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D&D-34992
Revision 0

Sample and Analysis Plan for Demolition of 105-K East Basin Structure

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

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J. L. Westcott
Fluor Hanford, Inc.

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EXECUTIVE SUMMARY

The 105-K East Basin with adjacent outside structures and the Hose-in-Hose sludge transfer system are being demolished and removed for disposal at the Environmental Restoration Disposal Facility (ERDF) as described in DOE/RL-2007-48, *Remedial Design Report and Remedial Action Work Plan for 100 Area Remaining Sites Interim Remedial Action: 105-K East Basin Demolition.* This document describes the waste and management processes necessary to dispose at ERDF the waste resulting from demolition of the 105-K East Basin.

The demolition action consists of the removal of the 105-K East Basin facility, except the discharge chute up, to the G line of the K East Reactor, plus outside equipment including the Hose-in-Hose transfer system and waste sites located immediately north of the basin. Liquid and dangerous waste components of the 105-K East Basin and outside structures will be removed before the structures and equipment are reduced to rubble. Liquid may be stabilized then sent to ERDF for disposal. Dangerous waste will be treated if necessary then disposed at ERDF. The facility and equipment will be reduced to rubble, encapsulated in grout for dose rate control and liquid stabilized as necessary, then transported to ERDF for disposal. Five waste streams have been identified requiring disposal at ERDF: basin superstructure rubble, basin substructure rubble, rubble exhibiting high dose rates requiring encapsulation with grout, outside building structure and equipment rubble, and stabilized liquids.

The characterization of 105-K East Basin waste uses existing data quality objectives documents and information collected in accordance with sampling and analysis plans that were developed and executed to support the deactivation of the basin. The information collected by deactivation activities includes the quantity of radioactive contamination on debris, sludge content of waste, and quantity of radioactive contamination that has penetrated concrete surfaces below-water. In this document, new data quality objectives and information collection requirements are developed for liquids and for rubble from waste sites located to the north of the basin building. The concentration of radioactivity in basin substructure rubble has been calculated using data collected during deactivation. A radionuclide distribution appropriate to most of the rubble, except substructure rubble, is developed herein.

The waste is characterized for radioactive content via one of three methods: dose rate-to-curie conversion with a total radioactivity calculated using a radioactive distribution, a calculated concentration, or a concentration determined by analysis of samples. Most rubble, except the basin substructure rubble, will be characterized via the dose rate-to-curie method. The concentration of radioactivity in substructure rubble has been determined using data collected by deactivation activities. Specific structures outside the basin, the C sump and collection box, will be sampled to determine by analysis the concentration of radioactivity in rubble.

The waste is characterized for chemical content using process knowledge, including existing laboratory results, except the C sump and collection box, which will have samples tested for toxic metals and semi-volatile organic compounds, polychlorinated biphenyl (PCB) and pH. The waste will be designated using process knowledge and, if applicable, sample analysis results. Substructure rubble will be managed as PCB remediation waste because it contains K East Basin sludge, which is PCB remediation waste.

The data collection directed by this document that is needed to characterize waste includes collection of samples for analysis, collection of dose rate measurements around containers of waste, and measurements of waste volume and/or mass. This document also provides characterization methods, such as field and laboratory analysis and field assay for radioactivity that may be used if anomalous waste (waste that does not fit the description of the identified waste streams) is generated by demolition activities.

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TERMS

COC	contaminants of concern
D&D	deactivation and demolition
DEP	Dummy Elevator Pit
DOT	U.S. Department of Transportation
DQO	data quality objective
DR	decision rules
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford, Inc.
FTS	fuel transfer system
GEA	gamma energy analysis
HIH	Hose-in-Hose
IXC	Ion Exchange Column
IXM	Ion Exchange Module
KE	105-K East (Basin)
KW	105-K West (Basin)
MDA	Minimum detectable activity
MSDS	Material Safety Data Sheet
NLOP	north loadout pit
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
PPE	personal protection equipment
QA	quality assurance
QAO	QA objectives
QC	quality control
SAP	sampling and analysis plan
SLOP	south loadout pit
SNF	spent nuclear fuel
TRU	transuranic (waste)
VOC	volatile organic compounds
WIPP	Waste Isolation Pilot Plant

1.0 INTRODUCTION

The 105-K East Basin will be removed as part of the K Basin *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial action (*Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (also known as the "100 Area Remaining Sites ROD")* [EPA 1999a]). The105-K East Basin will be prepared for removal as part of the K East Basin *Interim Action Record of Decision for the 100-KR-2, Operable Unit, Hanford Site, Benton County, Washington* (EPA 1999b) and amendment (EPA 2005).

The demolition of the 105-K East Basin will be achieved by removing the entire structure and shipping it to the Environmental Restoration Disposal Facility (ERDF) for disposal. The105-K East Basin will be removed primarily by reducing the structure to rubble; however, some debris and/or rubble may be grout encapsulated in a container and two pieces of equipment, Ion Exchange Columns (IXC) and an empty K East Sand filter vessel, will be grout encapsulated into monolith waste forms.

This sampling and analysis plan (SAP) implements the applicable deactivation activities preparing the facility for demolition as described in DOE/RL-2007-41, *Remedial Design Report / Remedial Action Work Plan for the K Basins Interim Remedial Action: 105-K East Basin Deactivation.* This SAP governs the management of waste generated from the demolition of the 105-K East Basin as described in DOE/RL-2007-48, *Remedial Design/Remedial Action Work Plan for 105-K East Demolition Located Within the 100-KR-2 Operable Unit.* This SAP replaces KBC-24414 *Sampling and Analysis Plan for the 105-K East Basin Monoliths* and supersedes HNF-6495, *Sampling and Analysis Plan for K Basin's Debris* at the time of initiation of 105-K East Basin demolition. This SAP uses other existing documents developed to support facility deactivation as identified in the scope section of this SAP.

1.1 BACKGROUND

The 105-K East Basin is located in the Hanford Site 100 K Area. A picture and plan view of the facility is provided in Figures 1-1 and 1-2, respectively. The fuel basin is a large open-topped concrete pool containing approximately 4.9 million L (1.2 million gal[1]) of demineralized water. The basin, constructed in the early 1950s, was used to store spent nuclear fuel (SNF) from the K East Reactor until the early 1970s, when the reactor was removed from service. In 1975, the 105-K East Basin began storing SNF from N Reactor. The last fuel was received in 1989. Removal of SNF with subsequent drying and shipment to the 200 East Area for storage began in 2000 (*Hanford – A Conversation About Nuclear Waste and Cleanup*, [Gephart 2003]). Except for an 18-in.-wide band of protective concrete sealant (BIO-DUR 560[2] [MSDS 062812,

[1] In 2004, grouting of the K East Basin Discharge Chute resulted in the displacement and removal of approximately 108,000 gal of water.

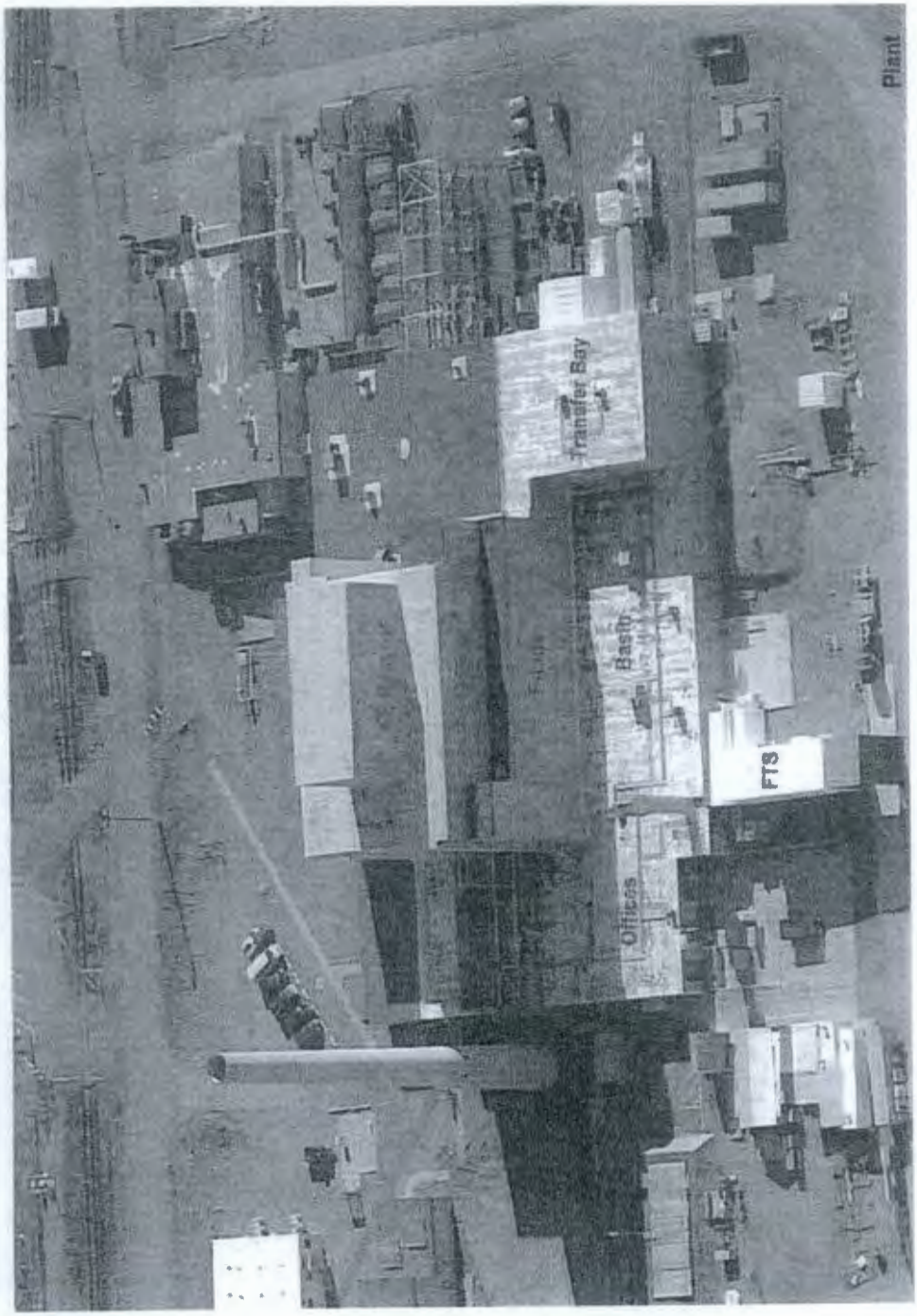
[2] BIO-DUR is a registered trademark of Thin Film Technology, Inc., Houston, Texas.

BIO-DUR 560 Epoxy Base Material Safety Data Sheet, and MSDS 052505, *BIO-DUR 560 White Curing Agent Material Safety Data Sheet*]) applied near the waterline in 1996, the 105-K East Basin walls and floor are bare concrete (ECN 190564, *Engineering Changes Notice (ECN)-190564: Clean and Seal Concrete Walls and Raise Water Level to Reduce Radiation Dose Levels to Workers Over Foreseeable Life of Facility*). BIO-DUR 560 was also applied to portions of the wall and floor surfaces of the adjacent pits. Over the years that N Reactor SNF was stored in the 105-K East Basin, the fuel condition degraded and sludge accumulated in the basin. Sludge consists of SNF corrosion products (including metallic uranium, uranium hydrides and oxides, plutonium, fission and activation products, and aluminum and zirconium compounds from the cladding), metal oxides from corrosion of basin equipment, ion exchange media from the water treatment system, concrete grit from the basin walls and floor, sand, and dust.

Soon after N Reactor SNF storage began at the basin, the basin water quality deteriorated exhibiting increased radionuclide loading. The water treatment loop was upgraded in 1978, by adding filtration and ion exchange removal for Cs-137. Because of continued water loading with Sr-90 and tritium, further water treatment system upgrades were completed in 1986. After these upgrades, the water quality improved markedly, generally showing a reduction in radionuclide concentrations of more than a factor of ten. In general, the 105-K East Basin water did not experience biological growth; however, some spot algaecide applications have occurred. Hydrogen peroxide is currently being employed as a spot algaecide.

The deactivation of the 105-K East Basin was initiated in 2000 scoped to remove fuel, sludge, water, and, as necessary, debris in preparation for demolition of the facility. In 2002, spent fuel was removed from the 105-K East Basin, and relocated in the 105-K West Basin. By May 2007, sludge and spent fuel had been removed from the 105-K East Basin in compliance with the completion criteria contained in letter FH-0701292, "Completion Criteria For K East Sludge And Fuel Transfer." Sludge removal in compliance with the completion criteria is the basis for determining completion of Hanford Site Tri-Party Agreement (TPA) Milestone M-034-34 (Ecology et al. 1989).

Figure 1-1. 105 K East Basin Building



K East Storage Basin General Arrangement Plan

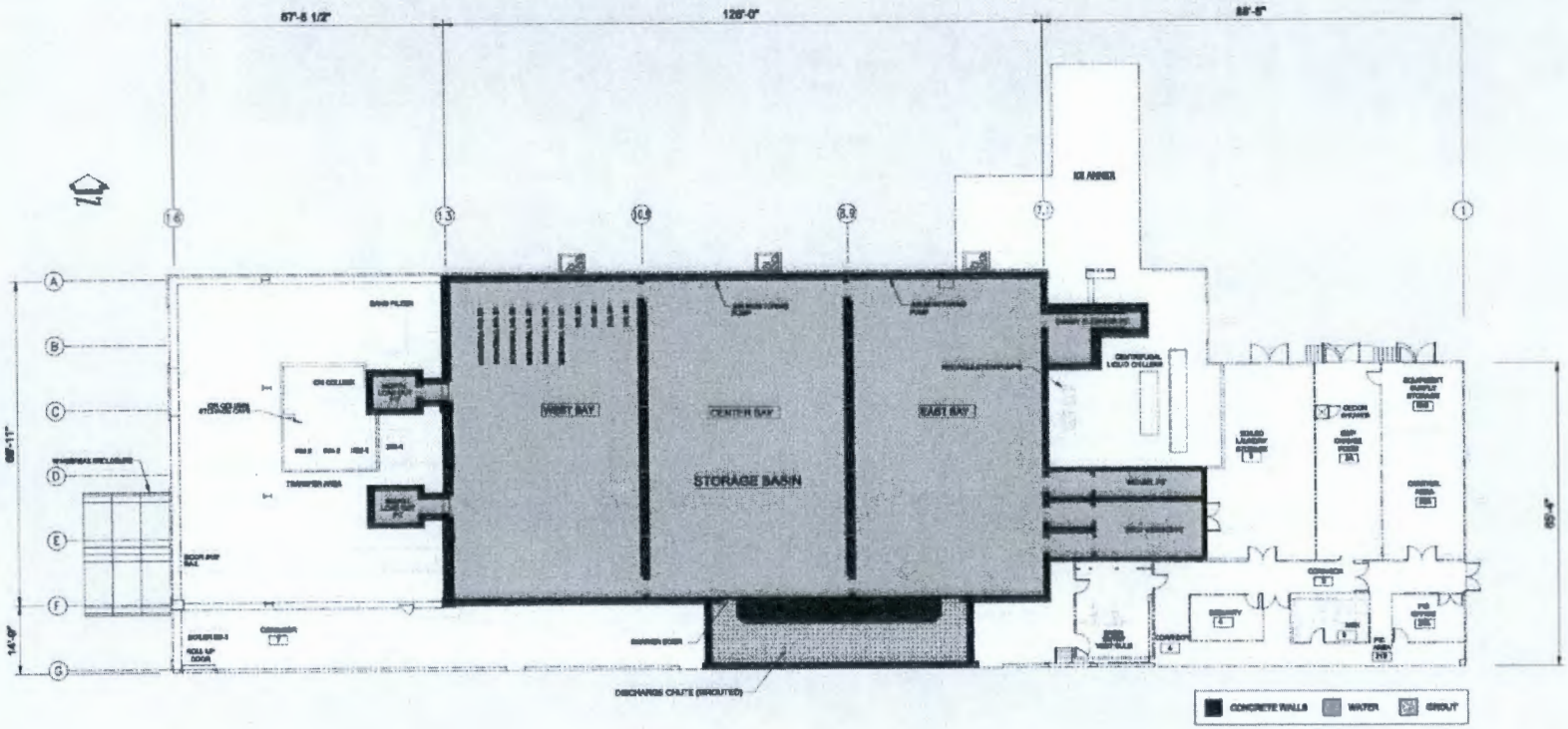


Figure 1-2. 105-K East Basin Plan View.

1.2 105-K EAST BASIN DEACTIVATION AND DEMOLITION ACTIVITIES

At the time of document preparation, the facility deactivation has not been completed so that it may be demolished; however, spent fuel had been removed and sludge removed to the extent possible. The amount of sludge contaminating the 105-K East Basin has been determined as reported in KBC-33964, *Determination of K East Basin Rubble and Pit Waste Form Compliance with ERDF Waste Acceptance Criteria to Support Evaluation of Sludge Removal Milestones.* The deactivation activities that will be completed prior to the initiation of demolition include:

- Remove baskets containing strainer material from the 105-K East Basin building
- Remove sand filter media from the 105-K East Basin building
- Remove Ion Exchange Modules (IXM) from the 105-K East Basin building
- Prepare debris and either remove from the 105-K East Basin building or place in the basin or pit for grouting
- Grout floor of basin and pits to fix contamination and provide shielding (nominally one foot two inches thick)
- Remove water from the basin and pits
- Apply fixatives to dewatered surfaces
- Place engineered backfill into the grouted basin and pits.

A grout layer of about one foot two inches is planned to be placed on the bottom of the basin and pit floors and four open-top tanks remaining in the techview and weasel pits with two exceptions. These two exceptions are the north and south loadout pits (NLOP and SLOP) that will have about a six foot two inch layer due to the pits being five feet deeper than the rest of the basin floor and tank 104 that will have about a five foot layer of grout in it due to nuclear safety issues. More details concerning these deactivation activities are provided in DOE/RL-2007-41.

The completion of the deactivation activities will provide a facility that is ready for demolition. The facility conditions at the start of demolition will be:

- All IXM, fuel, sludge, to the extent practicable, and water have been removed
- The basin and pits contain a layer of grout on the floor
- Four tanks remaining in the techview and weasel pits have grout placed in them
- Debris has been prepared as necessary and encapsulated in grout as necessary
- Fixative is applied to basin and pit walls and other locations, as necessary
- The basin and pits are filled with an engineered backfill.

The demolition will proceed by first removing liquid and/or hazardous material, asbestos pipe insulation, and transite wall panels, then knocking down the above grade building structure and

Hose-in-Hose (HIH) system and loading the rubble into shipping containers for transport to the ERDF for disposal. Then soil with some piping, equipment, and structure is excavated from around the basin and pit substructure and the substructure is reduced to rubble except for two monoliths, the IXC monolith and sand filter monolith. Rubble is monitored for dose rate exposure control as it is loaded into shipping containers for transport to the ERDF for disposal. Some of the rubble may exhibit high dose rate that will require grout encapsulation within a shipping container for transport to ERDF for disposal. The two monoliths are shipped, as is, to the ERDF for disposal.

1.3 SCOPE

This SAP governs all the waste generated by the 105-K East Basin demolition activities with two exceptions. A list of the waste streams that are expected to be generated by demolition activities is provided in Table 1-1. The last two waste streams listed in Table 1-1 are not within the scope of this SAP but are governed by two stand-alone SAP documents, KBC-32692, *Sample and Analysis Plan for the 105-K East Basin Ion Exchange Column Monolith* and KBC-24706, *Sampling and Analysis Plan for 105-K East Basin Sand Filter Monolith*. These two waste streams are not discussed further in this SAP.

Table 1-1. Waste Streams and Data Quality Objectives Documents.

Waste Streams	Data Quality Objectives Document
Basin and pit superstructure rubble	HNF-6273
Basin and pit substructure rubble	KBC-24413 and KBC-25121
High dose rate rubble and debris encapsulated in a container	HNF-6273, KBC-24413 and KBC-25121
Outside structures and equipment	HNF-6273 and D&D-34992 Appendix B
Liquids removed from equipment such as oils, water, or greases	D&D-34992 Appendix B
Encapsulated in grout IXC monolith	KBC-31475
Encapsulated in grout KE sand filter monolith	KBC-24705

HNF-6273, *Data Quality Objectives Process for Designation of K-Basins Debris*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.
KBC 24413, *Data Quality Objectives Summary Report for the 105 K East Basin Monoliths*, Rev. 1, Fluor Hanford, Inc., Richland, Washington.
KBC-24705,*105-K East Basin Sand Filter Monolith Data Quality Objectives Summary Report*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.
KBC-25121, *Sampling and Analysis Plan For Waste Containing K East Basin Below Water Concrete Surfaces*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.
KBC-31475, *Data Quality Objectives Summary Report for the 105-K East Basin Ion Exchange Column Monolith*, Rev. 1, Fluor Hanford, Inc., Richland, Washington.

IXC = Ion Exchange Column.
KE = 105-K East (Basin).

The scope of this document is the waste generated from the demolition of 105-K East Basin (including pits) both the subgrade structure and above grade superstructure, office and personnel areas connected to the 105-K East Basin building, and outside the facility structures and

equipment including the T1-tank, leak collection system under the basin, the HIH transfer system, the fuel transfer system (FTS), and those waste sites identified in Table 2-2. The 105-K East Basin structure is removed up to the G-line to the K East Reactor building wall but does not include the discharge chute as shown in Figure 1-2. The term "105-K East Basin" when used hereafter means all the equipment and structures listed as being in the scope of this document as stated above. Excavated soil is not in the scope of this document but it is acknowledge that incidental quantities of soil will be removed with the demolition waste.

This SAP uses other existing documents developed to support facility deactivation as identified in Table 1-1. This SAP references and uses KBC-25121, *Sampling and Analysis Plan For Waste Containing K East Basin Below Water Concrete Surfaces* to manage and dispose of wastes within the scope of this document. This SAP replaces KBC-24414 and supersedes HNF-6495 at the initiation of 105-K East Basin demolition.

1.4 DATA QUALITY OBJECTIVES

The data quality objectives (DQO) are established for demolition of the 105-K East Basin in various reports that were developed to support deactivation and in Appendix B. The DQO reports that were written to support deactivation and the applicable waste streams are listed in Table 1-1. The wastes not already included in DQO documents developed for deactivation, liquids and the waste sites listed in Table 2-2, were subjected to the DQO process that is summarized in Appendix B. All of the DQO reports listed in Table 1-1 and Appendix B were written in accordance with the seven-step planning process described in EPA QA/G-4, *Guidance for Data Quality Objectives Process.*

The information pertinent to this SAP is reproduced from the DQO reports and Appendix B of this SAP. For application of the complete DQO process, see the DQO report or appendix that is applicable to the waste stream.

The SAP development team members are listed in Table 1-2. The SAP decision-makers are listed in Table 1-3.

Table 1-2. Data Quality Objectives and Sampling and Analysis Plan Team Members. (2 sheets)

Name	Company/Organization	Position or Area of Expertise
Rich Lipinski	WCH/Waste Services	Waste Management
Jeff Westcott	FH/Waste Management	Task Lead and Waste Management
Tino Romano	DFSNW/Transportation	Transportation Specialist
Mary Ann Green	FH/K Basins Closure Project	D&D Project
Dan Moder	FH/Waste Services	Waste Management
Tom Orgill	FH/K Basins Closure Project	D&D Project
Cliff Narquis	FH/ESH	QA
Craig Larson	D&D Project/Proj. Protection	Radcon
Fred Ruck III	FH/ESH	Environmental

Table 1-2. Data Quality Objectives and Sampling and Analysis Plan Team Members. (2 sheets)

Name	Company/Organization	Position or Area of Expertise
Andrea Prignano	FH/ESH	Environmental
Mike Stevens	D&D Project	D&D Project
Howard Rew	Plateau Projects QA	QA
Naeem Abdurrahman	FH/Waste Management	Assay expert

D&D = deactivation and demolition.
DFSNW = Duratek Federal Services Northwest.
ESH = Environmental, Health, and Safety
FH = Fluor Hanford, Inc.
QA = quality assurance.
WCH = Washington Closure Hanford, LLC.

Table 1-3. Key Decision Makers.

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

1.4.1 Statement of the Problem

Radioactive waste and perhaps some mixed radioactive and dangerous waste will be generated by the demolition of the 105-K East Basin that must be disposed at ERDF, if possible. This SAP shall establish the requirements and methods to be used to designate, radioactively classify, and determine the compliance of the waste with the ERDF waste acceptance Criteria WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.*

1.4.2 Contaminants of Concern

The list of contaminants of concern (COC) that are applicable to each waste stream is listed in Table 1-4. The list was compiled from the DQO document that is applicable to each waste stream, see Table 1-1.

Table 1-4. List of Contaminants of Concern. (2 sheets)

Number	Waste Stream Description	Contaminants of Concern
1	Basin and pit superstructure rubble	Radioactivity: H-3, C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Zr-93, Nb-93m, Tc-99, Pd-107, Cd-113m, Sn-121m, Sb-125, Sn-126, Cs-134, Cs-135, Cs-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, U-234, U-235, U-236, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-242m, Am-243, Cm-242, and Cm-244 Chemical: PCB, Hg, Se, As, Ba, Cd, Cr, Pb, and Ag

Table 1-4. List of Contaminants of Concern. (2 sheets)

Number	Waste Stream Description	Contaminants of Concern
2	Basin and pit substructure rubble	Radioactivity: H-3, C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Mo-93, Zr-93, Nb-93m, Nb-94, Tc-99, Pd-107, Cd-113m, Sn-121m, Te-123, Sb-125, Sn-126, I-129, 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, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-242m, Am-243, Cm-242, Cm-243, and Cm-244 Chemical: PCB, Hg, Se, As, Ba, Cd, Cr, Pb, and Ag
3	High dose rate rubble and debris encapsulated in a container	Same as 1, 2 and/or 4
4	Rubble from outside structures and equipment including the Hose-in-Hose system and waste sites.	Radioactivity: H-3, C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Mo-93*, Zr-93, Nb-93m, Nb-94*,Tc-99, Pd-107, Cd-113m, Sn-121m, Sb-125, Sn-126, Cs-134, Cs-135, Cs-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, U-234, U-235, U-236, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-242m, Am-243, Cm-242, and Cm-244 Chemical: As, Ba, Cd, Cr, Total Cresol, 2,4-Dinitrotoluene, Hexachlorobenzene, Hexachlorobutadiene, Hexachloroethane, Pb, Hg, Nitrobenzene, Pentachlorophenol, Pyridine, Se, Ag, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, PCB, pH (C sump and collection box only)
5	Liquids such as oils, greases, hydraulic fluids, cooling fluids and water removed from pumps or other equipment that has been stabilized for disposal.	Radioactivity: basin water- H-3, Sr-90, Cs-137, Pm-147, Sm-151, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Am-241 All other liquids- H-3, C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Zr-93, Nb-93m, Tc-99, Pd-107, Cd-113m, Sn-121m, Sb-125, Sn-126, Cs-134, Cs-135, Cs-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, U-234, U-235, U-236, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-242m, Am-243, Cm-242, and Cm-244 Chemical: basin water- none All other liquids- 2 -(Diethylamino) Ethanol, Diethylene Glycol, lithium hydroxide, chlorinated parrafin (alkanes, chloro)

*Applies to rubble generated from the collection box, waste site 100-K-71, only.

1.4.3 Decisions Rules

Table 1-5 lists the decision rules that are applicable to all of the wastes streams that are the subject of this SAP.

Table 1-5. Decision Rules.

DR No.	Decision Rule
1	1. If the waste **is** a listed dangerous waste, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the material **is not** a listed dangerous waste, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.
2	1. If the waste **is** a characteristic dangerous waste, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **is not** a characteristic dangerous waste, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.
3	1. If the waste **is** a toxic dangerous waste, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **is not** a toxic dangerous waste, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.
4	1. If the waste **is** a persistent dangerous waste, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **is not** a persistent dangerous waste, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.
5	1. If the waste **is** a PCB waste, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **is not** a PCB waste, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.
6	1. If the waste complies with the radiological waste acceptance criteria or can be treated to comply, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **does not** comply with the radiological waste acceptance criteria, **do not** dispose at ERDF, but if TRU at WIPP or if not TRU then at an EPA approved facility in accordance with the facility's waste acceptance criteria.
7	1. If the waste complies with the waste acceptance criteria physical form requirements or can be treated to comply, dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **does not** comply with the waste acceptance criteria physical form requirements, **do not** dispose at ERDF, but at an EPA approved facility in accordance with the facility's waste acceptance criteria.
8	1. If the waste is land disposal restricted, treat as needed and dispose at the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria. 2. If the waste **is not** land disposal restricted and **does not** require treatment prior to disposal, dispose to the ERDF or other facility approved by EPA and in accordance with the facility's waste acceptance criteria.

DR = decision rules.
EPA = U.S. Environmental Protection Agency.
ERDF = Environmental Restoration Disposal Facility.
PCB = polychlorinated biphenyl.
TRU = transuranic (waste).
WIPP = Waste Isolation Pilot Plant.

2.0 SAMPLING AND MEASUREMENT RATIONALE AND DESIGN

This section describes the data collection processes that will be used to resolve the decision rules. The resolution of the decision rules will resolve the problem statement, that is, is the waste compliant for disposal at ERDF or not. The basis for the data collection and the processes being used are also provided here.

The demolition of the 105-K East Basin will be accomplished by performing the activities that are identified in Section 1.2 of this SAP. These activities produce the waste streams listed in Table 1-4. The data collection process for each of the waste streams listed in Table 1-4 is described in the sections provided below. The waste streams include incidental soil, however it is noted that incidental soils may constitute the bulk of the contents of a small number of disposal containers. Disposal containers containing mostly soil are expected to occur mostly when removing subgrade equipment and structures, such as the waste site piping and basin leak collection system. As described later in this section, the soil contamination will be dominated by the contamination resident in the rubble that is mixed with the soil.

This SAP uses data collected by documents prepared to support deactivation of the 105-K East Basin KBC-24414 and KBC-25121. The data collected under KBC-24414 and KBC-25121 are used to calculate the concentration of radioactivity reported in D&D-35176, *Calculation of Radioactive Concentrations in 105-K East Basin and Pits Substructure Rubble.*

2.1 WASTE STREAM #1- REMOVAL OF SUPERSTRUCTURE RUBBLE

The superstructure waste being removed includes all the rubble being generated from the 105-K East Basin structure and offices up to the G-line interface at the reactor wall that is above grade, and the FTS. The superstructure waste does not include the IXC or sand filter monoliths. Generally, this includes the building roof, walls that are above grade, and floor and equipment, piping, and electrical wiring and equipment located in the building or connected to the building. The basin roof and walls are constructed of transite that contains asbestos. The waste stream is described in more detail and COC identified in Table 1-4 of HNF-6273, *Data Quality Objectives Process for Designation of K-Basins Debris*, listed as waste streams 1-13 and 16-20.

The facility superstructure will be demolished using shears and/or other equipment dropping the structure and cutting it into pieces that will then be loaded into roll-off boxes for transport to the ERDF. As the structure is being dropped and cut up, the waste material will be monitored for radioactive dose rate as necessary to control personnel exposure and ensure the transport roll-off box will be compliant for transportation. If radioactive dose rate hot spots are identified, the material will be managed as waste stream number 3 material as described in Section 2.3.

In preparation for demolition, all IXMs are removed, and components that would cause the waste to be designated as dangerous waste will either be removed from the 105-K East facility or segregated from rubble and treated. Further, all above-water piping or equipment that could contain sludge will be flushed or removed from the facility. Consequently, the rubble waste

generated will not be designated as dangerous waste in accordance with WAC 173-303, *Dangerous Waste Regulations* or polychlorinated biphenyl (PCB) regulated in accordance with 40 CFR 761, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*.

The transite wall panels will be removed prior to demolition of the structure. The roof material that also contains asbestos will remain to be size reduced during demolition and mixed with the other material to create rubble for disposal. Airborne particulate samples will be collected and analyzed for the presence of asbestos fibers during demolition of the roof material for the purpose of monitoring personnel exposure to asbestos, not for the purpose of waste characterization. The air sample analysis results will be made available to ERDF personnel. The rubble containing asbestos will be prepared for disposal in accordance with ERDF waste disposal requirements of WCH-191.

The waste will be contaminated with radioactivity. The amount of radioactive contamination on the building structure and equipment located in the 105-K East facility is minimal as demonstrated by historical contamination surveys performed in recent years. However, piping and equipment that contained basin water, such as the basin water chiller, do exhibit substantial amounts of contamination. Based on these data, the amount of radioactive contamination from basin water contacted material overwhelms the building structure surface contamination; therefore, the radioactive distribution to be used to calculate the radioactive inventory will be developed from the K East/K West (KE/KW) below-water washed metal debris data identified in Table A-1 of HNF-6495. The radioactive distribution and COC are determined in Appendix C with the results presented in Table 2-1. The radioactive content of the waste will be calculated by determining the Cs-137 content using dose rate-to-curie relationships developed for a specific container as described in Section 2.2.1 of HNF-6495. The total radioactive inventory is calculated by multiplying the Cs-137 inventory by the distribution ratio to Cs-137 provided in Table 2-1.

Soft and liquid wastes will be generated by demolition activities. Soft waste includes material such as paper, plastic and personal protection equipment (PPE). Soft waste is not dangerous waste and is not a source of radioactivity, but may be contaminated with radioactivity from structure rubble. Therefore, all soft waste will be placed in the waste container with structure rubble for transport to ERDF for disposal. Structure or debris waste that is dangerous waste, such as lead shielding, will be segregated from the rubble, treated, and disposed at ERDF. The management of liquid waste is discussed in Section 2.5.

The data collection required for this waste stream is the collection of dose rate survey information on the exterior of containers in accordance with the dose rate-to-curie conversion model requirements and either the calculation or measurement of the waste mass and volume.

2.2 WASTE STREAM #2- REMOVAL OF SUBSTRUCTURE RUBBLE

The substructure waste being removed includes all the rubble being generated from the 105-K East Basin structure that is below grade including the basin leak collection system, but not including those outside the building structures equipment constituting the HIH transfer system

and waste sites listed in Table 2-2. The substructure waste does not include the IXC or sand filter monoliths. The substructure with the debris that remains in it will be demolished using shears and/or other equipment crushing and cutting the structure into rubble that will then be loaded into roll-off boxes for transport to the ERDF. As the structure is being crushed and/or cut up, the waste material will be monitored for radioactive dose rate as necessary to control personnel exposure and ensure the transport roll-off box will be compliant for transportation. If radioactive dose rate hot spots are identified, the material that could result in non-compliant waste for shipping or disposal will be managed as waste stream number 3 material as described in Section 2.3. Hot spots are small areas of rubble or debris (something that could be picked up) that exhibit a surface dose rate of nominally greater than or equal to 3.0 R/hr. The waste will also contain grout and an engineered backfill that was placed in the basin and pits to facilitate demolition of the superstructure, the leak collection system located underneath the basin and pits, and incidental soil. The leak collection system consists of perforated pipe in a bed of gravel mounted over a water barrier paper. The waste is described in more detail and COC identified in KBC-24413, *Data Quality Objectives Summary Report for the 105-K East Basin Monoliths*.

Table 2-1. K East Basin Waste Radionuclide Distribution.

Isotope	Activity Ratio to Cs-137	Isotope	Activity Ratio to Cs-137
H-3	0.202%	Sm-151	1.54%
C-14	0.00654%	Eu-152	0.00546%
Fe-55	0.00153%	Eu-154	0.877%
Co-60	1.18%	Eu-155	0.359%
Ni-59	0.000387%	U-234	0.00345%
Ni-63	0.0396%	U-235	0.000133%
Se-79	0.000814%	U-236	0.000499%
Sr-90	75.6%	U-238	0.00274%
Zr-93	0.00378%	Np-237	0.000230%
Nb-93m	0.00279%	Pu-238	0.146%
Tc-99	0.0272%	Pu-239	0.857%
Pd-107	0.000154%	Pu-240	0.468%
Cd-113m	0.0206%	Pu-241	16.6%
Sn-121m	0.000666%	Pu-242	0.000216%
Sn-126	0.00147%	Am-241	5.30%
Sb-125	0.530%	Am-242m	0.000735%
Cs-134	0.00601%	Am-243	0.000472%
Cs-135	0.000732%	Cm-242	0.000607%
Cs-137	100%	Cm-244	0.00392%
Pm-147	0.346%		

The substructure will be prepared for demolition by managing debris, placing grout in the basin and pits, removing basin water, applying fixatives, as necessary, and lastly filling the basin and

pits with an engineered backfill to provide shielding and a surface on which to work to remove the superstructure. Debris will either be removed from the 105-K East Basin or inspected, dose rates collected, and placed in the basin. Some debris will be removed including baskets of strainer material. Then nominally one foot two inches of grout will be placed on the floor of the basin and pits to fix contamination and provide shielding. A one foot two inches depth of grout is necessary to provide the required water head to operate the basin dewatering pump. Grout on the NLOP and SLOP floors will be nominally six foot two inches thick because these pits are five feet deeper than the basin. This additional grout is necessary to displace water thereby removing liquid in compliance with the ERDF waste acceptance criteria WCH-191. Three tanks remaining in the techview and weasel pits will also receive nominally one foot of grout in the bottom to fix contamination and provide shielding. A fourth tank, number 104, will also remain in the techview and weasel pits that will receive nominally five foot of grout in the bottom to fix contamination, provide shielding, and comply with nuclear safety requirements. Basin water will be pumped out of the basin and pits and fixative placed on grout and wall surfaces as necessary to control radioactive contamination. When the substructure is removed, the engineered backfill will be mixed with and collected with rubble. The leak collection system will be size reduced as necessary then removed.

In preparation for demolition, all components that would cause the substructure rubble to be designated as dangerous waste will either be removed from the 105-K East facility or segregated from rubble and treated. All the components of the waste stream, grout, structural concrete, debris, leak collection system, and engineered backfill will not designate as dangerous waste. Further, the remaining sludge is not dangerous waste as per letter 0101943, "Contract No. DE-AC06-96RL13200 - Completion of Waste Designation for K Basin Sludge Waste Streams;" therefore, the rubble waste that is a mixture of all these components is not dangerous waste.

Sludge is a PCB remediation waste regulated in accordance with 40 CFR 761; therefore, the resulting rubble that is contaminated with sludge is PCB remediation waste. As described in DOE/RL-2007-41 and DOE/RL-2007-48, rubble PCB remediation waste shall be managed for its radioactive content and not the PCB content.

The radioactive characterization and a calculated inventory of the substructure rubble have been completed. The radioactive inventory of the rubble is the sum of three contributions: sludge, radioactivity that penetrated the below-water wall and floor, and contamination on debris. An inventory of sludge contaminating the basin, pits, and debris has been prepared in accordance with KBC-24414 and KBC-24721, *105 K East Qualified Process Demonstrating Endpoint Criteria*. The radioactive inventory of below-water concrete walls and floor has been completed in accordance with KBC-25121. The radioactive inventory of contaminated debris has been prepared in accordance with KBC-24414. These inventories are all presented in D&D-35176. An inventory of debris, sludge, and below-water concrete surface content shall be maintained for each basin bay, NLOP, SLOP, Dummy Elevator Pit (DEP), and techview/weasel Pit combination. The radioactive content of soil and the leak collection system collected with the rubble is insignificant when compared to the inventory of radioactivity resident in the rubble.

With the radioactive inventory known, the concentration of radioactivity in rubble can be calculated. The concentration of radioactivity has been calculated in consideration of the demolition process, over areas that will logically be removed generally as one unit or pile of

rubble in D&D-35176, *Evaluation of 105-K East Basin and Pits Substructure Rubble for Compliance with ERDF Radioactive Waste Requirements*. The upper walls will be removed with little if any mixing with rubble created from the floor because the demolition process will start at the top and move down; therefore, the concentration of radioactivity calculated for the upper wall will not include any significant contribution from sludge unless specifically identified. A small amount of debris is included in the upper wall waste. A single concentration has been calculated for all the upper basin and pit walls in D&D-35176. The lower wall, at least five feet, will be included with the floor areas because there is mixing inherent in the demolition process and it may be necessary to mix this wall and floor rubble to control radiation dose rate exposure of personnel and ensure the shipping container is compliant with transportation requirements. The rubble will also be mixed with engineered backfill and small quantities of soil; both of these materials are not included in the waste mass for the purpose of determining the radioactive waste class because they are incidental added material. The floor and lower wall rubble concentrations are calculated for the following areas: each basin bay, NLOP, SLOP, DEP, and combined techview/weasel pits.

In calculating the concentration of radioactivity for the purpose of demonstrating compliance with the ERDF waste acceptance criteria, the rubble was evaluated in accordance with the U.S. Nuclear Regulatory Commission (NRC) guidance on concentration averaging provided in branch technical position paper (NRC 1995). The evaluation is provided in Appendix D. The evaluation concludes that the radioactive concentration may be calculated over the volume and mass of the wall for the rubble produced by the upper wall and over the basin and pits structural floor, nominally one foot two inches of grout on the floor (six foot two inches of grout in the NLOP and SLOP) and the tanks and nominally one foot of grout in four tanks located in the techview/weasel pits, and at least five foot of wall above the basin floor for each of the areas. The concentrations of radioactivity in upper wall rubble and rubble from all the areas identified above are calculated in D&D-35176. The radioactive inventory of each shipping container shall be calculated by multiplying the concentration of radioactivity in the rubble and the mass or volume of rubble in the container.

Small quantities of soft waste such as paper, plastic and PPE, liquid, and dangerous waste will be generated by demolition activities. The management of soft waste and dangerous waste generated by this activity is the same as described for these materials for superstructure in Section 2.1. The management of liquid waste is discussed in Section 2.5.

The data collection required is the measurement or calculation of the rubble mass or volume to multiply by the concentration of radioactivity in rubble to determine the inventory for each shipping container.

2.3 WASTE STREAM #3- REMOVAL OF HIGH DOSE RATE RUBBLE AND DEBRIS

The high dose rate rubble and debris is a waste stream that consists of the other waste stream numbers 1, 2, 4, and 5 material that exhibits high radioactive dose rates. High dose rate materials exhibit a surface dose rate of nominally greater than or equal to 3.0 R/hr. in small areas of rubble or debris (something that could be picked up). Therefore, the generation process, waste

description, and characterization are described in Sections 2.1, 2.2, 2.4, and 2.5. High dose rate waste will be identified by field surveys conducted as the demolition proceeds. Because of the high dose rate, this waste will be placed in a container then encapsulated with grout to reduce the radiation dose rate. The grouted waste form will be shipped to ERDF for disposal. As described for the other waste streams, the waste is not dangerous waste but may be PCB remediation waste. If PCB remediation waste, it is managed for its radioactive content and not the PCB content.

The radioactive inventory will be determined using one of two methods: (1) summing the radioactivity of the material added to the container or (2) using a dose rate-to-curie method. The concentration of radioactivity in waste stream number 2 rubble has been calculated (D&D-35176); so, with information about the quantity of rubble added, the radioactive inventory may be calculated. The use of dose rate-to-curie method is described in Section 3.3. If a dose rate-to-curie method is used, the radionuclide distribution used will be the one that represents the content of the waste in the container. For example, if a container contains waste from the basin center bay, then the distribution established in Table C-8 of D&D-35176 will be used.

In calculating the concentration of radioactivity for the purpose of demonstrating compliance with ERDF waste acceptance criteria, the encapsulated waste was evaluated in accordance with the NRC guidance on concentration averaging provided in branch technical position paper (NRC 1995). The evaluation is provided in Appendix D. The evaluation concludes that the radioactive concentration shall be calculated over the volume and mass of the rubble, debris, and encapsulating grout added to the container.

Small quantities of soft waste such as paper, plastic and PPE, liquid, and dangerous waste will be generated by demolition activities. The management of soft waste and dangerous waste generated by this activity is the same as described for these materials for superstructure in Section 2.1. The management of liquid waste is discussed in Section 2.5.

The data collection required for this waste stream is either information to support a dose rate-to-curie calculation or the sum of the volume, mass, and radioactivity of waste and grout components that are added to the container. The dose rate-to-curie method requires collection of dose rate survey information on the exterior of containers in accordance with the dose rate-to-curie conversion model requirements and either the calculation or measurement of the waste mass and volume.

2.4 WASTE STREAM #4- REMOVAL OF OUTSIDE EQUIPMENT AND STRUCTURES

The waste consists of the structures, equipment, hose, piping, and electrical equipment associated with the HIH sludge transfer system between the K East Basin and the K West Basin and with the waste sites listed on Table 2-2. These outside structures and equipment have completed their mission and are no longer needed so they will be removed and disposed of at ERDF. The waste stream is described in more detail and COC identified in Appendix B for the waste sites listed in Table 2-2 and Table 1-4 of HNF-6273 listed as waste streams seven, eight, and twelve for the HIH system.

Small quantities of soft waste such as paper, plastic and PPE, liquid, and dangerous waste will be generated by demolition activities. The management of soft waste and dangerous waste generated by this activity is the same as described for these materials for superstructure in Section 2.1. The management of liquid waste is discussed in Section 2.5.

Hose-in-Hose System, D Sump, and Holding Tank

The HIH system has been flushed to remove sludge to the extent practicable. The HIH system will be taken apart, size reduced as necessary, and liquid drained from or solidified in the hose and pumps. The D sump and holding tank, waste sites 100-K-68 and 70, are excavated and size reduced to rubble. The rubble and debris will then be placed in a shipping container for transport to ERDF for disposal. As the structures and equipment are cut up, the rubble will be monitored for radiation dose rate as necessary to control personnel exposure and ensure the transport roll-off box will be compliant for transportation. If radioactive dose rate hot spots are identified, the material will be managed as waste stream number 3 material as described in Section 2.3.

The service of the D sump and holding tank is the same as the HIH system except the systems serviced basin water that did not contain sludge. The D sump returned water from basin overflows and the leak collection system to the basin. The holding tank had not been placed into service, but if it had been, it would have contained basin water. Therefore, the radioactive and chemical characterization for the D sump and holding tank is the same as described for the HIH system except the systems do not contain sludge contamination.

In preparation for demolition, all HIH, D sump, and holding tank system components that would cause the waste to be designated as dangerous waste will be removed and segregated from rubble and treated. Sludge has been removed from the HIH system to the extent practicable. Sludge is not dangerous waste as per letter 0101943, therefore the waste, if it contains sludge, will not be designated as dangerous waste in accordance with WAC 173-303. Sludge is a PCB remediation waste regulated in accordance with 40 CFR 761; therefore, the resulting HIH rubble if contaminated with sludge is PCB remediation waste. As described in DOE/RL-2007-41 and DOE/RL-2007-48, debris PCB remediation waste shall be managed for its radioactive content and not the PCB content.

The HIH, D sump, and holding tank system waste will be contaminated with radioactivity. The total radioactive inventory is calculated using the Cs-137 inventory determined by dose rate-to-curie and a radioactive distribution developed from the KE/KW below-water washed metal debris data identified in Table A-1 of HNF-6495. The radioactive distribution and COC are determined in Appendix C with the results presented in Table 2-1. The dose rate-to-curie method will be performed as described in Section 2.2.1 of HNF-6495. The radioactive distribution ratio to Cs-137 to be used in radioactive inventory calculations is provided in Table 2-1. If sludge dominates the contamination of HIH waste, the sludge distribution provided in Table A-1 of KBC-24413 shall be used instead of the KE/KW below-water washed metal debris.

The data collection required for the HIH, D sump, and holding tank systems portion of this waste stream is the collection of dose rate survey information on the exterior of containers in

accordance with the dose rate-to-curie conversion model requirements and either the calculation or measurement of the waste mass and volume.

C Sump and Collection Box

The service of the C sump and collection box, waste sites 100-K-69 and -71, is different from the other outside structures and equipment in that it received decontamination solutions and reactor and rod cooling waters in addition to basin water. The services of each system are described more completely in Table 2-2. Both the C sump and collection box will have samples of sludge (not K Basin sludge) that is contaminating each system collected and submitted for analysis before demolition. The C sump and collection box will be excavated and size reduced to rubble. The rubble and debris will then be placed in a shipping container for transport to ERDF for disposal. As the structures and equipment are cut up, the rubble will be monitored for radiation dose rate as necessary to control personnel exposure and ensure the transport roll-off box will be compliant for transportation. If radioactive dose rate hot spots are identified, the material will be managed as waste stream number 3 material as described in Section 2.3.

In preparation for demolition, all C sump, and collection box system components that would cause the waste to be designated as dangerous waste will be removed and segregated from rubble and treated. Sludge contamination in each system will be collected and tested for toxic characteristic metals and semi-volatile (SVOA) organic chemicals, PCB, and pH in order to designate the rubble in accordance with WAC 173-303 and 40 CFR 761. Toxic characteristic volatile organics, pesticides, and herbicides will not be tested because they are not expected to be present. Volatile organic compounds by their nature would escape as vapor from the vented sump or collection box over their many years of service. Pesticides and herbicides would not have collected in these systems. These chemcials plus pH have been identified as possible COC requiring more information to designate the waste as discussed in Appendix B. These systems did service basin water, but discharges of basin water that could have included K East Basin sludge or any other source of PCB have not been identified. However, the sludge will be tested for PCB because PCB has been found in K East Basin sludge.

The C sump and collection box systems waste will be contaminated with radioactivity. The radioactivity is expected to reside in sludge contamination lying on the floor of the sump and collection box. Samples of sludge will be collected and tested for gamma emitting radionuclides (e.g., Cs-137, Co-60, Eu-152) and gross alpha/beta. The gross alpha measurement will use Table 2-1 data to determine each alpha emitting radionuclide concentration because the table represents contamination from water that is contaminated by spent fuel. Both basin water and reactor cooling water contaminated by fuel ruptures are the source of alpha contamination. The radioactive contamination in the rubble will be the concentration in the sludge multiplied by the quantity of sludge contaminating each system. The quantity of sludge contaminating the C sump and collection box will be determined by visual observation at the time samples are collected.

The design of the sample collection from the C sump and collection box will use a judgmental rather than a probabilistic design because the small quantity of sludge does not support the collection of multiple samples required to execute a probabilistic design. Samples will be collected from the floors because that is where the bulk of the contamination is expected to be located. The C sump floor is a six by three foot rectangle. The collection box floor is two

separate chambers that are both six by six foot squares. A single composite sample will be submitted for analysis, one for the C sump and one for the collection box. A composite sample will provide results that represent each system as an aggregate of the sludge contamination. An aggregate of the sludge contamination is appropriate because the sludge contamination will be mixed throughout the rubble when the system is size reduced. At the time samples are collected, the contamination will be visually observed to calculate the quantity of sludge contamination in each system. To ensure the composite represents the sludge contamination, a minimum of five samples will be collected for compositing from each the C sump and collection box. If not enough sludge is present in the systems to collect the required amount of samples, scraping of the floor and wall up to the outlet points may be used to collect sample for analysis.

The data collection required for the C sump and holding tank systems portion of this waste stream is the collection and analysis of samples, determination of the quantity of sludge contamination by visual observation, and either the calculation or measurement of the rubble mass and volume.

2.5 WASTE STREAM #5- LIQUID REMOVED FROM EQUIPMENT

Liquids will be removed from equipment during the demolition before structure and equipment are reduced to rubble. The liquids known to exist include oils, greases, hydraulic fluids, cooling fluids such as propylene glycol and water. Small quantities of water are expected to be collected (i.e., less than 55 gallons) before demolition. If larger quantities of water are collected, it will be disposed at the Effluent Treatment Facility if compliant with the waste acceptance requirements. Generally, fluids removed from equipment are expected to be small in quantity and not aqueous in nature. The water is expected to be basin water that is described in more detail and COC identified in Appendix B. The oils, greases, hydraulic fluids, and cooling fluids expected to be encountered are also listed in Appendix B.

The oils, greases, hydraulic fluids, and cooling fluids that are expected to be removed from equipment have been designated; none of the liquids contain PCB and are not designated as dangerous waste except one hydraulic fluid and grease. The hydraulic fluid Houghto-Safe 620 is designated as Washington State dangerous waste with waste code WT02. The grease Mobilux EP 111 is designated as Washington State dangerous waste with waste codes WT02 and WP02. All of these waste liquids will be absorbed/stabilized then placed in with the rubble for transport to ERDF for disposal. Other liquids will be designated as they are encountered. If a liquid is designated as hazardous waste in accordance with 40 CFR 261, "Identification and Listing of Hazardous Waste," extremely hazardous dangerous waste, or regulated for PCB content, it will be managed as anomalous waste.

Table 2-2. Waste Site Descriptions. (2 sheets)

Site Name	Site Description
Site code 100-K-68- 105-K East Pump Gallery and Catch Tank, D Sump	A steel caisson structure constructed of corrugated metal with two sump pumps mounted in a catch tank located at the bottom of the caisson. Sump received K East Basin water overflow or water collected by the leak collections system under the basin. Water collected in D-Sump is pumped through filters and returned to the northwest corner of the basin.
Site code 100-K-69- 105-K East Sump C	A concrete sump with two sump pumps mounted inside. Sump receives water and decontamination solutions from floor drains located in the K East Basin transfer area. Water collected in C-Sump is pumped through filters and returned to the northwest corner of the basin. Originally the plan was to route the water to the waste storage tank (100-K-70). The line going to the tank was capped and is no longer available. Tri-sodium-phosphate was the decontamination agent normally used, that would have made its way to the floor drains.
Site code 100-K-70- 105-K East Waste Storage Tank, Holding Tank	Tank TK-1 constructed of metal with no pump mounted in it. Originally the plan was to route the water to the waste storage tank (100-K-70). The line going to the tank was capped and is no longer available. The tank was never placed into service.
Site code 100-K-71- 105-K East Collection Box- A concrete effluent collection box used to direct effluent to a drain field, crib or to the river, via the outfall. The box is divided into two sections. The east half receives water from the Acid/Rinse sinks, Basin Drains, Basin Overflow and the Pluto crib drain. The east half diverts the water collected to either the original crib, or the mile long trench. In addition, a vent line exits the collection box and returns back into the reactor area. The west half receives water from the Rod Cooling water, Contaminated drains and the Potentially contaminated drains. Water from the west half is diverted to the river outfall.	Rod cooling water line consisting of a 6-inch metal pipe. This is filtered water used on the interior of the horizontal reactor rods to remove heat. The horizontal reactor rods are used to control power levels within the reactor core.
	Poison Ink system as originally scoped has not been completed. Some of the piping and equipment was installed. The forty process tubes which were to be used in this system are used for control purposes. The drain line consisting of a 6-inch metal pipe which feeds into the 10-inch "Potentially Contaminated" drain.
	Contaminated drain consisting of a 10-inch metal pipe. The pipe collects contaminated water from various locations within the reactor processing area. This line feeds into the west half of the collection box
	Potentially contaminated drain consisting of a 10-inch metal pipe. This pipe collects water from the floor drains located in clean rooms, which are located within a radiological zone. The pipe feeds into the west half of the collection box.
	Clean drain consisting of a 10-inch metal pipe. It is fed from a number of floor drains and service sinks located in the office area and prep rooms located east of the basin.
	The Acid/Rinse Decon sink drain constructed of a 4-inch vitrified clay pipe. This pipe received waste water from the various decontamination sinks located throughout the reactor and basin areas. The sinks located in room 3, were taken out prior to the basins being used to store N-Reactor spent fuel.

Table 2-2. Waste Site Descriptions. (2 sheets)

Site Name	Site Description
	Per WHC-SD-EN-TI-239, the decon solutions used during reactor operations included chromic, citric, nitric, sulfamic acids, and fluoride compounds. This line feeds into the east half of the collection box.
	K East Basin drain consisting of a 12-inch metal pipe. This line is fed from drain valves located in various basin pits and along the north wall of the basin, which would allow for the draining of basin water. This line feeds into the east half of the collection box.
	K East Basin overflow water drain consisting of a 8-inch metal pipe. The overflow weirs are located on the north side of the basin, in the discharge chute, the dummy elevator pit, and the techview pit. Any overflow water would be routed through this 8-inch line into the east half of the collection box.
	Pluto crib drain K East Basin overflow water drain consisting of a 6-inch metal pipe. This drain was used if a fuel rupture was detected in the reactor. This reactor cooling water went to the east side of the collection box.

WHC-SD-EN-TI-239, *100-K Area Technical Baseline Report*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Basin water is contaminated with radioactivity from exposure to fuel and sludge. Samples of 105-K East Basin water are routinely tested for radioactivity. The test results for the last three months have been used with fuel data to determine the radioactive COC concentrations in the water as described in Attachment B1 to Appendix B. The radioactive COC concentrations in 105-K East Basin water are listed in Table B4-2. The total radioactive inventory of treated basin water waste is determined by measuring the mass or volume of water then multiplying the water mass or volume by the concentrations listed in Table B4-2.

All other liquids are contaminated by the radioactivity in the area from which it is removed. Liquid is removed from superstructure, substructure, and outside equipment and structures before it is reduced to rubble, waste stream numbers 1, 2, and 4; therefore, the source of radioactive contamination and method to calculate the quantity of radioactivity is the same as described in Sections 2.1, 2.2, and 2.4. The radioactive content of the waste will be calculated by determining the Cs-137 content using dose rate-to-curie relationships developed for a specific container as described in Section 2.2.1 of HNF-6495. The total radioactive inventory is calculated by multiplying the Cs-137 inventory by the distribution ratio to Cs-137 provided in Table 2-1.

Small quantities of soft waste such as paper, plastic and PPE and dangerous waste will be generated by demolition activities. The management of soft waste and dangerous waste generated by this activity is the same as described for these materials for superstructure in Section 2.1.

The data collection required for this waste stream is either the mass of basin water or, for all other liquids, the collection of dose rate survey information on the exterior of containers in accordance with the dose rate-to-curie conversion model requirements and either the calculation or measurement of the total waste mass and volume.

2.6 ANOMALOUS WASTE

Anomalous waste is waste generated from demolition activities that are not consistent in characteristics with the waste stream numbers one through five that are described above. These anomalous wastes may include wastes that are dangerous waste or the radioactivity contaminating the waste is not consistent with an identified waste stream. Anomalous waste may require sampling and analysis or assay as described herein. Process knowledge about the waste will be used to minimize and focus the anomalous waste sampling and assaying activities to the extent possible. The lead regulatory agency will be notified when testing of anomalous waste will be performed.

3.0 SAMPLE AND MEASUREMENT LOCATION AND FREQUENCY

The location and frequency of sample and measurement collection is established in this section. The collection of samples for analysis is limited to sampling of the C sump, collection box, and anomalous waste. Anomalous waste analysis could also occur if the waste is classified as potential transuranic (TRU) waste. As described in Section 2.0 of this SAP, the collection of samples for analysis is not planned in this document for any other location.

Before conducting sampling of anomalous waste, Deactivation and Demolition (D&D) project staff will determine if there are cost-effective alternatives, such as process knowledge. If sampling or assay is chosen, then a specific work document for sampling or performing assay will be developed and provided to EPA for review and approval (approval via e-mail is acceptable). Sections 3.0 and 4.0 discuss the planned strategy to conduct assay for radioactivity and sampling and analysis.

The application of SW-846, *Test Methods for Evaluating Solid, Waste Physical/Chemical Methods* (EPA 1997), sample collection requirements were considered in the preparation of this SAP. Sample collection shall comply with applicable SW-846 requirements.

Measurements in the field are also being collected. These measurements include radiation dose rates of waste and exterior of waste containers, weight of a container and contents, volume of waste or sludge contamination in a sump or box, and assay for radioactivity in a container. These measurements are discussed in Section 3.3. Generally, SW-846 methods do not apply to measurement collection activities with the exception of the probabilistic sample collection design and statistical calculations described in Chapter 9, as applicable.

3.1 SAMPLE COLLECTION LOCATION AND FREQUENCY

C Sump and Collection Box Sampling

Samples shall be collected for compositing from the floor of each system. The floor of each system will be grided with samples being collected from each point of the grid if sludge is present that can be collected. Samples must be collected at a minimum of five grid points unless all of the sludge contamination is in one or two small areas (each being one or two square foot). If all contamination is in one or two small areas, then the locations shall be recorded and samples collected from each area for compositing. If contamination does not exist at some grid locations, then a sample does not have to be collected; however, a minimum of five samples shall still be collected for compositing. For example, suppose that the collection box east chamber contains only a thin film but the west chamber contains a layer of sludge. In this case, no samples are collected from the east chamber but the west chamber is grided at one and a half foot lines producing nine points where samples are collected for compositing. All samples collected from each system will be mixed into one composite that will be submitted to a laboratory for analysis. If not enough sludge exists to collect enough sample material, then scraping of the floor and wall up to the discharge point may be collected for compositing.

Anomalous Sampling

Waste that has been determined to require sampling will be staged in a controlled area while a work document is written to sample the waste, and a laboratory is obtained to perform the analyses. If anomalous waste sampling is conducted, a representative sample of the waste will be collected. A probabilistic sample collection design may be applied, but often this design is not necessary. For example, sampling often is used to confirm process knowledge. The confirmation may use this process knowledge to develop a judgment design.

3.2 SAMPLE COLLECTION METHODS

C Sump and Collection Box Sampling

Samples may be collected with scoops, spoons, knives, trier, or thief depending on the consistency and depth of the sludge contaminating the systems. The sample shall collect the full column of sludge residing on the floor. The amount of sample collected at each grid point shall be enough to provide the required amount of composite sample and be proportional in sample quantity to the depth of contamination at the location (a location with twice the depth of other locations should contain twice the amount of material in the sample). The sample equipment used shall be compatible with the waste being sampled to the extent that it shall not contaminate the sample. The sampling equipment used shall be clean so as not to contaminate the samples being collected for analysis. The sample collection activity and methods shall be performed in accordance with written work documents.

Anomalous Sampling

The methods used to collect samples of waste for anomalous waste analysis shall be described in work documents controlling the sample collection activity. The sample collection methods and equipment used shall include those described in Chapter 9 of SW-846 or other methods that may be appropriate to the waste matrix being sampled. The sample equipment used shall be compatible with the waste being sampled to the extent that it shall not contaminate the sample. The sampling equipment used shall be clean so as not to contaminate the samples being collected for analysis.

3.3 MEASUREMENT LOCATION AND FREQUENCY

Dose Rate Surveys

Radiation dose rates are collected for the purpose to calculating the Cs-137 content of the container using dose rate-to-curie conversions. The location and frequency of dose rate measurements for the purpose of calculating the Cs-137 content of the container using dose rate-to-curie conversions is dependent on the dose rate-to-curie model being used. All containers of waste shall have the prescribed number of dose rates collected at the locations specified. The work documents shall include at a minimum:

- The waste form or configuration to which the curve applies, as applicable
- The number and locations of dose rate measurements required to be collected
- The data collection documentation and recording requirements.

The work documents shall control the data collection parameters that could affect the quality of the dose rate-to-curie conversion results. For example, a dose rate-to-curie model applicable to an ERDF roll-off box containing hard waste material was developed and described in HNF-26419, *ERDF Roll-off Container Dose Rate-to-Curie Method for Hard Debris Waste*. The work documents controlling data collection supporting the example dose rate-to-curie conversion will specify:

- Recording roll-off box identification
- Recording the box contents
- Recording uncorrected dose rate measurements as per Table 4-2
- Recording of the background dose rate
- Location of 32 dose rate measurements as being the center on each of the two ends and three locations equally spaced horizontally and centered vertically on each of the two sides with measurements at each location collected at distances from the roll-off box at contact with the surface and 30, 100, and 200 centimeters from the surface.

Measurements of mass and volume will be conducted as necessary. Mass measurements will use a weight scale. Volume may be measured by visually observing the material being measured against a standard such as a container or ruler.

Anomalous Assay

Waste that has been determined to require assay will be staged in a controlled area while a work document is written to assay the waste. Radioactive assay is performed on whole containers of waste (drums and boxes); samples are not collected. Generally, all containers of waste are subjected to assay or if intending to confirm process knowledge, then only a portion of the total waste may be assayed.

4.0 MEASUREMENTS AND SAMPLE HANDLING AND ANALYSIS

The sample handling and analysis requirements are established in this section. The collection of laboratory samples for analysis is limited to C sump, collection box, and anomalous waste sampling. Sample handling requirements generally do not apply to field measurements such as radiation dose rate, waste weight, and radioactive assay. The requirements that do apply to field measurement collection methods are specified in Section 4.3.

The application of SW-846 (EPA 1997) sample handling and analysis requirements were considered in the preparation of this SAP. The document SW-846 is designed to manage and test samples for physical and chemical parameters, not radioactivity analysis, assay, or survey dose rates. Therefore, management and testing are performed in accordance with SW-846 requirements for the testing of samples for physical and chemical parameters only. The analysis of samples for radioactive constituents is performed in accordance with laboratory-specific procedures. Radioactive dose rate measurements are performed in accordance with work documents prepared pursuant to 10 CFR 835, "Occupational Radiation Protection," and the Fluor Hanford, Inc. (FH) radiation protection plan requirements. Radioactive assay measurements are conducted in accordance with HNF-RD-10484, *Nondestructive Assay Management Program* requirements.

4.1 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample-handling, shipping, and chain-of-custody activities will be performed in accordance with quality processes and work documents that satisfy the requirements of the company quality assurance (QA) program and of SW-846 (EPA 1997). A chain-of-custody will be prepared for the samples and maintained per Section 5.1.6. Samples will be stored in a secure clean and dry area and be protected against intrusion of contamination until shipment.

4.1.1 Sample Preservation, Containers, and Holding Times

C Sump and Collection Box Samples

The composite samples being submitted to the laboratory to test for pH, metals, GEA, and gross alpha/beta shall fill a 500-milliliter square polyethylene bottle. No preservation applies to this sample bottle. A six-month holding time applies to the sample for the analysis of metals.

The composite samples being submited to the laboratory to test for SVOA and PCB shall be placed in bottles and preserved as specified in Table E-1 for each method. The chemicals being tested for and test methods are specified in Table 4-1.

The multiple bottles of sample may be consolidated as directed by the laboratory as long as compliance with SW-846 requirements (e.g., preservation) is maintained.

Anomalous Samples

Samples collected for anomalous waste analysis at a fixed laboratory shall be packaged in containers, and preserved as specified for the analytical method per Table E-1. The sample shall be subjected to testing in accordance with hold times specified in Table E-1.

Samples collected for field analysis generally have no preservation, container, or hold time requirements except as specified in Table E-1, because the samples are tested promptly in the field.

4.1.2 Sample Shipping

Transportation of samples will be performed in accordance with processes and work documents developed to ensure compliance with U.S. Department of Transportation (DOT) regulations, Title 49, *Code of Federal Regulations*, "Transportation," Parts 100 to 185 (49 CFR 100-185). Alternately, onsite transfers of samples over nonpublic thoroughfares may be transported in accordance with requirements that provide a level of safety equivalent to the DOT regulations.

4.2 SAMPLE ANALYSIS

C Sump and Collection Box Sample Analysis

Two composite samples, one collected from the C sump and the other from the collection box, shall be submitted for analysis to a laboratory. The laboratory shall test the samples for pH, chemicals listed in Table 4-1, gamma emitting radionuclides, and gross alpha/beta in accordance with SW-846 methods listed in Table 4-1, SW-846 method 9045, gamma energy analysis (GEA), and gross alpha/beta analysis. The laboratory shall comply with performance requirements stated in Table E-1 for each method and the required detection level stated in Table 4-1. The gross alpha/beta analysis is not listed in Table E-1. The performance requirements for gross alpha/beta analysis are a lower limit of detection of 5 picocuries per gram gross alpha and 10 picocuries per gram gross beta. The laboratory shall plan its work to comply with the performance requirements stated herein. However, the actual laboratory performance may be different due to sample matrix and/or interferences.

Anomalous Analysis

Samples of waste will be collected and submitted for analysis to a laboratory or may be tested in the field. The work documents shall specify the analysis method selected from Table E-1 located in Appendix E, or if not in Table E-1, then a laboratory-specific method. The laboratory shall plan its work to comply with the method performance requirements of precision, accuracy, and quantitation limits specified in Table E-1. However, the actual laboratory performance may be different due to sample matrix and/or interferences. If necessary, the laboratory shall determine, with the concurrence of the project, an alternate analysis method or performance requirement for an analysis method.

Table 4-1. List of Analytes, Methods, and Required Detection.

Chemical Name	Test Method	Required Detection (mg/Kg)
Arsenic	6010	5.0
Barium	6010	100.0
Cadmium	6010	1.0
Chromium	6010	5.0
Total Cresol	8270	200.0
2,4-dinitrotoluene	8270	0.1
Hexachlorobenzene	8270	0.1
Hexachlorobutadiene	8270	0.5
Hexachloroethane	8270	3.0
Lead	6010	5.0
Mercury	7471	0.2
Nitrobenzene	8270	2.0
Pentachlorophenol	8270	100.0
Pyridine	8270	5.0
Selenium	6010	1.0
Silver	6010	5.0
2,4,5-Trichlorophenol	8270	400.0
2,4,6-Trichlorophenol	8270	2.0
Polychlorinated biphenyl	8082	1.0

4.3 MEASUREMENTS

Weight and Survey Measurements

Dose rate measurements are collected and measurements of waste weight may be collected. The dose rate measurements shall be performed using methods and equipment that are compliant with a radiation control program established in accordance with 10 CFR 835. The measurements of weight shall be performed using weight scales. The measurement performance standards applicable to dose rate and weight measurements are presented in Table 4-2.

Table 4-2. Field Instrument Performance Requirements.

Measurement	Measurement Method	Accuracy Requirement*	Precision Requirement*
Dose rate	Bicron microrem meter or ion chamber	± 20%	± 20%
Weight	Weigh scale	± 1 % of scale	± 1 % of scale
Flammable Gas Meters	TMX 410	±15% of reading; range for any sensor as indicated on inst. sticker	Manufacturer specification
	TMX 412	±15% of reading; range for any sensor as indicated on inst. sticker	Manufacturer specification
	Foxboro TVA 1000	Greater of ± 2.5 ppm or ± 25% reading	Manufacturer specification

*The stated performance standard or manufacturer specification.

Anomalous Field Measurements

Field measurements include use of dip strips and gas meters. The performance requirements for some flammable gas meters are listed in Table 4-2. Performance requirements for some dip strip and other field tests are described in Table E-1. Other methods may be selected, but performance requirements must be established in the governing work documents.

Anomalous Assay

Either or both of two general types of assay systems may be used, gamma spectroscopy and neutron counting. The measurement performance standards for radioactive assay are presented in Table 4-3 that apply to each method stated. Other systems may be used if they meet performance standards that support decision-making, that is, they exhibit adequate limits of detection and acceptable measurement uncertainty. All assay systems shall comply with the requirements of HNF-RD-10484.

Table 4-3. Assay Instrument Performance Requirements.

Measurement	Measurement method	Accuracy (%R)	Precision (%RSD)
Pu-239 or Pu-240	Active or Passive Neutron Counting	Low: 40% High: 160%	< 15%
Pu-239 or any other isotope which is directly measured)	Gamma Spectroscopy	Low: 40% High: 160%	< 15% for radionuclides present at greater than or equal to 10 times the MDA < 30% for radionuclides present at less than 10 times the MDA

%R = Percent recovery defined as the ratio of the mean of the measured value to the known (or accepted) value, expressed as a percent.

%RSD = Percent relative standard deviation based on six replicate measurements. The relative standard deviation is referenced to the known (or accepted) value for the test, not to the mean of the measurements.

MDA = Minimum detectable activity.

5.0 QUALITY ASSURANCE PROJECT PLAN

This QA project plan describes the specific QA procedures and quality control (QC) activities associated with data acquisition supporting the disposal of waste generated from 105-K East Basin demolition.

This document has been prepared consistent with EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*, as supplemented by EPA QA/G-5, *Guidance for Quality Assurance Project Plans*. A crosswalk is provided in Appendix A that indexes the requirements of EPA QA/R-5 with the layout of this SAP. The quality assurance project plan includes the following four elements:

- Project management
- Data generation and acquisition
- Assessment and oversight
- Data review, verification, validation, and usability.

This document applies the requirements of SW-846 (EPA 1997) where applicable. The SW-846 requirements apply to sample collection and analysis for chemical constituents but not other activities such as assay and radiation dose rate measurement.

5.1 PROJECT MANAGEMENT

This section establishes the Project task, organization and roles, training requirements, quality objectives, and document control requirements.

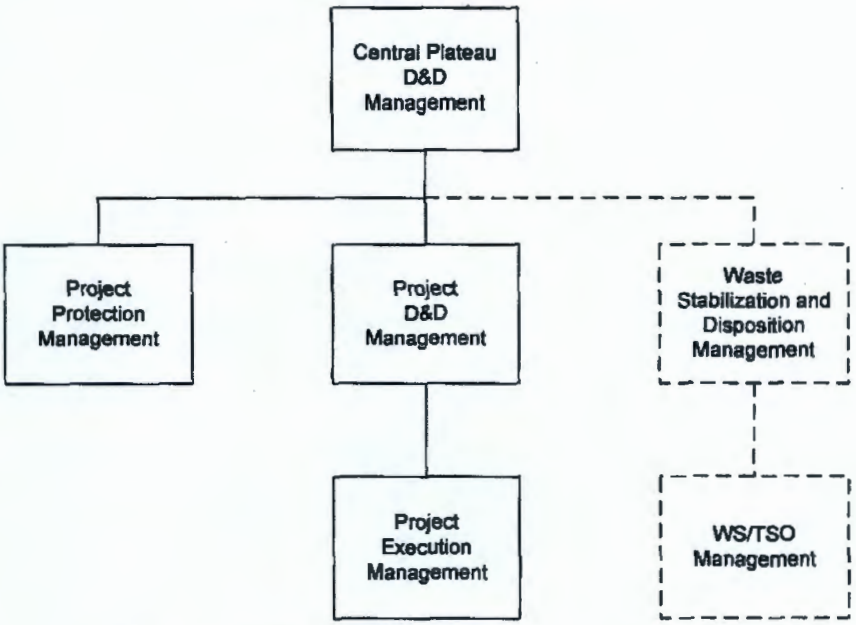
5.1.1 Project Task/Description

The D&D Project will excavate soil to gain access to the basin sub grade and demolish and remove the 105-K East Basin. The excavated soil will remain as stock piled material and is not within the scope of this project task. The removal will generally involve fixing radioactivity with grout and other fixatives, then crushing or cutting of the structure and equipment for loading into transport containers. The demolition will generate rubble and debris that will or could be contaminated with radioactivity that must be transported for disposal at ERDF. To ensure proper disposal, the waste must be generated and characterized to comply with the ERDF waste acceptance criteria.

5.1.2 Project Organization

Figure 5-1 is an organization chart showing project relationships and lines of communication.

Figure 5-1. Project Organization.



D&D = Deactivation and demolition.
TSO = Transportation Safety Operations
WS = Waste Services

5.1.3 Roles and Responsibilities

This section identifies the responsibilities of the organizations demolishing the 105-K East Basin and disposing of the waste. Each organization is responsible to manage corrective actions associated with work performed by the organization and maintain the qualifications of personnel performing work in accordance with this SAP. The specific roles and responsibilities are listed below for each organization.

Central Plateau D&D Management

The Central Plateau D&D Project management is responsible for all activities to accomplish demolition of 105-K East Basin, integrating the activities and setting priorities as necessary.

Project- D&D/Project Execution Management

The Project D&D/Project Execution management is responsible to:

- Manage and integrate 105-K East Basin demolition activities
- Procure equipment and services necessary to perform demolition operations
- Manage operations to demolish the facility and load rubble and debris waste for transport to disposal
- Excavate around the basin to gain access to the facility substructures

- Collect samples from the C sump and collection box
- Perform data review and validation of data collected, as necessary.

Project Protection Management

The Project Protection management is responsible to:

- Provide environmental, health, QA, and safety support to demolition activities
- Collect dose rate measurements to support waste characterization and monitoring for hot spots
- Perform data review and validation of survey data collected to perform dose rate-to-curie calculations
- Conduct surveillances to verify compliance with the implementation of this SAP.

Waste Stabilization and Disposition /Waste Services and Transportation Safety Operations Management

The Waste Stabilization and Disposition/Waste Services and Transportation Safety Operations management are responsible to:

- Perform data review and validation for data collected, as necessary, and evaluate data for compliance with user requirements
- Perform waste designation and radioactive waste classification determinations
- Prepare ERDF waste profile and shipping papers
- Ship waste to ERDF for disposal.

5.1.4 Special Training Requirements and Certifications

The activities performed in accordance with this SAP are routine and do not require special training with the exception of assay operators. The training of personnel is performed and maintained in accordance with the FH training and QA program.

The assay unit personnel shall be trained in accordance with training requirements of ASTM C 1490, *Standard Guide for Selection, Training, and Qualification of Nondestructive Assay (NDA) Personnel ANSI N15.54, Radiometeric Calorimeters- Measurement Control Program* (ASTM 2004).

5.1.5 Quality Assurance Objectives and Criteria for Measurement Data

The objective of this SAP is to obtain data of known and appropriate quality to support waste disposal at the ERDF as established by the decision rules (DR) presented in Table 1-5.

Data QA objectives (QAO) are expressed as representativeness, comparability, accuracy, precision, and completeness. These parameters are defined as follows:

- **Representativeness** – A measure of how closely data reflect the characteristic of a population, a parameter, variations at a sampling point, or environmental conditions.
- **Comparability** – A measure of the confidence with which one data set can be compared to another.
- **Accuracy** – The degree to which the data agree with an accepted reference or true value.
- **Precision** – A measure of the mutual agreement between comparable data gathered or developed under similar conditions.
- **Completeness** – A measure of the amount of valid data obtained compared to the amount that was expected.

The applicable QC 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. The QAO are specified for assay, field measurements (dose rate and weight), and sample analysis in Table F-1, F-2, and F-3 of Appendix F.

5.1.6 Documentation and Records

The project documentation will be maintained in accordance with quality process and work documents that satisfy the quality criteria fundamentals expressed in the FH QA program. These processes and work documents identify records and establish record access control, retention, and record management requirements.

The laboratory documentation will be maintained in accordance with quality process and work documents that satisfy the quality criteria fundamentals expressed in the laboratory QA program. These processes and work documents identify records and establish record access control, retention, and record management requirements.

5.2 DATA GENERATION AND ACQUISITION

This section describes QC requirements; instrument testing, inspection, and maintenance requirements; calibration; and acceptance inspection requirements. Information regarding sample collection and measurement design, sample collection and measurement methods, sample handling and custody, and test methods is provided in Sections 2.0, 3.0, and 4.0 of this SAP.

5.2.1 Quality Control Requirements

Field Samples

Field QC samples will be specified in the work documents prepared for sampling as necessary. The possible field QC samples that may be specified are:

- Field duplicates- samples collected with enough volume to permit two separate samples being submitted for analysis using the same analytical equipment.
- Split samples- duplicates that are sent to separate analytical facilities.
- Equipment blanks- pure material that has been contacted with sample collection equipment (e.g., deionized water washed through decontaminated sampling equipment and placed in containers identical to those used for actual samples).
- Field blanks- analyte-free material (e.g., water, which is poured into a sample container at the sample collection site).
- Trip blanks- organic-free water in a 40-mL vial sent from the laboratory that will be performing volatile organic compounds (VOC) analyses for the project.

One equipment blank will be submitted with the C sump and collection box composite samples to the laboratory to be subjected to the same analyses as the composite samples.

Laboratory Testing

Laboratory QA/QC procedures and adherence to analytical method tolerances are critical to obtaining high-quality laboratory data. Each analysis conducted on samples will adhere to all QA/QC procedures, QA/QC control limits, and method-specific corrective actions as possible given the radioactive nature of the samples. Table E-1 specifies the acceptable QA/QC tolerances applicable to most methods. The QA/QC laboratory samples shall be run in batches of 20 samples or less.

Laboratory QA/QC limits applicable to gross alpha/beta analysis is:

- Laboratory control sample recovery between 80% and 120%
- Duplicate result is ± 20% relative percent difference
- Blank result is ± 10 ρCi/L.

Field Testing

The QC of testing waste samples in the field (not at a fixed laboratory) shall involve the testing of one duplicate and one field or equipment blank per 20 or less field tests.

Radioactive Assay

The radioactive assaying of containers of waste shall meet the performance standards shown in Table 4-3. The following QC tests are performed daily:

- Sources used for equipment calibration and QC checks shall have a documented pedigree (or secondary traceability) to a nationally recognized standard. Calibration standards and check standards shall be independent of each other.

- Perform background and other applicable performance checks prior to the first assay of a batch and before and after the assay measurements of a batch and maintain the assay system in statistical process control. For a gamma system, such checks typically include energy, resolution, and efficiency. For neutron systems, such checks may include efficiency and other checks related to the neutron source if such a source is used (e.g., active neutron interrogation).

- The QC checks (e.g., background, energy calibration and resolution and efficiency) shall be documented by the Contractor on a control chart and the assay system operated within statistical process control limits as defined in the Contractor's work documents.

Also, a minimum of one replicate assay is performed during a batch or once per week.

Field Measurements

A weight scale shall be calibrated and operated in accordance with manufacturer instructions.

A dose rate meter shall be calibrated and operated in accordance with manufacturer instructions. Each dose rate meter when used will be subjected to daily performance check for response.

A gas meter shall be calibrated and operated in accordance with manufacturer instructions. Each gas meter when used shall be subjected to daily performance checks for response to a gas standard.

5.2.2 Instrument Testing, Inspection, and Maintenance

Field instruments used to take measurements will be tested, inspected, and maintained in accordance with quality processes and work documents that satisfy the requirements of the FH QA program. The processes and work documents shall identify the instruments that require testing, inspection, or maintenance, specify the frequency, and establish the methods to be used to test, inspect, and/or maintain each instrument. Correction of nonconformances shall be in accordance with quality processes and work documents that describe the identification, tracking, and close out of issues, and satisfy requirements of the FH QA program.

Instruments used by laboratories to conduct testing shall be tested, inspected, and maintained in accordance with quality processes and work documents established by the laboratory. The processes and work documents identifies the instruments requiring testing, inspection, or maintenance, specify the frequency, and establish the methods to be used to test, inspect, and/or maintain each instrument. Correction of nonconformances shall be in accordance with quality processes and work documents that describe the identification, tracking, and close out of issues in accordance with laboratory work documents.

5.2.3 Instrument Calibration and Calibration Frequency

Field instruments used to take measurements will be calibrated in accordance with quality processes and work documents that satisfy the requirements of the FH QA program. The processes and work documents shall identify the instruments that require calibration, specify the frequency, and establish the methods to be used to calibrate each instrument. Correction of nonconformances shall be in accordance with quality processes and work documents that describe the identification, tracking, and close out of issues, and satisfy requirements of the FH QA program.

Instruments used by laboratories to conduct testing shall be calibrated in accordance with quality processes and work documents established by the laboratory. The processes and work documents shall identify the instruments that require calibration, specify the frequency, and establish the methods to be used to calibrate each instrument. Correction of nonconformances shall be in accordance with quality processes and work documents that describe the identification, tracking, and close out of issues in accordance with laboratory work documents.

5.2.4 Inspection/Acceptance Requirements for Supplies

Supplies obtained to support field instruments used to take measurements will be inspected and accepted in accordance with quality processes and work documents that satisfy the requirements of the FH QA program. The processes and work documents shall identify the supply inspection/acceptance requirements and the methods used to inspect/accept supplies. Correction of nonconformances shall be in accordance with quality processes and work documents that satisfy requirements of the FH QA program.

Supplies obtained to support laboratory instruments used to take measurements will be inspected and accepted in accordance with quality processes and work documents that satisfy the requirements of the laboratory QA program. The processes and work documents shall identify the supply inspection/acceptance requirements and the methods used to inspect/accept supplies. Correction of nonconformances shall be in accordance with quality processes and work documents that satisfy requirements of the laboratory QA program.

5.2.5 Non-direct Measurement

The radioactive characterization of waste streams number1, 105-K East Basin superstructure rubble; number 4, outside equipment and structures rubble produced from the HIH; D sump; and holding tank systems; and number 5, liquids, use a dose rate-to-curie method. The radioactive characterization of waste stream number 3, high dose rate rubble and debris, may also use a dose rate-to-curie method. The dose rate-to-curie method measures dose rate to determine an inventory of Cs-137 then use a radionuclide distribution to calculate a total radionuclide inventory in a container. A radionuclide distribution has been determined that is applicable to waste streams number 1, number 4, and number 5 is provided in Table 2-1. A distribution applicable to a container of waste stream number 3, high dose rate rubble and debris, may be

determined by either identifying the preponderance of the radioactivity as being from one source (e.g., techview/weasel pit area) then using that source distribution or calculated by aggregating the activity added to a container then using the aggregated distribution.

The concentration of radionuclides has been calculated for rubble generated in each of the areas in waste stream number 2, 105-K East Basin substructure. The areas that have concentrations calculated are the upper walls, each basin bay, NLOP, SLOP, DEP, and combined techview/weasel pits. The calculations aggregate the radioactivity contributions from sludge, debris, and activity that penetrated below-water concrete surface to determine a concentration. These calculated concentrations are all presented in Table C-1 and Tables C-3 through C-9 of D&D-35176.

The radioactive distributions for HIH, D sump, holding tank, and superstructure rubble and concentrations of radioactivity in sludge and concrete surfaces have all been established using both measured values and ratios to fuel data. Generally, the measured values are used as reported, then the nuclides that are not measured are calculated using a ratio to spent fuel of a measured nuclide. The process of determining the radioactive distributions for HIH, D sump, holding tank, and 105-K East Basin superstructure rubble is provided in Appendix C. The process of determining the radioactive concentrations of sludge and below-water concrete surfaces are provided in Appendix A and B of KBC-24413 and Appendix D of KBC-25121, respectively.

The concentration of COC for C sump and collection box rubble shall be calculated using sample analysis results and determination of the quantity of sludge contaminating the systems. The concentration of chemicals and radioactivity in the rubble generated by size reducing each system is calculated by multiplying the sample analysis result by the quantity of sludge contaminating the system then dividing the result by the volume or mass of rubble. Some radionuclides that are COC will not be reported; the concentration of these will be calculated by ratioing them to a measured radionuclide using both K East Basin below-water metal distribution listed in Table 2-1 and contamination from reactor process tube (cooling water) listed in Table B4-3. It is appropriate to represent the radionuclide contamination by both reactor process tube contamination and KE below-water washed metal because the sources of contamination include both basin water and reactor cooling water. The quantity of COC in a container is calculated by multiplying the rubble concentration by the quantity of rubble in the container.

The volume of waste in a container may be calculated based on the capacity of the container and observation of the container when it is filled or using an appropriate bulk density of the waste and the measured waste weight. The mass of waste in a container may be calculated based on the capacity of the container and observation of the container when it is filled and an appropriate bulk density.

5.2.6 Data Management

Data will be collected and reported in accordance with work documents governing the activity. The work documents shall describe data reduction, data reporting, and mechanisms to detect and correct errors. The Project will collect dose rate measurements, visually observe contamination in the C sump and collection box and submit samples collected from the C sump and collection

box for laboratory analysis. The Project may characterize anomalous waste by collecting other samples for analysis, weight measurements, gas meter measurements, and container assay data. The data reporting requirements for the various data types is described below.

Radiation Survey

All dose rates collected for the purpose of performing a dose rate-to-curie calculation shall be recorded in a survey report. The survey reports of dose rate shall contain at a minimum the following information:

- The date the survey was performed
- A unique survey identification number
- The area, building, and room location, as appropriate, where the survey was performed
- The radiation work permit and work document under which the survey was performed
- The identity of the instruments used
- The identity of the container being surveyed
- A map and/or description of the locations where measurements were taken on the container
- The measurements of beta/gamma dose rate are reported in mRem/hr.
- Radiation Control Technician name and signature and date
- Report reviewer name and signature and date.

Weight, Visual Observation and Gas Meter Measurements

The data sheet used to record container weights shall contain at a minimum the following information:

- Identification of the container, as applicable
- Person's name and signature recording the measurement
- Date the measurement was taken
- Identification of the equipment used to make the measurement (equipment number or make, model, and serial number)
- The measurement with units specified
- Identification of the work document directing the measurement activity

- Location where the measurement was taken
- Identification of conditions or occurrences that may affect the quality of the data, as necessary.

Laboratory Data

The laboratory shall provide the Project batch data reports consisting of sample analysis results performed in a day or operating period (may be more than one day). For each batch data report, the following shall be reported:

- Sample chain of custody
- A case narrative describing the analysis, limitations on the analysis results, and QA/QC issues associated with the results
- Report the analytical results with QA/QC measurement results
- Report analytical results per the units specified for the method per Table E-1
- Index of laboratory sample number with sample number assigned by the Project.

Documentation of analysis of samples performed by a fixed laboratory will be maintained in accordance with the laboratory QA program.

Assay

Assay personnel quantify radionuclide values in accordance with requirements in work documents. Computer software will be identified, documented, changed, and controlled in accordance with work documents. Quantification of radionuclides is performed in accordance with work documents that specify equipment operation, personnel training, data reduction and calculations, and report review and approval. Correction of nonconformances shall be in accordance with requirements established and implemented through a QA plan that meets the requirements of the FH QA program.

Assay data will be reported in batch data reports consisting of assays performed in a day or operating period (may be more than one day). For each batch data report, 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

- The results of QC checks performed
- 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 low-level waste (LLW)
- 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 percent confidence level of each isotope detected or identified by ratio
- Identification of radionuclide ratios used for plutonium quantification
- The TRU concentration reported in nCi/g and the uncertainty value calculated at the two-sided 95 percent confidence level
- The minimum detectable activity (MDA) of gamma-emitting isotopes of concern that were not detected by gamma energy analysis
- Total measurement uncertainty for the assay system.

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

5.3 ASSESSMENT/OVERSIGHT FOR MEASUREMENTS

This section describes assessments and reports to management applicable to 105-K East Basin demolition.

5.3.1 Assessments and Response Actions

Audits, assessments, and self-assessments shall be performed as described in DOE/RL-2007-48. Nonconformance corrections shall be in accordance with quality processes and work documents that satisfy the quality criteria fundamentals expressed in the FH QA program.

5.3.2 Reports to Management

Project QA personnel will report surveillance and assessment of the 105-K East Basin demolition process results to D&D Project management and Waste Stabilization and Disposition management, as applicable. Nonconformance corrections shall be in accordance with quality processes and work documents that satisfy the quality criteria fundamentals expressed in the QA program.

5.4 DATA REVIEW, VERIFICATION, VALIDATION, AND USABILITY

This section specifies data review, verification, validation, and usability requirements.

5.4.1 Data Review, Verification, and Validation

The data collected shall be reviewed, verified, as applicable, and validated prior to use for decision making. An independent third party data validation will not be conducted for these data. All the measurements and tests performed in accordance with this SAP are reviewed, verified, and validated as indicated in Table 5-1.

Table 5-1. Data Review, Verification, and Validation.

Data Collection	Review	Verification	Validation
Assay	Assay operator	Assay technician	Project designee
Field Measurements (weight, dose rate, etc)	Radiation control supervisor for dose rates, all others are Project designee	Not applicable	Radiation control supervisor for dose rates, all others are Project designee
Laboratory Tests	Laboratory representative	Laboratory representative	WS representative
Field Tests (pH, paint filter, etc.)	Project designee	Not applicable	Project designee

WS = Waste Services.

All data reports shall be reviewed by the organization identified in Table 5-1 to ensure that it contains the required elements of Section 5.2.6, is complete, and calculations, if applicable, are performed correctly. The data report reviewer shall sign the report or work document indicating that the review has been completed.

5.4.2 Data Verification and Validation Methods

The laboratory and assay equipment operating organizations shall verify their respective batch test reports documenting their test results before issuing them to the Project. The other data collection activities are not subject to these verification requirements. Data verification performed on fixed laboratory results is primarily to confirm that sampling and chain-of-custody

documentation are complete, sample numbers can be associated with the specific sampling locations, samples were analyzed within the required holding times, and analyses met the data QC requirements of Section 5.2.1 of this SAP. Data verification performed on assay results shall confirm the container numbers can be associated with the test results and the results satisfy the QC requirements of Section 5.2.1 of this SAP. The results of the verification shall be incorporated in the batch report provided by the laboratory or assay technician, as applicable, to the Project in accordance with Section 5.2.6 of this SAP.

All the data collected shall be validated by evaluating the measurement system to ensure the QAO applicable to the data are satisfied. The evaluation will be recorded on the checklists, or equivalent, of Figures F-1 and F-2 provided in Appendix F. The criteria that are applicable to determining satisfaction of the QAO are provided by measurement type in Tables F-1 through F-4 located in Appendix F.

5.4.3 Reconciliation with User Requirements

Data that have been reviewed, verified, and validated are evaluated to determine the data adequately supports decision making to dispose of the waste at the ERDF. Each shipment of waste to ERDF shall be evaluated for compliance with the requirements of this SAP prior to shipment to the ERDF for treatment and/or disposal. At a minimum, compliance with the DR requirements described in this SAP shall be evaluated. The evaluation of compliance with user requirements shall be recorded on the checklist of Figure G-1, or equivalent, provided in Appendix G, and placed in records.

6.0 REFERENCES

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APPENDIX A

EPA QUALITY ASSURANCE PROJECT REQUIREMENTS CROSSWALK

APPENDIX A

EPA QUALITY ASSURANCE PROJECT REQUIREMENTS CROSSWALK

Table A-1 is a crosswalk of the requirements of EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans* that this SAP was written in accordance with to the sampling and analysis (SAP) document organization. The section number and title shown in the column entitled SAP indicates where in the SAP the EPA QA/R-5 elements are incorporated. The elements A1 through A3 of EPA QA/R-5 are not shown in Table A-1, but are incorporated by the title page, document approval record, and distribution.

Table A-1. Crosswalk of SAP Outline with EPA QA/R-5 Required Elements. (2 sheets)

EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans	Sampling and Analysis Plan
A4- Project/Task Organization	5.1.2 Project Organization
A4- Project/Task Organization	5.1.3 Roles and Responsibilities
A5- Problem Definition and Background	1.1 BACKGROUND
A5- Problem Definition and Background	1.2 K East Basin Deactivation and Demolition Activities
A5- Problem Definition and Background	1.4.1 Statement of Problem
A6- Project/Task Description	5.1.1 Project/Task Description
A7- Quality Objectives and Criteria	5.1.5 Quality Assurance Objectives and Criteria for Measurement Data
A8- Special Training/Certification	5.1.4 Special Training Requirements and Certification
A9- Documents and Records	5.1.6 Documentation and Records
B1- Sampling Process Design	2.0 SAMPLING AND MEASUREMENT RATIONALE AND DESIGN
B2- Sampling Methods	3.1 SAMPLE COLLECTION LOCATION AND FREQUENCY
B2- Sampling Methods	3.2 SAMPLE COLLECTION METHODS
B2- Sampling Methods	3.3 MEASUREMENT LOCATION AND FREQUENCY
B3- Sample Handling and Custody	4.1 SAMPLE HANDLING AND CUSTODY REQUIREMENTS
B3- Sample Handling and Custody	4.1.1 Sample Preservation, Containers, and Holding Times
B3- Sample Handling and Custody	4.1.2 Sample Shipping
B4- Analytical Methods	4.2 SAMPLE ANALYSIS
B4- Analytical Methods	4.3 MEASUREMENTS
B5- Quality Control	5.2.1 Quality Control Requirements
B6- Instrument/Equipment Testing, Inspection, and Maintenance	5.2.2 Instrument Testing, Inspection, and Maintenance
B7- Instrument/Equipment Calibration and	5.2.3 Instrument Calibration and Calibration

Table A-1. Crosswalk of SAP Outline with EPA QA/R-5 Required Elements. (2 sheets)

EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans	**Sampling and Analysis Plan**
Frequency	Frequency
B8- Inspection/Acceptance of Supplies and Consumables	5.2.4 Inspection/Acceptance Requirements for Supplies
B9- Non-direct Measurements	5.2.5 Non-direct Measurement
B10- Data Management	5.2.6 Data Management
C1- Assessments and Response Actions	5.3.1 Assessments and Response Actions
C2- Reports to Management	5.3.2 Reports to Management
D1- Data Review, Verification, and Validation	5.4.1 Data Review, Verification, and Validation
D2- Verification and Validation Methods	5.4.2 Verification and Validation Methods
D3- Reconciliation with User Requirements	5.4.3 Reconciliation With User Requirements

EPA = U.S. Environmental Protection Agency.
SAP = Sampling and Analysis Plan..

REFERENCE

EPA QA/R-5, 2001, *EPA Requirements for Quality Assurance Project Plans*, U.S. Environmental Protection Agency, Washington, D.C.

APPENDIX B

DATA QUALITY OBJECTIVES REPORT FOR LIQUID REMOVED FROM THE 105-K EAST BASIN AND WASTE SITES

APPENDIX B

DATA QUALITY OBJECTIVES REPORT FOR LIQUID REMOVED FROM THE 105-K EAST BASIN AND WASTE SITES

B1.0 INTRODUCTION

This appendix contains a summary of the data quality objectives (DQO) process applied to liquids and rubble created from waste sites removed by the 105-K East Basin demolition. These wastes were not considered in DQO documents prepared for deactivation such as HNF-6273, *Data Quality Objectives Process for Designation of K-Basins Debris*, so the DQO process was applied to these demolition waste streams herein. This appendix is prepared in accordance with guidance provided in EPA QA/G-4, *Guidance for the Data Quality Objectives Process*.

Demolition of the 105-K East Basin will involve the collection of liquids for treatment and removal of some contaminated waste sites that are located outside and adjacent to the 105-K Basin facility for eventual disposal at the Environmental Restoration Disposal Facility (ERDF). Liquid will be removed from equipment prior to reducing the 105-K East Basin to rubble, though some liquid could be encountered during structure and debris size reduction. The liquid waste, which consists of oils, hydraulic fluid, cooling fluid, and greases collected from equipment, are listed in Table B1-1. Waste sites will be removed with the excavation of soil on the north side of the 105-K Basin facility to gain access to the basin substructure. Soil, except for incidental quantities, is not in the scope of this document. The waste sites being removed are listed on Table 2-2 and consist of tanks, structures, pumps, pipes, and electrical equipment. The waste site equipment will be removed, reduced to rubble, and the rubble transported to ERDF for disposal. The Hose-in-Hose (HIH) system is not included in the scope of this appendix.

Table B1-1. List of Liquid Products. (2 sheets)

Liquid Product Name
Conaco Hydroclear R&O 100
Houghto-Safe 620
Chevron Gear Compound EP-ISO 320
Chevron Delo Motor Oil 400 SAE 10W
Durex All Purpose Gear Oil 80W-90W
Propylene Glycol Industrial Grade
Lubriplate® No. 630-A, No. 630-AA, No. 630-AAA, 630-2
Chevron Dura-Lith grease, EP NLGI 2
CITCO EP Compound 460
DOW[3] Corning M Gear Oil Additive

[3] A trademark of the DOW Chemical Company.

Table B1-1. List of Liquid Products. (2 sheets)

Liquid Product Name
Mobilfluid 424
Mobil lubricant 970446 Glygoyle grease 00
Mobilith AW-2
Mobilux EP 2
Mobilux EP 111
Coffing Transmission Oil H7813
00927 MARFAK 0

B2.0 STEP 1 - STATE THE PROBLEM

Radioactive rubble created from waste sites and liquid wastes will be generated during the demolition of the 105-K East Basin that must be disposed at ERDF, if possible. Waste site waste consists of rubble made by size-reducing structures, equipment, piping, and electrical equipment. This DQO process shall establish the requirements and methods to be used to designate, radioactively classify, and determine the compliance of the rubble made from waste sites and liquid waste with the ERDF waste acceptance Criteria WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.*

B2.1 Available Information

A listing of sources of information about the liquid and rubble wastes are provided in Table B2-1.

Table B2-1. Existing Documents and Data Sources for Waste Characteristics. (4 pages)

Reference	Summary
Material Safety Data Sheets	
Number 010775, Conaco Hydroclear R&O 100	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 014202A, Houghto-Safe 620	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 018349A, Chevron Gear Compound EP-ISO 320	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 013409, Chevron Delo Motor Oil 400 SAE 10W	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 061546, Durex All Purpose Gear Oil 80W-90W	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.

Table B2-1. Existing Documents and Data Sources for Waste Characteristics. (4 pages)

Reference	Summary
Number 042824, Propylene Glycol Industrial Grade	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 011494, Lubriplate® No. 630-A, No. 630-AA, No. 630-AAA, 630-2	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 019404, Chevron Dura-Lith grease, EP NLGI 2	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 062363, CITCO EP Compound 460	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 062264, DOW[4] Corning M Gear Oil Additive	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 032701, Mobilfluid 424	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 066061,Gygoyle Grease	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 018030, Mobilith AW-2	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 011582A, Mobilux EP 2	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 023411, Mobilux EP 111	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 031152, Coffing Transmission Oil H7813	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Number 013821A, 00927 MARFAK 0	Material Safety Data Sheets provide physical, chemical, safety, use, and environmental information about the product.
Liquid Characterization Documents	
Analytical Report Number WSCF20071576	A report of analysis performed on samples of 105-K East Basin water.
Analytical Report Number WSCF20071381	A report of analysis performed on samples of 105-K East Basin water.

[4] A trademark of the DOW Chemical Company.

Table B2-1. Existing Documents and Data Sources for Waste Characteristics. (4 pages)

Reference	Summary
Analytical Report Number WSCF20071754	A report of analysis performed on samples of 105-K East Basin water.
HNF-6495, *Sampling and Analysis Plan for K Basins Debris*	A document describing the characterization of debris waste removed from the 105-K East and West Basins.
HNF-SD-SNF-TI-009, *105-K Basin Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities*	A document presenting information about the characteristic of spent fuel that had been stored in the 105-K East and West Basins.
SD-CP-TI-105, 1987, *ORIGEN2 Prediction of Reactor Fuel Actinide Composition*	A document presenting information about the radioactive content of spent fuel that had been stored in the 105-K East and West Basins
WHC-EP-0877, *K Basin Corrosion Program Report*	A document that describes K Basins water conditions history and related activities.
Waste Site Characterization Documents	
Analytical Report Number WSCF20071560	A report of analysis performed of a monthly sample of water discharged to the river.
Analytical Report for Sample 0328WQL	A report of analysis performed of a sample of water collected from D sump.
Waste Information Data System General Summary Report for 100-K-68	Site 100-K-69, 105-K East Pump Gallery and Catch Tank, D Sump report provides descriptions of the processes, site, location and structures associated with the site.
Waste Information Data System General Summary Report for 100-K-69	Site 100-K-69, 105-K East Sump C report provides descriptions of the processes, site, location and structures associated with the site.
Waste Information Data System General Summary Report for 100-K-70	Site100-K-70, 105-K East Waste Storage Tank, Holding Tank report provides descriptions of the processes, site, location and structures associated with the site.
Waste Information Data System General Summary Report for 100-K-71	Site 100-K-71, 105-K East Collection Box report provides descriptions of the processes, site, location and structures associated with the site.
HW-24800-103, Vol. 1, *Completion Report Project CA-512, 100-K Reactor Plants*	The document describes the systems installed composing the 105-K reactor and the status at that time.
WHC-SD-EN-TI-239, *100-K Area Technical Baseline Report*	The document describes the facilities and environmental conditions of the facilities located in the 100-K Area.
UNI-3714, 1987, *Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford*	The document calculates the radionuclide inventory of Hanford production reactors including the K East reactor.
D&D-35109, *Description of Rooms and Equipment Located Between the Structural F and G Line of 105KE Reactor*	The document describes the systems installed located between the 105-K reactor F and G lines and hazards posed by the material and systems.
SNF-11168, *100 K Facility Deactivation Document*	The document describes the activities undertaken to

Table B2-1. Existing Documents and Data Sources for Waste Characteristics. (4 pages)

Reference	Summary
	deactivate the 100 K reactor facilities.

Notes:
Full reference information is provided in Section B9.0, References.

B2.2 Identification of Contaminants of Concern

Contaminants of concern (COC) for the facility under investigation are generated by initially listing the contaminants of potential concern (COPC) based on historical process operations. Radionuclide COPCs with short half-lives, COPCs not environmentally regulated, and COPCs for which process knowledge and analytical data are sufficient to confirm that insignificant concentrations exist are excluded, thus leaving the final COC list. A list of COPC is provided in Table B2-2.

The identification of COC is based on Material Safety Data Sheet (MSDS) information and service for all liquids except basin water. Oils to be removed from waste sites will potentially be contaminated with same material as the rubble being created in the area. Basin water has been tested for chemical contamination and is routinely tested for radioactive content.

The rubble from waste sites is characterized based on the waste site service. As described in Table 2-2, the D sump and holding tank either serviced or could have serviced basin water, so the characterization applicable to KE/KW below-water washed metal is applicable. The C sump serviced basin water and solutions from decontamination performed in basin areas, so radioactive contamination is the same as KE/KW below-water washed metal. The collection box serviced basin water; drains located in office areas, basin areas, and reactor areas, decontamination performed in reactor areas; rod cooling water; and reactor water contaminated with ruptured fuel (Pluto crib drain). Therefore, the collection box radioactive contamination will be the same as KE/KW below-water washed metal plus contaminants from reactor water service.

Table B2-2. Contaminants of Potential Concern for Each Waste Stream. (3 sheets)

WS No.	Waste Stream	Known or Suspected Source of Contamination	Type of Contamination (General)	COPCs (Specific)
B1	Oils, greases, hydraulic fluids, and cooling fluids that are removed from equipment.	Spent fuel	Radionuclides	Radionuclides[a]

Table B2-2. Contaminants of Potential Concern for Each Waste Stream. (3 sheets)

WS No.	Waste Stream	Known or Suspected Source of Contamination	Type of Contamination (General)	COPCs (Specific)
		Oil	Chevron Delo Motor Oil 400 SAE 10W, Durex All Purpose Gear Oil 80W-90W, CITCO EP Compound 460, DOW Corning M Gear Oil Additive, Mobilfluid 424, Mobilith AW-2, Coffing Transmission Oil H7813	Lubricating base oil, zinc alkyl dithiophospates, highly-refined base oils solvent-refined heavy paraffinic petroleum distillate, petroleum, calcium sulfonate,
		Grease	Chevron Gear Compound EP-ISO 320, Lubriplate (No. 630-A, No. 630-AA, No. 630-AAA, 630-2), Chevron Dura-Lith grease (EP NLGI 2), Mobil lubricant 970446 Glygoyle grease 00, Mobilux EP 2, Mobilux EP 111, 00927 MARFAK 0	Highly-refined base oils, lubricating base oil, octadecanoic acid; 12-hydroxy-; monolithium salt, fatty acids; C16-C22; lithium salts, phosphorodithioic acid; mixed O; O- bis(iso-BU and pnetyl) esters; zinc salts, resin acids and rosin acids; zinc salts, zinc dialkyl dithiphosphate, disulfides; C5-C12-alkyl, molybdenum; bis(O,O-bis(2-ethylhexyl) phosphorodithioate-S;S') dioxodi-mu-thioxodi, lithium hydroxide, calcium tallowate, sodium tallowate, chlorinated parrafin (alkanes, chloro), highly-refined base oils solvent-refined heavy paraffinic petroleum distillate, petroleum
		Hydraulic fluid	Conaco Hydroclear R&O 100, Houghto-Safe 620	Highly-Refined Base Oils, 2 -(Diethylamino0 Ethanol, Diethylene Glycol
		Heat exchanger fluid	Propylene glycol water mixture	Propylene glycol
B2	Basin water	Spent fuel	Radionuclides	Radionuclides[a]
		Basin water	Radionuclides (from spent fuel), algaecides	Radionuclides[a], sodium fluorescein, H_2O_2, NaOCl, $Ca(OCl)_2$[b]

Table B2-2. Contaminants of Potential Concern for Each Waste Stream. (3 sheets)

WS No.	Waste Stream	Known or Suspected Source of Contamination	Type of Contamination (General)	COPCs (Specific)
		sludge	PCB	PCB
B3	Waste sites 100-K-68 and 100-K-70 that either was not placed into service or serviced basin water.	Spent fuel	Radionuclides	Radionuclides[a]
		Basin water	Radionuclides (from spent fuel), algaecides	Radionuclides[a], sodium fluorescein, H_2O_2, NaOCl, $Ca(OCl)_2$[b]
		sludge	PCB	PCB
B4	Waste sites 100-K-69 and 100-K-71 that serviced various water, decon, or other process solutions.	Spent fuel	Radionuclides	Radionuclides[a]
		Basin water	Radionuclides (from spent fuel), algaecides	Radionuclides[a], sodium fluorescein, H_2O_2, NaOCl, $Ca(OCl)_2$[b]
		Decontamination solutions from reactor and basin areas	Radionuclides (from spent fuel), soap, chromic acid, citric acid, oxalic acid, nitric acid, sulfamic acid, fluoride and organic compounds	Radionuclides[a,c], pH, oxidizer, soap, chromic acid, citric acid, oxalic acid, nitric acid, sulfamic acid, fluoride, trisodium phosphate, toxic characteristic metals and organics[e]
		Rod cooling water	Radionuclides (from spent fuel and activated elements) and water treatment chemicals	Radionuclides[a,c], sodium dichromate[d]
		Reactor cooling water	Radionuclides (from spent fuel and activated elements) and water treatment chemicals	Radionuclides[a,c], sodium dichromate[d]

Notes:

[a]Radionuclides are listed in Table 3.5 of HNF-SD-SNF-TI-009, 1999, *Spent Nuclear Fuel Project Technical Data Book*, Vol. 1, "Fuel," Rev. 3, Fluor Hanford, Inc., Richland, Washington.

[b]WHC-EP-0877, 1995, *K Basin Corrosion Program Report*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[c]Activated nuclides from reactor listed in Table 21 of UNI-3714, 1987, *Radionuclide Inventory and Source Terms for the Surplus production Reactors at Hanford*, Rev. 1, UNC Nuclear Industries, Richland, Washington.

[d]D&D-35109, *Description of Rooms and Equipment Located Between the Structural F and G Line of 105KE Reactor*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

[e]WAC 173 303, "Dangerous Waste Regulations," Washington Administrative Code, as amended, Olympia, Washington.

COPC = contaminant of potential concern.
PCB = polychlorinated biphenyl.
WS = waste stream.

The COPC are evaluated to determine if they may be excluded, the evaluation is recorded in Table B2-3.

Table B2-3. Excluded Contaminants of Potential Concern and Their Exclusion Rationale. (3 sheets)

WS No.	COPCs	Rationale for Exclusion
B1	Rh-106, Ru-106, Sn-113, Sn-121, Te-125m, Sb-126, Sb-126m, and Am-242	Nuclides removed from consideration because of <2 years half life, which is not reportable per ERDF waste acceptance criteria.[a]
	Y-90 and Ba-137m	Y-90 daughter to Sr-90 and Ba-137m daughter to Cs-137, isotopes not reportable per ERDF waste acceptance criteria.
	Kr-85	Element exists as a gas, which will not be retained in concrete, debris, or soil.
	Y-91, Nb-95, Nb-95m, Zr-95, Ag-110, Ag-110m, In-113m, Sn-113, Sn-119m, Sn-123, Te-123m, Sb-124, Te-127, Te-127m, I-129, Ce-144, Pr-144, Pr-144m, Gd-153, Tb-160, U-232, U-233, Cm-243	Calculation of possible radionuclide content is <1 pCi/g of waste, which is not reportable per ERDF waste acceptance criteria.
	Lubricating base oil, zinc alkyl dithiophospates, highly-refined base oils solvent-refined heavy paraffinic petroleum distillate, petroleum, calcium sulfonate, Highly-refined base oils, lubricating base oil, octadecanoic acid; 12-hydroxy-; monolithium salt, fatty acids; C16-C22; lithium salts, phosphorodithioic acid; mixed O; O- bis(iso-BU and pnetyl) esters; zinc salts, resin acids and rosin acids; zinc salts, zinc dialkyl dithiphosphate, disulfides; C5-C12-alkyl, molybdenum; bis(O,O-bis(2-ethylhexyl) phosphorodithioate-S;S') dioxodi-mu-thioxodi, calcium tallowate, sodium tallowate, 1-naphthalenesulfonic acid; 4-hydroxy-3,4'azodi, propylene glycol,	Chemicals will not cause the waste to be designated as dangerous waste in accordance with WAC 173-303.
	PCB	Basin water has been tested and found not to exhibit PCB at concentrations above the 0.5 parts-per-billion therefore the waste is not regulated for PCB content.
B2	Rh-106, Ru-106, Sn-113, Sn-121, Te-125m, Sb-126, Sb-126m, and Am-242	Nuclides removed from consideration because of <2 years half life, which is not reportable per ERDF waste acceptance criteria.[a]
	Y-90 and Ba-137m	Y-90 daughter to Sr-90 and Ba-137m daughter to Cs-137, isotopes not reportable per ERDF waste acceptance criteria.
	Kr-85	Element exists as a gas, which will not be retained in concrete, debris, or soil.

Table B2-3. Excluded Contaminants of Potential Concern and Their Exclusion Rationale. (3 sheets)

WS No.	COPCs	Rationale for Exclusion
	C-14, Fe-55, Co-60, Ni-59, Ni-63, Se-79, Y-91, Zr-93, Zr-95, Nb-93 Nb-95, Nb-95m, Tc-99, Pd-107, Ag-110, Ag-110m, Cd-113m, In-113m, Sn-113, Sn-119m, Sn-121m, Sn-123,, Sn-126 Te-123m, Sb-124,Sb-125, Te-127, Te-127m, I-129, Cs-134, Cs-135,Ce-144, Pr-144, Pr-144m, Eu-152, Eu-155 Gd-153, Tb-160, U-232, U-233, U-234, U-235, U-236, U-238, Np-237, Pu-242, Am-242m, Am-243, Cm-242, Cm-243, Cm-244	Calculation of possible radionuclide content is <1 pCi/g of waste, which is not reportable per ERDF waste acceptance criteria.
	PCB	Basin water has been tested and found not to exhibit PCB at concentrations above the 0.5 parts-per-billion therefore the waste is not regulated for PCB content.
	Sodium fluorescein	The chemicals are not regulated as a dangerous waste.[b]
	H_2O_2, NaOCl, and $Ca(OCl)_2$	Small quantities (10 ppm basin concentration) used for local applications. Hypochlorites would have to be >1% to be Washington State toxic, which is not credible. Hydrogen peroxide would have to be >0.01% to be Washington State toxic, which is not credible. Also, hypochlorites and peroxides chemicals react with environment to decompose.[b]
B3	Same as waste stream B1 above	Same as waste stream B1 above
B4	Cr-51, Zn-65, Rh-106, Ru-106, Sn-113, Sn-121, Te-125m, Sb-126, Sb-126m, and Am-242	Nuclides removed from consideration because of <2 years half life, which is not reportable per ERDF waste acceptance criteria.[a]
	Y-90 and Ba-137m	Y-90 daughter to Sr-90 and Ba-137m daughter to Cs-137, isotopes not reportable per ERDF waste acceptance criteria.
	Kr-85	Element exists as a gas, which will not be retained in concrete, debris, or soil.
	C-14, Fe-55, Co-60, Ni-59, Ni-63, Se-79, Y-91, Zr-93, Zr-95, Nb-93 Nb-95, Nb-95m, Tc-99, Pd-107, Ag-110, Ag-110m, Cd-113m, In-113m, Sn-113, Sn-119m, Sn-121m, Sn-123,, Sn-126 Te-123m, Sb-124,Sb-125, Te-127, Te-127m, I-129, Cs-134, Cs-135,Ce-144, Pr-144, Pr-144m, Eu-152, Eu-155 Gd-153, Tb-160, U-232, U-233, U-234, U-235, U-236, U-238, Np-237, Pu-242, Am-242m, Am-243, Cm-242, Cm-243, Cm-244	Calculation of possible radionuclide content is <1 pCi/g of waste, which is not reportable per ERDF waste acceptance criteria.

Table B2-3. Excluded Contaminants of Potential Concern and Their Exclusion Rationale. (3 sheets)

WS No.	COPCs	Rationale for Exclusion
	Ca-41 and Cl-36	Nuclides do not contact reactor or rod cooling waters so there is no transport to the collection box.
	Toxic characteristic pesticide and herbicides: chlordane, 2,4-D, endrin, heptachlor, lindane, methoxychlor, toxaphene, 2,4,5-TP	The C sump and collection box were not exposed to pesticides or herbicides. The drains and water running through the systems did not contain pesticides or herbicides. The systems are underground thereby being isolated from surface applications of these chemicals.
	Toxic characteristic volatile organics: benzene, carbon tetrachloride, chlorobenzene, chloroform, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichlorethylene, methyl ethyl ketone, tetrachloroethylene, trichloroethylene, vinyl chloride	The C sump and collection box have been in service since 1956, both are vented allowing volatile materials to escape from the systems. The quantity of these chemicals, if used, would have been relatively small and infrequent thus these quantities would have escaped from the system.
	Sodium fluorescein, trisodium phosphate	The chemicals are not regulated as a dangerous waste (except for pH).[b]
	oxidizer	Concentration of chemicals is low enough to not exhibit the characteristic
	Fluoride compounds	The chemicals are not regulated as a dangerous waste.[b]

Notes:

[a]Radionuclides are listed in Table 3.5 of HNF-SD-SNF-TI-009, 1998, *Spent Nuclear Fuel Project Technical Data Book*, Vol. 1, Rev. 3, Fluor Hanford, Inc., Richland, Washington.

[b]TOMES Plus database, *Registry of Toxic Effects of Chemical Substances*, Hanford Technical Library Website (http://library.pnl.gov/databases.asp), Pacific Northwest National Laboratory, Richland, Washington.

Notes (cont):

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

ERDF = Environmental Restoration Disposal Facility.
COPC = contaminant of potential concern.
PCB = polychlorinated biphenyl.
WAC = *Washington Administrative Code.*
WS = waste stream.

The COC remaining for the waste are listed in Table B2-4.

Table B2-4. List of Contaminants of Concern. (2 sheets)

Waste Stream	Contaminants of Concern
B1	H-3, C-14, Fe-55, Ni-59, Co-60, Ni-63, Se-79, Sr-90, Zr-93, Nb-93m, Tc-99, Pd-107, Cd-113m, Sn-121m, Sb-125, Sn-126, Cs-134, Cs-135, Cs-137, Pm-147, Sm-151, Eu-152, Eu-154, Eu-155, U-234, U-235, U-236, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-242m, Am-243, Cm-242, and Cm-244
	2 -(Diethylamino) Ethanol, Diethylene Glycol, lithium hydroxide, chlorinated

Table B2-4. List of Contaminants of Concern. (2 sheets)

Waste Stream	Contaminants of Concern
	parrafin (alkanes, chloro)
B2	H-3, Sr-90, Cs-137, Pm-147, Sm-151, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Am-241
B3	The same as waste stream # B1 above.
B4	Radionuclides: C sump- same as # B1 above Collection box- same as # B1 above plus Mo-93, and Nb-94,
	Arsenic, Barium, Cadmium, Chromium, Total Cresol, 2,4-Dinitrotoluene, Hexachlorobenzene, Hexachlorobutadiene, Hexachloroethane, Lead, Mercury, Nitrobenzene, Pentachlorophenol, Pyridine, Selenium, Silver, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, Polychlorinated Biphenyl, pH

B3.0 STEP 2 - IDENTIFY THE DECISIONS

Table B3-1 presents the decision statements (DS) relevant to determine that each waste stream is compliant for disposal at ERDF.

Table B3-1. Decision Statements for K East Basin Excavated Soil Waste Designation. (2 sheets)

DS #1 – Determine if the waste **is** a listed dangerous waste and will be evaluated for treatment and disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility), **OR** if the material **is not** a listed dangerous waste and will be evaluated for disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility).
DS #2 – Determine if the waste **is** a characteristic dangerous waste and will be evaluated for treatment and disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility), **OR** if the material **is not** a characteristic dangerous waste and will be evaluated for disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility).
DS #3 – Determine if the waste **is** a toxic dangerous waste and will be evaluated for treatment and disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility), **OR** if the material **is not** a toxic dangerous waste and will be evaluated for disposal at ERDF or other Hanford Site TSD facility.
DS #4 – Determine if the waste **is** a persistent dangerous waste and will be evaluated for treatment and disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility), **OR** if the material **is not** a persistent dangerous waste and will be evaluated for disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility).
DS #5 – Determine if the waste **is** a PCB waste and will be evaluated for disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility), **OR** if the material **is not** a PCB waste and will be evaluated for disposal at a candidate facility (e.g., ERDF or other Hanford Site TSD facility).
DS #6 – Determine if the waste complies with the ERDF radiological waste acceptance criteria and can be disposed at ERDF, **OR** if the waste **does not** comply with the ERDF radiological waste acceptance criteria and must be disposed at WIPP if TRU or another Hanford Site TSD facility if not TRU.
DS #7 – Determine if the waste complies with the ERDF waste acceptance criteria physical form requirements and can be disposed at ERDF, **OR** if the waste **does not** comply with the ERDF waste acceptance criteria physical form requirements and must be disposed at another Hanford Site TSD facility.

Table B3-1. Decision Statements for K East Basin Excavated Soil Waste Designation. (2 sheets)

DS #8 – Determine if the waste **is** land disposal restricted and requires treatment prior to disposal, **OR** if the material **is not** land disposal restricted and may be disposed at ERDF or a Hanford Site TSD facility without treatment.

Notes:

DS = decision statement.
ERDF = Environmental Restoration Disposal Facility.
PCB = polychlorinated biphenyl.
TSD = treatment, storage, and disposal.

The Table B3-2 lists the action levels for COC identified for the waste that is appropriate for resolving the decision rules for all waste streams.

Table B3-2. Decision Action Levels. (2 sheets)

COC	Action Level	Basis
Radionuclides	1 pCi/g	Reportable limit for ERDF.
2 -(Diethylamino) Ethanol, Diethylene Glycol, lithium hydroxide	Equivalent Concentration ≥0.001%	WAC 173-303-100(5)
chlorinated parrafin	Concentration of halogenated organic compounds of ≥0.01%	WAC 173-303-100(6)
Free liquid	Free liquid per paint filter test, SW-846 method 9095 (EPA 1997)	Disposal of liquids governed by ERDF waste acceptance criteria, Sec. 4.3.5.
pH	≤2 or ≥12.5	WAC 173-303-090(6)
Toxic characteristics	As ≥5.0 mg/L Ba ≥100.0 mg/L Cd ≥1.0 mg/L Cr ≥5.0 mg/L Total cresol ≥200.0 mg/L 2,4-Dinitrotoluene ≥0.1 mg/L Hexachlorobenzene ≥0.1 mg/L Hexachlorobutadiene ≥0.5 mg/L Hexachloroethane ≥3.0 mg/L Pb ≥5.0 mg/L Hg ≥0.2 mg/L Nitrogenzene ≥2.0 mg/L Pentachlorophenol ≥100.0 mg/L Pyridine ≥5.0 mg/L Se ≥1.0 mg/L Ag ≥5.0 mg/L 2,4,5-Trichlorophenol ≥400.0 mg/L 2,4,6-Tricholorphenol ≥2.0 mg/L	WAC 173-303-090(8)
Polychlorinated Biphenyl	Polychlorinated Biphenyl ≥1.0 mg/Kg	40 CFR 761

COC = contaminants of concern.
ERDF = Environmental Restoration Disposal Facility.

Table B3-2. Decision Action Levels. (2 sheets)

COC	Action Level	Basis

Notes :

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

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

SW-846, *Test Methods for Evaluating Solid, Waste Physical/Chemical Methods*, 3rd Edition, as amended, U.S. Environmental Protection Agency, Washington, D.C.

B4.0 STEP 3 - IDENTIFY INPUTS TO THE DECISIONS

Table B4-1 specifies the information and data required to satisfy each decision statement (DS) shown in Table B3-1 and identifies whether these data sets already exist for all the waste streams. For existing data, the source references are provided with a qualitative assessment of whether the data are of sufficient quality to satisfy the corresponding DS.

The evaluation results indicate that waste stream number B1 through B3 process knowledge is adequate to determine whether or not the waste is dangerous waste and regulated for polychlorinated biphenyl (PCB) content under 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." The waste stream numbers B1, B2, and B3 are not dangerous waste or regulated for PCB except Houghto-Safe 620 hydraulic fluid and Moblux EP 111 grease. Houghto-Safe 620 hydraulic fluid is dangerous waste with the waste code WT02. Moblux EP 111 grease is a dangerous waste with the waste codes WT02 and WP02. A waste coded with WT02 and/or WP02 does not invoke any treatment requirements for disposal. During demolition, if a waste is designated as hazardous waste in accordance with 40 CFR 261, "Identification and Listing of Hazardous Waste," extremely hazardous dangerous waste, or regulated for PCB content, then it will be segregated and treated separately from the other waste and managed as anomalous waste.

The waste stream number B4 is not regulated as dangerous waste for listed constituents because there are no known discharges to the systems that contain discarded chemical products or that were from dangerous waste sources. Therefore, the rubble is not designated as dangerous waste due to listed waste content because process knowledge does not identify it.

The waste stream number B4 may be regulated as dangerous waste as a corrosive solid or for toxic characteristic metals and organics listed in Table B2-4 and/or PCB content. Samples of residues contaminating the 105-K East C sump and 105-K East collection box, waste sites 100-K-69 and -71, will be collected for analysis to test for pH, toxic characteristic metals and semi-volatile (SVOA) organic chemicals listed for the waste stream B4 in Table B2-4, and PCB. Toxic characteristic volatile organics, pesticides, and herbicides will not be tested because they are not expected to be present. Volatile organic compounds by their nature would have escaped as vapor from the vented sump or collection box over their many years of service. Pesticides and herbicides would not have reported to these systems because the systems serviced cooling water and various basin and reactor area drains. Also, these systems are underground and therefore are isolated from surface application of pesticides and herbicides. These systems did service basin water, but discharges of basin water that could have included K East Basin sludge or any other source of PCB have not been identified. However, the sludge will be tested for PCB because

PCB has been found in K East Basin sludge. The analysis results will be used to designate the rubble created from these structures.

All the waste streams are contaminated with radioactivity. The radioactive content of waste stream number B2 is from105-K East Basin water itself, which is tested at least monthly. The average concentration of radioactivity in basin water for the last three months is tabulated in Table B4-2. The data collection required to calculate the radioactive inventory of stabilized basin water is the amount of water in the waste either as mass or volume. The waste stream numbers B1 and B3 consist of materials contaminated by the 105-K Basin environment that have been characterized in Appendix C of this document. The total radioactive inventory is calculated by collecting radiation dose rates that are converted to a Cs-137 content using a dose rate-to-curie relationship, then multiplying the Cs-137 content by the radionuclide distribution listed in Table 2-1. The content of radioactivity in waste stream number B4 rubble will be determined based on analysis of samples of sludge contaminating the 105-K East C sump and 105-K East collection box, waste sites 100-K-69 and -71. The total radioactive inventory is calculated by multiplying the amount of contamination by the concentrations determined by analysis with nuclides not reported being calculated using reactor process tube contamination inventory data presented in Table B4-3 and below-water washed distribution presented in Table 2-1, as applicable. It is appropriate to represent the radionuclide contamination by both reactor process tube contamination and K East below-water washed metal because the sources of contamination include both basin water and reactor cooling water. Reactor cooling water contamination is based on sample analysis of samples collected from the walls of the reactor process tubes reported in UNI-3714, *Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford*. The amount of sludge contaminating the C sump and collection box will be determined by observation at the time samples are collected.

Table B4-1. Required Data and Methods and Available Sources References. (3 sheets)

DS No.	Required Data	Survey/Sampling/Data Collection Methods	Do Data Exist? (Y/N)	Available Source Reference	Are the Data of Sufficient Quality? (Y/N)	Additional Information Required? (Y/N)
1	Data to determine if the waste is regulated as a listed dangerous waste, in accordance with WAC 173-303-080, -081, and -082.	Process knowledge	Y	WHC-EP-0877 List of Material Safety Data Sheets on Table B2-1 WHC-SD-EN-TI-239 Waste Information Data System Reports for 100-K-68 through -71	Y	N All waste streams
2	Data to determine if the waste is regulated as a characteristic dangerous waste, in accordance with 40 CFR 261.24, 40 CFR 268.40, 40 CFR 268.45, WAC 173-303-090[2]-[8], and WAC 173-303-140.	Process knowledge and analysis of residues contaminating the collection box and C sump	Y	WHC-EP-0877 List of Material Safety Data Sheets on Table B2-1 WHC-SD-EN-TI-239 SNF-11168 Waste Information Data System Reports for 100-K-68 through -71	Y	N WS numbersB1, B2, and B3 Y WS number B4-analysis of sample and quantity of contamination in rubble
3	Data to determine if the waste meets the definition of a toxic dangerous waste, in accordance with WAC 173-303-100 and WAC 173-303-100[5].	Process knowledge	Y	WHC-EP-0877 List of Material Safety Data Sheets on Table B2-1 WHC-SD-EN-TI-239 SNF-11168 Waste Information Data System Reports for 100-K-68 through -71	Y	N All waste streams
4	Data to determine if the waste meets the definition of a persistent dangerous waste, in accordance with WAC 173-303-100.	Process knowledge	Y	WHC-EP-0877 List of Material Safety Data Sheets on Table B2-1 WHC-SD-EN-TI-239 SNF-11168 Waste Information Data System Reports for 100-K-68 through -71	Y	N All waste streams
5	Data to determine if the waste is regulated, because of PCB concentrations, in accordance with the TSCA or WAC 173-303-9904.	Process knowledge and analysis of basin water sample	Y	List of Material Safety Data Sheets on Table B2-1 WHC-SD-EN-TI-239 Waste Information Data System Reports for 100-K-68 through -71	Y	N All waste streams

Table B4-1. Required Data and Methods and Available Sources References. (3 sheets)

DS No.	Required Data	Survey/Sampling/Data Collection Methods	Do Data Exist? (Y/N)	Available Source Reference	Are the Data of Sufficient Quality? (Y/N)	Additional Information Required? (Y/N)
6	Data to determine how the waste meets the ERDF radiological waste acceptance criteria.	Sample analysis, process knowledge, radiological surveys, quantity measurements	Y	HNF-SD-TI-009, Vol. 1 SD-CP-TI-105 HNF-6495 Analytical Report Number WSCF20071576 Analytical Report Number WSCF20071381 Analytical Report Number WSCF20071754 Analytical Report for Sample 0328WQL Waste Information Data System Reports for 100-K-68 through -71 UNI-3714	Y	Y WS numbers B1and B3- dose rate surveys and waste mass in containers. WS number B2- mass or volume of water WS number B4- analysis of sample and quantity of contamination in rubble
7	Data to determine how the waste meets the ERDF waste acceptance criteria physical form requirements.	Process knowledge and observing the waste	Y	List of Material Safety Data Sheets on Table B2-1 Waste Information Data System Reports for 100-K-68 through -71	Y	Y All WS numbers- observation of the waste form, both stabilized liquid rubble.
8	Data to determine if the waste is land-disposal restricted, in accordance with 40 CFR 268.	Process knowledge and analysis of basin water sample and analysis of sludge contaminating the collection box and C sump	Y	WHC-EP-0877 WHC-SD-EN-TI-239 List of Material Safety Data Sheets on Table B2-1	Y	N WS numbersB1, B2, and B3 Y WS number B4- analysis of sample and quantity of contamination in rubble

Table B4-1. Required Data and Methods and Available Sources References. (3 sheets)

DS No.	Required Data	Survey/Sampling/Data Collection Methods	Do Data Exist? (Y/N)	Available Source Reference	Are the Data of Sufficient Quality? (Y/N)	Additional Information Required? (Y/N)

Notes:
Full reference information is provided in Section B9.0, References.

DS = decision statement.
ERDF = Environmental Restoration Disposal Facility.
PCB = polychlorinated biphenyl.
TSCA = *Toxic Substances Control Act of 1976.*
WS = waste stream.

Table B4-2. Concentrations of Radioactivity in Basin Water.

Nuclide	Activity in Basin Water (pCi/g)
H-3	1.93E+03
Sr-90	8.07E+02
Cs-137	1.25E+03
Pm-147	4.32E+00
Sm-151	1.93E+01
Eu-154	3.58E+00
Pu-238	1.73E+00
Pu-239	8.00E+00
Pu-240	4.37E+00
Pu-241	1.55E+02
Am-241	1.25E+01

Table B4-3. Radionuclide Inventory of Reactor Process Tube Contamination.

Nuclide	Inventory in Process Tubes (Ci)
Co-60	9.43
Ni-59	13
Ni-63	1450
Sr-90	0.173
Zr-93	11
Mo-93	0.199
Nb-94	0.6
Tc-99	0.003
Eu-152	0.62
Eu-154	0.253

Notes:
1. Inventory shown is data from Table 22 in UNI-3714, *Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford*, decayed to January 1, 2008.

B5.0 STEP 4 - DEFINE THE STUDY BOUNDARIES

To identify the target population of interest, define the spatial and temporal boundaries that apply to each DS, and identify practical constraints (i.e., hindrances or obstacles) that must be taken into consideration. Implementing this step in the DQO process ensures that the sampling design will result in data collection that accurately reflects the conditions of the waste.

The spatial boundary is the liquid that is collected and removed from 105-K East Basin equipment and the equipment located outside and north of the 105-K East Basin facility not including the HIH system. The outside equipment consisting of structures, tanks, pumps, piping, and electrical equipment are listed as waste sites identified in Table 2-2..

Liquid will be removed before the outside structures and equipment are reduced to rubble. All equipment will be drained of liquid before it is reduced to rubble or grouted in an IP2 box though some liquid may be found as material is being reduced to rubble. The outside equipment and structures will be removed after the 105-K East Basin superstructure is removed but before the substructure is removed.

Samples will be collected for analysis from the collection box and the C sump. The collection box, waste site 100-K-71, is an eight foot by fifteen foot by thirteen foot high box constructed of concrete buried to the ground north of the 100-K East building. The box is separated into two chambers each with an inside floor of six foot by six foot. The C sump, waste site 100-K-69, is a twelve foot high with a three foot by six foot inside dimension floor box constructed of concrete with two pumps mounted inside buried in the ground north of the 100-K East building. It is anticipated that sludge residue will be resident on the floors of the collection box and C sump, which will be collected as samples for analysis.

The work is constrained by confined space in the sump and collection box, physical access to the sump and collection box, weather conditions, and contamination with radioactivity. For personnel safety, work will be conducted to minimize exposure to radioactivity and chemicals that may exist.

B6.0 STEP 5 - DECISION RULES

Decision rules provide the criteria for taking actions. The decision rules (DR) state what action is to be performed when prescribed conditions are met. The decision rules applicable to all waste streams are presented in Table 1-5.

B7.0 STEP 6 - LIMITS ON DECISION ERROR

The purpose of this section is to control the uncertainty in any new measurement data that may be required to resolve the decision rules for the waste streams by specifying tolerable limits on decision errors that are used to establish performance goals for the data collection design.

For waste streams numbers B1 and B3, the data collection is limited to process knowledge, dose rate around containers, and measurement of quantity of waste in a container (mass or volume). For waste stream number B2, the data collection is limited to process knowledge (existing analysis data) and measurement of the quantity of basin water. A probabilistic error tolerance is not applicable to the collection and evaluation of process knowledge. A probabilistic error tolerance is not applied to the other measurements because the information is being used to make decisions about radioactive COC waste acceptance which does not require the application of error tolerances.

For waste stream number B4, the data collection includes process knowledge, analysis of samples for pH, metals, SVOA, and radioactivity, and measurement of the quantity of sludge contaminating the sump or box. A probabilistic error tolerance is not applicable to the collection and evaluation of process knowledge. A decision error tolerance is not applied to the sump and collection box for chemical COC because the quantity of sludge contamination is small and does no lend itself to the analysis of multiple samples required to apply a probabilistic design.

B8.0 STEP 7 - OPTIMIZATION OF DESIGN FOR OBTAINING DATA

This section of a DQO generally is used to determine the most resource-effective data collection design for a probabilistic based sample design. The data collection necessary to support decision-making does not use a probabilistic based design. Most information gathering including collection of process knowledge, quantity measurement, and dose rate measurement is performed on all the waste and, therefore, is not a candidate for optimization. The analysis of sludge samples collected from the C sump and collection box are optimized by collecting multiple samples then submitting one composite of these samples for each. Submitting a single composite sample minimizes the number of samples to test while ensuring that the single sample represents the aggregate of the sludge contaminating the structures. An aggregate of sludge contamination is appropriate because the structures when reduced to rubble will be mixed, distributing the contamination throughout the rubble. To ensure the composite samples represent the sludge contamination, a minimum of five samples will be collected for compositing from each.

B9.0 REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

40 CFR 761, 1992, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

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MSDS 011494, Lubriplate® No. 630-A, No. 630-AA, No. 630-AAA, 630-2, Fiske Brothers Refining Co., Toledo, Ohio.

MSDS 011582, Mobilux EP 2, Mobil Oil Corporation, Fairfax, Virginia.

MSDS 013409, Chevron Delo Motor Oil 400 SAE 10W, Chevron Texaco Global Lubricants, San Ramon, California.

MSDS 013821, 00927 MARFAK 0, Texaco, Inc., Beacon, New York.

MSDS 014202, Houghto-Safe 620, E. F. Houghton & Company, Valley Forge, Pennsylvania.

MSDS 018030, Mobilith AW-2, Exxon Mobil Oil Corporation, Fairfax, Virginia.

MSDS 018349A, Chevron Gear Compound EP-ISO 320, Chevron Texaco Global Lubricants, San Ramon, California.

MSDS 019404, Chevron Dura-Lith grease, EP NLGI 2, Chevron USA Products Company, San Francisco, California.

MSDS 023411, Mobilux EP 111, Mobil Oil Corporation, Fairfax, Virginia.

MSDS 031152, Coffing Transmission Oil H7813, Elf Lubricants North America, Inc., Rockingham, North Carolina.

MSDS 032701, Mobilfluid 424, Exxon Mobil Oil Corporation, Fairfax, Virginia.

MSDS 042824, Propylene Glycol Industrial Grade, The Dow Chemical Company, Midland, Michigan.

MSDS 061546, Durex All Purpose Gear Oil 80W-90W, Christenson Oil, Portland, Oregon.

MSDS 062264, DOW[5] Corning M Gear Oil Additive, Dow Corning Corporation, Midland, Michigan.

MSDS 062363, CITCO EP Compound 460, CITGO Petroleum Corporation, Tulsa, Oklahoma.

MSDS 066061, 642801-60 Glygoyle Grease 00, Exxonmobile Oil Corporation, Fairfax, Virginia.

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[5] A trademark of the DOW Chemical Company.

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ATTACHMENT B1

IDENTIFICATION OF RADIOACTIVE CONTAMINANTS OF CONCERN FOR 105-K EAST BASIN WATER

The radioactive contaminants of concern (COC) for 105-K East Basin water was developed using analysis results of center of basin water samples for the last three months. The basin water analytical results except for Zn-65, Nb-94, and Ru-103 are tabulated in Table ATTACH-B1-1. The three nuclides Zn-65, Nb-94, and Ru-103 were not tabulated because they were not detected and were not on the list of significant radionuclides placed in Table 3.5 of HNF-SD-TI-009, Volume 1, *Spent Nuclear Fuel Project Technical Data Book*. The result tabulated in Table ATTACH-B1-1 is the method detection limit when the nuclide was not detected as indicated by the "<" sign. The average of the results is calculated in the column labeled "Activity per Analysis Results" unless no detections were recorded. When no detections are recorded, then the minimum detection limit is set in the column labeled "Activity per Analysis Results."

The analyses performed did not test for and report all of the radionuclides that may be of concern. These other contaminants of potential concern (COPC) were calculated using data about the fuel stored at the basins as reported in Table 3.5 of HNF-SD-SNF-TI-009, *Spent Nuclear Fuel Project Technical Data Book*. The fuel data from HNF-SD-SNF-TI-009 was augmented for radionuclides U-232, U-233, and Cm-243 using Table 7 page H18 of SD-CP-TI-105, *ORIGEN2 Prediction of Reactor Fuel Actinide Composition*. The K Basin fuel information was decayed to January 1, 2008 and is represented as a ratio to Cs-137 as presented in Table C-1. For each of the radionuclides that was not reported by the analysis results of metals contaminated with basin water, the radionuclide was estimated by ratioing either to Cs-137, Pu-239/Pu-240, or U-233/U-234 in fuel to the concentration determined by analysis. Table B1-2 identifies to what key radionuclide a radionuclide is calculated from using the fuel ratios.

The COC were identified by evaluating each of the identified radionuclides against the reporting criteria for the Environmental Restoration Disposal Facility (ERDF) (WCH-191) and considering physical characteristics of the radionuclide. All nuclides that have a two year or greater half life and a concentration equal to or greater than 1 ρCi/g must be reported to the ERDF. The evaluation to identify COC in the stabilized water waste form used the concentrations in basin water to identify COC even though the concentration of radionuclides will be less in the stabilized waste form than are listed in Table B1-2 for basin water. The COC are those radionuclides that are identified with a "Retain" statement in the decision column in Table B1-2.

REFERENCES

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WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 0, Washington Closure Hanford, Richland, Washington.

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Table ATTACH-B1-1. 105-K East Center of Basin Water Analysis Results.

Nuclide	Sample Number W070000740 (ρCi/L)	Sample Number W070000741 (ρCi/L)	Sample Number W070000811 (ρCi/L)	Sample Number W070000812 (ρCi/L)	Sample Number W070000935 (ρCi/L)	Sample Number W070000936 (ρCi/L)	Activity per Analysis Results (ρCi/L)
H-3	2.00E+06	1.80E+06	2.10E+06	2.00E+06	1.90E+06	1.80E+06	1.93E+06
Co-60	< 5.60E+02	< 1.00E+03	< 9.20E+02	< 9.00E+02	< 8.20E+02	< 1.00E+03	5.60E+02
Sr-90[b]	2.60E+05	1.50E+06	2.70E+05	1.40E+06	3.10E+05	1.10E+06	8.07E+05
Ru-106	< 1.40E+04	< 2.40E+04	< 1.90E+04	< 2.90E+04	< 1.40E+04	< 2.20E+04	1.40E+04
Sn-113	< 2.50E+03	< 4.80E+03	< 3.30E+03	< 5.80E+03	< 3.00E+03	< 4.70E+03	2.50E+03
Sb-125	< 6.50E+03	< 1.10E+04	< 8.20E+03	< 1.40E+04	< 7.10E+03	< 1.10E+04	6.50E+03
Cs-134	< 7.90E+02	< 8.90E+02	< 4.40E+02	< 8.90E+02	< 6.40E+02	< 5.90E+02	4.40E+02
Cs-137	4.41E+05	1.38E+06	6.88E+05	2.69E+06	5.62E+05	1.73E+06	1.25E+06
Ce-144	< 9.20E+03	< 1.60E+04	< 1.10E+04	< 1.80E+04	< 9.60E+03	< 1.50E+04	9.20E+03
Pr-144	< 1.80E+04	< 3.30E+04	< 2.30E+04	< 3.60E+04	< 1.90E+04	< 3.00E+04	1.80E+04
Eu-152	< 5.70E+03	< 9.50E+03	< 6.90E+03	< 1.20E+04	< 6.30E+03	< 9.60E+03	5.70E+03
Eu-154	< 2.60E+03	< 3.70E+03	< 2.40E+03	< 4.00E+03	< 1.20E+03	7.58E+03	3.58E+03
Eu-155	< 4.90E+03	< 8.20E+03	< 5.60E+03	< 9.50E+03	< 5.00E+03	< 7.80E+03	4.90E+03
U-233[c]	3.00E+01	2.90E+02	2.30E+01	4.10E+02	3.50E+01	7.90E+02	2.63E+02
U-235	< 2.40E+01	1.30E+02	< 1.20E+01	< 1.00E+02	< 1.90E+01	1.40E+02	7.08E+01
U-238	3.60E+01	< 1.40E+02	2.90E+01	2.30E+02	< 2.20E+01	5.40E+02	1.66E+02
Pu-238	1.10E+02	8.50E+02	2.50E+02	1.40E+03	1.60E+02	7.60E+03	1.73E+03
Pu-239[a]	1.10E+03	7.10E+03	1.60E+03	9.60E+03	8.10E+02	5.40E+04	1.24E+04
Am-241	1.50E+03	1.40E+04	1.30E+03	1.20E+04	9.00E+02	4.50E+04	1.25E+04

[a]Result reported for Pu-239 also contains Pu-240.
[b]Result reported for Sr-90 contains Sr-89, Sr-89 is ignored due the < 1.0 year half life.
[c]Result reported for U-233 also contains U-234.

Notes:
1. The method detection limit is shown for all results shown as not detected.
2. When all results are not detected the minimum detection limit is shown in the average column.
3. For Eu-154, U-235, U-238, the method detection limit is used to calculate the average.
4. Analysis results for Zn-65, Nb-94, and Ru-103 are not shown because they were all not detected and are not on the list of nuclides for fuel per HNF-SD-TI-009.

Table ATTACH-B1-2. Evaluation for Radioactive Contaminants of Concern. (2 sheets)

Nuclide	Fuel Activity Ratio to Cs-137[3,4]	Water Analysis Results (ρCi/L)	Calculated Water Activity (ρCi/L)	Activity in Basin Water (ρCi/g)	Decision
H-3	2.02E-03	1.93E+06		1.93E+03	Retain > 1 ρCi/g
C-14	6.54E-05		8.16E+01 [1]	8.16E-02	Remove < 1 ρCi/g
Fe-55	1.53E-05		1.91E+01 [1]	1.91E-02	Remove < 1 ρCi/g
Co-60	1.06E-04	5.60E+02		5.60E-01	Remove < 1 ρCi/g
Ni-59	3.87E-06		4.83E+00 [1]	4.83E-03	Remove < 1 ρCi/g
Ni-63	3.96E-04		4.95E+02 [1]	4.95E-01	Remove < 1 ρCi/g
Se-79	8.14E-06		1.02E+01 [1]	1.02E-02	Remove < 1 ρCi/g
Kr-85	3.00E-02		3.74E+04 [1]	3.74E+01	Remove- lost as gas
Sr-90	7.56E-01	8.07E+05		8.07E+02	Retain > 1 ρCi/g
Y-90	7.56E-01		9.44E+05 [1]	9.44E+02	Remove- daughter to Sr-90
Y-91	2.02E-39		2.53E-33 [1]	2.53E-36	Remove < 1 ρCi/g
Zr-93	3.78E-05		4.72E+01 [1]	4.72E-02	Remove < 1 ρCi/g
Zr-95	5.48E-36		6.84E-30 [1]	6.84E-33	Remove < 1 ρCi/g
Nb-93m	2.79E-05		3.48E+01 [1]	3.48E-02	Remove < 1 ρCi/g
Nb-95	1.21E-35		1.51E-29 [1]	1.51E-32	Remove < 1 ρCi/g
Nb-95m	6.39E-38		7.97E-32 [1]	7.97E-35	Remove < 1 ρCi/g
Tc-99	2.72E-04		3.40E+02 [1]	3.40E-01	Remove < 1 ρCi/g
Ru-106	2.36E-07		2.94E-01 [1]	2.94E-04	Remove- < 2 year half life
Rh-106	2.36E-07		2.94E-01 [1]	2.94E-04	Remove- < 2 year half life
Pd-107	1.54E-06		1.92E+00 [1]	1.92E-03	Remove < 1 ρCi/g
Ag-110	1.54E-15		1.93E-09 [1]	1.93E-12	Remove < 1 ρCi/g
Ag-110m	1.22E-13		1.52E-07 [1]	1.52E-10	Remove < 1 ρCi/g
Cd-113m	2.06E-04		2.58E+02 [1]	2.58E-01	Remove < 1 ρCi/g
In-113m	1.40E-23		1.75E-17 [1]	1.75E-20	Remove < 1 ρCi/g
Sn-113	1.40E-23		1.75E-17 [1]	1.75E-20	Remove < 1 ρCi/g
Sn-119m	7.08E-12		8.84E-06 [1]	8.84E-09	Remove < 1 ρCi/g
Sn-121	5.17E-06		6.45E+00 [1]	6.45E-03	Remove- < 2 year half life
Sn-121m	6.66E-06		8.32E+00 [1]	8.32E-03	Remove < 1 ρCi/g
Sn-123	1.14E-20		1.42E-14 [1]	1.42E-17	Remove < 1 ρCi/g
Sn-126	1.47E-05		1.84E+01 [1]	1.84E-02	Remove < 1 ρCi/g
Sb-124	9.05E-43		1.13E-36 [1]	1.13E-39	Remove < 1 ρCi/g
Sb-125	2.84E-04		3.55E+02 [1]	3.55E-01	Remove < 1 ρCi/g
Sb-126	2.06E-06		2.57E+00 [1]	2.57E-03	Remove- < 2 year half life
Sb-126m	1.47E-05		1.84E+01 [1]	1.84E-02	Remove- < 2 year half life
Te-123m	4.06E-27		5.07E-21 [1]	5.07E-24	Remove < 1 ρCi/g
Te-125m	7.12E-05		8.89E+01 [1]	8.89E-02	Remove- < 2 year half life
Te-127	1.91E-23		2.38E-17 [1]	2.38E-20	Remove < 1 ρCi/g
Te-127m	1.95E-23		2.43E-17 [1]	2.43E-20	Remove < 1 ρCi/g

Table ATTACH-B1-2. Evaluation for Radioactive Contaminants of Concern. (2 sheets)

Nuclide	Fuel Activity Ratio to Cs-137[3,4]	Water Analysis Results (ρCi/L)	Calculated Water Activity (ρCi/L)	Activity in Basin Water (ρCi/g)	Decision
I-129	6.02E-07		7.51E-01 [1]	7.51E-04	Remove < 1 ρCi/g
Cs-134	6.01E-05	4.40E+02		4.40E-01	Remove < 1 ρCi/g
Cs-135	7.32E-06		9.14E+00 [1]	9.14E-03	Remove < 1 ρCi/g
Cs-137	1.00E+00	1.25E+06		1.25E+03	Retain > 1 ρCi/g
Ba-137m	9.46E-01		1.18E+06 [1]	1.18E+03	Remove- daughter to Cs-137
Ce-144	1.72E-08		2.15E-02 [1]	2.15E-05	Remove < 1 ρCi/g
Pr-144	1.72E-08		2.15E-02 [1]	2.15E-05	Remove < 1 ρCi/g
Pr-144m	2.58E-10		3.22E-04 [1]	3.22E-07	Remove < 1 ρCi/g
Pm-147	3.46E-03		4.32E+03 [1]	4.32E+00	Retain > 1 ρCi/g
Sm-151	1.54E-02		1.93E+04 [1]	1.93E+01	Retain > 1 ρCi/g
Eu-152	5.46E-05		6.82E+01 [1]	6.82E-02	Remove < 1 ρCi/g
Eu-154	4.66E-03	3.58E+03		3.58E+00	Retain > 1 ρCi/g
Eu-155	5.30E-04		6.61E+02 [1]	6.61E-01	Remove < 1 ρCi/g
Gd-153	5.32E-16		6.65E-10 [1]	6.65E-13	Remove < 1 ρCi/g
Tb-160	6.86E-37		8.57E-31 [1]	8.57E-34	Remove < 1 ρCi/g
U-232	2.29E-08		7.27E-02 [5]	7.27E-05	Remove < 1 ρCi/g
U-233	4.24E-10	2.63E+02	1.35E-03 [5]	1.35E-06	Remove < 1 ρCi/g
U-234	8.28E-05		2.63E+02 [5]	2.63E-01	Remove < 1 ρCi/g
U-235	3.18E-06	7.08E+01		7.08E-02	Remove < 1 ρCi/g
U-236	1.20E-05		3.81E+01 [5]	3.81E-02	Remove < 1 ρCi/g
U-238	6.57E-05	1.66E+02		1.66E-01	Remove < 1 ρCi/g
Np-237	5.52E-06		2.15E+00 [2]	2.15E-03	Remove < 1 ρCi/g
Pu-238	9.72E-03	1.73E+03		1.73E+00	Retain > 1 ρCi/g
Pu-239	2.06E-02	1.24E+04	8.00E+03 [2]	8.00E+00	Retain > 1 ρCi/g
Pu-240	1.12E-02		4.37E+03 [2]	4.37E+00	Retain > 1 ρCi/g
Pu-241	3.98E-01		1.55E+05 [2]	1.55E+02	Retain > 1 ρCi/g
Pu-242	5.18E-06		2.02E+00 [2]	2.02E-03	Remove < 1 ρCi/g
Am-241	4.26E-02	1.25E+04		1.25E+01	Retain > 1 ρCi/g
Am-242	1.76E-05		6.83E+00 [2]	6.83E-03	Remove- < 2 year half life
Am-242m	1.77E-05		6.87E+00 [2]	6.87E-03	Remove < 1 ρCi/g
Am-243	1.13E-05		4.40E+00 [2]	4.40E-03	Remove < 1 ρCi/g
Cm-242	1.46E-05		5.67E+00 [2]	5.67E-03	Remove < 1 ρCi/g
Cm-243	4.80E-07		1.87E-01 [2]	1.87E-04	Remove < 1 ρCi/g
Cm-244	9.42E-05		3.66E+01 [2]	3.66E-02	Remove < 1 ρCi/g

[1]Nuclide are determined by ratioing to Cs-137 of in waste and fuel activity.
[2]Nuclide are determined by ratioing to fuel activity of combined Pu-239/Pu-240 reported by analysis.
[3]Table 7 on page H 18 of SD-CP-TI-105, ORIGEN2 Predictions of N Reactor Fuel Actinide Compositions and 10 years and Pu-239, U-232, U-233, and Cm-243 decayed to 1/1/2008.
[4]Nuclide are determined by ratioing to fuel activity of combined U-233/U-234 reported by analysis.

APPENDIX C

IDENTIFICATION OF RADIOACTIVE CONTAMINANTS OF CONCERN FOR 105-K EAST BASIN DEMOLITION WASTE

APPENDIX C

IDENTIFICATION OF RADIOACTIVE CONTAMINANTS OF CONCERN FOR 105-K EAST BASIN DEMOLITION WASTE

The data used to determine the distribution for K East and West underwater washed metal was used here to develop the radioactive contaminants of concern (COC) and distribution for 105-K East Basin demolition waste, except the substructure. The data consists of four different sets of analyses of metal surfaces contaminated by basin water as reported in Table A-1 of HNF-6495, *Sampling and Analysis Plan for K Basins Debris*. The data used from Table A-1 of HNF-6495 are those with the column titles: metal coupons from KE pipes ratio % to Cs-137, pipe smears from KE ratio % to Cs-137, Canister NDA from KE ratio % to Cs-137, and canister smears from KE ratio % to Cs-137. All of the data sets were decay corrected to January 1, 2008. The average of the test results of the four sets of data were used to establish the concentration ratios to Cs-137 as reported in Table C-1.

The analyses performed did not test for and report all of the radionuclides that may be of concern. These other contaminants of potential concern (COPC) were calculated using data about the fuel stored at the basins as reported in Table 3.5 of HNF-SD-SNF-TI-009, *Spent Nuclear Fuel Project Technical Data Book.* The fuel data from HNF-SD-SNF-TI-009 was augmented for radionuclides U-232, U-233, and Cm-243 using Table 7 page H18 of SD-CP-TI-105, *ORIGEN2 Prediction of Reactor Fuel Actinide Composition.* The K Basin fuel information was decayed to January 1, 2008, and is represented as a ratio to Cs-137 as presented in Table C-1. For each of the radionuclides that was not reported by the analysis results of metals contaminated with basin water, the radionuclide was estimated by ratioing either to Cs-137 or Pu-239 in fuel to the average concentration determined by analysis. Table C-1 identifies to what key radionuclide a radionuclide is calculated from using the fuel ratios.

The COC were identified by evaluating each of the identified radionuclides against the reporting criteria for the Environmental Restoration Disposal Facility (ERDF) (WCH-191) and considering physical characteristics of the radionuclide. All nuclides that have a two-year or greater half life and a concentration equal to or greater than 1 ρCi/g must be reported to the ERDF. A maximum possible concentration of nuclides in the waste was calculated in order to evaluate the radionuclides to determine if they are reportable to ERDF and, therefore, are COC. The maximum possible concentration of nuclides in the waste was calculated as being the concentration in waste that is just below the U.S. Nuclear Regulatory Commission (NRC) greater than class C waste threshold. The COC are those radionuclides that are identified with a "Retain" statement in the decision column in Table C-1.

REFERENCES

WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 0, Washington Closure Hanford, Richland, Washington.

HNF-6495, *Sampling and Analysis Plan for K Basins Debris*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-SD-SNF-TI-009, 1999, *Spent Nuclear Fuel Project Technical Data Book*, Vol. 1, "Fuel," Rev. 3, Fluor Hanford, Inc., Richland, Washington.

SD-CP-TI-105, 1987, *ORIGEN2 Prediction of Reactor Fuel Actinide Composition*, Rockwell Hanford Operations, Richland, Washington.

Table C-1. K East Basin Radioactive Distribution and Contaminants of Concern. (4 sheets)

Isotope	Metal coupon from KE pipes Fraction to Cs-137	Pipe Smears from KE Fraction to Cs-137	Canister NDA from KE Fraction to Cs-137	Canister Smears from KE Fraction to Cs-137s	Average Activity Fraction to Cs-137	Fuel Activity Ratio Fraction to Cs-137[4,5]	Debris Activity Fraction to Cs-137	Maximum Activity in Waste[3] (ρCi/g)	Decision
H-3						2.02E-03	2.02E-03[1]	2.78E+03	Retain > 1 ρCi/g
C-14						6.54E-05	6.54E-05[1]	9.02E+01	Retain > 1 ρCi/g
Fe-55						1.53E-05	1.53E-05[1]	2.11E+01	Retain > 1 ρCi/g
Co-60	1.23E-03	4.84E-03	3.47E-02	6.36E-03	1.18E-02	1.06E-04	1.18E-02	1.62E+04	Retain > 1 ρCi/g
Ni-59						3.87E-06	3.87E-06[1]	5.34E+00	Retain > 1 ρCi/g
Ni-63						3.96E-04	3.96E-04[1]	5.47E+02	Retain > 1 ρCi/g
Se-79						8.14E-06	8.14E-06[1]	1.12E+01	Retain > 1 ρCi/g
Kr-85						3.00E-02	3.00E-02[1]	4.13E+04	Remove- lost as gas
Sr-90						7.56E-01	7.56E-01[1]	1.04E+06	Retain > 1 ρCi/g
Y-90						7.56E-01	7.56E-01[1]	1.04E+06	Remove- daughter to Sr-90
Y-91						2.02E-39	2.02E-39[1]	2.79E-33	Remove < 1 ρCi/g
Zr-93						3.78E-05	3.78E-05[1]	5.21E+01	Retain > 1 ρCi/g
Zr-95						5.48E-36	5.48E-36[1]	7.56E-30	Remove < 1 ρCi/g
Nb-93m						2.79E-05	2.79E-05[1]	3.85E+01	Retain > 1 ρCi/g
Nb-95						1.21E-35	1.21E-35[1]	1.67E-29	Remove < 1 ρCi/g
Nb-95m						6.39E-38	6.39E-38[1]	8.81E-32	Remove < 1 ρCi/g
Tc-99						2.72E-04	2.72E-04[1]	3.75E+02	Retain > 1 ρCi/g
Ru-106						2.36E-07	2.36E-07[1]	3.25E-01	Remove- < 2 year half life
Rh-106						2.36E-07	2.36E-07[1]	3.25E-01	Remove- < 2 year half life
Pd-107						1.54E-06	1.54E-06[1]	2.12E+00	Retain > 1 ρCi/g
Ag-110						1.54E-15	1.54E-15[1]	2.13E-09	Remove < 1 ρCi/g
Ag-110m						1.22E-13	1.22E-13[1]	1.68E-07	Remove < 1 ρCi/g
Cd-113m						2.06E-04	2.06E-04[1]	2.85E+02	Retain > 1 ρCi/g
In-113m						1.40E-23	1.40E-23[1]	1.93E-17	Remove < 1 ρCi/g

C-3

Table C-1. K East Basin Radioactive Distribution and Contaminants of Concern. (4 sheets)

Isotope	Metal coupon from KE pipes Fraction to Cs-137	Pipe Smears from KE Fraction to Cs-137	Canister NDA from KE Fraction to Cs-137	Canister Smears from KE Fraction to Cs-137s	Average Activity Fraction to Cs-137	Fuel Activity Ratio Fraction to Cs-137[4,5]	Debris Activity Fraction to Cs-137	Maximum Activity in Waste[3] (ρCi/g)	Decision
Sn-113						1.40E-23	1.40E-23[1]	1.93E-17	Remove < 1 ρCi/g
Sn-119m						7.08E-12	7.08E-12[1]	9.76E-06	Remove < 1 ρCi/g
Sn-121						5.17E-06	5.17E-06[1]	7.13E+00	Remove- < 2 year half life
Sn-121m						6.66E-06	6.66E-06[1]	9.19E+00	Retain > 1 ρCi/g
Sn-123						1.14E-20	1.14E-20[1]	1.57E-14	Remove < 1 ρCi/g
Sn-126						1.47E-05	1.47E-05[1]	2.03E+01	Retain > 1 ρCi/g
Sb-124						9.05E-43	9.05E-43[1]	1.25E-36	Remove < 1 ρCi/g
Sb-125			5.30E-03		5.30E-03	2.84E-04	5.30E-03	7.31E+03	Retain > 1 ρCi/g
Sb-126						2.06E-06	2.06E-06[1]	2.84E+00	Remove- < 2 year half life
Sb-126m						1.47E-05	1.47E-05[1]	2.03E+01	Remove- < 2 year half life
Te-123m						4.06E-27	4.06E-27[1]	5.60E-21	Remove < 1 ρCi/g
Te-125m						7.12E-05	7.12E-05[1]	9.82E+01	Remove- < 2 year half life
Te-127						1.91E-23	1.91E-23[1]	2.63E-17	Remove < 1 ρCi/g
Te-127m						1.95E-23	1.95E-23[1]	2.69E-17	Remove < 1 ρCi/g
I-129						6.02E-07	6.02E-07[1]	8.30E-01	Remove < 1 ρCi/g
Cs-134						6.01E-05	6.01E-05[1]	8.29E+01	Retain > 1 ρCi/g
Cs-135						7.32E-06	7.32E-06[1]	1.01E+01	Retain > 1 ρCi/g
Cs-137	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	100.00%	1.38E+06	Retain > 1 ρCi/g
Ba-137m						9.46E-01	9.46E-01[1]	1.31E+06	Remove- daughter to Cs-137
Ce-144						1.72E-08	1.72E-08[1]	2.37E-02	Remove < 1 ρCi/g
Pr-144						1.72E-08	1.72E-08[1]	2.37E-02	Remove < 1 ρCi/g
Pr-144m						2.58E-10	2.58E-10[1]	3.56E-04	Remove < 1 ρCi/g
Pm-147						3.46E-03	3.46E-03[1]	4.78E+03	Retain > 1 ρCi/g
Sm-151						1.54E-02	1.54E-02[1]	2.13E+04	Retain > 1 ρCi/g

C-4

Table C-1. K East Basin Radioactive Distribution and Contaminants of Concern. (4 sheets)

Isotope	Metal coupon from KE pipes Fraction to Cs-137	Pipe Smears from KE Fraction to Cs-137	Canister NDA from KE Fraction to Cs-137	Canister Smears from KE Fraction to Cs-137s	Average Activity Fraction to Cs-137	Fuel Activity Ratio Fraction to Cs-137[4,5]	Debris Activity Fraction to Cs-137	Maximum Activity in Waste[3] (ρCi/g)	Decision
Eu-152						5.46E-05	5.46E-05[1]	7.53E+01	Retain > 1 ρCi/g
Eu-154	2.36E-03	6.22E-03	1.64E-02	1.01E-02	8.77E-03	4.66E-03	8.77E-03	1.21E+04	Retain > 1 ρCi/g
Eu-155	2.86E-03	1.95E-03	6.77E-03	2.79E-03	3.59E-03	5.30E-04	3.59E-03	4.96E+03	Retain > 1 ρCi/g
Gd-153						5.32E-16	5.32E-16[1]	7.34E-10	Remove < 1 ρCi/g
Tb-160						6.86E-37	6.86E-37[1]	9.47E-31	Remove < 1 ρCi/g
U-232						2.29E-08	9.53E-09[2]	1.31E-02	Remove < 1 ρCi/g
U-233						4.24E-10	1.77E-10[2]	2.44E-04	Remove < 1 ρCi/g
U-234						8.28E-05	3.45E-05[2]	4.76E+01	Retain > 1 ρCi/g
U-235						3.18E-06	1.33E-06[2]	1.83E+00	Retain > 1 ρCi/g
U-236						1.20E-05	4.99E-06[2]	6.89E+00	Retain > 1 ρCi/g
U-238						6.57E-05	2.74E-05[2]	3.78E+01	Retain > 1 ρCi/g
Np-237						5.52E-06	2.30E-06[2]	3.17E+00	Retain > 1 ρCi/g
Pu-238	1.46E-03				1.46E-03	9.72E-03	1.46E-03	2.02E+03	Retain > 1 ρCi/g
Pu-239	8.57E-03				8.57E-03	2.06E-02	8.57E-03	1.18E+04	Retain > 1 ρCi/g
Pu-240						1.12E-02	4.68E-03[2]	6.45E+03	Retain > 1 ρCi/g
Pu-241						3.98E-01	1.66E-01[2]	2.28E+05	Retain > 1 ρCi/g
Pu-242						5.18E-06	2.16E-06[2]	2.98E+00	Retain > 1 ρCi/g
Am-241	1.71E-02	5.76E-02		8.42E-02	5.30E-02	4.26E-02	5.30E-02	7.30E+04	Retain > 1 ρCi/g
Am-242						1.76E-05	7.32E-06[2]	1.01E+01	Remove- < 2 year half life
Am-242m						1.77E-05	7.35E-06[2]	1.01E+01	Retain > 1 ρCi/g
Am-243						1.13E-05	4.72E-06[2]	6.50E+00	Retain > 1 ρCi/g
Cm-242						1.46E-05	6.07E-06[2]	8.38E+00	Retain > 1 ρCi/g
Cm-243						4.80E-07	2.00E-07[2]	2.76E-01	Remove < 1 ρCi/g
Cm-244						9.42E-05	3.92E-05[2]	5.41E+01	Retain > 1 ρCi/g

Table C-1. K East Basin Radioactive Distribution and Contaminants of Concern. (4 sheets)

Isotope	Metal coupon from KE pipes Fraction to Cs-137	Pipe Smears from KE Fraction to Cs-137	Canister NDA from KE Fraction to Cs-137	Canister Smears from KE Fraction to Cs-137s	Average Activity Fraction to Cs-137	Fuel Activity Ratio Fraction to Cs-137[4,5]	Debris Activity Fraction to Cs-137	Maximum Activity in Waste[3] (ρCi/g)	Decision

[1]Nuclide are determined by ratioing to Cs-137 of in waste and fuel activity.
[2]Nuclide are determined by ratioing to Pu-239 of in waste and fuel activity.
[3]The maximum concentration is when the waste is at the NRC class C limit (1 Ci Cs-137 and 725,000 kg).
[4]Fuel from Table 3.5 of HNF-SD-TI-009, vol. 1, Rev 3 that is decayed to January 1, 2008.
[5]Table 7 on page H 18 of SD-CP-TI-105, ORIGEN2 Predictions of N Reactor Fuel Actinide Composition and 10 years, Pu-239, U-232, U-233, and Cm-243 that is decayed to January 1, 2008.

APPENDIX D

EVALUATION OF THE USE OF CONCENTRATION AVERAGING TO CALCULATE THE CONCENTRATIONS OF RADIOACTIVITY IN RUBBLE AND ENCAPSULATED WASTE FORMS

APPENDIX D

EVALUATION OF THE USE OF CONCENTRATION AVERAGING TO CALCULATE THE CONCENTRATIONS OF RADIOACTIVITY IN RUBBLE AND ENCAPSULATED WASTE FORMS

The practice of concentration averaging as a method to calculate the concentration of radionuclides to classify radioactive waste is evaluated for two different waste form types: (1) rubble waste and (2) rubble and debris encapsulated with grout in a container. The rubble waste form consists of waste stream numbers 1, 2, and 4 material as identified in Section 2.0. The rubble and debris encapsulated with grout in a container waste form is waste stream number 3 material as identified in Section 2.0. Both waste form types are evaluated separately in this appendix under their respective heading name.

D1.0 WASTE STREAM NUMBERS 1, 2, AND 4- RUBBLE WASTE

Waste Description

The waste consists of structures, debris, and grout that has been crushed and cut up reducing the material to rubble for loading in waste containers for shipment to the Environmental Restoration Disposal Facility (ERDF) for disposal. Rubble will have some soil in it. Engineered backfill will be mixed with the 105-K East Basin substructure rubble but is not considered part of the waste mass as evaluated herein for radioactive waste classification purposes.

The demolition process as it proceeds will naturally create piles primarily of rubble that correspond to each waste stream. Generally each of these piles will be loaded separately into containers for transport to disposal. These separate and distinct piles are waste streams 1, 4, and for waste stream 2 the areas of upper wall and lower wall that consist of each basin bay, north loadout pit (NLOP), south loadout pit (SLOP), Dummy Elevator Pit (DEP), and combined techview/weasel pits.

Evaluation

The calculation of an average concentration for rubble generated from demolition has been evaluated against guidance provided by branch technical position (BTP) *Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position* (NRC 1995). In regard to the application of concentration averaging to evaluate the waste class in accordance with 10 CFR 61.55, the BTP states:

> "Principal considerations include: (1) whether the distribution of radionuclides within the waste can be considered to be reasonably homogeneous (i.e., volume distributed); (2) whether the "as-generated" waste has been processed and, if so, what is the mass/volume of the processed waste; (3) whether the waste includes mixtures of various waste types (i.e., a waste stream with a particular set of physical characteristics); (4) whether the waste includes mixtures of the same waste type, but at differing radioactivity concentration levels; and (5) whether the

volume of the waste container, if used to represent the volume of the waste, is significantly larger than the volume of the waste itself, and differential volume consists largely of void space."

The rubble waste is homogeneous for the purposes of waste classification even though it consists of a variety of materials such as concrete, metal, and plastic, because the process size reduces and mixes the material together. The BTP affirms this judgment saying, "Contaminated trash waste, which is composed of a variety of miscellaneous materials, may be considered homogeneous for the purposes of waste classification, when placed in containers." The waste homogeneity is supported by the consistent dose rate measurement values recorded for concrete surfaces listed in Tables A-2 and A-3 in D&D-35176, *Evaluation of 105-K East Basin and Pits Substructure Rubble for Compliance with ERDF Radioactive Waste Requirements,* and for debris in survey reports.

The waste "as-generated" is processed by adding grout and then reducing the material to rubble producing the waste form for disposal. Grout is added to fix contamination and provide shielding for worker protection and transportation compliance. All the grout added to the basin and pits is included as part of the waste mass except the grout added to the 104 tank that is greater than nominally one foot above the bottom of the tank. The grout above one foot in the 104 tank is eliminated as waste mass to calculate an average concentration because it is not added for the purposes stated earlier, rather for nuclear safety purposes.

The average concentration of radionuclides is calculated per a single waste type, in this case rubble. So rubble of each pile for the purposes of concentration averaging is composed of one waste type having a particular set of physical characteristics.

The concentration of radioactivity may vary with the rubble pile depending on the structure or equipment that the rubble is made from. However, within a pile, the concentrations will be relatively consistent because the rubble will be mixed as it is being created and hot spots will be removed as they are identified. The consistency of radioactive content in waste is supported by the consistent dose rate measurement values recorded for concrete surfaces listed in Tables A-2 and A-3 in D&D-35176 and for debris in survey reports. The engineered backfill is eliminated as waste mass to calculate an average concentration because the concentration of radioactivity is different by a factor of greater than 10 from the substructure.

The actual volume that the waste takes up in the container will be used to calculate the concentration of radioactivity in the waste. The volume may be determined by weighing the container then applying a rubble density or by observation of the container volume. This practice will be implemented by work documents.

Conclusion

The rubble (including grout added to the basin and pits) waste streams satisfy the five criteria identified by the BTP that govern the use of concentration averaging to calculate radionuclide concentrations in waste for the purpose of determining the radioactive waste class in accordance with 10 CFR 61.55 with the following limitations.

- Grout in the 104 tank above one foot from the bottom of the tank is not included as waste mass.
- The engineered backfill is not included as waste mass.
- The actual waste volume will be used to calculate the concentration of radioactivity in a container.

D2.0 WASTE STREAM NUMBER 3- RUBBLE AND DEBRIS ENCAPSULATED IN GROUT

Waste Description

During the demolition process, rubble waste will be monitored to identify dose rate hot spots, nominally exhibiting 3 R/hour or more dose rate. This high dose rate material will be segregated, placed in a container, and encapsulated in grout. Also, dangerous waste material may be macroencapsulated with grout in a container. This waste form constitutes waste stream number 3, rubble and debris encapsulated with grout in a container and dangerous waste material treated by macroencapsulation. These waste hot spots will need to be stabilized with grout to meet transportation requirements, reduce exposure to workers, eliminate void spaces and stabilize the waste in order to meet waste disposal stability criteria. A loaded IP-II container will generate dose rates as high as 500 mR/hr or greater on contact prior to stabilization. The current One-time-shipment-request (OTRS) for transportation of containers limits the dose rate to 200 mR/hr on contact and 50 mR/hr at 2 meters. The waste will need to be stabilized to insure that this limitation can be met. It is also incumbent on the Project to reduce exposure to the workers to the extent practical. Stabilization of the waste will assure that the waste does not shift during handling and transport and will significantly lower the exposure to the workers. This process will initiate better ALARA practices throughout packaging, storage, and disposal. Once stabilized, the dose rate will be reduced to ~5 mR/hr at 1 foot. This will greatly reduce the exposure to the workers, both on project and at the ERDF, during storage and final disposal of the waste. This waste will meet the provisions of the BTP to take credit for the stabilization material in the container activity calculations in addition to the waste itself.

Evaluation

Section 3.7 of the BTP document provides guidance for encapsulation of solid material. This section states "For routine wastes such as filters, filter cartridges, or sealed sources centered in an encapsulated mass, classification may be based on the overall volume of the final solidified mass, provided that: (1) the volume and attributes of the encapsulated waste comply with the constraints established in Appendix C of this technical position: (2) The solidified mass meets the waste form structural stability criteria of 10 CFR 61.56 for Class B and Class C waste; and (3) the disposal unit containing the encapsulated mass is segregated from disposal units containing Class A wastes, that do not meet the structural stability requirements in 10 CFR 61.56(b)." The grouted debris waste will meet all three criteria by:

1. See Below for Appendix C applicability.

2. KE Basin Demolition Project will use ERDF approved controlled density fill grout mix and therefore, meets the waste form structural stability criteria.

3. ERDF is approved to take up to Class C waste and is not impacted by Class A waste.

Appendix C Criteria:

1. "A minimum Solidified volume or mass for encapsulation should be that which can reasonably be expected to increase the difficulty of an inadvertent intruder moving the waste by hand, following the loss of institutional control over the disposal site. This minimum size or weight should preclude any significant movement without the assistance of mechanical equipment"

   Compliance method: The IP-II container and stabilized contents will preclude any significant movement without the assistance of mechanical equipment. The IP-II dimensions are 20'x10'x9' and will have a stabilized mass of ~180,000 lbs.

2. "A maximum solidified volume or mass for encapsulation of a single discrete source (from which concentrations are determined) should be 0.2 m^3 or 500 Kg (typical 55-gallon drum). Larger volumes and masses may be used for encapsulation of single sources but, in general, unless a specific rationale is provided, no credit beyond the volume or mass indicated should be considered when determining waste concentrations."

   Compliance method: The waste to be encapsulated consists of <18,000 lbs of debris waste from the basin. The waste is to be packaged in a 20 ftx 10 ftx 9 ft IP-II metal box. During execution of the rubble and debris Loadout from 105-K East Basin, the waste will be loaded into a wood insert. The intent of the wood insert is to minimize impacts of dose and lower the exposure to the worker by keeping the waste off the floor and sides of the container.

   The approximate dimensions of the wood insert are 18 ft x 8 ft x 9 ft. The volume of the wood insert is calculated to be 36.70 m^3 which is equivalent to 184 drums. Because of the varying size and shape of the rubble and debris, the material will take up 75% of the volume of the wood insert. This equates to 27.53 m^3 which is equivalent to 138 drums. The <18,000 lbs of waste can conceptually be size reduced to fit into the 138 drums, which would equate to ~130 lbs for each discrete source. The maximum amount of material from the basin that could fit into a drum is ~400 lbs. Therefore, each drum would conceptually contain 0.065 m^3 of waste.

   If each drum were analyzed as a single source, that would allow 0.2 m^3 per drum. For 138 drums the total allowable volume for averaging is 27.6 m^3. The actual volume of waste in the drums based on 0.065 m^3 for the 138 drums is 8.97 m^3, which is well below the 27.6 m^3, and, therefore, allowable under the guidance of Appendix C for the rubble and debris waste. It would be acceptable to take credit for all 27.6 m^3 of the encapsulation material in the activity level calculation.

3. "A maximum amount of gamma-emitting radioactivity (e.g., Cs-137/Ba-137m, Nb-94) or radioactive material generally acceptable for encapsulation is that which, if credit is taken for a 500-year decay period, would result in a dose rate of less than 0.2 μSv/hr (0.02 mrem/hr)

on the surface of the encapsulating media. The calculation to determine compliance with this criterion may consider the minimum attenuation factor provided by the shielding properties of the encapsulating media but, in general, this factor should not exceed an attenuation factor that would be provided by 15 inches of concrete encapsulating material. Furthermore, the maximum Cs-137/Ba-137m gamma-emitting generally acceptable for encapsulation in a single disposal container is 1.1 TBq (30 Ci).

Compliance method: The maximum calculated Cs-137 activity value for a loaded IP-II container is 15 Ci. Which is half of the bounding value and therefore the calculation dose rate in a 500-year decay period will be well below the regulatory guidance. The thickness of the encapsulation material around the waste will vary, but no credit is taken for thicknesses greater than 15 inches of encapsulation material.

4. "A maximum amount of any radionuclide that should be encapsulated in a single disposal container intended for disposal at a commercial low-level waste disposal facility is that which, when averaged over the waste and the encapsulating media, does not exceed the maximum concentration limits for Class C waste, as defined in Tables 1 and 2 of 10 CFR 61.55."

   Compliance method: Stabilized IP-II containers will be shipped under ERDF Profile KBasin008. At 100% percent of profile the waste would not exceed Class C.

5. "In all cases when a discrete source of radioactive solid waste is encapsulated, written procedures should be established to ensure that the radiation source(s) is reasonable centered within the encapsulating medium."

   Compliance method: D&D Project has procedures that cover the installation of the wood insert into the IP-II container. The inclusion of the wood insert will assure that the waste material is centered in the container to the extent practical.

Conclusion

Therefore, it is concluded that the grouted IP-II Monolith waste form used to package and dispose of 105-K East Basin High Dose Waste and macroencapsulation treated dangerous waste will meet the BTP guidance and is acceptable to evaluate these containers for disposal at the ERDF using concentrations of radioactivity calculated including both waste and grout mass added into the container.

D3.0 REFERENCES

D&D-35176, *Evaluation of 105-K East Basin and Pits Substructure Rubble for Compliance with ERDF Radioactive Waste Requirements*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

NRC, *1995, Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position*, dated January 17, U.S. Nuclear Regulatory Commission, Washington, D.C.

APPENDIX E

SAMPLE ANALYSIS METHODS

APPENDIX E

SAMPLE ANALYSIS METHODS

Laboratory and field-testing methods that may be used to test samples of waste are listed in Table E-1. The Table E-1 lists common test methods used to characterize waste physical, chemical, and radiological properties and specifies sample preservation and method performance requirements. The list of test methods is not exhaustive. If the method is not available or the performance standards can not be attained as listed in Table E-1, then the laboratory shall determine, with the concurrence of the project, an alternate analysis method or performance requirements. If a test method not listed in Table E-1 is chosen, or alternate performance requirements are specified, it shall be documented.

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [p]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Laboratory Measurements – Metals[a]										
Antimony	7440-36-0	500 mL, P or G, HNO_3 to pH <2, 6 months	10 g, P or G, 6 months	SW-846 Method 6010 or 6020 (ICP) or EPA Method 200.8 (ICP/MS)	0.06	6	±30	70-130	±30	70-130
Arsenic	7440-38-2	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.1	10	±30	70-130	±30	70-130
Barium	7440-39-3	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.2	20	±30	70-130	±30	70-130
Beryllium[c]	7440-41-7	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.005	0.5	±30	70-130	±30	70-130
Cadmium	7440-43-9	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.005	0.5	±30	70-130	±30	70-130
Chromium (Total)	7440-47-3	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.01	1	±30	70-130	±30	70-130
Lead	7439-92-1	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.1	10	±30	70-130	±30	70-130

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [p]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Mercury	7439-97-6	500 mL, P or G, HNO_3 to pH <2, 28 days	10 g, P or G, 28 days	SW-846 Method 7471 (solid) (CVAA) or EPA Method 200.8 (ICP/MS)	N/A	0.20	N/A	N/A	±30	70-130
				SW-846 Method 7470 (TCLP Extracts) (CVAA) or EPA Method 200.8 (ICP/MS)	0.0005	N/A	±30	70-130	N/A	N/A
Selenium	7782-49-2	500 mL, P or G, HNO_3 to pH <2, 6 months	10 g, P or G, 6 months	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.1	10	±30	70-130	±30	70-130
Silver	7440-22-4	Same as above	Same as above	SW-846 Method 6010 (ICP) or EPA Method 200.8 (ICP/MS)	0.02	2	±30	70-130	±30	70-130
Laboratory Measurements – Semi volatile Organics[a]										
o-Cresol	95-48-7	4X1 L, aG w/ Teflon lined lid, 0.008 % $Na_2S_2O_3$, Store at 4 °C, 7 days	125 g, aG w/ Teflon lined lid, Store at 4 °C, 14 days	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f,g]	±30	[q]	±30	[q]
m-Cresol	108-39-4	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f,g]	±30	[q]	±30	[q]
p-Cresol	106-44-5	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f,g]	±30	[q]	±30	[q]
Cresol (Total)	1319-77-3	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f,g]	±30	[q]	±30	[q]

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [p]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
2,4-Dinitrotoluene	121-14-2	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	59-106[d]	±30	59-106[d]
Hexachloro-benzene	118-74-1	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
Hexachloro-butadiene	87-68-3	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
Hexachloro-ethane	67-72-1	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
Nitrobenzene	98-95-3	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
Pentachloro-phenol	87-86-5	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	62-114[d]	±30	55-120[d]
Pyridine	110-86-1	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
2,4,5-Trichloro-phenol	95-95-4	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
2,4,6-Trichloro-phenol	88-06-2	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[q]	±30	[q]
Other SVOCs	Compound-specific	Same as above	Same as above	SW-846 Method 8270 (GC/MS)	0.02	0.33-0.85[f]	±30	[d, q]	±30	[d, q]

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [P]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Laboratory Measurements – Volatile Organics[a]										
Benzene	71-43-2	3x40 mL G VOA vials w/ Teflon-lined septum caps, 0-Headspace, 0.008 % $Na_2S_2O_3$, store at 4 ° C, 14 days	1x40 mL G VOA vial w/ Teflon-lined septum cap. 0-Headspace. Store at 4 ° C, 14 days	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Carbon Tetrachloride	56-23-5	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Chlorobenzene	108-90-7	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Chloroform	67-66-3	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
1,4-Dichloro-benzene	106-46-7	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
1,2-Dichloroethane	107-06-2	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130[d]	±30	70-130
1,1-Dichloro-ethylene	75-35-4	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Methyl ethyl ketone	78-93-3	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [P]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Tetrachloro-ethylene	127-18-4	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Trichloro-ethylene	79-01-6	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Vinyl chloride	75-01-4	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Other VOCs	Compound-specific	Same as above	Same as above	SW-846 Method 8260 (GC/MS)	0.005	0.005-0.05[f]	±30	70-130	±30	70-130
Laboratory Measurements – Others										
TOX (Total Organic Halides)[k]	N/A	500 mL, aG 0-Headspace, Teflon lined lid, pH <2 w/ H_2SO_4, store @ 4 °C, 28 days	N/A	SW-846 Method 9020	3.0	N/A	--	--	--	--
PAH	N/A	4X1 L, aG w/ Teflon lined lid, 0.008 % $Na_2S_2O_3$, Store at 4 °C, 7 days	125 g, aG w/ Teflon lined lid, Store at 4 °C, 14 days	SW-846 Method 8270 (GC/MS)	Compound Specific	Compound Specific	--	--	--	--

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [P]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Screening Measurements										
PCB, Total (sum of all PCB isomers, or all 9 Aroclors)	1336-36-3	4X1 L, aG w/ Teflon lined lid, Store at 4 °C, 7 days	125 g, aG w/ Teflon lined lid, Store at 4 °C, 14 days	SW-846 Method 8082 (GC)	0.02	1.5	--	--	--	--
Chlordane	57-74-9	Same as above	Same as above	SW-846 Method 8081 (GC)	0.01	0.2	--	--	--	--
Endrin	72-20-8	Same as above	Same as above	SW-846 Method 8081 (GC)	0.005	0.04	--	--	--	--
Heptachlor (and its peroxide	76-44-8	Same as above	Same as above	SW-846 Method 8081 (GC)	0.001	0.02	--	--	--	--
Lindane	58-89-9	Same as above	Same as above	SW-846 Method 8081 (GC)	0.001	0.02	--	--	--	--
Methoxychlor	72-43-5	Same as above	Same as above	SW-846 Method 8081 (GC)	0.01	0.2	--	--	--	--
Toxaphene	8001-35-2	Same as above	Same as above	SW-846 Method 8081 (GC)	0.1	2.0	--	--	--	--
2,4-D	94-75-7	Same as above	Same as above	SW-846 Method 8151 (GC)	0.4	8.0	--	--	--	--
2,4,5-TP (Silvex)	93-72-1	Same as above	Same as above	SW-846 Method 8151 (GC)	0.02	0.4	--	--	--	--

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [P]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Flash Point	N/A	10 mL, P or G, cool	10 g, P or G, cool	ASTM Methods D-93-79, D-93-80, or D-3278-78; SW-846 Method 1020	N/A	N/A	--	--	--	--
PCB, Total (sum of all PCB isomers, or all Aroclors)		N/A	N/A	HazCat Kit[r] chloro-n-oil/water/soil	N/A	N/A	N/A	N/A	N/A	N/A
HOC (Total Chlorine)	N/A	N/A	N/A	HazCat Kit[r] – Halogenated Organic Carbon	N/A	N/A	N/A	N/A	N/A	N/A
PAH	N/A	7 days	14 days	SW-846 Method 8310	Compound Specific	Compound Specific	--	--	--	--
pH	N/A	25 mL, P or G, 24 hours except for solids	50 g, P or G, 24 hours except for solids	SW-846 Method 9045 (solids)	N/A	N/A	--	--	--	--
				SW-846 Method 9041 or HazCat Kit[j,r] (pH paper method)	N/A	N/A	N/A	N/A	N/A	N/A
				EPA Method 150.1 or SW-846 Method 9040 (pH meter method)	N/A	N/A	--	--	--	--
Peroxide	N/A	N/A	N/A	HazCat Kit[r]	N/A	N/A	N/A	N/A	N/A	N/A
Oxidizer	N/A	N/A	N/A	HazCat Kit[r]	N/A	N/A	N/A	N/A	N/A	N/A
Water Reactivity	N/A	N/A	N/A	HazCat Kit[r]	N/A	N/A	N/A	N/A	N/A	N/A
Sulfide	N/A	N/A	N/A	HazCat Kit[r]	N/A	N/A	N/A	N/A	N/A	N/A
Cyanide (Soluble)	57-12-5	14 days	14 days	HazCat Kit[r]	N/A	N/A	N/A	N/A	N/A	N/A

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [p]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Liquids	N/A	N/A	N/A	Paint Filter Liquids Test per HNF-1886 (FH 1999)	N/A	N/A	N/A	N/A	N/A	N/A
Toxic Air Pollutants	N/A	N/A	N/A	Field GC	N/A	Compound -specific[i]	--	--	--	--
				MIRAN SapphIRe Ambient Air Analyzer[o]	N/A	Compound -specific[i]	--	--	--	--
Flammable Gas	N/A	N/A	N/A	Mobile Drum Venting System	N/A	N/A	N/A	N/A	N/A	N/A
				Combustible Gas Indicator	N/A	Compound -specific[i]	--	--	--	--
				Field GC	N/A	Compound -specific[i]	--	--	--	--
Radioactivity Measurements										
H-3	Compound-specific	250 mL, G	100 g, G	Distillation/LSC	N/A	4.40E+04 pCi/g	--	--	--	--
C-14	Compound-specific	None	None	Oxidation to CO_2 with LSC	N/A	1.70E+04 pCi/g	--	--	--	--
Co-60, Nb-94, Sb-125, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155	Compound-specific	500 mL square Poly bottle	500 mL square Poly bottle	GEA	N/A	Compound -specific[i]	--	--	--	--
Ni-63	Compound-specific	None	None	KOH fusion or acid digest, separation, LSC	N/A	2.90E+06 pCi/g	--	--	--	--
Se-79	Compound-specific	None	None	Acid digest, separation LSC	N/A	7.00E+07 pCi/g	--	--	--	--
Sr-90	Compound-specific	1 L, P or G, pH <2 w/ HNO_3	10 g P or G.	Separation, beta counting	N/A	2.30E+06 pCi/g	--	--	--	--

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [P]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
Tc-99, Sn-126, Cs-135, Sm-151, Th-232, Pa-231, U-232, U-233, U-234, U-235, U-236, Np-237, U-238, Pu-239, Pu-240, AMU-241(Pu), AMU-242(Am), AMU-242(Pu), AMU-242(Cm), AMU-243(Am), AMU-243(Cm), AMU-244(Cm)	Compound-specific	N/A	N/A	Acid digest, ICP/MS	N/A	Compound -specific[k]	--	--	--	--

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [p]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				
I-129	Compound-specific	1 LL, G, cool.	offsite	KOH/water digest, separation, LEPS, GEA	N/A	3.50E+01 pCi/g	--	--	--	--
Pu-238, Pu-239/240, Am-241, Cm-242, Cm-243/244	Compound-specific	2 x 1 LL, P	See Bullet #1	KOH fusion or acid digest, separation, AEA	N/A	Compound -specific[i]	--	--	--	--

Notes:
Complete references for the cited documents are provided in Section6.0, References.
[a]All TCLP determinations are made on aqueous sample extracts produced using SW-846 Method 1311.
[b]The ability to meet required detection limits is dependent on the sample matrix.
[c]Universal Treatment Standard (mg/Kg unless mg/L TCLP specified).
[d]Statistically derived accuracy limits - Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also are performed for matrix spikes and surrogates as appropriate to the method.
[e]Fluor Hanford, Inc. has an administrative limit of 0.01 $\mu g/m^3$ for beryllium.
[f]Values shown are "nominal" compound-specific minimums and maximums. Most constituents will be within the given range. A limited number would have higher detection limits. Individual compounds will be evaluated against established laboratory quantitation limits (based on EPA guidance documents).
[g]If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol concentration is used. The regulatory level of total cresol is 200 mg/L.
[h]Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory limit.
[i]No action levels are specified for general groupings of compounds; action levels are compound specific.
[j]HOC and PAH, WAC 173-303-100[6].
[k]Washington State Department of Ecology, *Chemical Testing Methods for Designating* Dangerous Waste target list.
[l] Ignitability, WAC 173-3-3-090[5]
[m]PCB, 40 CFR 761 and WAC 173-303-9904.
[n]pH, WAC 173-303-100[7]
[o]MIRAN and the SapphIRe Ambient Air Analyzer are registered trademarks of Thermo Electron Corporation, Franklin, Maryland.
[p]The bottle material is specified as:"P" is polyethylene, "G" is glass, and "aG" is amber glass.
[q]Limits are not set specific to this constituent, but an acceptance limit is set for a key constituent that represents this constituent.
[r]HazCat is a registered trademark of the Haztech Systems, Inc. of Mariposa California.

Table E-1. Analytical Performance Requirements for Samples and Screening Methods. (11 sheets)

COC	CAS #	Bottle Size, [a]Type, Sample Preservation, and Hold Time		Name/Analytical Technology	Target Required Quantitation Limits[b]		Precision Water (%)	Accuracy Water (%)	Precision Soil (%)	Accuracy Soil (%)
		Water	Soil		Water Conc. (mg/L)	Soil-Other Conc. (mg/kg)				

AEA = alpha energy analysis.
CAS = Chemical Abstract Services.
COC = contaminant of concern.
Conc. = concentration.
CVAA = cold vapor atomic adsorption.
EPA = U.S. Environmental Protection Agency.
GC = gas chromatography.
GC/MS = gas chromatography/mass spectrometry.
GEA = gamma energy analysis.
HOC = halogenated organic compounds
ICP = inductively coupled plasma.
ICP/MS = inductively coupled plasma/mass spectrometry.
KOH = potassium hydroxide.
LEPS = low-energy photon system.
LSC = liquid scintillation counting.
N/A = not applicable.
PAH = polynuclear aromatic hydrocarbons.
PCB = polychlorinated biphenyls.
SVOC = semivolatile organic compound.
VOA = volatile organic analysis.
VOC = volatile organic compound.
TCLP = toxicity characteristic leaching procedure.
TOX = total organic halides.

APPENDIX F

QUALITY ASSURANCE OBJECTIVES

APPENDIX F

QUALITY ASSURANCE OBJECTIVES

The quality assurance objectives (QAO) of precision, accuracy, representativeness, completeness, and comparability are defined in Section 5.1.5 of this sampling and analysis plan (SAP) are evaluated as part of the validation of the data collected. A description of the criteria measuring the attainment of the QAO for each of the data collection methods subject to validation are provided in this appendix (see Tables F-1 through F-4).

The data validation evaluation shall be recorded on the forms shown as Figures F-1 and F-2 or equivalent. If this form is used, a check in the "yes" box means that the attribute has been evaluated and determined to be compliant as stated in the column labeled "Attainment Criteria." A check in the "no" box means that the attribute has been evaluated and determined to not be compliant as stated in the column labeled "Attainment Criteria." If these forms are used, attributes where the QAO criteria are stated as not being applicable shall be marked as "N/A" for not applicable. All attributes that are applicable must be evaluated. If the attribute is not attained, or there are qualifications of the data, this information must be documented by the evaluator.

Table F-1. Nondestructive Assay QAO Criteria.

QAO	Attainment Criteria
Precision	The percent relative standard deviation shall be within the values of Table 4-3 as demonstrated by a measurement of the parameter in compliance with system QC requirements of Section 5.2.1 of this SAP.
Accuracy	The percent recovery shall be within the values of Table 4-3 as demonstrated by a measurement of the parameter in compliance with system QC requirements of Section 5.2.1 of this SAP.
Representativeness	The attribute is ensured through the assay of each waste container when assay is used to resolve the DQO (see DR of Section 1.4.3 of this SAP).
Completeness	The required completeness is 100%. All assay data necessary to satisfy the DQO (see DR of Section 1.4.3 of this SAP) must be valid and useable.
Comparability	Comparability is ensured through meeting the training requirements and quality requirements that are applicable to the assay process. Unless the assay is being performed by different organizations or facilities, this attribute is not applicable because the QAO is achieved via contract provisions and work documents.

DQO = data quality objectives.
DR = decision rules.
QAO = quality assurance objectives.
QC = quality control.
SAP = sampling and analysis plan.

Table F-2. Field Measurements QAO Criteria.

QAO	Attainment Criteria
Precision	Precision is established and maintained within the recommendations of the manufacturer of the instrument or performance requirements of Table 4-2 as applicable.
Accuracy	Calibration is established and maintained within the recommendations of the manufacturer of the instrument used or performance requirements of Table 4-2 as applicable.
Representativeness	The measurement is applied to the entire waste.
Completeness	100% of the measurements needed are performed and useable.
Comparability	Measurements are performed by personnel trained in their use and in accordance with applicable standards and work documents.

QAO = quality assurance objectives.

Table F-3. Fixed Laboratory QAO Criteria. (2 sheets)

QAO	Attainment Criteria
Precision	Laboratory precision will be calculated as defined in the analytical methods used. Laboratory precision goals for this project will be established consistent with the method's published precision criteria (when available). The precision requirement applicable to each analysis is provided in Table E-1. If the precision requirements must be changed due to the method, sample radioactivity and/or matrix, or other constraints, the alternate precision requirement will be documented.
Accuracy	The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for those analytical methods on similar sample matrices. Laboratory QA/QC samples will be analyzed as required by the analytical methods or laboratory standard work documents under which the sample analyses are conducted. The accuracy requirement applicable to each analysis is provided in Table E-1. If the accuracy requirements must be changed due to the method, sample radioactivity and/or matrix, or other constraints, the alternate precision requirement will be documented.
Representativeness	Representativeness is a qualitative parameter that addresses the proper design of the sampling program. The representativeness criterion is satisfied by confirming that sampling locations are selected properly and a sufficient number of samples are collected to meet the confidence level required by the intended use of the data. In some cases, such as waste screening, a nonprobabilistic approach will be used to collect samples, or nonrepresentative samples will be taken to meet specific scientific objectives, which will be documented in the work documents written for that waste stream.
Completeness	100% of the tests needed are performed and useable. The number of tests required is specified in the work documents prepared for the waste stream. If a probabilistic based sample design is used, then the confidence levels applicable to the decision (e.g., 90% confidence the mean of results is less than the regulatory threshold as per SW-846 [EPA 1997]) must be attained.

Table F-3. Fixed Laboratory QAO Criteria. (2 sheets)

QAO	Attainment Criteria
Comparability	Comparability will be assessed qualitatively by comparing the following information on each data set: field collection and sample handling methods, laboratory QA/QC procedures, laboratory detection limits, and the sample matrix. Variations between data sets of the sampling and analyses conducted during waste characterization activities will be noted and the possible effect on the results discussed and documented.

QAO = quality assurance objectives.
QA/QC = Quality assurance/quality control.

Table F-4. Field Testing QAO Criteria.

QAO	Attainment Criteria
Precision	The precision of field techniques is not measured quantitatively but relies on good sample design and application of field quality control practices (field duplicates, splits, etc.) that are provided in governing work documents. The attribute of accuracy is attained by ensuring the sample design and field quality control specified in the work documents were appropriate and were in acceptable ranges.
Accuracy	The accuracy of field techniques is not measured quantitatively but relies on good sample design and application of field quality control practices (spikes, blanks, etc.) that are provided in governing work documents. The attribute of accuracy is attained by ensuring the sample design and field quality control specified in the work documents were appropriate and were in acceptable ranges.
Representativeness	Representativeness is a qualitative parameter that addresses the proper design of the sampling program. The representativeness criterion is satisfied by confirming that sampling locations are selected properly and a sufficient number of samples are collected to meet the confidence level required by the intended use of the data. Field testing, such as waste screening, often uses a nonprobabilistic approach to collect samples, or nonrepresentative samples will be taken to meet specific scientific objectives, which will be documented in the work documents written for that waste stream.
Completeness	100% of the tests needed are performed and useable. The number of tests required is specified in the work documents prepared for the waste stream. If a probabilistic based sample design is used, then the confidence levels applicable to the decision (e.g., 90% confidence the mean of results is less than the regulatory threshold as per SW-846 [EPA 1997]) must be attained.
Comparability	Comparability will be assessed qualitatively by comparing the following information on each data set: field collection and sample handling methods, field method procedures, and the sample matrix. Variations between data sets of the sampling and analyses conducted during waste characterization activities will be noted and the possible effect on the results discussed and documented.

QAO = quality assurance objectives.

Figure F-1. Validation Form.

Data Evaluation Checklist		
Batch Report or Data Identification:		
Waste Steam Identification:		
SAP under which data was collected:	D&D-34992	
Data Assurance Objective	**Demonstration of Compliance Notes**	**Decision**
The data are **representative** of the waste.		☐yes ☐no
The waste data are **comparable.**		☐yes ☐no
The data **accuracy** is within acceptable limits.		☐yes ☐no
The data **precision** is within acceptable limits		☐yes ☐no
The data meets **completeness** objective.		☐yes ☐no
Data meets quality requirements and are valid for use in decision-making.		☐yes ☐no
Assessor Comments and Notes:		
Assessor Certification Print Name, sign, and date:		

Figure F-2. Data Validation Continuation Form.

Data Evaluation Checklist
Batch Report or Data Identification:
SAP under which data was collected: D&D-34992
Evaluator Notes and Resolutions (cont.):
Page ___ of ___

REFERENCES

EPA, 1997, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846, Update III, U.S. Environmental Protection Agency, Washington, D.C.

APPENDIX G

RECONCILATION WITH USER REQUIREMENTS

APPENDIX G

RECONCILATION WITH USER REQUIREMENTS

The validated waste information is evaluated against the user requirements. The evaluation shall be documented on the checklist of Figure G-1 or equivalent. If this form is used, a check in the "yes" box means that the attribute has been evaluated and determined to be compliant as stated in the column labeled "Criteria." A check in the "no" box means that the attribute has been evaluated and determined to not be compliant as stated in the column labeled "Criteria." All of the boxes, if applicable, must be marked "yes" for the waste or the nonconformance resolved to be compliant for shipment to the Environmental Restoration Disposal Facility (ERDF) for treatment and/or disposal. If the form of Figure G-1 is used, attributes that are not applicable are marked "N/A" (not applicable). All the applicable attributes must be evaluated. If the attribute is not attained, this information and resolution must be recorded by the evaluator.

Figure G-1. User Requirements Evaluation Form.

User Requirements Evaluation Checklist		
Shipment Identification:		
ERDF Profile (waste stream) Identification:		
SAP under which data was collected: D&D-34992		
DR Number	**Criteria**	**Decision**
1, 2, 3, 4	The waste has been designated per WAC 173-303 to determine if it is dangerous waste. If it is dangerous waste then DR 8 is evaluated. If the waste does not designate as dangerous/hazardous waste, then it will not be evaluated for disposal at the ERDF per Decision Rule 8.	☐ yes ☐ no
5	The waste has been evaluated to determine the PCB content and status per 40 CFR 761.	☐ yes ☐ no
6	*The waste is compliant or can be treated to comply with the ERDF waste acceptance critieria radiological requirements. Waste must not be NRC greater-than-class C.*	☐ yes ☐ no
7	The waste is compliant with or can be treated to comply with the ERDF waste acceptance critieria physical form requirements.	☐ yes ☐ no
8	The waste, if dangerous waste, has been evaluated to determine the land disposal restrictions status as per WAC 173-303-140. If it is land disposal restriction compliant or will be treated at the ERDF then it may be sent to the ERDF.	☐ yes ☐ no
Waste is encompassed by the ERDF profile.		☐ yes ☐ no
Waste is compliant for treatment and/or disposal at the ERDF.		☐ yes ☐ no
Assessor Comments and Notes:		
Assessor Certification Print Name, sign, and date:		

Notes: DR = decsision rules

G1.0 REFERENCES

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

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

WAC 173-303-140, "Land Disposal Restrictions," *Washington Administrative Code*, as amended, Olympia, Washington.