01	1.2E+03	<0.1%
Cd115m	2.0E-54	-	-
Ce141	8.5E-72	-	-
Ce142	0.0E+00	-	-
Ce144	8.6E-04	1.4E+00	<0.1%
Cf249	2.0E-16	-	-
Cf250	1.0E-16	-	-
Cf251	4.5E-19	-	-
Cf252	1.1E-20	-	-
Cm241	6.1E-81	-	-
Cm242	2.6E-17	-	-
Cm243	1.7E-06	-	-

Table F-1. (continued).

Cm244	8.5E-04	-	-
Cm245	3.8E-08	-	-
Cm246	8.5E-10	-	-
Cm247	3.0E-16	-	-
Cm248	9.3E-17	-	-
Cm250	2.6E-25	-	-
Co57	1.7E-03	2.8E+00	<0.1%
Co58	2.8E-17	-	-
Co60	9.2E+01	1.5E+05	<0.1%
Cr51	1.1E-54	-	-
Cs132	0.0E+00	-	-
Cs134	5.3E+00	8.5E+03	<0.1%
Cs135	1.7E-02	-	-
Cs136	0.0E+00	-	-
Cs137	1.2E+04	1.7E+09	<0.1%
Er169	0.0E+00	-	-
Eu150	8.2E-09	-	-
Eu152	4.6E+02	7.3E+05	<0.1%
Eu154	3.9E+02	6.2E+05	<0.1%
Eu155	8.4E+01	1.3E+05	<0.1%
Eu156	0.0E+00	-	-
Fe59	2.1E-35	-	-
Fe55	1.5E+06	4.6E+07	3.3%
Fr221	2.4E-08	-	-
Fr223	1.3E-07	-	-
Gd152	1.3E-14	-	-
Gd153	9.5E-12	-	-
H3	2.3E+01	3.8E+04	<0.1%
Hf181	3.7E-37	-	-
Ho166m	1.3E-06	-	-
I129	6.1E-01	2.4E+00	26.05%
I131	0.0E+00	-	-
In114	8.9E-55	-	-
In114m	9.4E-55	-	-
In115	2.7E-12	-	-
In115m	0.0E+00	-	-
K40	9.1E-01	1.8E+02	0.50%
Kr81	2.5E-09	-	-
Kr85	5.5E+02	-	-
La138	0.0E+00	-	-
La140	1.3E-105	-	-
Mn54	9.1E-09	-	-
Nb92	3.0E-19	-	-
Nb93m	6.4E-03	-	-
Nb94	4.2E-06	-	-
Nb95	2.3E-33	-	-
Nb95m	8.7E-36	-	-
Nd144	1.5E-10	-	-
Nd147	0.0E+00	-	-
Ni59	7.2E+03	1.5E+09	<0.1%
Ni63	4.6E+04	7.2E+06	0.6%
Np235	3.2E-11	-	-
Np236	3.3E-08	-	-
Np237	3.0E-01	4.9E+02	<0.1%
Np238	1.0E-07	-	-

Table F-1. (continued).

Np239	1.6E-04	-	-
Np240	1.3E-14	-	-
Np240m	1.2E-11	-	-
Pa231	3.3E-05	-	-
Pa233	2.1E-02	-	-
Pa234	1.3E-06	-	-
Pa234m	8.1E-04	-	-
Pb209	2.3E-08	-	-
Pb210	5.2E-07	-	-
Pb211	8.7E-06	-	-
Pb212	2.6E-04	-	-
Pb214	2.7E-06	-	-
Pd107	2.9E-03	-	-
Pm146	2.8E-03	-	-
Pm147	1.8E+02	2.9E+05	<0.1%
Pm148	1.9E-59	-	-
Pm148m	3.9E-58	-	-
Po210	4.8E-07	-	-
Po211	3.2E-10	-	-
Po212	1.6E-04	-	-
Po213	2.1E-08	-	-
Po214	2.7E-06	-	-
Po215	8.7E-06	-	-
Po216	2.6E-04	-	-
Po218	2.7E-06	-	-
Pr143	0.0E+00	-	-
Pr144	8.4E-04	-	-
Pr144m	1.2E-05	-	-
Pu236	2.6E-06	-	-
Pu237	5.7E-59	-	-
Pu238	1.1E+02	7.6E+03	1.46%
Pu239	3.2E+00	5.1E+03	<0.1%
Pu240	7.1E-01	1.1E+03	<0.1%
Pu241	3.0E+01	4.9E+04	<0.1%
Pu242	1.1E-04	-	-
Pu243	3.0E-16	-	-
Pu244	1.2E-11	-	-
Pu246	6.5E-26	-	-
Ra222	5.5E-117	-	-
Ra223	9.6E-06	-	-
Ra224	2.6E-04	-	-
Ra225	2.4E-08	-	-
Ra226	2.2E-01	3.6E+02	<0.1%
Ra228	7.2E-11	-	-
Rb86	0.0E+00	-	-
Rb87	5.3E-06	-	-
Rh102	1.4E-05	-	-
Rh103m	1.3E-58	-	-
Rh106	5.4E-03	-	-
Rn218	6.0E-117	-	-
Rn219	9.6E-06	-	-
Rn220	2.6E-04	-	-

Table F-1. (continued).

Rn222	2.9E-06	-	-
Ru103	9.5E-30	-	-
Ru106	5.8E-03	9.2E+00	<0.1%
Sb124	9.8E-41	-	-
Sb125	4.4E+00	7.0E+03	<0.1%
Sb126	9.8E-03	-	-
Sb126m	7.0E-02	-	-
Sc46	1.3E-20	-	-
Se79	7.9E-02	-	-
Sm146	2.0E-10	-	-
Sm147	1.9E-06	-	-
Sm148	4.8E-13	-	-
Sm149	2.4E-12	-	-
Sm151	1.6E+02	2.6E+05	<0.1%
Sn117m	0.0E+00	-	-
Sn119m	7.0E-08	-	-
Sn121m	1.3E-02	-	-
Sn123	4.0E-17	-	-
Sn125	0.0E+00	-	-
Sn126	7.0E-02	-	-
Sr89	2.8E-44	-	-
Sr90	1.1E+04	2.7E+09	<0.1%
Tb160	1.5E-34	-	-
Tb161	0.0E+00	-	-
Tc98	8.4E-08	-	-
Tc99	2.7E+00	4.4E+03	<0.1%
Te123	2.1E-15	-	-
Te123m	1.4E-23	-	-
Te125m	1.1E+00	1.7E+03	<0.1%
Te127	4.4E-20	-	-
Te127m	4.5E-20	-	-
Te129	3.2E-71	-	-
Te129m	5.1E-71	-	-
Th226	1.0E-117	-	-
Th227	8.6E-06	-	-
Th228	1.6E-02	1.2E+01	0.13%
Th229	2.4E-08	-	-
Th230	8.2E-02	1.1E+01	0.77%
Th231	7.6E-02	-	-
Th232	7.4E-02	1.3E+01	0.58%
Th234	8.1E-04	-	-
Tl207	8.7E-06	-	-
Tl208	9.4E-05	-	-
Tl209	5.0E-10	-	-
Tm170	3.0E-26	-	-
Tm171	7.6E-13	-	-
U230	0.0E+00	-	-
U232	2.5E-04	-	-
U233	1.2E-05	1.9E-02	<0.1%
U234	2.9E+00	4.6E+03	<0.1%
U235	5.2E-02	8.3E+01	<0.1%
U236	9.6E-02	1.5E+02	<0.1%

Table F-1. (continued).

U237	0.0E+00	-	-
U238	9.2E-01	1.5E+03	<0.1%
U240	1.2E-11	-	-
Xe127	7.5E-73	-	-
Xe129m	0.0E+00	-	-
Xe131m	1.3E-112	-	-
Xe133	0.0E+00	-	-
Y90	1.1E+04	1.7E+07	<0.1%
Y91	2.0E-37	-	-
Zn65	1.3E-09	-	-
Zr93	4.1E-01	-	-
Zr95	1.4E-25	-	-