HNF-21786
Revision 0

Sampling and Analysis Plan for the Low-Level Waste Fraction of Retrievably Stored Waste

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

Approved for Public Release;
Further Dissemination Unlimited

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EDC #: HNF-EDC-04-23678

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Program/Project: WM

C. K. Girres
Duratek Technical Services

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March 2005

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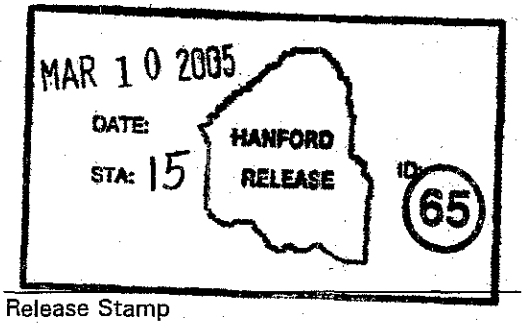

Release Approval — Date: 3/10/05 — Release Stamp

Approved for Public Release;
Further Dissemination Unlimited

Total Pages: 45

Key Words:

Contaminant, detection, Environmental Restoration Disposal Facility, burial grounds, nondestructive examination, waste acceptance criteria

Abstract:

This document provides a sampling and analysis plan for retrievably stored waste (RSW) and secondary waste from burial grounds 218-W-4C, 218-W-4B, 218-E-12B, and 218-W-3A. This RSW is to be treated, if necessary, and disposed of at the Environmental Restoration Disposal Facility.

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TERMS

AEA	alpha energy analysis
ARAR	applicable or relevant and appropriate
BHI	Bechtel Hanford, Inc.
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
DFSNW	Duratek Federal Services Northwest
DOE	U.S. Department of Energy
DQO	data quality objective
DR	decision rule
DS	decision statement
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford, Inc.
GEA	gamma energy analysis
HGET	Hanford General Employee Training
LLBG	Low-Level Burial Ground
MDL	method detection limit
NDA	nondestructive analysis
NIST	National Institute of Standards
NRC	U.S. Nuclear Regulatory Commission
PAM	Portable Alpha Meter
PCB	polychlorinated biphenyl
PHMC	Project Hanford Management Contract
QA	quality assurance
QC	quality control
RLS	radioactive lead solids
RPD	relative percent difference
SAP	Sampling and Analysis Plan
TC	toxic characteristic
TRU Program	Hanford Site Transuranic Waste Certification Program
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant

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SAMPLING AND ANALYSIS PLAN FOR THE LOW-LEVEL WASTE FRACTION OF RETRIEVABLY STORED WASTE

1.0 INTRODUCTION

Since 1970, approximately 37,400 suspect transuranic (TRU) waste containers were placed in retrievable storage at the Hanford Site. The majority of these waste containers (approximately 26,200 drums) are stacked vertically on asphalt pads in earth-covered trenches in the low-level burial grounds. Retrieval of this waste is currently underway. The specific burial grounds and trenches where retrieval operations are expected include Burial Ground 218-W-4C (trenches 1, 4, 7, 20, and 29); Burial Ground 218-W-4B (trench 7, V-7, and 11); Burial Ground 218-E-12B (parts of trenches 17 and 27); and Burial Ground 218-W-3A (parts of trenches 1, 4, 5, 6, 8, 10, 15, 17, 23, 30, 32, 34, S6, and S9). Retrievably stored waste (RSW) containers that are determined to be low-level waste (LLW) or mixed low-level waste (MLLW) will be treated, if necessary, and disposed of at the Environmental Restoration Disposal Facility (ERDF). Secondary waste generated from retrieval operations will be treated, if necessary, and disposed of at the ERDF.

The Washington State Department of Ecology (Ecology), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE) determined that these wastes present a potential threat to human health and the environment. Therefore, EPA and DOE approved, with Ecology concurrence, a time-critical removal action memorandum to accelerate the disposition of these wastes (*Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Time Critical Removal Action Memorandum for Disposal at the Environmental Restoration Facility [ERDF] of Non-Transuranic [TRU] Waste Generated During the M-91 Retrieval Operations at Burial Ground 218-W-4C* [EPA 2004]). Waste from Burial Ground 218-W-4C that is covered under the time-critical removal action (EPA 2004) includes the following:

- LLW debris fraction of the RSW contained in drums,
- MLLW debris and radioactive lead solids (RLS) fraction of the RSW contained in drums, and
- Secondary wastes generated by waste retrieval operations; e.g., personal protective equipment, wood, plastic, paper, metal, and soil.

This sampling and analysis plan (SAP) provides criteria for the characterization of this waste. This revision is currently limited to RSW debris waste from the Plutonium Finishing Plant (PFP) original waste-generating source and suspect-contaminated secondary waste from retrieval operations. This SAP will be revised, as required, to include RSW from other original waste-generating sources and contaminated secondary waste. LLW debris, MLLW debris and RLS packaged in a container other than a drum, and RSW in other burial grounds (i.e., 218-W-3A,

218-E-12B, and 218-W-4B) are not covered under this SAP. The disposition of this waste will be addressed by subsequent *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) actions. This document meets the applicable requirements of EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*.

2.0 QUALITY ASSURANCE PROJECT PLAN

The Quality Assurance Project Plan establishes the quality requirements for data collection for the field measurements required for this waste including radioassay, weight measurements, and physical verification. This section provides the organization structure and identifies the responsibilities of the organizations supporting data collection and analysis. This section also discusses special training requirements for staff performing the work

2.1 PROJECT ORGANIZATION

Figure 2-1 presents the organization chart that details the primary organizations responsible for measurement collection and waste management interfaces under this SAP. Organizational names and reporting relationships may change and will not necessitate a revision to this SAP.

2.1.1 Vice President/Project Director

The Project Director has the following responsibilities:

- Establish priorities and the organizational roles and responsibilities for work activities.
- Authorize resources to perform retrieval operations, mixed waste treatment, radioassay, and other activities required by this SAP.

2.1.2 Mixed Waste Treatment Project Manager

The mixed waste treatment (MWT) project manager has the following responsibilities:

- Define the data quality objectives, sampling requirements, and analytical requirements for the project.
- Communicate SAP requirements to the organizations responsible for implementation.
- Obtain and maintain contract services for the treatment and disposal of the waste.
- Perform data review of measurements gathered under this SAP.

- Manage conformance issues and complete corrective actions for work performed under MWT procedures.
- Maintain qualifications of MWT personnel performing work.
- Resolve and document deviations from this SAP in accordance with Section 2.6.

2.1.3 Waste Retrieval Operations

Waste Retrieval Operations has the following responsibilities:

- Perform retrieval operations, provide waste for radioassay, provide support to the mobile radioassay contractor, and perform drum weight measurements for the mobile radioassay contractor.
- Obtain and maintain contract services for the mobile radioassay of the retrieved waste.
- Assign a radioassay coordinator to oversee the mobile radioassay contractor, receive radioassay data packages, and perform verification of data packages.
- Develop procedures and processes so that radioassay activities, including documentation, are performed in accordance with this SAP, except when field conditions or other problems require deviation.
- Request deviations from the MWT Project Manager and provide technical justification for the requested deviations.
- Manage conformance issues and complete corrective actions associated with work performed under retrieval procedures.
- Maintain copies of radioassay and waste weight records.

2.1.4 Mobile Radioassay Contractor

The mobile radioassay contractor has the following responsibilities under this SAP as specified in the contract and performance requirements:

- Perform assay of drums and document results.
- Maintain assay system and personnel qualifications.
- Develop, implement, and manage a quality assurance program to meet the requirements of 10 CFR 830, "Nuclear Safety Management," 830.122, "Quality assurance criteria."

- Manage conformance issues and complete corrective actions associated with work performed under procedures.
- Maintain qualifications of personnel performing work.
- Identify field conditions or other problems that may require deviation from the contractual requirements. Request resolution from the radioassay coordinator.

2.1.5 Treatment Contractor

The Treatment Contractor has the following responsibilities as specified in their contract:

- Receive waste in accordance with regulatory and contract requirements.
- Perform treatment to meet land disposal restrictions standards.
- Document treatment results.

2.1.6 Waste Services Technical Support

Waste Services Technical Support has the following responsibilities:

- Perform waste designations to the requirements of WAC 173-303-070, "Designation of dangerous waste" through WAC 173-303-100, "Dangerous waste criteria."
- Manage conformance issues and complete corrective actions associated with work performed under Waste Services Technical Support procedures.
- Maintain qualifications of Waste Services Technical Support personnel performing work.

2.1.7 Waste Receiving and Processing Operations

Waste Receiving and Processing Operations has the following responsibilities:

- Perform assay of drums and document results using Waste Isolation Pilot Plant (WIPP) requirements established by the Hanford Site Transuranic Waste Certification Program (TRU Program.)
- Maintain assay system and personnel qualifications using WIPP requirements established by the TRU Program.

- Manage conformance issues and complete corrective actions associated with work performed under TRU Program procedures.
- Maintain qualifications of personnel performing work under TRU Program procedures.

2.1.8 TRU Program

The TRU Program organization has the following responsibilities:

- Maintain and implement the HNF-2599, *Hanford Site Transuranic Waste Characterization Quality Assurance Project Plan.*
- Procure and maintain WIPP weigh scale.
- Manage conformance issues and complete corrective actions associated with work performed under TRU Program procedures.
- Maintain qualifications of personnel performing work under TRU project requirements.

2.1.9 Quality Assurance Organization

The Quality Assurance Organization has the following responsibilities:

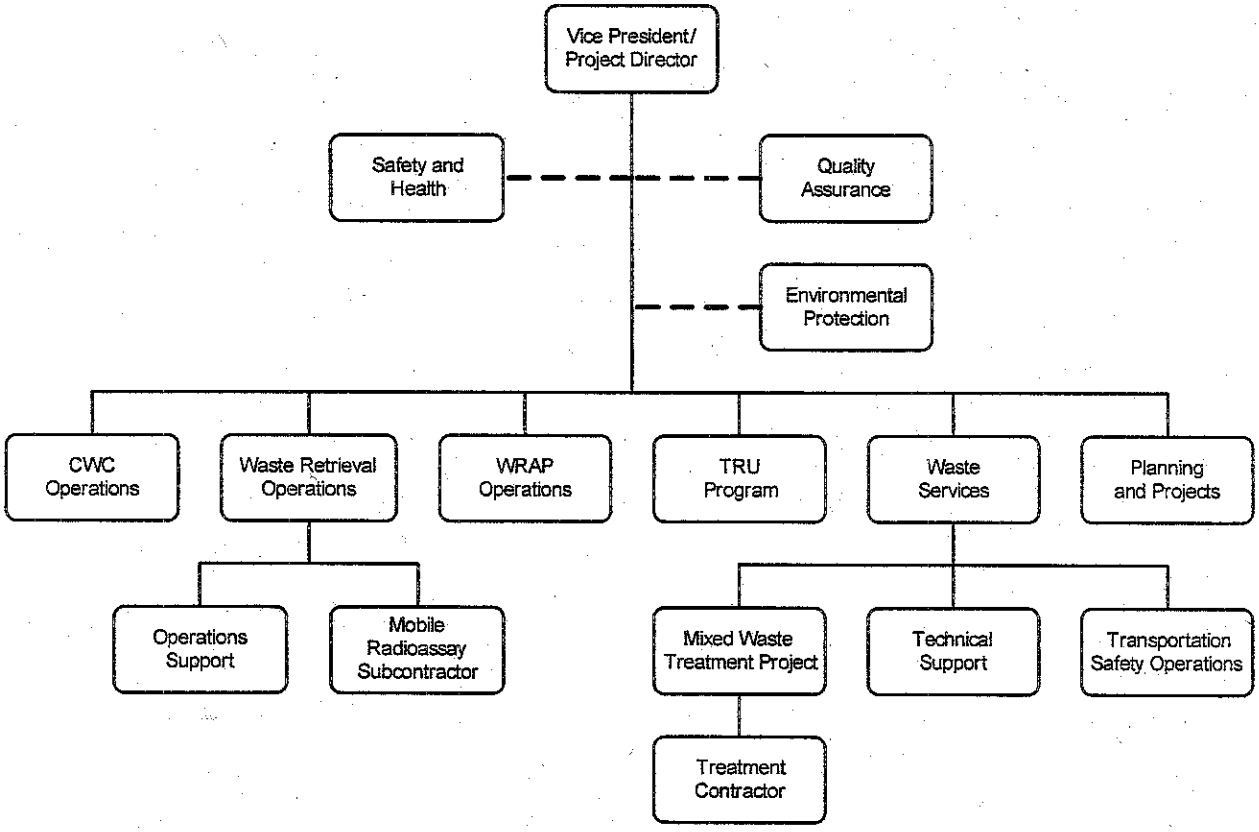
- Provide oversight of MWT project activities covered under this SAP to help ensure compliance to contractual and regulatory Quality Assurance requirements.
- Review and approve MWT project documentation that establishes and/or implements Quality Assurance requirements.
- Assist in the preparation of Quality Assurance Program/Project Plans.
- Plan, schedule and perform Quality Assurance assessments and surveillances to evaluate the effectiveness of implementation of Quality Assurance requirements.
- Assist in the resolution of Quality Assurance conformance issues and in the development and completion of identified corrective actions.

2.1.10 Environmental Protection Organization

The Environmental Protection Organization has the following responsibilities:

- Provide oversight of MWT project activities covered under this SAP to help ensure compliance to contractual and regulatory environmental requirements.
- Review and approve MWT project documentation that establishes and/or implements environmental requirements.
- Assist in the reporting, prioritizing, and resolving of environmental issues and serve as the point of contact for any environmental inspections.

Figure 2-1. Solid Waste Stabilization and Disposition Organization Chart.



2.2 BACKGROUND

The methodology for dispositioning retrievably stored LLW and MLLW drums from Burial Ground 218-W-4C to the ERDF for disposal consists of the following steps:

- Perform radiological characterization and identify those that are non-TRU (i.e., LLW and MLLW).
- Designate the LLW and MLLW drums and identify the subset appropriate for processing (if required), treatment (if required) and disposal at the ERDF.
- Verify that the waste meets the appropriate treatment and/or disposal criteria.
- Prepare and transport LLW and MLLW drums to a treatment and/or disposal facility (e.g., ERDF).
- Treat MLLW to meet the disposal facility acceptance criteria and applicable land disposal restrictions.
- Manage newly generated secondary waste from retrieval operations.
- Dispose of LLW drums, MLLW drums, and secondary waste at the ERDF.

Characterization of the RSW includes using process knowledge, performing a radioassay of each drum to provide data on the radionuclide inventory, weighing each waste container, and conducting physical verification (e.g., visual inspection or non-destructive evaluation) of waste contents. The radioassay units are either mobile units located at the retrieval site or stationary units located at the Waste Receiving and Processing (WRAP) Facility. Physical verification may be performed at the WRAP Facility, the treatment facility, or another appropriate location.

Measurements collected on RSW drums include contents inventory, weight, and radioassay. No samples are collected for analysis for the debris waste. As such, this SAP does not discuss activities specific to sampling and laboratory analysis such as sample process design, sampling methods, sample handling and custody, and laboratory analytical methods. Activities relevant to field measurements (i.e., visual inspection or nondestructive examination, weight determination, and radioassay) are discussed.

Radioassay results will be used in conjunction with process knowledge to determine the radionuclide inventory for each RSW drum. The characterization data, drum radionuclide inventory, waste weight, and physical verification results will be used to determine if the container is LLW or MLLW. Containers determined to be LLW or MLLW will be assessed to determine compliance with treatment criteria and/or the ERDF waste acceptance criteria for disposal.

Secondary waste streams generated during retrieval could consist of debris and/or soil. Non-debris waste (e.g., soil) will be segregated from debris. The secondary waste soil is separate

from the small number of RSW drums at 218-W-4C containing contaminated soils. Material that is found, by means of portable survey instruments, to contain detectable contamination or that is visibly contaminated will be segregated and further evaluated to determine the appropriate disposition path. Measurements collected on secondary waste include physical screening and radiological surveys. Secondary waste determined to be non-contaminated will be collected in a shipping container and managed as LLW to be sent to ERDF for disposal.

2.3 QUALITY OBJECTIVES AND CRITERIA

The Data Quality Objectives for this project are summarized in Section 3.0.

2.4 SPECIAL TRAINING/CERTIFICATION

Training for activities performed in accordance with this document is defined and implemented through a contractor-approved training program. Subcontractors perform work to training requirements established in the specific contract for the work activity being performed.

Training and certification requirements that apply to operation of the radioassay units (including weight measurements) at the WRAP Facility are performed to contractor-approved procedures developed to meet WIPP program requirements.

The mobile radioassay contractor will have at least three years of experience in supplying NDA services. The mobile radioassay contractor shall train and select NDA oversight and data analysis personnel and analytical personnel in accordance with ASTM C 1490-01, *Standard Guide for the Selection, Training, and Qualification of Nondestructive Assay (NDA) Personnel.*

2.5 DOCUMENTS AND RECORDS

Document control procedures are established to provide for the control, updates, and distribution of documents. Records are managed to final disposition. Records generated from activities covered under this SAP include: radioassay results, weight measurement results, process knowledge (acceptable knowledge) documents, designation records, training records, verification records, waste records, procedures, equipment calibration records, and maintenance records.

For the TRU Program and the WRAP Facility, documents are records are managed using contractor-approved procedures developed to meet WIPP program requirements.

For the Waste Retrieval Project and Waste Services, documents and records are managed using contractor-approved procedures.

2.6 DEVIATIONS AND REVISIONS

If a deviation from a requirement in the SAP is considered necessary, the process for resolving and documenting the deviation is as follows:

- A minor deviation provides additional clarification, addresses a technical difference for a small number of containers, or otherwise provides specific exceptions for a waste stream or set of data. The deviation will be evaluated and determined to be minor through discussions with the EPA. Minor deviations will be documented using e-mail correspondence or a teleconference memorandum with approval by EPA. The approved deviation record will be maintained as part of the project file.

- Deviations determined not to be minor will be considered major and will require a revision of the SAP and subsequent approval by EPA.

Additional waste streams and/or original waste-generating sources covered under the time critical removal action (EPA 2004) may be identified and targeted for treatment, if required, and disposal at the ERDF. An appendix will be added to this SAP for each waste stream and/or original waste-generating source. The appendix will include a description of the waste and contaminants of concern. Approval of this appendix by the U.S. Environmental Protection Agency (EPA) will be documented via an e-mail or concurrence page attached to the appendix.

3.0 DATA QUALITY OBJECTIVES

This section provides a summary of the data quality objectives (DQO). The DQO process is used to develop DQOs that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

The DQOs applicable to the RSW and secondary waste are provided in HNF-20770, *Data Quality Objectives Summary Report for Disposition of the Low-Level Waste Fraction of Retrievably Stored Waste* (most current version). The DQOs are currently limited to RSW debris/RLS waste from the PFP and suspect-contaminated low-level secondary waste. For purposes of discussion, when the term debris is used, radioactive lead solids are included. Boxed waste, nondebris waste, RSW from other original waste-generating sources, RSW from other burial grounds, and contaminated secondary waste are not included. Appendix A provides a summary of the contaminants of concerns for the PFP and suspect-contaminated low-level secondary waste streams. The DQOs will be revised, as required, to include additional original waste-generating sources that are part of the non-TRU fraction of the RSW as well as contaminated secondary wastes.

A team was assembled to provide input and review the DQOs and the SAP. Table 3-1 identifies the team members. Table 3-2 identifies the key decision makers.

Table 3-1. Data Quality Objectives and Sampling Analysis Plan Team Members.

Name	Company/Organization	Position or Area of Expertise
Naeem Abdurrahman	FH/the WRAP Facility	Waste Management/Radioassay
Chad Cornelison	DTS/Waste Services	Waste Management
Darrin Faulk	FH/Solid Waste Storage and Disposal	Environmental Compliance
Lori Fritz	FH/Waste Management	Strategic Planning
Cindy Girres	DTS/Waste Services	Waste Management
Bill Jasen	PEC/Waste Management	Waste Retrieval/Radioassay
Rich Lipinski	BHI/Waste Management	Waste Management
Ryan Ollero	BHI/Waste Management	Waste Management
Bill Scott	FH/Waste Management	Waste Retrieval
Doug Sherwood	River's Edge Environmental/ Waste Management	Regulatory Support
Dean Nester	FH/Waste Management	Task Lead and Waste Management
John Woodbury	DTS/Transportation	Transportation

BHI = Bechtel Hanford, Inc.
DTS = Duratek Technical Services.
FH = Fluor Hanford, Inc.
PEC = Performance Enhancement Corporation.

Table 3-2. Key Decision Makers.

Name	Organization
Greg Sinton	U.S. Department of Energy, Richland Operations Office
Dave Einan	U.S. Environmental Protection Agency

3.1 STATEMENT OF THE PROBLEM

The objective of DQO Step 1 is to evaluate the available information and define the problem so that the data requirements and decisions can be developed. This is the problem:

The low-level and mixed low-level fractions of retrievably stored waste, including secondary waste, will be treated (if required), processed (if required), and then disposed at the ERDF. The waste must be characterized and the RSW must meet the definition of debris or RLS eligible for macroencapsulation in order to properly manage the waste to the requirements of the ERDF waste acceptance criteria (WAC).

3.2 IDENTIFY THE DECISIONS

The objective of DQO Step 2 is to define the decision statements that must be addressed to resolve the problem. Table 3-3 lists the decision statements that will be answered as part of the characterization and evaluation.

Table 3-3. Decision Statements for Characterization

Decision Statement #1—Determine whether or not the RSW exceeds classification as TRU waste.
Decision Statement #2—Determine whether or the not the RSW contains dangerous/hazardous wastes.
Decision Statement #3—Determine whether or the not the RSW contents classify as debris or RLS.
Decision Statement #4—Determine whether or the not the RSW contents contain ERDF restricted wastes.
Decision Statement #5—Determine whether the secondary waste contains radiological and/or dangerous/hazardous constituents.

ERDF = Environmental Restoration Disposal Facility
RLS = radioactive lead solids
RSW = retrievably stored waste.
TRU = transuranic.

3.3 IDENTIFY INPUTS TO THE DECISIONS

The data inputs needed to resolve each of the decisions statements were identified along with the areas where additional data collection is required. The DQOs provide an assessment of the usability of the existing data and the logic behind the selection of data requirements and data collection methods.

Process knowledge will be used to designate RSW for hazardous/dangerous constituents and to make the debris/RLS determination. Radioassay and weight measurements will be performed on every RSW drum to determine the radiological characterization. A statistically based sampling design will not be employed for radioassay because all drums of retrievably stored LLW and MLLW are required to be radioassayed. Prior to treatment, the accuracy of the documented waste contents will be verified by performing nondestructive examination or visual examination on a representative number of containers from each waste stream.

Data from WIPP certification activities on a RSW waste stream may be used as the basis for verification. Real-time radiography and visual examination results performed to date have identified waste items that are not eligible for macroencapsulation or are otherwise prohibited at the ERDF. Examples include containerized mercury (typically in thermometers), containerized liquids such as acids, and cadmium batteries.

Process knowledge will be used to characterize secondary waste. Visual examination of the waste is performed as it is generated to ensure that no visible signs of chemical contamination are found on the waste. Suspect-contaminated secondary waste cannot be free-released. Radiological surveys are completed, documenting that radiological contamination above detection limits was not found.

3.4 DEFINE THE STUDY BOUNDARIES

The objective of DQO Step 4 is to define the spatial and temporal components of the RSW for each decision statement to ensure that the data collected are representative of the population. The scale of decision making for each decision statement is defined by combining the population of interest with the spatial and temporal boundaries. Practical constraints that could interfere with sampling are also identified.

The population of interest for these DQOs is the RSW drums and the suspect-contaminated secondary waste. The geographic boundary is Burial Ground 218-W-4C. This section establishes the limits for gathering data to address each decision statement. Table 3-4 provides a summary of these limits.

Table 3-4. Boundaries for Data Collection.

DS #	Population of Interest	Unit Measurement Size	Temporal Boundary	Scale of Decision Making
1	All RSW Drums	Each drum will be radioassayed; multiple measurements may be taken on a drum.	Radioassay results may be used from previous retrieval campaign assay units, a mobile radioassay unit, or from an assay unit located at the WRAP Facility.	The TRU/non-TRU determination will be made for each drum.
2	Non-TRU RSW Drums	The waste stream designation will be completed for the waste-generating source (e.g., PFP).	Visual verification or real-time radiography results will be used to confirm the designation. Data from the WIPP certification program will be used when possible.	The designation will be completed by waste stream for each original waste-generating source.
3	Non-TRU RSW Drums	The waste inventory for each drum will be reviewed to make the debris/RLS determination.	Visual verification or real-time radiography results will be used to confirm the waste contents. Data from the WIPP certification program will be used when possible.	Each drum will be evaluated to determine if it is debris/RLS and eligible for treatment.
4	Non-TRU RSW Drums	The waste stream will be evaluated for the presence of ERDF-restricted wastes. Calculations for greater than U.S. NRC Class C limits will be completed for each drum.	Visual verification or real-time radiography results will be used to confirm the designation. Data from the WIPP certification program will be used when possible.	The prohibited item determination will be made for each original waste-generating source. A greater than U.S. NRC Class C determination will be made for each drum.
5	Secondary Waste	The waste will be evaluated as it is generated.	Visual examination and radiological surveys are conducted as the waste is generated.	Each waste article is examined and surveyed.

NRC = U.S. Nuclear Regulatory Commission.
PFP = Plutonium Finishing Plant.
RLS = radioactive lead solids.
RSW = retrievably stored waste.
TRU = transuranic.
WIPP = Waste Isolation Pilot Plant.
WRAP = Waste Receiving and Processing.

3.5 DECISION RULES

The objective of DQO Step 5 is to use the results from DQO Steps 1 through 4 to develop decision rules. Decision rules provide the parameter of interest, unit of decision making, action level, and alternative actions. The action levels and basis that apply to each COC are presented in Table 3-5, Table 3-6, and Table 3-7. The action levels are generally based on regulatory thresholds for waste designation and the ERDF WAC limits.

Table 3-5. Action Levels.

Parameter	Action Level
Transuranic Radionuclides	100 nCi/gram of TRU isotopes as defined in DOE M 435.1-1 Chg 1.
Dangerous/Hazardous Constituents	Regulatory limits as defined in WAC 173-303 and 40 CFR 268.4.
Debris Classification (including RLS)	> 50% manufactured objects, plant or animal matter, natural geological material that exceeds 60 mm (2.36 in) particle size as defined in 40 CFR 268.2. Material with a specific treatment standard as provided in 40 CFR 268 is not authorized. Lead not meeting the RLS treatment subcategory per 40 CFR 268.42.
ERDF Restricted Wastes such as the following: • Explosives or reactives • Toxic gases, fumes, or vapors • Gaseous waste at a pressure in excess of 1.5 atmospheres at 20 °C • Free liquid • Pyrophoric material • Biological, pathogenic, or infectious material	Identified in the ERDF WAC as generally restricted.
ERDF Restricted Wastes NRC Class C Waste	Greater than U.S. NRC Class C limits as defined in 10 CFR 61.55.
ERDF Radionuclide Levels	See Table 6-3 based on the ERDF WAC
ERDF Chemical Levels	See Table 6-4 based on the ERDF WAC
Secondary Waste	Visible signs of chemical contamination or detectable radiological contamination.

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," 61.55, "Waste classification," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," 268.2, "Definitions applicable in this part," 268.4, "Treatment surface impoundment exemption," 268.42, "Treatment standards expressed as specific technologies," *Code of Federal Regulations*, as amended.

DOE M 435.1-1 Chg 1, 2001, *Radioactive Waste Management Manual*, U.S. Department of Energy, Washington, D.C.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended, Olympia, Washington.

ERDF = Environmental Restoration Disposal Facility.
NRC = U.S. Nuclear Regulatory Commission.
RLS = radioactive lead solids.
TRU = transuranic.
WAC = waste acceptance criteria.

In addition to the transuranic radionuclide and NRC Class C levels, the ERDF has established limits for certain radionuclides that are provided in Table 3-6. When two or more radionuclides are present, the sum of the fractions is used to determine acceptability. Each radionuclide in the

waste mixture must be divided by its associated limit, with the sum being less than or equal to 1.0. Waste sources above a limit must be evaluated further by the ERDF for acceptability.

In addition to the regulatory limits as defined in WAC 173-303 and 40 CFR 268.4, the ERDF has established concentration limits for certain chemicals that are provided in Table 3-4. Each chemical constituent must be below the established limit.

Table 3-6. ERDF Radionuclide Action Levels.

Radionuclide	Action Level
Major radionuclides	>1 pCi/g
Americium-241	0.050 Ci/m^3
Americium-243	0.057 Ci/m^3
Cesium-137	32 Ci/m^3
Cobalt-60	Unlimited
Europium-152	21,000,000 Ci/m^3
Europium-154	Unlimited
Neptunium-237	0.0015 Ci/m^3
Plutonium-238	1.5 Ci/m^3
Plutonium-239	0.029 Ci/m^3
Plutonium-240	0.029 Ci/m^3
Plutonium-241	6.2 Ci/m^3
Plutonium-242	0.11 Ci/m^3
Potassium-40	0.095 Ci/m^3
Strontium-90	7,000 Ci/m^3
Thorium-232	0.0060 Ci/m^3
Uranium-233/234	0.074 Ci/m^3
Uranium-235	0.0027 Ci/m^3
Uranium-238 + daughters	0.012 Ci/m^3

[a]A major radionuclide must also meet all of the following conditions:

- Half life greater than 2 years.
- Not in secular equilibrium with a parent nuclide.
- Is not naturally occurring at an activity level consistent with levels determined in Hanford Site Background: Part 2, Soil Background for Radionuclides (DOE/RL-1996)

DOE/RL-96-12, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, Rev 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Table 3-7. ERDF Chemical Action Levels.

Chemical constituent	ERDF concentration limit (mg/kg)
Antimony	19,000
Arsenic	3,000
Barium	940,000
Cadmium	39,000
Chromium	Total 59,000 VI – 59,000
Manganese	440,000
Selenium	400,000
Silver	350,000
Thallium	5,600
Vanadium	330,000
Zinc	300,000

ERDF = Environmental Restoration Disposal Facility

3.6 LIMITS ON DECISION ERROR

This section describes the tolerable limits that will be employed for the radioassay equipment and verification.

3.6.1 Radioassay Tolerable Decision Errors

The radioassay equipment shall perform in a manner to accurately and reliably provide radioassay results with sufficient confidence to distinguish TRU waste from LLW. For each assay unit used, the radioassay techniques, instruments, and procedures used must meet these criteria:

- Capable of reporting a minimum detectable concentration of TRU isotopes sufficiently below 100 nCi/g to determine TRU from LLW.
- Capable of monitoring for fluctuations in background radiation levels, determining if background levels impact radioassay results, and correcting for excessive background radiation if applicable.
- Appropriate for the specific waste stream being assayed.
- Result in defensible values for the activity and mass of the reported radionuclide inventory.

3.6.2 Verification Tolerable Decision Errors

Verification is the evaluation performed to substantiate that the waste is the same as represented on the AK documentation and on the original waste records supplied by the generator.

Verification elements include container inspection, initial confirmation of AK documentation, and periodic confirmation.

One hundred percent of the containers being retrieved will be inspected for damage and to ensure the waste containers are those indicated on the documentation. The allowable decision error of a false negative (i.e., failing to correlate a container with a generating source) is 0%. If a positive identification cannot be established, the drum will not be eligible for subsequent treatment and disposal until further characterization takes place.

The AK designation for each waste stream will be confirmed prior to releasing the waste stream for treatment and disposal. Waste characterization of retrievably stored waste will take place using procedures and protocol from the WIPP certification program (i.e., radiography or visual examination, headspace gas sampling and analysis, and homogeneous sampling and analysis, if appropriate) or equivalent program. A minimum of 10% of the projected RSW waste volume will be non-destructively examined to confirm the AK designation. The allowable decision error of a false negative (i.e., failing to identify that a constituent or parameter exceeds a regulatory limit, action level, or is otherwise restricted at the ERDF) will be 10%.

The results of ongoing WIPP certification activities for a waste stream will be periodically assessed to determine if the established designation is accurate and that the established allowable decision error remains at 10%. The cumulative total of all verification data for a waste stream will be used in performing this assessment. TRU waste containers from a waste stream are characterized, sampled, and analyzed for headspace gas composition. They are also subjected to nondestructive examination by real time radiography (RTR) or VE. Results are documented and tracked as part of the WIPP certification program. For a waste stream that is being treated and disposed, these results will be assessed a minimum of once a quarter.

3.6.3 Secondary Waste Decision Errors

Secondary waste will be screened using field instrumentation to determine if any radiological contamination is present. Typically, for removable contamination, the minimum detectable activities (MDA) are <1000 dpm/100 cm^2 beta-gamma and <20 dpm/100 cm^2 alpha. For total contamination (i.e., direct surveys) the MDAs are <5000 dpm/100 cm^2 beta-gamma and <100 dpm/100 cm^2 alpha.

Secondary waste will be subjected to a visual examination. Waste can have no visible signs of potential contamination.

4.0 PHYSICAL VERIFICATION DATA GENERATION AND ACQUISITION

A verification program will be implemented to evaluate and identify any waste components or characteristics whose presence or concentration will impact management of the waste. The verification will substantiate that the waste in each waste stream meets the waste profile and matches the description provided on the waste records, the AK documentation, and designation. The acceptable tolerable decision error for a waste stream must be met.

4.1 VERIFICATION PROCESS DESIGN

One hundred percent of the containers being retrieved will be inspected for damage and to ensure the waste containers are those indicated on the documentation. During the initial inspection at the module face, the following information will be confirmed.

- Container number or other unique identifying characteristic (e.g., seal number).
- Module position.
- Vent clip installation.
- Contamination and surface dose.
- Container condition [corrosion, deformities, degradation].

The initial inspection of a container primarily demonstrates that the drums are accurately identified on the waste records. To be acceptable, the container must match up with a waste record and have a traceable association to a waste record and waste stream. The allowable decision error of a false negative (i.e., failing to correlate a container with a generating source) is 0%. If a positive identification cannot be established, the drum will not be eligible for subsequent treatment and disposal until further characterization takes place.

The designation for each waste stream will be confirmed as part of the initial waste stream characterization. Shipments of a new waste stream for treatment and disposal are not authorized until the initial confirmation of the waste stream is completed and documented. Once a waste stream has been released, it will be periodically assessed to evaluate whether the waste stream characteristics remain within established limits.

Containers selected for verification must be from the same waste stream. A waste stream is any waste material generated from a process or activity that is similar in material, physical form, hazardous constituents, and radiological constituents. Containers selected for verification may be selected from RSW containers or non-RSW containers from the same process. For example, for the PFP debris waste stream, containers selected for verification may be TRU or non-TRU RSW, or they may be from other PFP debris containers that fit under the same AK package.

The primary measurement parameter for physical verification is nondestructive examination. The inspection for retrievably stored waste will primarily utilize data gathered from the WIPP certification program (i.e., nondestructive examination using RTR or visual examination, headspace gas sampling and analysis, and homogeneous sampling and analysis, if appropriate).

Alternately, a visual verification program may be established at a commercial treatment location or other facility that is authorized to manage the waste.

Nondestructive examination is designed to identify discrepant items or waste not noted on the contents inventory for a container. The inspection results for all containers in a waste stream will be compiled and analyzed. The evaluation will determine whether the subject waste stream matches the AK documentation, designation, and treatment standards. The results will also be evaluated for the presence of the ERDF restricted items.

The performance standards that apply to the physical verification are as follows:

- For initial waste stream confirmation, a minimum of 10% of the projected RSW volume from each waste source will be physically verified to confirm the AK designation. For example, if the projected number of PFP debris containers in RSW is 1,000, then 100 PFP debris containers that are managed under the PFP Debris AK documentation must be selected.

- The allowable decision error of a false negative (i.e., failing to identify that a constituent or parameter exceeds a regulatory limit, action level, or is otherwise restricted at the ERDF) will be 10%.

- Periodic verification will be conducted a minimum of once a quarter for each waste stream that is actively being shipped for treatment or disposal. The established designation allowable decision error must remain at 10%. The cumulative total of all verification data for a waste stream will be used in performing this assessment.

Verification for secondary waste will consist of a periodic, independent review of the shipping container contents by a supervisor or designee. The review will establish that the waste is as described on the inventory and that the inspection and surveys are being completed in accordance with approved procedures.

4.2 VERIFICATION METHODS

TRU waste containers from a waste stream are characterized, sampled, and analyzed for headspace gas and undergo either nondestructive examination by RTR or visual examination. Contractor-approved procedures developed to meet WIPP program requirements are used to perform nondestructive examination. The results are documented and tracked as part of the WIPP certification program in accordance with contractor-approved procedures.

The Mixed Waste Treatment Project will obtain the results of the physical verification and complete a review against the AK documentation, designation, and the ERDF WAC. Based on data gathered to date, it is realistic to assume that prohibited items or other anomalies will be identified during verification activities. The results of the evaluation shall be documented. Nondestructive evaluation results will be reviewed and waste not described on the available paperwork will be evaluated further and the following questions answered.

- Is there a process or activity that was not previously identified?
- Does the physical form of the waste match the profile, and is management of debris allowed?
- Are hazardous constituents affecting treatment requirements identified?
- Are there radiological constituents affecting the TRU, NRC, or other action level?
- Is the waste stream as described in the AK accurate or does the waste stream need to be revised or a new waste stream created?

If, as a result of an evaluation, the waste designation is revised, the following actions are taken:

- Existing information is reviewed based on the container identification number and differences in hazardous waste code assignments are documented.
- If differences exist in the hazardous waste codes previously assigned, the information is reassessed and required AK information associated with the new designation is documented.
- Sampling and analytical data associated with the waste is reassessed and documented.
- The waste code reassignment is documented and verified (e.g., verification that the waste was generated within the specified time period, area and buildings, waste generating process, and that the process material inputs are consistent with the waste material parameters identified during RTR or VE).
- The treatment and disposal facilities will be notified of the changes. Receipt documentation will be updated accordingly. Waste that has already been shipped will not be subjected to the new designation.

When a failure in excess of the established 10% rate occurs, a recovery plan shall be developed. The SAP will be reevaluated and updated as needed to address the additional information and document the path forward.

4.3 QUALITY CONTROL

To ensure that the AK process is consistently applied, the TRU project imposes data quality requirements for AK documentation to meet WIPP requirements. These data quality objectives are documented by the TRU Program.

As a Quality Control (QC) check on the radiographic examination of waste containers, TRU project personnel statistically select a portion of the waste containers to be opened and visually examined in accordance with contractor-approved procedures developed to meet WIPP program requirements.

The Mixed Waste Treatment Project will review the QC results as part of confirmation activities.

4.4 DATA MANAGEMENT

The results of the verification reviews will be documented and placed in the project record files in accordance with contractor-approved procedures.

5.0 WEIGHT MEASUREMENT DATA GENERATION AND ACQUISITION

Weight measurements are taken on each drum. The measurements will typically be performed at the time of radioassay using a weigh scale. Calibration of scales and documentation of results are performed to established procedures.

5.1 WEIGHT MEASUREMENT PROCESS DESIGN

The weight of the waste is used in the calculation for transuranic concentration. The weight of the waste is determined by subtracting the tare weight of the container (including the weight of the rigid liner, other packaging, and any shielding external from the waste, if applicable) from the gross weight of the container. Standard manufacture tare weights may be used. For example, the Waste Retrieval Project uses a conservative tare weight of 29 Kg (63.9 lb) for all 17C and 17H 208 L (55-gal) drums. The weight of the rigid liner will be subtracted from the gross weight when the original waste record identifies that a rigid liner is used or when the AK documentation or verification program identifies the use of a rigid liner for the waste stream. When containers are overpacked, the inner container may be considered waste when there is a minimum of a 0.76 cm (0.3-in.) diameter hole in the inner container.

5.2 WEIGHT MEASUREMENT METHODS

Weight measurements collected at the WRAP Facility will use a weigh scale that is qualified in accordance with contractor-approved procedures developed to meet WIPP program requirements. The weigh scale is commissioned and maintained in a useable configuration per contractor-approved procedures developed to meet WIPP program requirements. Drum weights are taken, recorded, and maintained in the TRU project files.

Weight measurements collected at the Waste Retrieval Project will be performed using either a weigh scale or a certified dynamometer. The drum weight scale will have a range of 0 – 454 kg (0-1,000 lb) and accuracy of 0.1% or +/-0.45 kg (1 lb). When in use, a daily weight check will be performed. The mobile radioassay contractor provides a weight scale using the performance requirements defined in contract documents and contractor-approved procedures.

5.3 QUALITY CONTROL

Sources used for equipment calibration and QC checks must have a documented pedigree to a nationally recognized standard. Accuracy and precision requirements will be established based on the manufacturer's specifications. At the WRAP Facility, the calibration and QC checks will be established by contractor-approved procedures developed to meet WIPP program requirements. At the Waste Retrieval Project, the mobile radioassay contractor performs equipment calibration and QC checks in accordance with approved operating procedures as required by contract requirements.

5.4 INSTRUMENT CALIBRATION AND CALIBRATION FREQUENCY

The scale used for weighing will be calibrated to maintain its operation within specifications established by the contractor's program. Weights used for calibration will be traceable to a nationally recognized standard (e.g., National Institute of Standards). Calibration records will be maintained in the field records.

At the WRAP Facility, the weigh scale calibration and calibration frequency are governed by contractor-approved procedures developed to meet WIPP program requirements

At the Waste Retrieval Project, applicable system components (lifting device or weight scale) shall be calibrated or tested as required by contractor-approved programs, or by the mobile assay contractor as required by the manufacturer's operations and maintenance manual.

5.5 DATA MANAGEMENT

Weights will be recorded and documentation placed in the project record files.

6.0 RADIOASSAY MEASUREMENT DATA GENERATION AND ACQUISITION

Radiological characterization is used for these purposes:

- Accurately and reliably distinguish TRU waste from LLW.
- Identify and quantify the activity of isotopes requiring reporting under the ERDF WAC.
- Determine that the waste does not exceed Class C limits as defined in 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," 61.55, "Waste classification."
- Identify and quantify the activity for isotopes for compliance with DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, or U. S. Department of Transportation requirements.

Radioassay measurements may be made by qualified personnel at the WRAP Facility or by a contractor providing mobile radioassay services at the retrieval site. A qualified contractor provides mobile NDA equipment and services using a gamma energy unit and is responsible for setting up, maintaining, calibrating, and providing radioassay results. At the WRAP Facility, personnel perform measurements of each waste container using gamma energy radioassay or an imaging passive/active neutron system to determine the radioactive material composition and quantify radionuclide masses. This section provides quality assurance requirements for both locations.

6.1 MEASUREMENT METHOD

Radioassay systems will be capable of reporting a minimum detectable concentration of TRU isotopes sufficiently below 100 nCi/g to differentiate TRU from LLW. The NDA system shall be capable of monitoring for fluctuations in background radiation levels, determining if background levels impact results, and correcting for excessive background radiation, if applicable.

Technical procedures or documents must be provided for each radioassay unit that describe how the NDA techniques, instruments, and procedures are appropriate for the specific waste stream and waste contents being assayed, resulting in defensible values for the radionuclide inventory.

At the WRAP Facility, drums will be radioassayed using an imaging passive/active neutron unit or a gamma energy unit. NDA personnel at the WRAP Facility follow contractor-approved procedures developed to meet WIPP program requirements. The IPAN will be used to quantify radionuclide values only if all reportable radionuclide activities can be determined.

At the Waste Retrieval Project, the mobile radioassay contractor, ANTECH, maintains a mobile assay system that uses a gamma scanning technique, the ORTEC[1] ISOTOPIC and GAMMA VISION software. The radioassay contractor is qualified by meeting and working to the performance requirements defined in contract specifications. Waste Retrieval Project personnel supporting the mobile radioassay contractor follow contractor-approved procedures.

6.2 QUALITY CONTROL

The applicable quality control guidelines, quantitative target limits, and levels of effort for assessing data quality are established for each radioassay unit and documented in contractor-approved procedures. The measurement methods and method performance requirements are presented in Table 6-1.

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[1] ORTEC is a registered trademark for Oak Ridge Technical Enterprises Corporation, P.O. Box 485 Oak Ridge Tennessee.

Table 6-1. Assay Instrument Performance Requirements.

Measurement	Measurement method	Accuracy[a]	Precision
Pu-239 or Pu-240	Imaging passive/active neutron	Low: 40 %R High: 160 %R	Objective[b]: 29.2 %RSD Measured[c]: 16 %RSD
Pu-239 or Pu-240	Gamma Spectroscopy	< factor of 2 from the known value (+100% to –50%).	Measured[c]: RSD < 15% for radionuclides present at greater than or equal to 10 times the MDL RSD <30%. for radionuclides present at less than 10 times the MDL

[a]Limits on the two-sided 95% confidence bound for the ratio of the mean of the measured values to the known (or accepted) value, expressed as a percent.
[b]Limits for one relative standard deviation, expressed as a percent; precision is equal to the standard deviation of the underlying measurement distribution.
[c]Measured precisions that must be met to satisfy the precision criteria at the 95% upper confidence bound, based on six replicates. The values are one relative standard deviation referenced to the known (or accepted) value for the test, not to the mean of the measurements.

%R = percent recovery %RSD = percent relative standard deviation MDL = method detection limit

6.3 INSTRUMENT TESTING, INSPECTION, AND MAINTENANCE

At the WRAP Facility, the radioassay units are commissioned and maintained in a useable configuration per contractor-approved procedures developed to meet WIPP program requirements. Correction of nonconformances is to be completed in accordance with contractor-approved procedures developed to meet WIPP program requirements

At the Waste Retrieval Project, the mobile radioassay contractor is required by contract requirements to "provide for inspection, calibration, testing and maintenance to ensure continuing reliability and safety." Requirements must be established and implemented through a Quality Assurance Program (QAP) that meets the criteria of 10 CFR 830.122 or an equivalent program.

Correction of nonconformances shall be in accordance with requirements established and implemented through a QAP that meets the criteria of 10 CFR 830.122 or an equivalent program.

6.4 INSTRUMENT CALIBRATION AND CALIBRATION FREQUENCY

Each NDA system shall be calibrated before initial use. During calibration (or recalibration), system correction factors shall be established and algorithms adjusted such that the value of %R (percent recovery) is set equal to 100% (i.e., the system is calibrated to 100% R). When calibrating NDA instruments, a calibration curve is usually fitted to a number of data points obtained with calibration sources. The range of applicability of system calibrations must be specified in procedures. The matrix/source surrogate waste combination(s) used for calibration shall be representative of the activity range(s) or gram loading(s), and relevant waste matrix characteristics (e.g., densities, moderator content, container size) planned for measurement by the system. Individual components or functions (e.g., separate detectors or reference peak) may require individual calibration.

At the WRAP Facility, the assay unit calibration, calibration frequency, and determination of the lower limit of detection are governed by contractor-approved procedures developed to meet WIPP program requirements. Correction of nonconformances shall be in accordance with contractor-approved procedures developed to meet WIPP program requirements.

At the Waste Retrieval Project, the mobile radioassay contractor maintains equipment calibration in accordance with approved operating procedures as required by contract requirements. The NDA system components are required to be calibrated per approved procedures. Sources used for equipment calibration and QC checks have a documented pedigree using a nationally recognized standard. Background; energy calibration and resolution checks (e.g., full width at half maximum); and efficiency QC checks are performed prior to the first assay of a batch. Energy calibration and resolution checks, as well as efficiency QC checks, are performed after the last assay of a batch. The QC checks (background, energy calibration and resolution and efficiency) are documented on a control chart and the assay system operated within statistical process control limits.

Preventive maintenance is performed in accordance with a schedule based on the manufacturer's recommendations, instrument performance history, and use.

Correction of nonconformances shall be in accordance with requirements established and implemented through a QAP that meets the criteria of 10 CFR 830.122 or an equivalent program.

6.5 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

At the WRAP Facility, supplies are procured and managed using contractor-approved procedures developed to meet WIPP program requirements. Correction of nonconformances shall be in accordance with contractor-approved procedures developed to meet WIPP program requirements.

At the Waste Retrieval Project, the radioassay subcontractor maintains a spare parts inventory to help minimize downtime of radioassay. Spare parts include day-to-day consumables and

manufacturer's recommended spare parts. Requirements are established and implemented through a QAP that meets the criteria of 10 CFR 830.122 or an equivalent program.

Correction of nonconformances shall be in accordance with requirements established and implemented through a QAP that meets the criteria of 10 CFR 830.122 or an equivalent program.

6.6 NON-DIRECT MEASUREMENT

Acceptable knowledge (AK) may be used to supplement NDA for radionuclides (e.g., Sr-90 and U-234) when there is no method or the method detection limit (MDL) is not low enough to support decision making. The requisite data on isotopic ratios and quantities will be derived from AK, NDA, or both.

The means and methodology to quantify these isotopes using other measured isotopes shall be technically justified in the AK documentation. If measured isotopic results are not used, the use of AK must be either included with or referenced in NDA batch data reports. Examples of this quantification include using isotopic ratios to calculate U-234 from the measured U-235 (and possibly U-238) and Sr-90 from the measured Cs-137.

6.7 DATA MANAGEMENT

The NDA results together with process knowledge are used to calculate the inventory of radionuclides contained in a waste drum.

NDA personnel at the WRAP Facility quantify radionuclide values using AK data, assay measurements, and calculations to establish an isotopic profile of each waste container. Data is reported in batch data reports using contractor-approved procedures developed to meet WIPP program requirements. Correction of nonconformances shall be in accordance with contractor-approved procedures developed to meet WIPP program requirements

NDA personnel at the mobile radioassay unit quantify radionuclide values in accordance with requirements in contract specifications. Computer software will be identified, documented, changed, and controlled in accordance with subcontractor-approved procedures. Quantification of radionuclides is performed in accordance with subcontractor-approved procedures. Correction of nonconformances shall be in accordance with requirements established and implemented through a QAP that meets the criteria of 10 CFR 830.122 or an equivalent program.

Data will be reported on batch data reports. For each batch, the following shall be reported:

- The assay unit, batch number, and container numbers included in the batch.
- The sequence file number, assay date and time, and name and version of any software used for the assay and data analysis.
- The names of the individuals performing the assay and data analysis.

- A narrative of the data and any qualifiers, including any explanation of issues or problems associated with the batch.
- Any nonconformance report or corrective action report directly associated with that batch.
- Signature/date of both analyst and reviewer.

For each container, the following information shall be reported:

- The container identification number.
- Container net and gross weight in kilograms.
- Waste classification as either TRU or LLW.
- Total TRU activity in every container in nCi/g.
- Total fissile gram equivalents in grams.
- Total plutonium mass in grams.
- The measured value, in curies, +/- the uncertainty value calculated at the two-sided 95% confidence level of each isotope detected or identified by ratio.
- Identification of isotopic ratios used for plutonium quantification.
- The TRU concentration reported in nCi/g +/- the uncertainty value calculated at the two-sided 95% confidence level.
- The MDL of gamma-emitting isotopes of concern that were not detected by gamma energy analysis.
- Total measurement uncertainty for the NDA system.

Assay documentation and batch reports shall be placed in the project record files.

7.0 SECONDARY WASTE DATA GENERATION AND ANALYSIS

The debris waste consists of materials such as wood (generally pallets and plywood) used in supporting or protecting the waste packages, tarps, and personnel protective equipment generated during retrieval operation. Waste associated with the wood dunnage (plastic strapping, tape, staples, nails, etc.) could also be included. Trace amounts of soil may remain on the waste. The debris is considered suspect-contaminated; due to its porous nature, it cannot be surveyed for radiological release.

7.1 PROCESS DESIGN

Radiological surveys are performed on the secondary waste to determine if any contamination is present. Site-standard portable instruments for detection of beta-gamma and alpha contamination will be used. The Eberline[2] E-140 (also know as Geiger Mueller) is used for beta-gamma detection and the Portable Alpha Meter (PAM) is used for alpha detection.

7.2 MEASUREMENT METHODS

The detection limits or MDAs for instruments for surveys follow standard protocols regarding scan rates, geometries, etc. that are prescribed in contractor-approved procedures. Additional criteria on applications for instrument use can be found in Hanford Site instrument manuals.

Operational characteristics and limitations of the Eberline E-140 and PAM are identified in contractor-approved procedures. These instrument procedures include physical descriptions, radiation and energy response characteristics; calibration/maintenance and performance testing descriptions; and general operation descriptions for the instruments.

Although surveys of suspect-contaminated materials are not for release purposes, the procedural survey parameters are typically used in conjunction with the respective instrument procedures. In addition, procedures specify recording information for contamination survey results including the rationale for application of <MDA non-release surveys.

Typically, for removable contamination, the MDAs are <1000 dpm/100 cm^2 beta-gamma and <20 dpm/100 cm^2 alpha. For total contamination (i.e., direct surveys) the limits are <5000 dpm/100 cm^2 beta-gamma and <100 dpm/100 cm^2 alpha.

7.3 QUALITY CONTROL

Instrumentation calibration and quality control checks are conducted in accordance with manufacturers' recommendations and contractor-approved procedures.

7.4 DATA MANAGEMENT

Instrument maintenance records and field survey results are documented and placed in the project record files.

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[2]Eberline is a registered trademark of Eberline Instrument Corporation, Santa Fe, New Mexico.

8.0 ASSESSMENT/OVERSIGHT FOR SAMPLING AND ANALYSIS

QA may conduct random surveillances and assessments to verify compliance with requirements of this sampling and analysis plan, project work packages, procedures, and/or regulatory requirements.

At the WRAP Facility, the audit and surveillance program is governed by WIPP requirements. Assessments and surveillances are conducted and nonconformances managed in accordance with contractor-approved procedures developed to meet WIPP program requirements.

For the mobile assay contractor, nonconformances are identified and managed per the mobile assay contractor's Quality Assurance Plan and/or by the Waste Retrieval Project. The Waste Retrieval Project manages nonconformances per contractor-approved procedures.

9.0 DATA VALIDATION AND USABILITY

Review, verification, and validation of data are performed by the WRAP Facility, the Waste Retrieval Project and/or Mixed Waste Treatment personnel prior to use. The reported data is compared to the established data quality requirements. Mixed Waste Treatment personnel then review the data against acceptance criteria for transportation, processing (if applicable), treatment (if applicable), and disposal.

9.1 DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

The WRAP Facility, Waste Retrieval Project, and Mixed Waste Treatment procedures specify the requirements for data review, validation, and verification. The purpose of the data review is to determine if raw data have been properly collected and to ensure raw data are properly reduced. Data verification authenticates that the reported data represents the sampling and analysis activities as performed and have been subjected to the appropriate levels of data review.

9.1.1 Data Review

Nondestructive examination data are reviewed as part of the WIPP certification program.

Radioassay and weight data is reviewed and approved by qualified personnel before being reported. Areas reviewed include, but are not limited to these:

- Data generation and reduction performed in accordance with procedural requirements.
- Calculations or data entry verified as appropriate.

- Instrument performance and background measurements for the affected period performed, documented, and evaluated for adverse trends.
- Appropriate corrective actions, when required, documented and successfully completed.
- Batch data report assembled and completed in accordance with requirements>
- Data technically correct and justified.
- Anomalies, error messages, warning flags, etc., corrected or justified in the report.
- Analytical measurements performed within any limits for activity, waste matrix, calibration range, etc.
- Report completed and data properly reported.

NDA personnel at the WRAP Facility review radioassay results in accordance with contractor-approved procedures developed to meet WIPP program requirements.

The radioassay contractor reviews data to the performance requirements defined in HNF-15494.

9.1.2 Data Verification

Physical verification data is reviewed by a Waste Services representative who compiles the following information:

- Verification failure rates
- Comparison against performance criteria
- Summary of failures

Radioassay and weight data will be assessed to determine that the batch data report is complete, the results are technically reasonable, and the procedural or contract requirements have been met. Areas verified include, but are not limited to these:

- Batch data report is complete and data are properly reported (e.g., data are reported in the correct units, with the correct significant figures, and with appropriate qualifying flags).
- Data are within established data assessment criteria.
- Waste containers on the batch cover sheet match and are supported by a radioassay data sheet and NDA analysis for each waste container.
- Weights recorded on the NDA data sheet match drum weights on the drum weight chart.
- Instrument calibration is valid.

- Assay system was operated within process control limits for the background check, peak centroid, peak energy resolution FWHM, and peak energy response (activity).
- Nonconformance reports included in the batch data report have been dispositioned and closed.
- The radioassay data sheet contains the required information for each waste container.

Upon completion of the technical review and correction of any problems or nonconformances, the batch data report cover page is signed documenting the verification is complete and the radioassay data have been accepted for use.

9.1.3 Data Validation

Data will not undergo a third-party validation.

9.2 VERIFICATION METHODS

Verification of radioassay results at the WRAP Facility is conducted in accordance with contractor-approved procedures developed to meet WIPP program requirements.

Verification of radioassay results at the Waste Retrieval Project is conducted in accordance with contractor-approved procedures.

9.3 BACKLOG WASTE DATA REVIEW AND VERIFICATION

Approximately 450 LLW and MLLW drums were processed (radioassay and weight measurements) during retrieval campaigns conducted in fiscal year (FY) 1999, FY 2000, and FY 2001. Another 1,200 drums of LLW and MLLW were removed from the disposal trenches and processed from October 2003 through April 2004. Collectively, the waste processed prior to approval of the removal action memorandum (EPA 2004) is called backlog waste.

Weight data and radioassay data have already been gathered. A review of procedures, contracts, and data used to assay and weigh the backlog waste containers will be conducted to ascertain whether the minimum data requirements of the DQOs and SAP are met. The DQOs (HNF-20770, most current version) are applicable to the backlog waste. The waste stream identification, characterization, and designation process outlined in the DQOs is the same for the backlog waste as the remaining waste covered under DOE/RL-2004-65, *Removal Action Work Plan for Disposition of Low-Level and Mixed Low-Level Waste From Burial Ground 218-W-4C*. This section defines the minimum review and verification requirements for backlog waste.

9.3.1 Physical Verification Data Review

The requirements in Section 5 remain unchanged for the backlog waste. Each waste stream must meet the minimum physical verification requirements prior to being released for treatment and disposal. Data review and verification are conducted as described in Section 8.1 and 8.2.

9.3.2 Weight

The performance specifications for any weight scale shall be reviewed against the requirements of Sections 5.3 and 5.4. Equivalent requirements must be demonstrated. Data verification will meet the requirements of Section 9.1.2.

9.3.3 Radioassay Data

A mobile radioassay contractor maintained and operated a mobile assay system for the backlog waste. A passive neutron radioassay unit was used during the FY 2000 pilot retrieval campaign. Gamma radioassay was the radioassay method used during the FY 1999 and FY 2001 pilot retrieval campaigns, as well as from October 2003 through April 2004. Results from the passive neutron radioassay unit will not be used for this removal action. Containers assayed using the passive neutron radioassay unit will be reassayed using the current requirements as defined in Section 6.0.

The performance specifications for any radioassay system used shall be reviewed. The system must be capable of reporting a minimum detectable concentration of TRU isotopes sufficiently below 100 nCi/g to differentiate TRU from LLW (nominally at 60 nCi/g or lower). The NDA system shall be capable of monitoring for fluctuations in background radiation levels and determining if background levels impact results and correct for excessive background radiation if applicable. The requirements of Sections 6.2, 6.3, and 6.4 will be reviewed. Equivalent requirements must be demonstrated. The use of non-direct measurements will be used as defined in Section 6.5. The isotopic inventory of the backlog waste will be updated to include isotopes measured by non-direct measurement.

Radioassay batch reports will be verified. The minimum data requirements defined in Section 6.2.4.1 must be reported. Data verification will meet the requirements of Section 9.1.2.

9.4 RECONCILIATION WITH USER REQUIREMENTS

Once a data measurement has been reviewed and verified, the data are provided to Waste Services. The Mixed Waste Treatment Project reconciles the data to determine if the requirements of the SAP/DQOs and the requirements for transportation, treatment, and disposal are met. Reconciliation of data is performed to ensure the following:

- Requirements of HNF-20770 (most current version) and this Sampling and Analysis Plan are met.
- Shipments are properly identified per U.S. Department of Transportation regulations and/or DOE/RL-2001-36.
- Radioactive waste classification as non-TRU is performed per DOE O 435.1 and NRC Class calculations are complete.
- The status of the waste is determined under the *Washington Administrative Code*, *Resource Conservation and Recovery Act of 1976*, *Toxic Substances and Control Act of 1976*, and land disposal restrictions.
- Waste meets the ERDF acceptance requirements and conforms to the waste profile.

The review and approval process for shipments to the ERDF is defined in contractor-approved procedures.

10.0 REFERENCES

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*, as amended.

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

ASTM C 1490-01, 2003, *Standard Guide for the Selection, Training, and Qualification of Nondestructive Assay (NDA) Personnel,* American Society for Testing and Materials, Philadelphia, Pennsylvania.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601 et seq.

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APPENDIX A

SUMMARY OF PFP DEBRIS STREAM

The PFP began operating in 1949 to meet the increasing demands for plutonium to support Cold War efforts. The PFP processed plutonium nitrate to create buttons in the Remote Glove Line. The Remote Mechanical Line A (RMA) was a partially remote line that replaced the Remote Glove Line in 1952. Beginning in the late 1960s, the RMA was used exclusively to produce plutonium oxide. In 1960, the Remote Mechanical Line C (RMC) began and ran concurrently with the RMA to produce buttons and oxides.

Processes carried out in the Plutonium Reclamation Facility (PRF) and the laboratories supported the activities in the remote mechanical lines. The laboratories began operations in 1949, providing analytical and process development support. The PRF began operations in 1964, providing recovered plutonium as feed for the remote mechanical lines.

The waste consists of debris from the operational and decontamination and decommissioning activities; e.g., maintenance, clean-out, decontamination, decommissioning, stabilization. The debris wastes were comingled with chemicals within the gloveboxes. Waste materials include inorganic debris (lead [gloves]; iron-based metal; aluminum-based metal [hot plates, nuts, bolts, tubing, pipes, pumps]; glass; ceramics; asbestos [pot liners]) and organic debris (plastic [bags, liners]; rubber [gaskets, surgeon's gloves]; paper; cloth; wood). Waste packaging includes plastic, cloth (Conweb pads), and diatomaceous earth.

The waste materials expected to be present in this waste stream that could potentially contain dangerous waste constituents include dry cell batteries, lead gloves, dried paint, and fluorescent light tubes. Non-RSW containers from this same waste stream have been subjected to WIPP certification activities. During these activities, waste items that are not eligible for macroencapsulation or that do not meet the ERDF WAC have been identified. These types of restricted items include, for example, inner containers of liquid and mercury thermometers.

Before and during the 1950s, the PFP remote mechanical lines used defense grade plutonium with a ^{240}Pu weight percentage less than 6%. Defense grade plutonium metals and oxides were in high demand up to the mid-1960s, but in 1965 the need for defense grade plutonium diminished. Then the mission of the Complex turned toward fuels and reactor grade plutonium activities to support the commercial nuclear industry. The PFP Complex processed fuels and reactor grade material with varying concentrations of ^{240}Pu from 12% to 27% for experimental breeder reactor technology (e.g., Fast Flux Test Facility) and commercial reactors, but most of the fuels grade plutonium material was 12%. Fuels and reactor grade work ended in 1978 for both the RMA and the RMC. Defense work continued until shutdowns of the RMA and the RMC in 1983 and 1989, respectively.

Table A-1. List of Contaminants of Concern.

Waste source	Contaminants of concern
PFP	Radionuclides[a]: ^{60}Co, ^{90}Sr, ^{90}Y, ^{137}Cs, ^{137m}Ba, ^{154}Eu, ^{233}Pa, ^{233}U, ^{234m}Pa, ^{234}U, ^{235}U, ^{235m}U, ^{237}Np, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{231}Th, ^{243}Cm
	Chemicals: arsenic, barium, barium oxide, cadmium, cadmium hydroxide, cadmium oxide, calcium oxide, carbon tetrachloride, chromic oxide, chromium, chromium III, dipotassium dichromate, ethanolamine, hydroxylamine nitrate, lead, lead chromate, lead chromate oxide, lead dioxide, lead hydroxide, lead monoxide, mercury, mercuric oxide, potassium hydroxide, selenium, silver, silver chloride, silver (1+) oxide, soda lime, sodium carbonate, sodium hydroxide, 2,4-dinitrotoluene

PFP = Plutonium Finishing Plant.

[a]Other radionuclides may be identified during radioassay. These radionuclides will be evaluated to determine whether they are daughter products, fission products, or other reaction products from radionuclides in the PFP debris waste stream inventory. If the radionuclide can be associated with the PFP debris waste stream, it may be added to the waste profile for the ERDF.

APPENDIX B

SUMMARY OF SUSPECT-CONTAMINATED SECONDARY WASTE STREAM

Secondary waste streams generated during waste retrieval could consist of debris and/or soil. Non-debris waste (e.g., soil) will be segregated from debris. Material that is found to contain detectable contamination using portable survey instruments or is visibly contaminated will be segregated and evaluated further to determine the appropriate disposition pathway. The secondary waste soil is separate from the RSW drums that contain contaminated soils.

Secondary wastes generated by waste retrieval operations could include soil or debris such as used personal protective equipment, wood, plastic, paper, and non-regulated metals (e.g., iron, aluminum, copper).

The debris waste consists of materials such as wood (generally pallets and plywood) used in supporting or protecting the waste packages; tarps; and personnel protective equipment generated during retrieval operation. Waste associated with the wood dunnage (plastic strapping, tape, staples, nails, etc.) could also be included. Trace amounts of soil may remain on the waste. The debris is considered suspect-contaminated; due to its porous nature, it cannot be surveyed for radiological release.

Radiological surveys are performed on the secondary waste to determine if any contamination is present. Debris with no measurable quantities of contamination is suspected to be contaminated with radionuclides found in the 200 Area soils. As a bounding assumption, each cubic meter of debris is assumed to contain 280 grams of Hanford soil. Radionuclide inventories in soil are estimated from PNNL-13230, *Hanford Site Environmental Report for Calendar Year 1999*, Section 3.2, "Near -Facility Environmental Monitoring."

Table B-1. List of Contaminants of Concern.

Waste source	Contaminants of concern
Suspect-Contaminated Secondary Waste	Radionuclides: ^{90}Sr, ^{137}Cs, ^{234}U, ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu