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Sampling and Analysis Plan for Waste Disposition of Treated KE Basin North Loadout Pit Sludge Determined to be Low-Level Waste

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

Fluor Hanford
P.O. Box 1000
Richland, Washington

Contractor for the U.S. Department of Energy
Richland Operations Office under Contract DE-AC06-96RL13200

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JL Westcott, Fluor Hanford

May 2004

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TERMS

AJHA	Automated Job Hazards Analysis
BHI	Bechtel Hanford, Inc.
COC	contaminant of concern
CWC	Central Waste Complex
DFSNW	Duratek Federal Services Northwest
DQO	data quality objective
DR	decision rule
DS	decision statement
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford, Inc.
KE	K East
LLBG	low-level burial ground
LLD	low limit of detection
NLOP	North Loadout Pit
PCB	polychlorinated biphenyl
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
RPL	Radiochemical Processing Laboratory
SAP	Sampling and Analysis Plan
SBMS	Standards Based Management System
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Receiving and Processing (Facility)

1.0 INTRODUCTION

Sludge removed from the North Loadout Pit (NLOP) of the K East (KE) Basin will be transported to a facility for treatment. The sludge will be treated and packaged in 208 liter (55-gal) drums to meet waste acceptance criteria for the Waste Isolation Pilot Plant (WIPP) and the Hanford Central Waste Complex (CWC) as contact-handled transuranic (TRU)[1] waste. The treated waste will be certified compliant with WIPP criteria and shipped to WIPP for disposal. The certification process to classify the treated NLOP sludge as TRU waste is not covered by this document. However, information collected under this document may be utilized by the TRU Project to help characterize the waste as TRU waste in accordance with TRU project procedures.

In the course of treating sludge from the NLOP, some fraction of the treated sludge may be determined to be low-level rather than TRU waste. The drums of treated sludge determined to be low-level waste will be packaged for disposal at the Environmental Restoration Disposal Facility (ERDF). If treated sludge that is determined to be low-level waste does not comply with acceptance criteria for ERDF, then the waste will either be stored or disposed at another Hanford Site waste management facility as approved by the U.S. Environmental Protection Agency. The purpose of this document is to specify the data, data quality control, and data management necessary to dispose of treated NLOP sludge as low-level waste to the Environmental Restoration Disposal Facility (ERDF). Information collected per this document may be applied to burial of treated sludge as low-level waste to the Hanford low-level burial grounds in the event the waste does not comply with ERDF disposal criteria.

The sludge does not designate as a dangerous waste and is therefore not regulated as a dangerous waste under *Washington Administrative Code* (WAC) 173-303, "Dangerous Waste Regulations," (Letter 0101943). The treatment being performed is not for compliance with Land Disposal Restrictions requirements.

1.1 BACKGROUND

The KE Basin is located in the 100 K Area on the Hanford Site. The fuel basin is a large open-topped concrete pool containing approximately 4.9 million liters (1.3 million gal) of demineralized water. The basin was constructed in the early 1950s and used to store spent nuclear fuel from the KE reactor. The reactor was removed from service in the early 1970s. Spent nuclear fuel, primarily from the N Reactor, has been stored in the KE Basin since 1975 (DOE/EIS-0245, *Environmental Impact Statement-Management of Spent Nuclear Fuel from the K Basins at the Hanford Site*). Fuel stored in the basin has corroded, releasing particles and fuel pieces onto the basin floor, adding material to the sludge on the bottom of the basin.

In 1978, the water treatment system for the KE Basin was upgraded by adding ion-exchange columns and a sand filter. The sand filter is periodically backwashed into the NLOP to remove

[1] Waste materials contaminated with more than 100 nCi/g of alpha-emitting radionuclides of an atomic number higher than 92 and having half-lives longer than 20 years.

the buildup of filtered material in the filter bed. The KE Basin NLOP, which until about March of 2004 had been isolated from the rest of the basin, provides a collection area for the backwash of the sand filter.

1.2 DATA QUALITY OBJECTIVES

The data quality objectives (DQO) applicable to this waste are developed in document SNF-20424, *Data Quality Objectives Summary Report for Disposition of Treated KE Basin North Loadout Pit Sludge Determined to be Low-Level Waste.* The list of contaminants of concern (COC) determined by the DQOs process are provided in Table 1.

Table 1. List of Contaminants of Concern.

Waste stream no.	COCs
1	H-3,C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Mo-93, Zr-93, Tc-99, Cd-113m, Sb-125, Sn-126, Cs-134, Cs-135, Cs-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, Pa-231, Th-232, U-232, U-233, U-234, U-235, U-236, Np-237, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Am-242m, Pu-242, Cm-242, Am-243, Cm-243, Cm-244
	Hg, Se, As, Ba, Cd, Cr, Pb, Ag, Tl, Ni, Be, Sb
	PCB
	Free liquid

Notes:
COC = contaminant of concern.
PCB = polychlorinated biphenyl.

1.2.1 Statement of Problem

The disposal of treated KE Basin NLOP sludge requires collecting data on the radionuclide content and physical characteristics of the waste to demonstrate its compliance with the ERDF waste acceptance criteria.

A team was assembled and a workshop held to determine the DQOs and put together this sampling analysis plan (SAP). Table 2 identifies the DQO workshop team members. Table 3 identifies the key decision makers.

Table 2. Data Quality Objectives and Sampling Analysis Plan Team Members. (2 sheets)

Name	Company/Organization	Position or Area of Expertise
Dave Watson	FH/K Basins Project	Regulatory Support
Jeanne Kisielnicki	FH/Sludge Project	Sludge Project
James Larsen	PNNL/325 hot cells	Waste treatment
Gary Sevigny	PNNL/325 hot cells	Waste treatment
Terry Winward	FH/K Basins Project	Regulatory Support

Table 2. Data Quality Objectives and Sampling Analysis Plan Team Members. (2 sheets)

Name	Company/Organization	Position or Area of Expertise
Ryan Ollero	BHI/Waste Management	Waste Management
Jeff Westcott	FH/Waste Management	Task Lead and Waste Management
John Woodbury	DFSNW/Transportation	Transportation Specialist
Naeem Abdurrahman	FH/WRAP	Assay Subject Matter Expert
David DeRosa	FH/TRU Project	TRU Certification
Bill Ayers	POLES/Waste Management	Waste Management

Notes:
BHI = Bechtel Hanford, Inc.
CERCLA = *Comprehensive Environmental Response, Compensation and Liability Act of 1980*
DFSNW = Duratek Federal Services Northwest.
FH = Fluor Hanford, Inc.
PNNL = Pacific Northwest National Laboratory.
POLES = Polestar Applied Technology, Inc.

Table 3. Key Decision Makers.

Name	Organization
James Todd	U.S. Department of Energy, Richland Operations Office
Larry Gadbois	U.S. Environmental Protection Agency

1.2.2 Identify the Decisions

The decisions identified here are those necessary to manage treated NLOP sludge that has been determined to be low-level waste under the applicable or relevant and appropriate requirements identified by an amendment to the *Signed Record of Decision (ROD) for the K Basins Interim Remedial Action* and/or *Action Memorandum for Time Critical Response for Treatment and Disposal of Sludge from the 105-K East North Loadout Pit, USDOE Hanford* and to dispose of it as waste at ERDF. The treated NLOP sludge waste will not be designated as dangerous waste but will be managed for polychlorinated biphenyl (PCB) in accordance with the *Toxic Substances Control Act of 1976* applicable or relevant and appropriate requirements, so these decisions will not be considered further in this document as there are no information needs. SNF-20424 details the determination that the waste is not dangerous but requires management for PCB content. The decision statements shown here are those that still require data collection to support resolution.

The data obtained as directed by this document will be used to complete characterization of the waste for disposal.

Table 4. Decision Statements for Designation of K East Basin Treated North Loadout Pit Sludge.

DS 1 – Determine if the waste does not comply with the ERDF waste acceptance criteria, or cannot be treated to meet ERDF waste acceptance criteria, then the waste must be stored or disposed of at another candidate facility (e.g., CWC/LLBG). If the material does comply with the ERDF waste acceptance criteria, or can be treated to meet ERDF waste acceptance criteria, then the waste is disposed of at the ERDF.

Notes:
CWC = Central Waste Complex.
DS = decision statement.
ERDF = Environmental Restoration Disposal Facility.
LLBG = low-level burial ground.

1.2.3 Identify Inputs to the Decisions

The data inputs needed to resolve the decision statement have been identified, along with measurement performance requirements. See SNF-20424 for the detail behind the selection of inputs, measurement methods and field techniques, and tables that present these information needs. The data input necessary to support decision-making consists of field measurements of Pu-239 or Pu-240 content in a waste drum, waste drum weight, and visual inspection of the drum of waste to determine compliance with ERDF free liquid content and container void space requirements.

The KE Basin sludge has been designated and determined not to be a dangerous waste under WAC 173-303 (Letter 0101943). The treatment process will produce a waste form that is not dangerous waste. No chemical analysis is planned or necessary to support designation of the treated waste form.

The ERDF can dispose of solid PCB waste at unlimited concentration, so an estimate of the PCB content of the waste is all that is necessary to facilitate disposal at the ERDF. The source of PCB in NLOP sludge is basin and pit sludge so the concentration of PCB in the waste would be no higher than the maximum PCB concentration reported for basin sludge. The concentration of PCB in the treated sludge is assigned based on the maximum concentration of KE Basin sludge and sludge content in the treated waste form.

The existing radionuclide analyses and process knowledge provide data adequate to establish an estimate of nuclide concentrations in the KE Basin NLOP sludge. The radionuclide concentrations in the sludge are used to establish a radionuclide distribution or relationship to each other for both sludge and treated sludge. As the nuclide distribution for treated sludge is established, only selected key radionuclides will be measured. The nuclide distribution will then be used to estimate the concentration of all the other nuclides not measured. The radionuclide measurement will be performed using an imaging passive/active neutron assay instrument. The imaging passive/active neutron assay is a field assay instrument that will assay an entire 208 liter (55-gal) drum. Collection of a sample for radionuclide analysis is not planned or necessary to support decision-making regarding the treated waste form.

The treated waste form will be visually inspected to confirm that void space and free liquid content complies with the ERDF waste acceptance criteria (BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*). Inspection for free liquid is accomplished by observing the presence of absorbent in the drum containing treated NLOP.

Each drum of treated sludge will be weighed in order to determine the drum waste weight.

1.2.4 Define the Study Boundaries

The study boundaries identify the spatial and temporal boundaries of the action under investigation, as well as practical constraints that must be taken into consideration. The action that is the subject of this document is KE Basin NLOP sludge treated to comply with WIPP and CWC waste acceptance requirements that are determined to be low-level waste. Approximately 600 drums of treated sludge are expected to be produced. The sludge is treated and packaged in 208 liter (55-gal) drums at the 325 Waste Treatment Facility then shipped to the CWC for storage until the waste is subjected to the WIPP waste certification process. The drums containing treated sludge are assayed as part of the WIPP waste certification process. The drums will be assayed at the Waste Receiving and Processing (WRAP) Facility. A fraction of drums assayed for WIPP certification may be determined to be low-level waste, these low-level waste drums constitute the waste subject to the requirements of this document.

1.2.5 Decision Rules

The information developed in the previous steps of the DQO (SNF-20424) are combined with the parameter of interest and an action level to provide a concise description of what action will be taken based on the results of data collected. Table 4 in the DQO lists the final action level for each decision statement and COC; this information has been incorporated into performance requirements presented later in this document. Table 5 lists the decision rules that apply to the designation of the treated KE Basin NLOP sludge determined to be low-level waste.

Table 5. Decision Rules for Designation of K East Basin Treated North Loadout Pit Sludge.

DR 1 – If the waste <u>does not comply</u> with the ERDF waste acceptance criteria and cannot be treated to comply, the waste must be stored or disposed at the Hanford Site CWC or LLBG. **If the waste <u>does comply</u> with the ERDF waste acceptance criteria or has been treated to meet ERDF waste acceptance criteria, it will be disposed of at the ERDF.**

Notes:
CWC = Central Waste Complex.
DR = decision rule.
ERDF = Environmental Restoration Disposal Facility.
LLBG = low-level burial ground.

1.2.6 Limits on Decision Error

This section of a DQO generally is used to establish the parameters for a statistically-based sample design. A statistically-based approach will not be used because all drums of treated

sludge will be visually inspected, weighed, and subjected to assay for WIPP waste certification. See the DQO document (SNF-20424) for additional details.

The waste is presumed to contain levels of PCB commensurate with the maximum PCB loading in KE Basin sludge and the sludge content in the waste form.

1.2.7 Optimize the Design for Obtaining Data

This section of a DQO generally is used to determine the most resource-effective data collection design for a statistically based sample design. A statistically based approach is not being used, therefore, optimization of obtaining data is not applicable.

2.0 QUALITY ASSURANCE PROJECT PLAN

This document is written in accordance with the applicable requirements of EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*.

2.1 PROJECT MANAGEMENT

This section identifies the individuals or organizations participating in the project and discusses their specific roles and responsibilities. This section also discusses quality objectives for measurement data and special training requirements for staff performing the work.

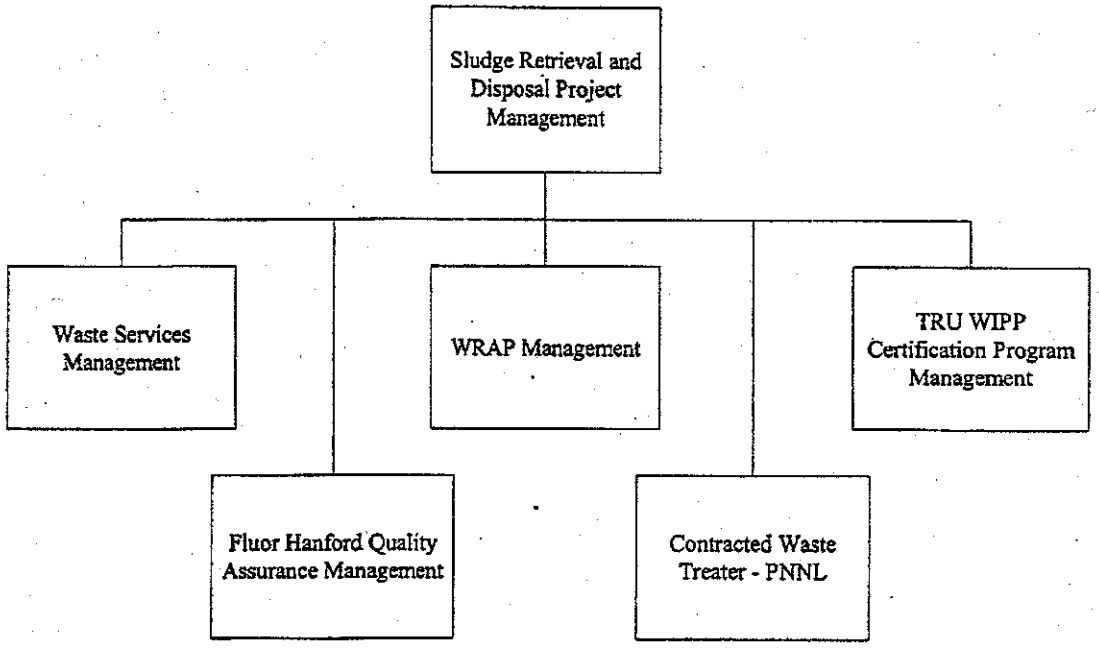
2.1.1 Project/Task Description

All of the drums of treated KE Basin NLOP sludge determined to be low-level waste will be characterized as necessary to determine compliance with waste acceptance criteria for disposal at ERDF. The characterization will include an assay of each drum to determine the radionuclide inventory, weighing each drum to determine waste weight, and visual inspection to determine compliance with free liquid and void space requirements. The two assay units that may be used are located at the WRAP facility. Visual inspection will be performed at the 325 Waste Treatment Facility prior to closing the drum for shipment. The assay results will be used with existing radionuclide data to determine the radionuclide inventory for each drum of treated sludge. The treated sludge drum radionuclide inventory, waste weight, and visual inspection results will be used to compare the waste to the ERDF waste acceptance criteria to determine whether the waste is acceptable for disposal at ERDF.

2.1.2 Project Organization

Figure 1 presents the organization chart for measurement collection and waste management interfaces to the ERDF.

Figure 1. Measurement Collection and Waste Management Organization Chart.



PNNL = Pacific Northwest National Laboratory.
TRU = Transuranic (waste materials contaminated with 100 nCi/g of transuranic materials having half-lives longer than 20 years).
WIPP = Waste Isolation Pilot Plant.
WRAP = Waste Receiving and Processing (Facility).

2.1.3 Roles and Responsibilities

This section identifies the responsibilities of the organizations supporting KE Basin NLOP sludge treatment and disposal activities that collect, analyze, survey, or assess results of data for waste disposal.

Sludge Retrieval and Disposal Project

The Sludge Retrieval and Disposal Project has the following responsibilities:

- Integrate activities of the project to accomplish removal, treatment, and disposal of KE Basin NLOP sludge.
- Obtain and maintain contract services for the treatment of KE Basin NLOP sludge.

Waste Services

The Waste Services Organization has the following responsibilities:

- Perform visual inspection on drums of treated KE Basin NLOP sludge.

- Approve receipt of drums of treated KE Basin NLOP sludge at the CWC.
- Perform data review and validation of measurements performed.
- Manage corrective actions associated with work performed under Waste Services procedures.
- Maintain qualifications of personnel performing work in accordance with this document.

Waste Receiving and Processing Organization

Waste Receiving and Processing organization has the following responsibilities:

- Perform assay of drums of treated NLOP sludge and document results.
- Maintain assay system and personnel qualifications.
- Manage corrective actions associated with work performed under TRU Program procedures.
- Maintain qualifications of personnel performing work in accordance with this document.

TRU Program

TRU Program organization has the following responsibilities:

- Determine status of drums of treated NLOP sludge as being TRU or low-level waste.
- Procure and maintain weigh scale.
- Manage corrective actions associated with work performed under TRU Program procedures.
- Maintain qualification of VE technique and NDA personnel performing work in accordance with TRU project requirements.

Quality Assurance Organization

The Quality Assurance Organization has the following responsibility:

- Conduct random surveillance to verify compliance with the implementation of this sample and analysis plan.

2.1.4 Special Training Requirements and Certification

Training that is specific or special in regard to performing the activities in accordance with this document are assay unit operation and visual inspection. Other activities performed in accordance with this document are common with training implemented by Fluor Hanford per

HNF-RD-11061, *Training Requirements* and by Pacific Northwest National Laboratory (PNNL) per PNL-MA-834, *Training Implementation Matrix for PNL-Managed Nuclear Facilities.*

Training and certification that apply to operation of the assay units are implemented in accordance with WMP-400, *Waste Isolation Pilot Plant Procedures*, Section 1.2.2, "Qualification of NDE, NDA, Visual Examination, Transportation, and Inspection and Test Personnel."

Training and certification that apply to visual examination are implemented in accordance with WMP-400, Section 1.2.2 and/or WMP-200, *Waste Management Project Procedures*, Section 5.1, "Training and Qualification Program."

2.1.5 Quality Objectives and Criteria for Measurement Data

The quality assurance (QA) objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality typically is assessed by representativeness, comparability, accuracy, precision, and completeness. These parameters are described in the following paragraphs. The applicable quality control guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the measurement method. A summary of COCs for each drum of treated sludge is provided in Table 1. The measurement methods and method performance requirements are presented in Table 6 and Table 7. The nomenclature used to describe quality parameters is contained in the discussion following Table 6.

Table 6. Field Instrument Performance Requirements.

Measurement	Measurement method	Accuracy requirement	Precision requirement
Drum weight	Weigh scale	*	*

Note:
*Per manufacturer's specifications.

Table 7. Assay Instrument Performance Requirements.

Measurement	Measurement method	Accuracy[a]	Precision
Pu-239 or Pu-240	Imaging passive/active neutron (IPAN)	Low: 40 %R High: 160 %R	Objective[b]: 29.2 %RDS Measured[c]: 16 %R

Notes:
a. Limits on the two-sided 95 percent 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 percent 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

Representativeness. Representativeness is a measure of how closely field measurement results reflect the actual quantity in the waste matrix. Test plan design, techniques, and management protocols (e.g., storage and transportation) have been developed to ensure measurements taken represent the waste. The data collection documentation will establish that protocols have been followed and measurement identification and integrity is ensured.

Comparability. Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained by using standard documented procedures, consistent methods, and consistent units.

Accuracy. Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of assay results is assessed by measuring known instrument standards of the matrix to be counted. Assay equipment accuracy is expressed as percent recovery. Accuracy targets for drum weighing are listed in Table 6. Accuracy targets for radionuclide assay measurements are provided in Table 7.

Precision. Precision is a measure of the data spread when more than one measurement has been taken on the same treated sludge drum. Precision targets for drum weighting are listed in Table 6. Precision for radionuclide assay measurements expressed as the percent relative standard deviation is shown on Table 7.

Completeness. Completeness is a comparison of the amount of valid data obtained to the valid data required from the measurement process. The completeness objective for drum weight, drum assay, and inspection for absorbent and void space in a drum is valid measurements of each parameter for each drum of treated NLOP sludge. If the completeness objective is not met, additional measurements will be taken.

2.1.6 Documentation and Records

Field measurement documentation will be kept in accordance with WMP-400, Section 1.4.1, "TRU Document Control;" Section 1.5.1, "TRU Records Management;" and/or WMP-370, *Waste Services Procedures*, Section 2.23, "Waste Services Records Management."

2.2 MEASUREMENT COLLECTION

The measurements collected per this SAP are all field measurements consisting of visual inspection, weighing, and assay of each drum of treated waste form. Measurements are collected on all of the drums of treated sludge, no samples are collected for analysis. Since samples are not collected, this document will not discuss activities specific to sampling and laboratory analysis including sample process design, sampling methods, sample handling and custody, and laboratory analytical methods. Activities appropriate for field instrumentation measurements are discussed in subsequent sections of this document.

2.2.1 Measurement Method

The drum of treated NLOP sludge will be assayed using an imaging passive/active neutron unit. The units are located at the WRAP facility and are managed and operated under the TRU waste certification for WIPP disposal program. The instruments are operated per procedure WRP1-OP-0905, *Imaging Passive/Active Neutron Assay Operation.*

The weighing of drums of treated sludge will be performed by 325 Waste Treatment Facility personnel using a weigh scale that is qualified in accordance with the WIPP waste certification program.

Visual inspection will be conducted in accordance with WMP-400, Section 7.1.10, "Waste Visual Examination Technique," and/or WMP-370, Section 1.10, "Verification Program."

2.2.2 Instrument Testing, Inspection, and Maintenance

The assay units and weigh scale are commissioned and maintained in a useable configuration per WMP-400, Section 2.4.5, "TRU Identification and Control of Items;" Section 2.4.2, "TRU Test Control;" and Section 2.4.1, "TRU Inspection Control."

These requirements are not applicable to visual inspection.

Correction of nonconformances shall be in accordance WMP-400, Section 1.3.2, "TRU Nonconforming Item Reporting and Control," and/or HNF-PRO-298, *Nonconforming Items.*

2.2.3 Instrument Calibration and Calibration Frequency

The assay unit calibration and calibration frequency is governed by WMP-350, *Waste Receiving and Processing Facility Procedures,* Sections 2.09, "Performing Calibration Verifications and Confirmations for NDA at WRAP" and 2.08, "WRAP NDA Measurement Control Program." The determination of the low limit of detection (LLD) is governed by WMP-350, Section 2.02, "Calculation of Assay Results."

The weigh scale calibration and calibration frequency is governed by WMP-400, Section 2.4.4, "TRU Control of Measuring, Testing, and Data Collection Equipment."

These requirements are not applicable to visual inspection.

Correction of nonconformances shall be in accordance WMP-400, Section 1.3.1, "Corrective Action Management;" and Section 1.3.3, "TRU Corrective Action Reporting and Control," and/or HNF-PRO-298.

2.2.4 Inspection/Acceptance Requirements for Supplies

Supplies are procured and managed under WMP-400, Section 2.3.3, "TRU Control of Purchased Items and Services;" and Section 2.1.4, "TRU Handling and Storage" and/or HNF-PRO-268, *Control of Purchased/Acquired Items and Services*.

These requirements are not applicable to visual inspection.

Correction of nonconformances shall be in accordance with WMP-400, Section 1.3.2. and/or HNF-PRO-298.

2.2.5 Non-direct Measurement

Except for the key radionuclide measured by assay, either Pu-239 or Pu-240, all other radionuclides are estimated using a distribution established from existing data. The radionuclide distribution is calculated from data in SNF-20424, Appendix A, and is presented here in Table 8. The radionuclide ratios to each other are valid for all drums of treated NLOP sludge.

Table 8. Radionuclide Distribution for Treated North Loadout Pit Sludge. (2 sheets)

Nuclide	Ratio to Pu-239 (Ci/Ci Pu-239)	Ratio to Pu-240 (Ci/Ci Pu-240)
H-3	1.97E-02	3.59E-02
C-14	7.74E-09	1.41E-08
Fe-55	4.65E-03	8.47E-03
Ni-59	1.25E-03	2.27E-03
Co-60	7.66E-02	1.40E-01
Ni-63	1.09E-03	1.99E-03
Se-79	2.89E-05	5.27E-05
Sr-90	2.01E+00	3.65E+00
Mo-93	1.91E-04	3.48E-04
Zr-93	2.62E-04	4.77E-04
Tc-99	1.17E-03	2.14E-03
Cd-113m	1.90E-03	3.47E-03
Sn-121m	6.37E-06	1.16E-05
Sn-126	4.35E-05	7.92E-05
Cs-134	9.55E-02	1.74E-01
Cs-135	4.88E-05	8.89E-05
Cs-137	5.30E+00	9.66E+00
Pm-147	9.34E-01	1.70E+00
Sm-151	1.08E-01	1.96E-01
Eu-152	6.58E-04	1.20E-03

Table 8. Radionuclide Distribution for Treated North Loadout Pit Sludge. (2 sheets)

Nuclide	Ratio to Pu-239 (Ci/Ci Pu-239)	Ratio to Pu-240 (Ci/Ci Pu-240)
Eu-154	1.11E-01	2.02E-01
Eu-155	3.87E-02	7.05E-02
Pa-231	2.61E-05	4.75E-05
Th-232	1.61E-05	2.94E-05
U-232	3.95E-07	7.19E-07
U-233	1.43E-08	2.60E-08
U-234	1.76E-03	3.20E-03
U-235	6.63E-05	1.21E-04
U-236	2.49E-04	4.53E-04
Np-237	2.60E-04	4.73E-04
U-238	1.43E-03	2.60E-03
Pu-238	2.09E-01	3.80E-01
Pu-239	1.00E+00	1.82E+00
Pu-240	5.49E-01	1.00E+00
Pu-241	2.94E+01	5.36E+01
Am-241	1.32E+00	2.40E+00
Am-242m	4.96E-05	9.04E-05
Pu-242	2.64E-04	4.81E-04
Cm-242	3.85E-02	7.01E-02
Am-243	1.22E-05	2.22E-05
Cm-243	8.81E-02	1.60E-01
Cm-244	3.41E-01	6.22E-01

2.2.6 Field Measurement Data Management

The assay system results are used to calculate the inventory of a key radionuclide contained in a drum of treated sludge. The IPAN assay calculations are performed per WMP-350, Section 2.02.

Visual inspection and drum weighing results will be recorded per WMP-400, Section 7.1.10, and/or WMP-370, Section 1.10.

Correction of nonconformances shall be in accordance with WMP-400, Sections 1.3.1 and 1.3.3, and/or WMP-370, Section 1.11, "Performance Evaluation System."

2.3 ASSESSMENT/OVERSIGHT FOR FIELD MEASUREMENTS

2.3.1 Assessments and Response Actions

Fluor Hanford, Inc. QA may conduct random surveillances and assessments in accordance with HNF-PRO-9769, *Surveillance Process*. Assessments and surveillances are performed to verify compliance with requirements outlined in this SAP, procedures, and regulatory requirements.

Correction of nonconformances shall be in accordance with WMP-400, Sections 1.3.1 and 1.3.3, and/or HNF-PRO-052, *Corrective Action Management*.

2.3.2 Reports to Management

Nonconformances and corrective action status are reported to Fluor Hanford management in accordance with WMP-400, Section 3.1.2, "Quality Assurance Reports to Management" and Section 1.3.3 and/or HNF-PRO-052.

The project status is maintained and presented to Fluor Hanford management via a summary report written for drums of treated sludge that are evaluated for ERDF acceptance. A summary report will be published on an as-needed basis.

2.4 DATA REVIEW, VALIDATION, AND USABILITY

Requirements for review and evaluation of data usability are described in the following sections.

2.4.1 Data Review, Verification, and Validation Requirements

The data collected will be assessed against the criteria in Section 2.1.5. Data assessment will include review of quantitative DQOs (e.g., accuracy, precision, and low limit of detection) as appropriate to the measurement, review of qualitative DQOs (representativeness, comparability, and completeness), and preparation of a summary report. The report will include an evaluation of the overall adequacy of the total measurement system with regard to the DQO of the data generated. The assay results will be assessed against all of the data quality parameters. The visual inspection and waste weight data will be assessed against the representativeness, comparability, and completeness data quality parameters only, the other data quality parameters are not applicable to these measurements. These quantitative DQOs are defined as follows.

Precision

If calculated from duplicate measurements:

$$\%RPD = \left| \frac{C_1 - C_2}{\left(\frac{C_1 + C_2}{2} \right)} \right| \times 100 \quad (1)$$

where:

%RPD= relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values.

If calculated from three or more replicates, use the relative standard deviation rather than the relative percent difference:

$$\%RSD = \frac{s}{\bar{y}} \times 100 \quad (2)$$

where:

%RSD= percent relative standard deviation
s = standard deviation
$\bar{y}$ = mean of replicate analyses.

Standard deviation, s, is defined as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(y_i - \bar{y})^2}{n-1}} \quad (3)$$

where:

s = standard deviation
y_i = measured value of the i^{th} replicate
$\bar{y}$ = mean of replicate measurements
n = number of replicates.

Alternately, the student T may be employed.

Accuracy

For measurements where reference masses are used:

$$\%R = \frac{M}{M_0} \times 100 \quad (4)$$

where:

%R = percent recovery
M = measured mass
M_0 = reference mass

Low Limit of Detection

The determination of LLD will be performed in accordance with WM-350, Section 2.02.

2.4.2 Verification and Validation Methods

Data verification involves the physical observation of activities being performed in compliance with this document. Verification includes the visual inspection of the drums of treated sludge. Verification is being performed in accordance with WMP-400, Section 7.1.10, and/or WMP-370, Section 1.10.

Data validation is the comparison of reported data and data quality measures to data quality requirements as per data acceptance criteria specified in Section 2.4.1 of this document. Each drum of treated waste will be evaluated with the results of the evaluation being recorded on the form provided in Appendix A.

The data collected will not undergo a third-party validation.

2.4.3 Reconciliation With User Requirements

A statistical data quality assessment will not be performed for data collected because random sampling will not be conducted.

The estimated concentrations of radionuclides with the waste weight, drum absorbent content, and drum void space will be compared by the project to the applicable BHI-00139 (ERDF waste acceptance criteria) for acceptance at the ERDF. A drum is acceptable to the ERDF if visual inspection shows the presence of absorbent in the drum and the treated waste level in the drum is less than 12.7 cm (5 in.) from the top of the drum. A confirmation by visual observation that the absorbent added is adequate will be performed after 16 hours of cure time on at least 5 drums from the first treatment batch and again if the treatment process changes.

A summary report evaluating the overall adequacy of the total measurement system with regard to the DQO of the data generated and comparison to the ERDF acceptance criteria will be sent to

Waste Services and Sludge Removal Project management. The report will be published on an as-needed basis.

3.0 HEALTH AND SAFETY

All field operations at Fluor Hanford-operated facilities required by this SAP will be conducted in accordance with HNF-MP-003, *Integrated Environmental, Safety, and Health Management System Description*. Field operations performed at the 325 waste treatment facility is conducted in accordance with PNNL safety program.

The management plan HNF-MP-003 identifies processes and procedures where the primary hazards associated with waste management activities are managed. Some of these hazards are direct radiation exposure, potential personnel contamination, potential inhalation of airborne concentrations of radioactive materials, and exposures to hazardous substances. Rather than list the requirements to mitigate and control radiological and hazardous chemical exposures, the management plan references documents that provide the necessary direction to mitigate and control these hazards. To assist in developing subtier- or task-/subproject-specific implementation of the management plan, the Automated Job Hazards Analysis (AJHA) will be used in accordance with HNF-PRO-079, *Job Hazard Analysis*. The AJHA is a computer-based application to help planners identify the potential hazards associated with a job task and to implement the proper controls based on the hazards identified. Proper use of the AJHA in conjunction with the project management plan, plus specifics associated with the task, will constitute acceptable subtier- or task-/subproject-specific implementation of the management plan. In accordance with Title 29, *Code of Federal Regulations*, Part 1910, "Occupational Safety and Health Standards," (29 CFR 1910) Subpart 120(6)(1)(v), the management plan shall be made available to Fluor Hanford employees and any contractor or subcontractor involved with hazardous waste operations.

Fluor Hanford has a robust and mature radiation protection program. This program is described in HNF-5173, *PHMC Radiological Control Manual*. HNF-5173 fully implements Title 10, *Code of Federal Regulations*, Part 835, "Occupational Radiation Protection" (10 CFR 835), as amended. The planning of work involving radiation and radioactive materials hazards is further described in HNF-PRO-1623, *Radiological Work Planning Process*. Implementation of radiological work and radiation protection activities are detailed in procedures. Procedures address roles and responsibilities, qualifications, training, implementation of the as low as reasonably achievable philosophy, external and internal dosimetry, monitoring and surveillance, work control mechanisms (e.g., radiation work permits, and access and entry requirements), self-assessments, and use of specific radiation monitoring devices and meters.

The Fluor Hanford Chemical Management Program, as described in HNF-PRO-10468, *Chemical Management Process*, in conjunction with implementation of the AJHA in accordance with HNF-PRO-079, will be relied upon to protect the workers, the general public, and the environment from specific chemical substances and their associated hazards. The Chemical Management Program provides direction for the acquisition, storage, transportation, use, final disposition, record keeping, and management review of program performance for chemicals at the Hanford Site.

PNNL has a robust and mature safety program. The radiation protection program is described in the Standards Based Management System (SBMS) radiological control procedure that fully implements 10 CFR 835, "Occupation Radiation Protection," as currently amended. The planning of work involving radiation and radioactive material hazards is further described in the SBMS, *Radiological Work Planning Process* and the work practices in the Radiochemical Processing Laboratory (RPL) Handbook and are monitored and controlled in the RPL integrated operations system and task specific work documents.

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APPENDIX A

DATA VALIDATION FORM

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DATA VALIDATION FORM

Data Validation Checklist		
Drum Number(s):		
Data Quality Attribute	**Attribute Criteria**	**Decision**
The measurements are representative of the waste.	The assay, weigh scale, and visual inspection documentation establishes that protocols specified in this document have been followed and measurement identity and integrity is maintained.	☐yes ☐no
The waste measurements are comparable.	Assay unit, weigh scale, and visual inspection were performed per procedures and nonconformances have been resolved.	☐yes ☐no
The measurement accuracy is within acceptable limits.	Key radionuclide: _____ Assay acceptable range: 40%R to 160%R Assay measured value: _____%R	☐yes ☐no
The measurement precision is within acceptable limits.	Key radionuclide: _____ Assay acceptable range: objective: 29.2%RSD measured: 16%R Assay measured values: objective: _____ %RSD measured: _____%R	☐yes ☐no
The measurement data is complete.	Valid assay, visual inspection, and weight results exist for all drums being assessed.	☐yes ☐no
The measurement detection limit is acceptable.	Assay unit detection limit for the key radionuclide is less than the minimum acceptable. Pu-239 low limit of detection threshold is 8.2E-3 Ci Pu-240 low limit of detection threshold is 4.5E-3 Ci Key radionuclide: _____ LLD is: _____ Ci	☐yes ☐no
Data for drums meet quality requirements and are valid for use for decision making.		☐yes ☐no
Assessor Comments and Notes:		
Assessor Certification Print Name, sign, and date:		

The acceptable detection limit is the estimated nuclide inventory when treated sludge radionuclide content is at the NRC class C limit (73 nCi/g TRU).

%R = percent recovery

%RSD = percent relative standard deviation