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324 Building REC and HLV Tank Closure Plan

Scientific Ecology Group, Inc.
Richland, Washington

B. Becker-Khaleel
K. Schlick

December 1995

Prepared by Scientific Ecology Group, Inc.
for Pacific Northwest National Laboratory
under Contract DE-AC06-76RLO 1830
with the U.S. Department of Energy
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Pacific Northwest Laboratory
Richland, Washington 99352

MASTER

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EXECUTIVE SUMMARY

1 In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site, northwest
2 of Richland, Washington, to locate facilities for reactors, chemical separations, and related
3 activities. With the end of the cold war, however, Hanford's mission has changed to waste
4 management and environmental remediation and restoration.
5

6 The Chemical and Materials Engineering Laboratory (the 324 Building located in the
7 300 Area at the Hanford Site), completed in 1965, contains laboratories, hot cells, support
8 facilities, and office space used to pursue technical studies ranging from laboratory to pilot-
9 plant scale. Materials with radioactivity levels ranging from natural background to full
10 process levels are used in these studies. The 324 Building was designed to meet the require-
11 ments of the Uniform Building Code (UBC) and Hanford Plant Standard Design Criteria 4.1,
12 Revision 2. The building has been operated for over 25 years with no serious safety or
13 environmental incidents.
14

15 This report provides the closure plan for two facilities housed in the 324 Building. The
16 first facility is the Radiochemical Engineering Cell Complex (Complex). The Complex is
17 comprised of four hot cells (A, B, C, and D Cell) and an airlock. Two of the cells in the
18 Complex are subject to Resource Conservation and Recovery Act (RCRA) closure due to the
19 hazardous/dangerous wastes stored in those cells. The unit designated as the Radiochemical
20 Engineering Cell or REC is comprised of the B-Cell and one drum of dangerous waste in
21 D-Cell. The second facility to be closed is the High Level Vault. The High Level Vault
22 houses four stainless steel tanks in a sub-basement vault. Three of the four tanks contain
23 hazardous/dangerous waste and are therefore subject to closure. The unit, designated as the
24 High Level Vault Tanks or HLV Tanks, is comprised of Tanks 104, 105, and 107. The
25 fourth tank, 106, is not subject to closure because no hazardous/dangerous waste is currently
26 housed in the tank, nor does the tank history reflect that hazardous/dangerous waste(s) were
27 ever managed in the tank.
28

29 The REC and HLV Tanks are to be cleaned so that no dangerous waste or dangerous-
30 waste contamination will remain to pose a threat to human health or the environment. This
31 closure plan provides clean-closure requirements and the plans for implementing those
32 requirements. Information provided includes a history of the major programs that have used
33 the REC and HLV tanks as well as additional information on how the waste was processed
34 and the overall waste-handling system. Additional details focus on waste inventory and the
35 characteristics of wastes treated at these facilities.
36

37 The closure strategy, performance standards for protecting human health and the envi-
38 ronment, and the actual closure activities are described. The sampling plan is also provided
39 along with detailed information on how the tanks will be decontaminated and closed.
40

41 A closure schedule is provided. Finally, provision is made for postclosure care, if
42 needed.

GLOSSARY

1		
2		
3		
4	AES	atomic emission spectroscopy
5	ALARA	as low as reasonably achievable
6	ASTM	American Society for Testing and Materials
7	BCCP	324 Building B-Cell Safety Cleanout Project
8	CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
9	Complex	Radiochemical Engineering Complex (broad definition: Cells A, B, C, and D
10		and airlock - not the unit subject to the closure plan)
11	CWC	Central Waste Complex
12	D&D	decontamination and decommissioning
13	DOE-RL	Department of Energy, Richland Operations Office
14	DW	dangerous waste
15	EC	engineered container
16	EDL	Engineering Development Laboratory
17	EPA	U.S. Environmental Protection Agency
18	EHW	extremely hazardous waste
19	ft	feet
20	FRG	Federal Republic of Germany
21	FSCC	Feasibility Study for Clean Closure (324 Building REC and HLV)
22	gal	gallon
23	HASP	Health and Safety Plan
24	HEPA	High Efficiency Particulate Air
25	HLLW	high level liquid waste
26	HLV	High Level Vault
27	ICP	inductively coupled plasma
28	IRA	interim removal action
29	IWMP	Interim Waste Management Plan
30	L	liter
31	LLI	Liquid Level Indicator
32	LLV	Low Level Vault
33	LLW	low level waste
34	LOS	Load-Out Station
35	LWR	Light Water Reactor
36	$\mu\text{Ci/g}$	micro curies
37	m	meter
38	MCi	million curies
39	NDE	non-destructive examination
40	NWTP	Nuclear Waste Treatment Program
41	NWVP	Nuclear Waste Vitrification Project
42	PMP	Project Management Plan
43	PNL	Pacific Northwest Laboratory (previous name - previously published
44		documents are still referred to with this designation)
45	PNNL	Pacific Northwest National Laboratory (new name for the laboratory)
5	PT	pipe trench

1	PUREX	plutonium uranium extraction
2	psig	per square inch gage
3	QA/QC	quality assurance/quality control
4	RCGs	Residual Contamination Guides
5	RCRA	Resource Conservation and Recovery Act
6	R&D	research and development
7	REC	Radiochemical Engineering Complex (restricted definition: B-Cell and one
8		drum of dangerous waste in D-Cell - the unit subject to the closure plan)
9	RI/FS	remedial investigation/feasibility study
10	RLFCM	Radioactive Liquid-Fed Ceramic Melter
11	RPS	retention process sewer
12	SAIC	Science Applications International Corporation
13	SCBA	self-contained breathing apparatus
14	SGI	specific gravity indicator
15	SPG	specific gravity
16	TCLP	Toxicity Characteristic Leaching Procedure
17	TLD	thermoluminescent dosimeter
18	TPP	technical project plan
19	TRU	transuranic
20	TSD	treatment, storage, and disposal
21	UBC	Uniform Building Code
22	WAC	Washington Administrative Code
23	WIPP	Waste Isolation Pilot Project
24	WSEP	Waste Solidification Engineering Prototypes
25	ZVDP	Zeolite Vitrification Demonstration Program

CHEMICAL ELEMENTS REFERRED TO

(not identified in text)

Ag	Silver	Ni	Nickel
Al	Aluminum	Pb	Lead
Ba	Barium	Pd	Palladium
Cd	Cadmium	Pu	Plutonium
Co	Cobalt	Rb	Rubidium
Cr	Chromium	Rh	Rhodium
Cs	Cesium	Ru	Ruthenium
Cu	Copper	Se	Selenium
Fe	Iron	Tc	Technetium
K	Potassium	U	Uranium

DEFINITION OF TERMS

CLEAN UP LEVELS - Refers to the chemical concentration levels that will indicate that the units have been cleaned to a level that will protect human health and the environment. Clean-up-level values are based on the maximum concentration of contaminants for the toxicity characteristic to classify material as dangerous waste as specified in 40 CFR 261.

FACILITY - For purposes of the *Resource Conservation and Recovery Act of 1976*, the Hanford site is considered to be a single facility consisting of a number of waste management units. The term "facility" also is commonly used in building nomenclature throughout the Hanford site.

CONTENTS

EXECUTIVE SUMMARY	iii
GLOSSARY	v
CHEMICAL ELEMENTS REFERRED TO	vii
DEFINITION OF TERMS	vii
1.0 INTRODUCTION	1-1
1.1 BACKGROUND	1-1
1.2 CLOSURE PLAN OBJECTIVE	1-2
1.3 324 BUILDING CLOSURE PLAN CONTENTS	1-2
1.3.1 Facility Description	1-3
1.3.2 Process Information	1-3
1.3.3 Waste Characteristics	1-3
1.3.4 Groundwater Monitoring	1-3
1.3.5 Closure Performance Standards	1-3
1.3.6 Closure Activities	1-3
1.3.7 Postclosure Plan	1-4
1.3.8 Bibliography	1-4
2.0 FACILITY DESCRIPTION	2-1
2.1 GENERAL HANFORD SITE DESCRIPTION	2-1
2.2 FACILITY DESCRIPTION AND GENERAL PROVISIONS	2-1
2.3 DESCRIPTION OF REC	2-2
2.3.1 General Description of the REC Complex	2-2
2.3.2 Description of B-Cell	2-3
2.3.3 Description of D-Cell	2-4
2.4 DESCRIPTION OF HIGH LEVEL VAULT AND TANKS	2-4
2.4.1 Tank 104	2-5
2.4.2 Tank 105	2-5
2.4.3 Tank 107	2-6
2.4.4 Ancillary Equipment	2-6
2.5 SECURITY INFORMATION	2-6

CONTENTS (cont)

3.0	PROCESS INFORMATION	3-1
3.1	DESCRIPTION OF WASTES AND SYSTEMS	3-1
3.1.1	Waste Solidification Engineering Prototypes	3-1
3.1.2	Nuclear Waste Vitrification Project	3-2
3.1.3	Fabrication of Cesium and Strontium Heat and Radiation Sources Program (FRG Program)	3-2
3.1.4	Present Conditions	3-2
4.0	WASTE CHARACTERISTICS	4-1
4.1	ESTIMATE OF MAXIMUM WASTE INVENTORY	4-1
4.1.1	REC Waste Inventory and Characteristics	4-1
4.1.1.1	Dispersible Debris	4-3
4.1.1.2	Lead Shielding/Counterbalances	4-3
4.1.1.3	Containerized Feed Tank Heels	4-3
4.1.1.4	Liquid-Metal Seal	4-5
4.1.1.5	Oil-Absorption Material	4-5
4.1.2	HLV Tank Waste Inventory and Characteristics	4-5
4.1.2.1	Tanks 104 and 105	4-5
4.1.2.2	Tanks 106 and 107	4-8
4.1.2.3	Process of Compiling Waste Characterization Information	4-8
4.2	WASTE TREATMENT PLANS FOR THE REC AND HLV TANKS	4-9
4.2.1	REC Waste-Treatment Plans	4-9
4.2.2	HLV Tank-Waste Treatment Plans	4-9
4.3	WASTE INVENTORY REMOVAL	4-9
4.4	RESIDUAL WASTE INVENTORY AND CHARACTERISTICS	4-10
5.0	GROUNDWATER	5-1
6.0	CLOSURE STRATEGY AND PERFORMANCE STANDARDS	6-1
6.1	CLOSURE STRATEGY	6-1
6.2	GENERAL CLOSURE ACTIVITIES	6-4
6.2.1	Closure Activities for D-Cell	6-4
6.2.2	Closure Activities for B-Cell	6-4
6.2.3	Closure Activities for the HLV Tanks	6-5

CONTENTS (cont)

6.3	MINIMIZE THE NEED FOR FUTURE MAINTENANCE	6-5
6.4	PROTECT HUMAN HEALTH AND THE ENVIRONMENT	6-5
6.5	RETURN LAND TO THE APPEARANCE AND USE OF SURROUNDING LAND	6-6
6.6	COMPLIANCE WITH CLOSURE REQUIREMENTS	6-6
7.0	CLOSURE ACTIVITIES	7-1
7.1	INTRODUCTION	7-1
7.2	REMOVAL OF WASTE INVENTORY	7-1
7.2.1	324 Building B-Cell Safety Cleanout Project	7-1
7.2.1.1	Approach for Recovering and Packaging Mixed Waste	7-3
7.2.2	HLV Interim Removal Action Plan	7-4
7.3	SAMPLING AND ANALYSIS CRITERIA	7-5
7.3.1	Sampling Design	7-6
7.3.1.1	Objectives	7-6
7.3.1.2	Analytical Parameters	7-6
7.3.1.3	Sampling Activities	7-6
7.3.1.4	B-Cell Sampling Procedure	7-7
7.3.1.5	B-Cell Sampling Locations	7-10
7.3.1.6	HLV Tank Sampling Procedure and Location	7-11
7.3.1.7	Data Quality	7-11
7.3.2	Modification to Sampling and Analysis Plan	7-11
7.3.3	Evaluation of Data	7-12
7.3.4	Statistical Treatment of Data	7-12
7.3.5	Assessment of Data Reliability	7-13
7.3.6	Reporting	7-13
7.3.7	Sampling Equipment, Containers, and Preservation	7-13
7.3.7.1	Sampling Equipment	7-13
7.3.7.2	Sample Containers and Preservation	7-14
7.3.8	Sample Quality Control	7-14
7.3.8.1	Field Quality Control	7-14
7.3.8.2	Field Logbook	7-15
7.3.8.3	Sample Labels	7-15
7.3.8.4	Sample Seals	7-16
7.3.8.5	Chain-of-Custody Record	7-16
7.3.8.6	Sample-Analysis Request	7-16

CONTENTS (cont)

7.3.8.7	Laboratory Receipt and Logging of Sample	7-17
7.3.8.8	Decontamination	7-17
7.3.8.9	Sample Disposition	7-17
7.3.9	Analytical Procedures	7-18
7.3.10	Laboratory Quality Assurance/Quality Control	7-18
7.3.11	Site Safety	7-19
7.3.11.1	Health and Safety Plan	7-19
7.3.11.2	Contamination Control	7-20
7.3.11.3	Personnel Training	7-20
7.3.11.4	Standard Safety Procedures	7-21
7.4	REMOVAL OF DANGEROUS WASTE RESIDUE	7-21
7.4.1	Contaminated Material to be Removed	7-22
7.4.2	Verification Sampling	7-22
7.5	INTEGRITY ASSESSMENT OF THE UNITS	7-22
7.5.1	HLV Tanks	7-22
7.5.2	D-Cell	7-23
7.5.3	B-Cell	7-23
7.5.3.1	Radiation Survey	7-23
7.5.3.2	Liquid Penetrant	7-24
7.5.3.3	Ultrasonic Testing	7-24
7.5.3.4	Eddy Current Testing	7-24
7.6	DECONTAMINATION OF THE HLV TANKS	7-25
7.7	DECONTAMINATION OF D-CELL	7-25
7.8	DECONTAMINATION OF B-CELL	7-25
7.8.1	Low-Pressure Foam	7-26
7.8.2	High/Ultrahigh-Pressure Water Wash	7-27
7.9	SECONDARY WASTE MANAGEMENT	7-28
7.10	OTHER ACTIVITIES REQUIRED FOR CLOSURE	7-28
7.11	SCHEDULE FOR CLOSURE	7-28
7.12	EXTENSION FOR CLOSURE TIME	7-29
7.13	AMENDMENT OF CLOSURE PLAN	7-29

CONTENTS (cont)

1			
2			
3			
4	7.14	CERTIFICATION OF CLOSURE AND SURVEY PLAT	7-30
5	7.14.1	Certification of Closure	7-30
6	7.14.2	Survey Plat	7-30
7			
8	8.0	POSTCLOSURE PLAN	8-1
9			
10	9.0	BIBLIOGRAPHY	9-1
11			
12	9.1	DOCUMENTS	9-1
13			
14	9.2	CODE OF FEDERAL REGULATIONS	9-4
15			
16	9.3	FEDERAL AND STATE ACTS	9-4
17			
18	9.4	WASHINGTON ADMINISTRATIVE CODES	9-4

FIGURES

1			
2			
3			
4	2-1.	Hanford Site and Regional Map	2-8
5	2-2.	300 Area	2-9
6	2-3.	Topographical Map of Hanford 300 Area - 324 Building	2-10
7	2-4.	324 Building Basement Plan	2-11
8	2-5.	324 Building First Floor Plan	2-12
9	2-6.	324 Building Second Floor Plan	2-13
10	2-7.	324 Building Third Floor Plan	2-14
11	2-8.	324 Building Radiochemical Engineering Cells	2-15
12	2-9.	324 Building High-Level Vault, Low-Level Vault, and Vault Tanks	2-16
13	2-10.	Tank 104 Piping	2-17
14	2-11.	Tank 105 Piping	2-18
15	2-12.	Tank 107 Piping	2-19
16	5-1.	Boundary of the 300 Area Operable Units	5-2
17	6-1.	REC Clean-Closure Pathway	6-2
18	6-2.	HLV Clean-Closure Pathway	6-3
19	7-1.	Randomly Selected Sampling Locations	7-8
20	7-2.	Wipe-Sampling Technique	7-9
21	7-3.	Closure Schedule	7-29

TABLES

22			
23			
24			
25			
26			
27			
28	4-1.	B-Cell Dangerous Waste Characteristics	4-2
29	4-2.	D-Cell Dangerous Waste Characteristics	4-3
30	4-3.	Dangerous Waste Constituent Concentrations in B-Cell Floor	
31		Dispersible Debris	4-4
32	4-4.	Dangerous Waste Constituent Concentrations in Feed Preparation Tanks	4-4
33	4-5.	Analytical Results of HLV Tanks	4-6
34	4-6.	Inductively Coupled Plasma Analytical Results	4-7
35	4-7.	HLV Tanks Dangerous Waste Characteristics	4-8
36	7-1.	REC Mixed Waste	7-2
37	7-2.	Clean-Closure Criteria for the HLV Tanks and REC	7-6
38	7-3.	Computer-Generated Random Numbers	7-7
39	7-4.	Sampling Locations	7-10

1.0 INTRODUCTION

This closure plan describes the activities necessary to close the 324 Radiochemical Engineering Cells (REC) and High-Level Vault (HLV) in accordance with the Washington State Dangerous Waste regulations. To provide a complete description of the activities required, the closure plan relies on information contained in the 324 Building B-Cell Safety Cleanout Project (BCCP) plans, the 324 Building REC HLV Interim Waste Management Plan (IWMP), the Project Management Plan for Nuclear Facilities Management 300 Area Compliance Program, and the 324 High Level Vault Interim Removal Action Project (project management plan [PMP]). The IWMP addresses the management of mixed waste in accordance with state and federal hazardous waste regulations. It provides a strategy for managing high-activity mixed waste in compliance with Resource Conservation and Recovery Act (RCRA) requirements or provides for an alternative management approach for the waste. The BCCP outlines the past, present, and future activities necessary for removing from B-Cell the solid waste, including mixed waste generated as a result of historical research and development (R&D) activities conducted in the cell. The BCCP also includes all records and project files associated with the B-Cell cleanout. This information is referenced throughout the closure plan. The PMP sets forth the plans, organization, and systems that Pacific Northwest National Laboratory (PNNL)^(a) will use to direct and control the 324 High-Level Vault Interim Removal Action Project. This project will develop and implement a treatment strategy that will remove and stabilize the inventory of liquid waste from the 324 HLV tanks. The PMP also provides for flushing and sampling the flush solution.

This chapter provides background information for closing the REC and HLV. The REC unit is part of a larger facility, the Radiochemical Engineering Cell Complex (Complex), which is comprised of four hot cells (A, B, C, D) and an airlock. The REC unit consists of B-Cell and one drum containing dangerous waste in D-Cell. The HLV facility contains tanks 104, 105, 106, and 107. Three of the four tanks (104, 105, and 107) contain hazardous/dangerous waste and are therefore subject to closure. These three tanks will hereafter be referred to as the HLV unit. The fourth tank, 106, is not subject to closure because no hazardous/dangerous waste is currently housed in the tank, nor does the tank history reflect that hazardous/dangerous waste(s) was ever managed in the tank.

An overview of the 324 Building REC and HLV Tank Closure Plan is also provided.

1.1 BACKGROUND

The 324 Building provides office and laboratory space for PNNL scientific and engineering staff conducting multidisciplinary research in the areas of waste characterization and

(a) The laboratory was previously named Pacific Northwest Laboratory (PNL). Current usage will be designated as PNNL, but when previous documents are referred to, the former name and acronym will be used.

immobilization, waste remediation and cleanup development, biomass research, spent fuel characterization, tritium development, and cesium chloride encapsulation. Because the 324 Building is a research and development facility, the work being conducted changes as programs are concluded and others are started. Typically, several projects or tasks are in progress at any one time. Currently, these processes have been discontinued in the REC and HLV tanks, which are now undergoing closure as defined in the *Resource Conservation and Recovery Act (RCRA) of 1976 and 40 CFR 270.2*. The 324 Building REC and HLV Tanks will be closed pursuant to the requirements of WAC 173-303-610.

This closure plan presents a description of the 324 Building REC and HLV Tanks, the history of materials and waste managed, and the procedures that will be followed to close the REC and HLV Tanks. The 324 Building is located within the 300-FF-2 (source) and 300-FF-5 (groundwater) operable units, as designated in the *Hanford Federal Facilities Agreement and Consent Order (Tri-Party Agreement)*. Contamination in the operable units 300-FF-2 and 300-FF-5 is scheduled to be addressed through the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980* remedial-action process. Therefore, all soil and groundwater remedial action (other than imminently dangerous conditions) at the 324 Building will be conducted as part of the CERCLA remedial action of operable units 300-FF-2 and 300-FF-5.

1.2 CLOSURE PLAN OBJECTIVE

The objective of this closure plan is to outline the activities for clean closure of the 324 Building REC and HLV Tanks. Clean closure, as used in this context, means that no dangerous waste or dangerous waste contamination will remain in the units to pose a threat to human health or the environment. This closure plan will provide detailed descriptions of the clean-closure requirements, plans, and implementation of clean-closure actions for the 324 Building REC and HLV Tanks. This closure plan does not address final closure of the 324 Building.

1.3 324 BUILDING CLOSURE PLAN CONTENTS

The 324 Building REC and HLV tanks Closure Plan consists of the following nine chapters:

- Introduction (Chapter 1.0)
- Facility Description (Chapter 2.0)
- Process Information (Chapter 3.0)
- Waste Characteristics (Chapter 4.0)
- Groundwater Monitoring (Chapter 5.0)
- Closure Strategy and Performance Standards (Chapter 6.0)
- Closure Activities (Chapter 7.0)
- Postclosure Plan (Chapter 8.0)

- Bibliography (Chapter 9.0)
- References (Chapter 10.0)

A brief description of each chapter is provided in the following sections.

1.3.1 Facility Description (Chapter 2.0)

This chapter provides a brief description of the Hanford Site and the location and description of the 324 Building REC and HLV Tanks. Information on Hanford Site security is also provided.

1.3.2 Process Information (Chapter 3.0)

This chapter provides detailed descriptions of operations in the 324 Building REC and HLV Tanks. Additional information is provided on how the waste was generated and the overall waste handling system.

1.3.3 Waste Characteristics (Chapter 4.0)

This chapter discusses the maximum material inventory and the characteristics of materials managed in the 324 building REC and HLV tanks.

1.3.4 Groundwater Monitoring (Chapter 5.0)

This chapter explains that groundwater in the 300 Area will be included in the 300-FF-5 operable unit and cleaned up by the CERCLA remedial action process. Therefore, detailed groundwater information is not included.

1.3.5 Closure Performance Standards (Chapter 6.0)

This chapter outlines the closure strategy, performance standards for protection of human health and the environment, and closure activities.

1.3.6 Closure Activities (Chapter 7.0)

This chapter contains the sampling plan and describes in detail how the 324 Building REC and HLV Tanks will be decontaminated and closed. A closure schedule is provided.

1 **1.3.7 Postclosure Plan (Chapter 8.0)**
2

3 This chapter outlines provisions for postclosure care, if required.
4
5

6 **1.3.8 Bibliography (Chapter 9.0)**
7

8 A list of all materials used to compile this Closure Plan is provided for the reader's
9 information.
10

11 All documents listed, which are not available from other sources, will be made available
12 for review, upon request, to any regulatory agency or public commentor. These documents
13 can be obtained by contacting the following:
14

15 Records Specialist
16 Public Access Room
17 Pacific Northwest National Laboratory
18 Battelle Boulevard
19 Richland, Washington 99352

2.0 FACILITY DESCRIPTION

This chapter describes the Hanford Site, the 324 Building, the 324 Building REC and HLV Tanks, and Hanford Site security.

2.1 GENERAL HANFORD SITE DESCRIPTION

The Hanford Site covers approximately 1,450 square kilometers (560 square miles) of semiarid land that is owned by the U.S. Government and managed by the U.S. Department of Energy, Richland Operations Office (DOE-RL). The Hanford Site is located northwest of the city of Richland, Washington (Figure 2-1). The city of Richland adjoins the southeastern most portion of the Hanford Site boundary and is the nearest population center. In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related activities for the production and purification of special nuclear materials and other nuclear activities. The mission of the Hanford Site recently has focused on waste management and environmental remediation and restoration.

Activities on the Hanford Site are centralized in numerically designated areas. The reactors are located along the Columbia River in the 100 Areas. The reactor-fuel reprocessing units are in the 200 Areas, which are on a plateau approximately 11 kilometers (7 miles) from the Columbia River. The 300 Area, located adjacent to and north of Richland, contains the reactor-fuel manufacturing plants and the research and development laboratories. The 400 Area, 8 kilometers (5 miles) northwest of the 300 Area, contains the Fast Flux Test Facility used for testing liquid metal reactor systems. The 600 Area covers all locations not specifically given an area designation. Adjacent to and north of Richland, the 1100 Area contains offices associated with administration, maintenance, transportation, materials procurement, and distribution. The 3000 Area, just east of the 1100 Area, contains engineering offices, and administrative offices. Administrative offices also are located in the 700 Area, which is in downtown Richland.

2.2 FACILITY DESCRIPTION AND GENERAL PROVISIONS

The initial construction of the 324 Chemical and Materials Engineering Laboratory (324 Building), was completed in 1965. The 324 Building is located in the central part of the 300 Area (Figure 2-2), on Locust Street. Figure 2-3 details the area around the 324 Building and illustrates adjacent buildings. The approximate coordinates of the 324 Building are N53,954 E15,709, Hanford Grid.

The 324 Building contains laboratories, hot cells, support facilities, and office space used to pursue technical studies that range from laboratory to pilot-plant scale. These studies involve the use of materials with levels of radioactivity ranging from natural background to full-process levels. In addition, laboratory research develops basic and applied data in support of DOE programs. The 324 Building was designed to the requirements of the

Uniform Building Code (UBC), 1961, and Hanford Plant Standard Design Criteria 4.1 Revision 2, 1959. The facilities have been continually maintained and upgraded to minimize operational impacts on the public, workers, and the environment. The building has been operated for over 25 years with no serious safety or environmental incidents.

2.3 DESCRIPTION OF REC

The RECs have been used in numerous DOE-sponsored programs since the mid-1960s. Major research and development programs undertaken by PNNL have included the Waste Solidification Engineering Prototypes (WSEP) Program, the Fabrication of Cesium and Strontium Heat and Radiation Sources Program (Federal Republic of Germany [FRG]), the Nuclear Waste Vitrification Program (NWVP), the Zeolite Vitrification Demonstration Program (ZVDP), and the Nuclear Waste Treatment Program's (NWTP's) Pilot Scale Radioactive Liquid-Fed Ceramic Melter (RLFCM) Testing Task. The REC has been used primarily for engineering evaluation of processes involving aqueous and solid radioactive and hazardous material. Metallographic investigation of highly radioactive material has also been performed in the RECs.

2.3.1 General Description of the REC Complex

The entire REC complex, located in the north portion of the 324 Building (Figures 2-4 through 2-7), consists of four hot-cells (A, B, C, and D) located around a central airlock. The walls are constructed of 1.3-m (4-ft)-thick high-density concrete or 1.37-m (4.5 ft)-thick normal-density concrete. The cells and airlock are joined, forming a "T"-shaped structure, with D-Cell located above C-Cell on the south side, and B-Cell at the bottom (west end) of the "T" (Figure 2-8). Access is by operating galleries on the first and second floor levels. The airlock is used primarily as a transition zone for maintenance, decontamination, and transfer of material and equipment into and out of adjoining hot cells.

The four cells (A, B, C, and D) are equipped with manipulators, remotely operated cranes, closed-circuit television, shielded viewing windows, and a communication system that permit complete experiments to be carried out. The B-, C-, and D-Cells have periscopes with optical magnification for detailed examination of materials. The airlock is equipped with cranes that facilitate remote installation, maintenance, and operation of equipment. An electrostatic precipitator and high-efficiency particulate air (HEPA) filters are installed in B-Cell. Cleanout of the hot cells was initiated in 1988 as part of the 324/325 Building's Hot-Cell Restoration Program and continues under the BCCP.

All normal operations in the RECs are performed remotely. Manned entry into the cells is prohibited due to the high dose rate of ionizing radiation from the present radioactive material inventory. The 9.1-m (30-ft)-high B-Cell functions as a general purpose processing cell and is operated by remote instrumentation from the control room. The shorter D-Cell, is

capable of handling equipment up to 3.4 m (11 ft) high, and is operated entirely by direct viewing and master-slave manipulators with assistance from remotely operated overhead cranes.

2.3.2 Description of B-Cell

Since the late 1960s, B-Cell has been used to demonstrate chemical engineering pilot-scale processes for high-activity waste management. Major B-Cell programs have included the WSEP Program, the NWVP, the ZVDP, and the NWTP Pilot-Scale RLFCM Testing Task. These programs have left the B-Cell filled with highly contaminated equipment, cell waste, radioactive materials, and quantities of materials that have been designated as mixed waste. In addition, B-Cell currently contains dispersible radioactivity that must be removed or containerized to prevent release in case of an accident.

The B-Cell is the largest of the four cells, measuring 7.6 m long x 6.7 m wide x 9.3 m high (25 ft x 22 ft x 30.5 ft). The floor and walls, up to 8.2 m high (27 ft), are lined with a stainless steel plate that is fully welded at the seams. Under the floor plate is a 15.24-cm (6-in.)-thick slab of concrete, and under the concrete is packed native soil. The cell is surrounded on three sides by operating galleries on the first and second floors and on two sides by a gallery at the basement level. The B-Cell sample hood is a stainless steel and lucite closed hood. This hood is equipped with glove ports, hoist, and a door for sample removal. Shielding walls are constructed of high-density concrete that is 1.3 m (4 ft) thick. Normal services into the B-Cell include electricity, water, and compressed air. Plasma torches are also located in the cell to aid in cutting up equipment for disposal covered under the BCCP.

The floor of B-Cell is sloped to a trench and sump to prevent liquids from accumulating in the cell. The floor of B-Cell is constructed with a 2% slope from the high point located along the west side of the cell to the low point on the east side. Any liquids accumulating in B-Cell drain across the floor to a trench that runs the length of the east side of the cell. The trench is sloped to a sump located in the northeast corner of B-Cell. The cell is equipped with an alarm to notify operating staff of any liquids accumulating in the cell.

Ventilation inlets were initially designed and installed with low-efficiency filters (dust stops). Penetrations for services such as manipulators and electrical cables are not completely sealed, but rely on the negative pressure in the cell to prevent escape of contamination. The inlet air contained particulate matter from the outside, some of which settled to the floor as it entered the lower velocity cell air. In April 1994, the dust stops were replaced with HEPA filters to minimize the dust entering the cell.

The B-Cell ventilation outlet passes through an electrostatic precipitator located upstream of a bank of in-cell HEPA filters. The air exhaust from B-Cell is filtered through two HEPA filter banks in addition to the in-cell HEPA filters before being exhausted from the building. The primary and final HEPA filters each remove at least 99.5% and collectively 99.95% of any particulate contained in the ventilation exhaust from the REC.

2.3.3 Description of D-Cell

The D-Cell is physically located directly over C-Cell in the southern end of the REC. It is accessible only from the second floor. The D-Cell measures 6.1 m long x 3.66 m wide x 4.9 m high (20 ft long x 12 ft wide x 16 ft high). The floor is lined with stainless steel, and the walls are painted concrete. The cell is adjoined by the airlock and by a service gallery on the south side. Shielding walls are constructed of 1.3-m (4 ft)-thick high-density concrete. Normal services into the D-Cell include electricity, water, and compressed air.

2.4 DESCRIPTION OF HIGH LEVEL VAULT AND TANKS

Two shielded, underground vaults (Figure 2-9) are equipped for temporary storage of radioactive liquids managed within the facility. The HLV, located under the floor of the cask handling area, is used for storage of high-activity liquids. The HLV is 6.4 m long x 4.0 m wide x 4.4 m deep (21 ft x 13 ft x 14.5 ft). A 1.8 m (6 ft) ledge at one end enlarges the upper level of the HLV to 8.2 m x 4.0 m x 4.4 m deep (27 ft x 13 ft x 14.7 ft). The HLV contains four stainless steel tanks (Tanks 104, 105, 106, and 107) with capacities ranging from 1,700 to 19,000 L (450 to 5,000 gal).

The vault is constructed of concrete and partially lined with a welded stainless steel plate, which covers the floor and extends 1.1 m (3.5 ft) up the walls. The stainless-steel plates provide secondary containment. The floor of the vault is sloped to a sump, which has an alarmed liquid-detection system to detect possible tank leakage. The HLV is shielded by thick concrete blocks totaling 1.8 m (6 ft). Due to radioactivity hazards, entry to the vault is prevented by a set of 1.2-m (4-ft)-thick concrete shielding blocks in place over cover blocks constructed of 0.6-m (2-ft)-thick concrete that have overlying removable steel-plate ventilation barriers with integral manhole covers.

The vault tanks are fitted with manometers for measuring liquid level, specific gravity, and static pressure. Thermocouples are used for measuring temperature. Instrument readings are logged daily. The tanks are also equipped with high-liquid-level and high-temperature alarms. The vault tanks are vented through a common-vessel vent system that pulls air and tank vapors through two HEPA filters and discharges them to the main 324 Building stack. A sample room for sampling each of the four tanks is located in Room 145 (Figure 2-7). The HLV Tank samplers are enclosed in a shielded hood, and sampling is performed remotely with a manipulator.

When the vault tanks were installed in the 324 Building in 1964, they included design features required or encouraged under current State and Federal RCRA regulations. These design features, which provide protection against releases of waste to the environment, include corrosion-resistant stainless steel tanks and ancillary piping, the use of welded pipe connections, tanks with top-entering penetrations only, secondary containment around tanks and piping plus instruments to control the fill level of the tanks and to detect leaks. Specific design details of HLV Tanks 104, 105, 107, and ancillary equipment are described below.

2.4.1 Tank 104

Tank 104 was originally built in 1954 and installed in the 321 Building. The tank was subsequently modified and moved in 1964 to its present location in the HLV in the 324 Building. All of the circumferential-shell and long-seam welds were completely radiographed as part of the facility modification. In addition, the tank was leak tested by filling it with water after modifications were completed, and the jacket was hydrostatically tested to 20 pounds per square inch gage (psig).

The cylindrical tank is 2.7 m (9.0 ft) in diameter by 2.7 m (8.9 ft) high and has a design capacity of 14,807 L (3912 gal).

The tank is constructed of 12.7-mm (0.5-in.)-thick 304L stainless steel. The top of Tank 104 is flat and the bottom is sloped. The tank rests on eighteen pads placed in two concentric circles under the tank. The tank is also equipped with a cooling jacket constructed of 304L stainless steel. Currently, the jacket is not used for cooling, and there is only air in the space between the tank and jacket shells.

Tank 104 can receive solution from the Load Out Station (LOS) on the second floor, the HLV Tank Sump, the Pipe Trench, and Tanks 105 and 107 in the HLV and 112 and 118 in B-Cell. The contents of Tank 104 can be transferred to Tanks 105, 112, or the LOS in B-Cell.

2.4.2 Tank 105

Tank 105 was originally built in 1943, but was not put into use until approximately 1950 when it was installed in the 321 Building. The tank was subsequently modified and moved in 1964 from the 321 Building to its present location in the HLV in the 324 Building. All of the circumferential shell and long seam welds on Tank-105 were completely radiographed as part of the facility modification. In addition, the tank was leak tested by filling it with water after modifications were completed, and the jacket was hydrostatically tested at 20 psig.

The cylindrical tank is 2.9 m (9.5 ft) in diameter and 2.71 m (8.88 ft) high and has a design capacity of 18,138 L (4792 gal).

The tank is constructed of 12.7-mm (0.5-in.)-thick 309 Columbium stainless steel. The tank is also equipped with a cooling jacket constructed of 18-8 Columbium stainless steel. The top of Tank-105 is flat and the bottom is sloped. Currently, the jacket is not used for cooling, and there is only air between the tank and jacket shells.

Tank 105 can receive solution from tanks 104, 106, and B-Cell Tanks 114 and 115, A-Cell, and B-Cell. The contents of Tank 105 can be transferred to Tanks 104, 112, or the LOS.

2.4.3 Tank 107

Tank 107 was built in 1963 and was subjected to radiography and dye-penetration testing of the welds.

Tank 107, located in the HLV, is 1.7 m (5.5 ft) in diameter by 1.8 m (6.0 ft) high and has a storage capacity of 3625 L (958 gal). The tank's surface consists of 6.4-mm (0.25-in.)-thick 304L stainless steel. The tank's jacket extends 1.1 m (3.5 ft) above the base of the tank. The tank is supported by three legs. The roof of the tank is flat, and the floor is concaved. The tank operates at a slight negative pressure.

Tank 107 can receive solution from Tank 106. The contents of Tank 107 can be transferred to the LOS, Tanks 104, 106, and B-Cell Tanks 112 and 114.

2.4.4 Ancillary Equipment

Piping connected to the vault tanks serves a variety of functions, including liquid transfer, instrumentation access, tank venting and sparging, cooling water supply and return, and sampling (refer to Figures 2-10, 2-11, and 2-12 for detailed connections). The 324 Building piping for radioactive liquids is constructed of 3.8-cm (1.5-in.) and 5.1-cm (2-in.)-diameter stainless steel pipe with welded joints. The piping was constructed above the tanks in the vault, which serves as secondary containment in the event a pipe leak should develop. The pipes are typically hung by harness and strap from the joist system of the floor above. The piping within the building is not encased except where it passes through a concrete structure. At these points, it is encased in a 10.2-cm (4-in.)-diameter fiberglass reinforced epoxy pipe. All building piping was pressure tested at 3 psi and then at 250 psi (gravity and steam, respectively) and did not experience pressure loss in 24 hours at the time of installation (in 1965).

The stainless steel piping drains to the tanks by gravity flow. The gravity piping system was designed with a fall of 0.1588 cm per 0.305 m (0.0625 in. per ft) of run. This slope yields a flow capacity of 30.32 L (8 gal) per minute for the 3.8-cm (1.5 in.)-diameter pipe and 60.64 L (16 gal) per minute for the 5.08-cm (2-in.)-diameter pipe. Material is also moved through the piping by way of steam jets. The steam jets create a venturi suction that serves to move liquid through the piping system. Instrumentation piping, vent piping, sparging piping, and sampling piping are constructed with a continuous upward slope from the vault tanks. This construction was designed to eliminate the potential for a siphon to develop in these particular piping systems.

2.5 SECURITY INFORMATION

The following sections describe the 24-hour surveillance system, warning signs, and barriers used to provide security and control access to the 324 Building.

1 The entire Hanford Site is a controlled-access area. The Hanford Site maintains around-
2 the-clock surveillance for protection of government property, classified information, and
3 special nuclear materials. The Hanford Patrol maintains a continuous presence of protective
4 force personnel to provide additional security.
5

6 All personnel accessing the 300 Area must display a DOE-issued security identification
7 badge indicating appropriate authorization. Personnel are subject to random searches of
8 items carried into and out of the area. Fences around the 300 Area provide physical barriers
9 for most avenues of approach. Currently, however the gates are not manned to limit access
10 to the 300 Area.
11

12 Signs are posted at area boundaries within the Hanford Site stating "NO TRESPASS-
13 ING. SECURITY BADGES REQUIRED BEYOND THIS POINT. GOVERNMENT
14 VEHICLES ONLY. PUBLIC ACCESS PROHIBITED" (or an equivalent legend).
15

16 In addition, warning signs stating "AUTHORIZED PERSONNEL ONLY" (or equivalent
17 legend) are posted at the 324 Building. The 324 Building is locked during non-work
18 hours (approximately 5:00 pm to 7:00 am), and access is regulated by office security during
19 work hours. Within the 324 Building, the REC and HLV are only accessed through
20 personnel access codes or keys.

Figure 2-1. Hanford Site and Regional Map

Figure 2-2. 300 Area

Figure 2-3. Topographical Map of Hanford 300 Area - 324 Building

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Figure 2-4. 324 Building Basement Plan

Figure 2-5. 324 Building First Floor Plan

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Figure 2-6. 324 Building Second Floor Plan

Figure 2-7. 324 Building Third Floor Plan

1

2
3

Figure 2-8. 324 Building Radiochemical Engineering Cells

Figure 2-9. 324 Building High-Level Vault, Low-Level Vault, and Vault Tanks

Figure 2-10. Tank 104 Piping

Nozzle Number	Line Size (cm)	Line No.	Designation	Function
A	5.08 (2.0 in.)	76	TPS-4	From LOS and Hot Pilot Cells
B	2.54 (1.0 in.)	18	MP-4	Spray Jet
C	1.27 (0.5 in.)	T-29		LLI and SPG
C	1.27 (0.5 in.)	T-35		LLI and SPG
C	1.27 (0.5 in.)	T-70		LLI and SPG
D	2.54 (1.0 in.)	J-06	M.P.-4	Jet to Pot
E	2.54 (1.0 in.)	J-07	M.P.-4	Jet to Pot
F	2.54 (1.0 in.)	26	CA-4	Sparger
G	2.54 (1.0 in.)	104		From HLV Sump - J-36
H	2.54 (1.0 in.)	J-28		From Tank-107 to Tank-104
J				
K	2.54 (1.0 in.)	337	TPS-4	Dip-Tube-to-Pipe Trench
K	2.54 (1.0 in.)	338	TPS-4	From Pipe Trench
L	1.27 (0.5 in.)	S-4	S4-A	Sampler
L	0.64 (0.25 in.)	S-4	S4-B	Sampler
L	0.64 (0.25 in.)	S-4	S4-C	Sampler
M	1.27 (0.5 in.)	104	T-E	Temperature
N	7.62 (3.0 in.)		VV	Vessel Vent
P	2.54 (1.0 in.)	331	TPS-4	Dip Tube to Pipe Trench
Q	2.54 (1.0 in.)	J-54		Tank-104 to Tank-105
R	2.54 (1.0 in.)	77	TPS-4	From LOS to Tank-104
R	2.54 (1.0 in.)	J-31		From 105 to Tank-104
S	2.54 (1.0 in.)	336	TPS-4	Pot-to-Pipe Trench
T	2.54 (1.0 in.)	38	TPS-4	Pot to LOS
U	2.54 (1.0 in.)			Jacket outlet to RPS
V	2.54 (1.0 in.)	283		Raw Water to Jacket
c	2.54 (1.0 in.)	156		Dip-Tube-to-Pipe Trench

LLI = Liquid Level Indicator.
RPS = retention process sewer.
SPG = specific gravity.

Figure 2-11. Tank 105 Piping

Nozzle Number	Line Size (cm)	Line No.	Designation	Function
A	5.08 (2.0 in.)	82	TPS-5	A & B Cell Cubicles
B	2.54 (1.0 in.)	19	MP-5	Spray Jet
C	1.27 (0.5 in.)	105	TE	Temperature
D	2.54 (1.0 in.)		J-08	Tank Jet to Pot
E	2.54 (1.0 in.)		J-09	Tank Jet to Pot
F	1.27 (0.5 in.)		T-30 (H.P.)	LLI and SGI
F	1.27 (0.5 in.)		T-36 (L.P.)	LLI and SGI
F	1.27 (0.5 in.)		T-71 (REF)	LLI and SGI
G	2.54 (1.0 in.)			From J-54 to Tank-105
H	2.54 (1.0 in.)		J-31	From Tank-105 to Tank 104
J	1.27 (0.5 in.)	S-5-A	S-5	Sampler
J	0.64 (0.25 in.)	S-5-B	S-5	Sampler
J	0.64 (0.25 in.)	Airlift	S-5	Sampler
		S-5-C		
K	7.62 (3.0 in.)	105	VV	Vessel Vent
L	2.54 (1.0 in.)	27	CA-5	Sparger
M	2.54 (1.0 in.)	339	TPS-5	Dip Tube to Pipe Trench
N	2.54 (1.0 in.)	340	TPS-5	From Pipe Trench
P	2.54 (1.0 in.)	330	TPS-5	Dip Tube to Pipe Trench
Q	2.54 (1.0 in.)	155	TPS-5	Dip Tube to Pipe Trench
R	2.54 (1.0 in.)			From 106 to Tank-105
S	2.54 (1.0 in.)	335	TPS-5	Pot to Pipe Trench
T	2.54 (1.0 in.)	39		Pot to LOS
U	2.54 (1.0 in.)			Jacket Water Outlet
V	2.54 (1.0 in.)	147	RW-5	Jacket Water Inlet

LLI = Liquid Level Indicator.
SGI = specific gravity indicator.

Figure 2-12. Tank 107 Piping

Nozzle Number	Line Size (in.)	Line No.	Designation	Function
A	1.0		J-39	Jet to Pot
B	1.0	157	TPS-7	Dip Tube
B	1.0		J-28	Tank-107 to Tank-104
C				Agitator - 107
D				Spare
E	1.0			Spare Dip Tube
E	0.5	S7A	S7A	Sampler
E	0.25	S7B	S7B	Sampler
F	1.0		CBWS	Coil Out
G	1.0	286		Coil In
H	3.0	217	VV	Vessel Vent
J	1.0		J-29	Tank-107 to Tank-106
J	1.0			Tank-106 to Tank-107
K	1.0		J-40	
L	1.0	284	J-38	Jet to Pot
M	1.0	285		Spray Jet
N	0.5	270		Jacket Water In
N	0.5	271	MP	LLI and SGI
N	0.5	273	REF	LLI and SGI
N	0.5	272	HP	LLI and SGI
P	1.0		TE-107-1	Temperature
R	1.0		RPS	Jacket Out
R	1.0	209	TPS-7	Jacket Out
R	1.0	334	TPS-7	LOS Jet
S	1.0	287	TPS-7	PT
U	1.0	207	CH-HLV	Air Sparger
V	1.0	329	TPS-7	Pot Suction
W	0.5	288	TPS-7	Pot Suction
W	0.5	294	CH-HLV	Chem. Add.
			TE-107-2	Resistance Bulb

LLI = Liquid Level Indicator.
RPS = retention process sewer.
SGI = specific gravity indicator.
PT = pipe trench.

3.0 PROCESS INFORMATION

The purpose of this section is to present a historical profile of the wastes and wastefeed materials stored in the REC and HLV Tanks. The information included in this section is based on information available in other documentation for the facility, including safety-analysis reports, integrity-assessment plans, project-management plans, and facility-effluent monitoring plans.

3.1 DESCRIPTION OF WASTES AND SYSTEMS

Liquids generated within the REC have been discharged at various times to the HLV Tanks since 1968. Three programs have generated the majority of the liquids: the WSEP, the NWVP, and the Fabrication of Cesium and Strontium Heat and Radiation Sources, also known as the FRG Program. The ZVDP was also conducted in the B-Cell, but the program handled only solid waste and thus did not use the HLV Tanks. The HLV Tanks handled liquids that have ranged from high-activity-waste feed material used in the waste-treatment process demonstrations to process condensates from the decontamination equipment located downstream of the solidification systems. Presently, the HLV Tanks are used to contain liquid wastes from the above-mentioned programs in addition to decontamination solutions.

The following sections provide information on programs and processes conducted in the REC and histories related to the characterization of wastes and feed materials discharged to the HLV Tanks.

3.1.1 Waste Solidification Engineering Prototypes

The WSEP program began in 1966 and continued through 1972. The program was designed to demonstrate three methods of solidifying highly radioactive waste: pot solidification, spray solidification, and phosphate glass formation.

High-activity radioactive wastes from aqueous reprocessing plants are primarily mixtures of fission products and various nonradioactive constituents in the nitrate form. The feed-material compositions used in the WSEP program were prepared to represent a 1) Pu-U extraction (PUREX) waste solution containing a large amount of Fe such as would result when an Fe canister is used to transfer chopped fuel elements from the mechanical head-end to the dissolver, and the canister is co-dissolved with the fuel and 2) a PUREX waste solution from a process optimized to produce a waste containing a minimum quantity of nonfission product material. Chemicals were substituted for several of the fission products. Molybdenum was substituted for Tc, Ni for Pd, Co for Rh, Cu for Ag and Cd, K for Cs, and Rb and Fe for a significant portion of the Ru. A significant amount of Al was unavoidably introduced at PUREX and was present in the feed material for WSEP.

3.1.2 Nuclear Waste Vitrification Project

The objective of the NWVP was to provide a demonstration of the vitrification of high-activity liquid waste (HLLW) from spent fuel discharged from an operating light water reactor (LWR). The NWVP encompassed two tasks of the Commercial High-Level Waste Immobilization Program: Waste Preparation and Radioactive Demonstration of Vitrification. The project was started in April 1976 and terminated in June 1979.

The NWVP involved equipment in the 324 and 325 buildings. The 324 Building was used for 1) fuel-cask unloading, 2) fuel disassembly, shearing, and dissolving, and 3) waste calcination and vitrification. The 325 Building was used to perform feed adjustment and solvent-extraction for HLLW preparation. In the 325 Building, the Pu by-product of the waste preparation was purified from U and fission products by ion exchange and the calcination of the Pu nitrate occurred.

3.1.3 Fabrication of Cesium and Strontium Heat and Radiation Sources Program (FRG Program)

From 1986 to 1987, the 324 Building facilities were used to produce 30 isotopic heat sources in canisters for the FRG to be used as part of a repository testing program. The 30 canisters were filled, closed, and decontaminated during these activities, frequently referred to as the FRG program. The canister filling and decontamination processes used the vault tanks to contain feed solutions, process condensates, and decontamination solutions as described below.

3.1.4 Present Conditions

Since 1987, no major programs have involved the vault tanks. The primary use of the HLV Tanks since 1987 has been to contain solutions remaining from the NWVP and FRG Program.

4.0 WASTE CHARACTERISTICS

Section 4.0 contains four major sections. Section 4.1 details the estimated maximum inventory or waste ever on site and the chemical and radiological characteristics of each waste stream. It is assumed that the maximum inventory of waste in the REC would have occurred immediately before the BCCP was initiated, and the maximum waste inventory in the HLV Tanks is the present volume. Section 4.2 describes the proposed waste-treatment plans for waste already present in the REC, and wastes that may be generated during cleanout activities. Section 4.3 outlines the current status of the cleanout activities, the current waste inventory in the REC and HLV Tanks, and current disposal plans. Section 4.4 describes the residual waste expected to be left in the REC and HLV Tanks after cleanout activities have been completed and when closure activities begin.

4.1 ESTIMATE OF MAXIMUM WASTE INVENTORY

This section describes the quantities and characteristics of dangerous and radiological constituents known to have been present in the REC and HLV Tanks. Because residue from the dangerous and radioactive constituents is likely to remain in the REC and HLV Tanks, the waste characteristics are discussed in detail. A description of each waste stream is provided.

The description of the waste characteristics is based on an evaluation of process records, process knowledge, and the limited waste-analyses-data available. Chemical analysis of the waste material has not been amenable to the use of specific U.S. Environmental Protection Agency (EPA) SW-846 methods because of "as low as reasonably achievable" (ALARA) concerns. Because of the safety constraints and the limitations of technology available for remote sampling and analysis, a comprehensive analytical waste characterization has not been conducted.

During the removal of inventory from the REC, samples of material have and will continue to be collected and analyzed. The liquid waste in the HLV Tanks and rinse solutions from rinsing the tanks will be sampled during the liquid-waste removal operation. The quantity of waste inventory listed in the following subsections is the estimated volume of waste present prior to the inventory removal project.

4.1.1 REC Waste Inventory and Characteristics

All of the REC mixed-waste generation occurred in B-Cell. The waste generation resulted from approximately 25 to 30 years of R&D activities. Mixed wastes collected during the BCCP activities are being placed in containers and stored within B-Cell. The D-Cell contains one sealed drum of dangerous waste that was removed from B-Cell for fire safety reasons.

The contamination in B-Cell occurred primarily during pilot-scale testing of vitrification technologies. In 1986, melter feed consisting of a nitric acid solution containing Cs and Sr was spilled on the southeast portion of the B-Cell floor during RLFCM operations. In addition, small tools, pieces of manipulator boots, air hoses, water hoses, pieces of pipe, etc., have been dropped to the floor during cell operations. This debris has been contaminated by spilled material. A substantial fraction of this debris may be dispersible because of its small particle size.

From the review of analytical data, process and operating records, and comparison with the designation criteria of 40 CFR 261 and WAC 173-303, several waste streams have been designated as mixed waste. These waste streams are classified as follows:

- Dispersible floor debris contaminated with spilled feed material
- Elemental Pb
- Dried tank heels (from the feed tanks)
- Liquid metal seal
- Oil absorption material.

These waste streams have been identified as dangerous wastes due to the presence of heavy metals. In addition to the wastes identified above, the oil in a B-Cell shielded viewing window leaked onto the cell floor; the oil and associated absorbent material has been designated a toxic waste as defined by WAC 173-303-100. This waste is stored in a sealed drum in D-Cell due to flammability considerations (torches are used to cut up the equipment as part of the B-Cell equipment removal process).

Tables 4-1 and 4-2 provide itemized lists of the characteristic dangerous waste present in B-Cell and D-Cell.

Table 4-1. B-Cell Dangerous Waste Characteristics

Waste Type	Waste Designation	Dangerous Constituents	Estimated Quantity
Dispersible Debris ^(a)	D006, D007, D008, WT02	Cd, Cr, Pb, Toxic	2.5 m ³ (0.33 m ³ in 208.45-L drums) (88 ft ³ [38 ft ³ in 55-gal drums])
Dried Melter Feed Heels	D007, D008, WT01	Cr, Pb, Toxic	0.17 m ³ in 15 11.4-L containers (6 ft ³ in 15 3-gal containers)
Elemental Pb	D008, WT01	Pb, Toxic	1.0 m ³ (36 ft ³)
Liquid Metal Seal	D006, D008, WT01	Cd, Pb, Toxic	<0.2 m ³ (<7 ft ³)
(a) Includes dispersible material, tools, equipment, and pieces of metal.			

Table 4-2. D-Cell Dangerous Waste Characteristics

Waste Type	Waste Designation	Dangerous Constituents	Estimated Quantity
Oil Absorption Material	WT02	Toxic	<0.2 m ³ (<7 ft ³)

4.1.1.1 Dispersible Debris. The dispersible debris consists of dirt, dust, process residues, and equipment and tools that have collected on the floor during operations in B-Cell. In addition, the dispersible debris includes "one time" or sporadically-spilled feed material that contained heavy metals and radionuclides from B-Cell's process equipment. It has been estimated that the dispersible debris contains about 1.5 million curies (MCi) of radioactive materials, primarily Cs and Sr. The estimated level of activity for a 0.09 m³ (3 ft³) canister of this mixed waste is about 100,000 R/h, and the canister has an estimated heat of generation of about 300 watts. Based on the levels of transuranic (TRU) radionuclides identified from sample analysis, the dispersible debris have been classified as TRU waste.

Ten containers of dispersible material have been characterized. After collecting the dispersible material from the floor, non hazardous metal and tools were segregated from the material, which was then packaged into containers. Once placed in containers, the containers were moved to a work station in front of a cell window where a vertical core of the material was obtained using a remotely controlled auger sampler. An aliquot of the sample was then removed for analysis.

Five grams of each sample were analyzed using the TCLP to determine the hazardous constituent content of the waste. The extract from the TCLP were analyzed using ICP spectroscopy. The analysis included the use of duplicate samples, preparation blanks, and TCLP extract blanks. Table 4-3 provides the analytical results.

4.1.1.2 Lead Shielding/Counterbalances. Approximately 0.7 m³ (25 ft³) of Pb was used as shielding or counterbalance weight, and 0.09 m³ (3 ft³) of Pb shot is stored in B-Cell. Also, Pb was poured into legs of equipment for stability. The Pb poured into equipment legs will be removed with the equipment. Process knowledge was used to designate the Pb as extremely hazardous waste.

4.1.1.3 Containerized Feed Tank Heels. Small process feed tanks located in B-Cell were used during the FRG melter testing project and other pilot process operations. The feed solution in the tanks, categorized as sludge, dried up, leaving a highly radioactive and potentially dangerous waste. This dried material is referred to as "dried heels." During previous cleanup activities in B-Cell, approximately 0.17 m³ (6 ft³) of this material was removed from the tanks and placed in fifteen 11.4-L (3-gal) steel-tube containers. These containers are currently stored inside B-Cell.

Table 4-3. Dangerous Waste Constituent Concentrations in B-Cell Floor Dispersible Debris

Container Number	Ba (ppm)	Cd (ppm)	Cr (ppm)	Pb (ppm)	Se (ppm)	Ag (ppm)	As (ppm)
TCLP Limits - DW	100	1	5	5	1	5	5
TCLP Limits - EHW	10,000	100	500	500	100	500	500
EC-14	0.64	0.35	0.09	0.09	ND	ND	ND
EC-15	<0.01	<0.02	<0.03	<0.08	<0.13	<0.02	<0.1
EC-16	1.80	1.00	0.87	34.6	ND	ND	0.17
EC-17	1.04	0.73	1.10	3.75	ND	ND	ND
EC-19	<0.01	<0.02	<0.03	<0.08	<0.13	<0.02	<0.1
EC-21	1.50	0.90	0.35	13	ND	ND	ND
EC-22	1.45	0.59	0.27	27.9	ND	ND	0.11
EC-23	1.03	0.70	0.30	13.7	ND	ND	0.12
EC-24	0.97	0.37	6.3	34.5	0.7	ND	0.28
EC-25	1.00	0.60	0.30	4.95	ND	ND	ND
DW = dangerous waste. EC = engineered container. EHW = extremely hazardous waste. ND = not detected.							

The original melter feed contained high levels of ^{137}Cs and ^{90}Sr and low levels of Pb, Cr, and Pu in solution. Characterization of the feed tank heels is based on process knowledge, and feed-material characterization conducted during research operations. Based on this characterization, an estimate of the concentration of Pb and Cr was made. This estimate is the basis for the TCLP concentrations shown in Table 4-4.

Table 4-4. Dangerous Waste Constituent Concentrations in Feed Preparation Tanks

Constituent	Estimated Material Concentration, $\mu\text{g/g}$	Maximum TCLP Concentration, mg/L	TCLP Limits, mg/L	
			DW	EHW
Cr	4000	200	5	500
Pb	5000	250	5	500
DW = dangerous waste. EHW = extremely hazardous waste.				

4.1.1.4 Liquid-Metal Seal. The liquid-metal seal is a metal alloy that is reported to contain 50% Bi, 26.7% Pb, 13.3% Sn, and 10% Cd. This alloy has a melting point of 70°C (158°F). It was used as a seal material as part of the glass melter. The waste is an inherently hazardous material and as packaged is $<0.2 \text{ m}^3$ ($<7 \text{ ft}^3$) in volume.

4.1.1.5 Oil-Absorption Material. An absorption material was used in B-Cell to clean up oil from a leaking window. It is contained within a 208.45-L (55-gal) drum. Exposure to the cell environment makes it a radioactive waste, and the oil is designated as a Washington State Toxic waste (WT02).

4.1.2 HLV Tank Waste Inventory and Characteristics

Liquids generated within the 324 Building hot cells have been discharged to the building vault tanks since 1968. The HLV Tanks have been used as holding tanks for feed solutions, feedstock tanks for process solutions, and collection tanks for process effluent. The HLV Tanks (104, 105, and 107) contain leftover research feed materials, which were declared mixed waste when no further use for them could be identified.

An analysis of the contents in Tanks 104, 105, and 107 was conducted in 1990. Analyses were conducted for several analytes, including those of greatest importance for designing the waste. The analyses were performed on the liquid samples using ICP. Analytical results of the samples are provided in Table 4-5 and Table 4-6. Table 4-7 provides the dangerous-waste characteristics in the HLV Tanks.

The analytical results presented in Table 4-5 are the only analytical data for the waste in the HLV Tanks. The analytical results in Table 4-5 are most representative of wastes generated during and following the FRG Program, with the exception of Tank 107, which was not used during the FRG Program and contained waste from NWVP at the time of sampling.

No waste is currently being added to the HLV Tanks. Tank 104 contains approximately 1516 L (400 gal) of dilute $^{137}\text{CsNO}_3$ solution and $^{90}\text{SrNO}_3$ solution. Tank 105 contains approximately 1895 L (500 gal) of a dilute $^{90}\text{SrNO}_3$ solution and $^{137}\text{CsNO}_3$ solution. Tank 107 contains approximately 625.4 L (165 gal) of a process feedstock solution. Documented process knowledge and review of operating records indicate that Tank 106 in the HLV is empty and contained no mixed waste.

The following sections provide information regarding the presence of halides, pH, and temperatures of the tank contents, as these conditions are generally expected to affect the integrity of the tanks.

4.1.2.1 Tanks 104 and 105. During the operation of the WSEP and the NWVP, Tanks 104 and 105 were set up to receive the bottoms from the evaporator and acid fractionator, respectively. The acid fractionator was used as a second-stage evaporator. Tank 105 could also

Table 4-5. Analytical Results of HLV Tanks (June 7, 1990)

Analyses	Tank 104	Tank 105	Tank 106	Tank 107
pH	1.4	1.5	6.19	0.7
⁹⁰ Sr, d/m-l	1.52E9	1.40E10	3.54E6	9.23E10
Total U, µg/mL	0.17	0.96	4E-2	4.9
Fluoride, ppm	NA	648 ^(a)	34	NA
Chloride, ppm	<500 ^(b)	3678 ^(a)	152	<15 ^(b)
Nitrate, ppm	6287	300 ^(a)	89	123,600
Nitrite, ppm	NA	38650 ^(a)	NA	NA
Phosphate, ppm	NA	<40 ^(a)	<40	NA
Sulfate, ppm	NA	1976	<40	NA
¹³⁷ Cs, d/m-mL	1.09E9	2.64E10	5.22E6	1.42E11
¹³⁴ Cs, d/m-mL	NA	10	4.22E4	6.47E8
¹⁵⁴ Eu d/m-mL	NA	3.77E5	5.69E4	1.50E9
²⁴¹ Am d/m-mL	8500	1.55E5	NA	NA
Total d/m-mL	1.65E4	NA	9.00E4	2.32E9
(a) Samples were taken 7/1/90				
(b) Samples were taken 6/18/90				

receive feed materials from the feed make-up tank (Tank 114). Reportedly neither of the tanks were used very often during the WSEP and NWVP due to their large size (Tank 104 is 15,160 L [4,000 gal] and Tank 105 is 18,950 L [5,000 gal]) and corresponding large heel. However, transfers of clean acid (10M HNO₃) from the acid fractionator to Tank 105 were reported in 1978. It is also reported that during May 1979, Tank 105 held very concentrated solutions that may have reached temperatures as high as 75°C for approximately 1 month.

During operation of the FRG Program, Tanks 104 and 105 (primarily Tank 105) were used to contain Sr and Cs nitrate feed material for the RLFCM. These feed materials contained residual fluorides and chlorides from the conversion of original feed material to nitrates (performed in the 200 Area). The analytical results in Table 4-6 indicate fairly high levels of chloride and fluoride concentrations for Tank 105.

Table 4-6. Inductively Coupled Plasma Analytical Results

Constituent	HLV Tank		
	104 (µg/mL)	106 (µg/mL)	107 (µg/mL)
Al	3.0	367	175
As		(4.9)	
B	5.47	262	131
Ba	1.90	78.6	1074
Be			394
Ca	12.6	165	44
Cd			800
Co			405
Cr	.48	(.43)	
Cu	5.04	26.8	
Dy	2.84		
Fe	7.88	144	12200
K	2.1	22	820
La	2.0		
Li			44
Mg	2.84	13	220
Mn	5.42	.51	1340
Na	45.9	731	190
Ni	1.49	3.6	360
P	11.5		
Pb	15.6	2.10	
Rh			830
Se			390
Si	19.6	190.8	660
Sr	15.4	1.6	
Te			120
Ti	.19	2.80	
V			93
Zn	1.2	5.2	620
Zr	2.78	1.4	
Values in () are approaching or at detection limits.			

Table 4-7. HLV Tanks Dangerous Waste Characteristics

Tank	Waste Type	Waste Designation	Dangerous Constituents	Estimated Quantity
104	Dilute $^{90}\text{Sr}^{137}\text{Cs}$ Nitrate Solution	D002, D008, WT02	Corrosive, Pb Toxic, pH 1.4	1516 L (400 gal)
105	Dilute $^{90}\text{Sr}^{137}\text{Cs}$ Nitrate Solution Liquid	D002, D008, WT02	Corrosive, Pb Toxic, pH 1.5	1516 L (400 gal)
106	Low-Activity Waste (LLW) Process Solution	None	None	Empty
107	NWVP Liquid Process Feedstock Solution	D005, D006, D007, D002, WT02	Ba, Cd, Cr, Corrosive, Toxic	420.7 L (111 gal)

4.1.2.2 Tanks 106 and 107. Tank 107 was routinely used during the WSEP and NWVP to contain feed materials before they were sent to the melter-feed make-up tank (Tank 114). During the NWVP, non-radioactive feed additions, including phosphoric acid, were made directly to Tank 107. The FRG program did not use Tank 107. In 1968 and 1979, the contents of Tank 107 reportedly reached a temperature of 75°C. Tank 107 has a cooling jacket that was frequently used to cool the feed materials during the WSEP and NWVP.

Tank 106 was used during the NWVP to accept HLLW from the 325A Building. The analytical results in Table 4-5 indicate that, at the time of sampling, Tank 106 contents were more typical of the process condensates stored in the low-level vault (LLV) Tanks and does not designate as dangerous waste.

4.1.2.3 Process of Compiling Waste Characterization Information. Information on the types of wastes and waste-feed materials stored in the tanks was obtained by Science Applications International Corporation (SAIC) through the following: 1) project reports, 2) engineering drawings and sketches, 3) interview notes, 4) available vault-tank analytical data, disposal-request sheets, and solution-transfer logs, and 5) miscellaneous information located in program and project files. Project reports were available for the WSEP, NWVP, and FRG Program. These reports provided information on the feed material used (analytical data in some cases), processes performed, the use of the auxiliary systems, and limited information on the use of the vault tanks. The engineering drawings and sketches were used to identify process routes for liquid-effluent transfers between the auxiliary tanks and the vault tanks. Interviews were conducted with people whose responsibilities ranged from program manager to technician; these people had been affiliated with 321 or 324 Building processes that discharged waste or waste-feed materials to the vault tanks. The interviews,

1 along with the waste-transfer records and miscellaneous project data, were typically used to
2 confirm information obtained from the reports and drawings and/or speculations made
3 regarding waste and waste-feed characteristics of the tanks and tank contents.
4
5

6 4.2 WASTE TREATMENT PLANS FOR THE REC AND HLV TANKS 7

8 Mixed wastes must comply with the treatment standards for the dangerous constituents in
9 the wastes. Debris contaminated with mixed wastes can be treated according to the treatment
10 standards in WAC 173-303-140 and 40 CFR 268. Because of the high activity of the wastes
11 in the REC and HLV Tanks, they pose special problems regarding implementation of the
12 treatment standards. Safety and health concerns associated with the radioactive components
13 rule out some conventional hazardous-waste management techniques. A complete description
14 of waste-treatment activities is provided in Section 7.2.
15
16

17 4.2.1 REC Waste-Treatment Plans 18

19 Treatment proposed for wastes stored in B-Cell currently consists of decontamination of
20 low-activity debris to reduce radioactivity to acceptable handling levels. When possible, the
21 wastes will be treated, packaged, and removed from the 324 Building and transported for
22 temporary storage at Hanford Site Treatment, Storage, and Disposal (TSD) Facilities. Until
23 the Waste Isolation Pilot Project (WIPP), located in New Mexico, accepts waste for disposal,
24 TRU waste will be temporarily stored on the Hanford site. Mixed wastes that are restricted
25 from land disposal will be stored temporarily at the Central Waste Complex (CWC), or in
26 other existing facilities in the 200 Area of the Hanford Site, until an appropriate repository is
27 permitted and appropriate waste treatment can be applied.
28
29

30 4.2.2 HLV Tank-Waste Treatment Plans 31

32 The *324 HLV Interim Removal Action (IRA) Project* was initiated as a result of prelim-
33 inary discussions with Ecology and EPA. The overall goal is to implement a preliminary
34 treatment strategy that will remove and stabilize the inventory of liquid waste from the
35 324 HLV Tanks. Within a relatively short time (one calendar year), the waste will be
36 transferred into D-Cell and stabilized by evaporation and isotope separation to solids with
37 available disposal and recycle pathways. The *PMP* details the treatment strategy for
38 removing and stabilizing the liquid waste stored in the HLV Tanks.
39
40

41 4.3 WASTE INVENTORY REMOVAL 42

43 The first step of the management process is removal of the waste inventories from the
44 REC and HLV Tanks. After the waste is removed, the unit and all equipment, bases, liners,
45 and all other materials containing or contaminated with dangerous waste or waste residue will
also be removed or decontaminated. The REC and HLV Tanks are being emptied by PNNL

1 in accordance with approved waste-removal plans. A complete description of waste-
2 inventory removal plans/actions is provided in Section 7.2.
3
4

5 **4.4 RESIDUAL WASTE INVENTORY AND CHARACTERISTICS** 6

7 Activities in the *BCCP* and the *HLV Interim Removal Action Project* will remove the
8 waste from the units; however, residual waste will remain. This section describes the
9 residual waste expected to be encountered in the REC and HLV Tanks. The *BCCP* and the
10 *HLV Interim Removal Action Project* include plans to remove and/or decontaminate all
11 process equipment used in the execution of these projects.

5.0 GROUNDWATER

In accordance with the Tri-Party Agreement, groundwater in the 300 Area is included in the 300-FF-5 operable unit with cleanup occurring as part of the CERCLA remedial-action process. Therefore, groundwater is not included as part of the 324 Closure Plan.

The 300-FF-5 operable unit consists of the aquifers beneath the 300-FF-1 and 300-FF-2 operable units and is bounded by the Columbia River on the east (Figure 5-1). The operable unit is defined by "the observed and assumed extent of U contamination in the groundwater." Ultimately, the operable unit will include all contamination exceeding applicable or relevant and appropriate requirements emanating from the two operable units, and detected in groundwater.

Figure 5-1. Boundary of the 300 Area Operable Units

6.0 CLOSURE STRATEGY AND PERFORMANCE STANDARDS

This chapter discusses the closure strategy and performance standards for protecting health and the environment. Clean-closure activities are also included.

6.1 CLOSURE STRATEGY

The primary goal for closure of the 324 Building REC and HLV Tanks is clean closure, which is contingent upon verification that dangerous constituents in the REC and HLV Tanks are not present in concentrations above Ecology/DOE/PNNL negotiated levels. This contingency will be assessed using data obtained from the implementation of sampling activities outlined in Section 7.3.

The strategy for closure of the 324 Building REC and HLV Tanks is to

- decontaminate the units to remove contamination
- conduct an integrity assessment of the REC and HLV Tanks
- perform a necessary sampling and analysis for the constituents of concern
- evaluate resulting data to determine any additional actions necessary to meet clean-closure levels.

The clean-closure criteria for the 324 Building REC and HLV Tanks is to verify that potentially dangerous constituents treated, stored, or used are not present above any cleanup levels. If the potentially dangerous constituents are above cleanup levels, a cleanup level evaluation will be implemented to determine additional action required. Figure 6-1 shows the clean-closure strategy for the REC, and Figure 6-2 shows the clean-closure strategy for the HLV Tanks.

In the unlikely event that the integrity inspection identifies a breach in the liner of the REC, the damage will be evaluated to determine if the B-Cell structure has lost integrity. In either situation, the breached area will be decontaminated to the maximum extent practical, and the breach will be sealed. The closure plan will require modification, and then closure activities will continue as detailed in this revised closure plan.

If the integrity assessment of the HLV Tanks identifies leakage in any of the tanks, the extent of leakage will be evaluated. The leaked material will be removed and the area decontaminated. Then the liner of the HLV Tanks will be assessed to ensure its integrity. The closure plan will be modified, and closure activities will continue as detailed in this closure plan.

The cleanup-level evaluation would be implemented to consider the type and extent to which the cleanup levels are exceeded. In the event decontamination activities did not remove potentially dangerous constituents to below the cleanup levels, additional

2
3
Figure 6-1. REC Clean-Closure Pathway

2
3
Figure 6-2. HLV Clean-Closure Pathway

decontamination methods would be implemented until below cleanup levels are attained. If additional decontamination is implemented, the closure plan will be amended.

In the event that clean closure cannot be accomplished for any portion of the REC and HLV Tanks, the remaining contamination will be isolated to protect human health and the environment. All further remediation will be deferred to the 324 Building Closure and to the CERCLA remedial investigation/feasibility study (RI/FS) process for the 300-FF-2 and 300-FF-5 operable units.

6.2 GENERAL CLOSURE ACTIVITIES

The 324 Building REC and HLV Tanks closure plan has been developed to be consistent with Washington State guidelines and regulations. The general clean-closure activities are shown in Figures 6-1 and 6-2. Closure activities will be monitored by a registered professional engineer who will certify that, in his or her judgment, closure was accomplished in accordance with the specifications of the approved plans as described herein. The professional engineer's report will be submitted to Ecology along with certification of closure. The report and certification will be sent by registered mail or hand carried and signed for.

These closure activities will be completed in accordance with this closure plan after approval by Ecology. Two copies of this closure plan will be located at the following office until closure is completed and certified: DOE-RL, Federal Building, 825 Jadwin Avenue, P.O. Box 550, Richland, Washington 99352.

The following activities are discussed in greater detail in Chapter 7.0.

6.2.1 Closure Activities for D-Cell

- Conduct a visual integrity inspection of 208.45-L (55-gal) drum in D-Cell.
- Remove the 208.45-L (55-gal) drum of dangerous waste from D-Cell, and dispose via approved pathways.
- Decontaminate and potentially remove waste used in the processing of HLV tank liquids.

6.2.2 Closure Activities for B-Cell

- Conduct inventory removal in accordance with the BCCP.
- Conduct integrity tests, using visual inspection, radiation survey methods, and dye penetrant; if necessary, use ultrasonic and eddy-current testing to ensure the integrity of the B-Cell liner.

- If B-Cell liner is breached, determine extent of contamination.
 - Determine if B-Cell structure has leaked.
 - Decontaminate breached area and seal.
 - Modify closure plan.
- Decontaminate the B-Cell ceiling, wall, and floor using the EPA prescribed method and performance standard for treatment of hazardous debris.
- Perform a visual inspection of the decontaminated B-Cell floor, ceiling, and walls to verify achievement of performance standards.
- Conduct analytical testing of samples and evaluate data results.
- Conduct additional decontamination, if required.
- Clean close REC.

6.2.3 Closure Activities for the HLV Tanks

- Conduct inventory removal in accordance with 324 HLV IRA Project PMP.
- Conduct visual integrity inspection of HLV Tanks 104, 105, and 107.
- If tanks have leaked, determine extent of contamination.
- Perform additional decontamination if necessary.
- Modify closure plan if necessary.

6.3 MINIMIZE THE NEED FOR FUTURE MAINTENANCE

Closure of the REC and HLV Tanks by removing and decontaminating (to below any cleanup levels) the surfaces of each unit will eliminate the need for further maintenance under RCRA. However, these units will remain in use for radiological research programs and will be maintained to DOE specifications.

6.4 PROTECT HUMAN HEALTH AND THE ENVIRONMENT

The 324 Building REC and HLV tanks will be clean closed to protect human health and the environment by removing all dangerous wastes and waste residues and decontaminating to below cleanup levels.

1 **6.5 RETURN LAND TO THE APPEARANCE AND USE OF SURROUNDING LAND**
2

3 After the 324 Building REC and HLV Tanks have been clean closed, the units will be
4 used for radiological research as is the rest of the 324 Building. The 324 Building currently
5 blends with the appearance and continued use of the surrounding 300 Area.
6
7

8 **6.6 COMPLIANCE WITH CLOSURE REQUIREMENTS**
9

10 Clean-closure activities will follow the steps outlined in Section 6.2. Decontamination
11 will be used to clean the HLV Tanks to below cleanup levels negotiated by Ecology/DOE/
12 PNNL. Sampling and analysis in conjunction with data evaluation will verify attainment of
13 the predetermined clean-closure levels. Decontamination techniques in accordance with the
14 alternative standards for debris treatment will be used to meet the debris rule performance
15 standards.

7.0 CLOSURE ACTIVITIES

Chapter 7.0 describes the activities necessary to close the 324 Building REC and HLV Tanks. Included are the sampling requirements, analytical requirements, quality assurance/quality control (QA/QC) provisions, and a schedule for completing the closure activities once the closure plan is approved.

7.1 INTRODUCTION

The primary goal for the closure of the 324 Building REC and HLV Tanks is to clean close each unit with the following activities:

- Integrity testing of each unit
- Decontamination of each unit
- Visual verification of compliance with performance standards for alternative treatment standards for hazardous debris for REC
- Verification sampling and analysis if applicable.

Closure is to be assessed using information obtained from implementing the sampling and analysis plan in Section 7.3. In the event that more extensive remediation is required (i.e., clean closure is not possible or practical), it is proposed that the remaining remediation be performed in conjunction with the activities planned for closure of the 324 Building and the 300-FF-2 and 300-FF-5 operable units.

7.2 REMOVAL OF WASTE INVENTORY

All inventories of waste contained in the 324 Building REC and HLV Tanks are currently being removed, or plans have been established for removal. Mixed waste from the REC will be removed in compliance with the *BCCP*, and the HLV Tanks will be emptied in accordance with the *Project Management Plan HLV Interim Removal Action Project* (HLV-IRA). Specifics for each project are provided below. All sampling and analysis activities will be carried out in accordance with Section 7.3 of this plan.

7.2.1 324 Building B-Cell Safety Cleanout Project

The B-Cell cleanout was initiated in mid-FY 1988, as part of the 324 and 325 Building Hot-Cell Restoration Program. The objective of this program was to restore the cells for continued use. Plans were then made to remove old process equipment, equipment racks, waste, and debris that had accumulated since operations started in the late 1960s.

The B-Cell contains known and suspected mixed waste. The cleanout operations result in the recovery and containment of either contact-handled mixed waste, remotely handled mixed waste, or radioactive waste. For project-planning purposes, it is assumed that present and future wastes that might contain hazardous constituents are mixed waste. Table 7-1 summarizes the types and estimated volumes of these B-Cell wastes, giving a total estimated volume of B-Cell mixed waste of 4.1 m³ (144 ft³).

The B-Cell contains approximately 4.1 m³ (144 ft³) of mixed waste, which was generated during the conduct of various research and operational activities. This waste is divided into eight sources. Six of these sources have been collected, temporarily packaged, and stored in the cell awaiting final packaging and relocation to permitted storage in the 200 Area on the Hanford Site. The remaining two sources have been partially collected. The waste that has not yet been collected (representing 1.8 m³ [64 ft³]) is either a part of, inside, or beneath large pieces of equipment that are mounted to the interior cell walls. In accordance with the project's technical plan, work on the project is more than 50% complete. Approximately 74% of the cell-floor area has been cleared of dispersible mixed waste.

The high levels of radioactivity mean that all operations in the cell must be done without human access. The size of equipment, the need to do all operations with remotely operated cranes and manipulators, and the amount of debris and radioactivity have a significant impact on the time and cost required to complete the effort. The following milestones are key to disposing of the mixed waste in B-Cell. The milestones are based on the best available planning information and the assumptions stated in the September 1995 324 Building BCCP PMP.

- 80% of cell-floor area cleared of dispersible material - Jan 1997
- 86% of cell-floor area cleared of dispersible material - Jan 1998
- 99% of cell-floor area cleared of dispersible material - Sept 1998
- Complete initial cleaning and decontamination of B-Cell - April 1999
- Complete secondary cleaning and decontamination of B-Cell - Feb 2000

Table 7-1. REC Mixed Waste

Mixed Waste Type	Volume m ³ (ft ³)
Dispersible Debris	2.5 (88)
Dried Melter Feed	0.2 (6)
Liquid Metal Seal	<0.2 (<7)
Oil Absorption Material	<0.2 (<7)
Elemental Pb	1.0 (36)

- Complete first mixed waste loadout into dry storage - Feb 1996
- Complete second of mixed waste loadout to dry storage - April 2000
- Complete Phase I of the B-Cell Cleanout - May 2000
- Initiate closure plan - May 2000.

About 90% of the mixed waste to be recovered from the B-Cell must be handled remotely; it cannot be packaged in a reasonable volume and still meet contact-handled dose limitations.

As part of the B-Cell cleanout operations, LLW is packaged, removed from its point of origination, and taken to the Central Waste Complex (CWC) for disposal in the LLW Burial Ground.

7.2.1.1 Approach for Recovering and Packaging Mixed Waste. As B-Cell cleanout activities progress, removal and size reduction of the large process equipment and equipment racks in the cell provide access to known and suspected mixed waste, which is collected. The wastes are either designated from process knowledge (when available) or in accordance with a sampling plan that allows a representative sample to be obtained. After collection, the sample(s) are analyzed, and the waste designation is based on the results. Of the estimated 4.1 m³ (144 ft³) volume of B-Cell mixed waste, approximately 2.5 m³ (80 ft³) has been collected and 1.8 m³ (64 ft³) is being collected (1.4 m³ [50 ft³] of dispersible debris and 0.4 m³ [14 ft³] of elemental Pb).

Remotely handled mixed waste is being stored in B-Cell because no permitted storage facility has been identified to receive the waste in its current form or packaging at any location at Hanford or elsewhere in the United States. The project's plan for disposition of this waste has been to retain the waste in B-Cell until an acceptable pathway becomes available. If a pathway is defined earlier than planned, it would become feasible to remove a portion of the mixed waste from B-Cell earlier than shown on the schedule; however, not all of the mixed waste would be collected until final cleanout operations were completed in April 2000.

7.2.1.1.1 Dispersible Debris. Most of this material is on the floor of B-Cell, under racks that are mounted to the cell walls. The racks contain the old process equipment that was used during research activities. Access to this floor material is needed for its collection. Access will be obtained by removing the racks from the cell walls, size reducing them, and packaging the pieces as LLW. As access to the cell floor is achieved, loose waste material is collected and temporarily packed in vented 208.45-L (55 gal) drums. The next step is to sort the loose waste material to remove previously designated non-mixed waste (based on process knowledge), such as tools or pieces of metal dunnage that may have fallen to the floor during operations. The loose waste material is placed in vented, engineered containers and sampled. The samples are analyzed, and the waste is designated. Venting is necessary because of the potential for hydrogen generation due to radiolysis of organics, moisture, and combined waste. These containers will then remain in the cell until the disposition pathways are defined. The mixed-waste debris collected to date has a volume of 1.1 m³ (38 ft³),

approximately 0.8 m³ (28 ft³) of which is remotely handled mixed waste; approximately 0.28 m³ (17 ft³) has been designated as non-hazardous from sample analysis.

7.2.1.1.2 Dried Melter Feed. All of this material has been collected and placed in fifteen 11.4-L (3 gal) containers stored in B-Cell. Its designation as remotely handled mixed waste was based on process knowledge of the material that generated the waste. The waste will be packaged/treated as necessary for transport to an appropriate permitted storage location.

7.2.1.1.3 Liquid Metal Seal. This material, which was used to attach the melter to the turntable rack, is referred to as "liquid metal" because of its low melting point (70°C [158°F]). It has been recovered and designated as remotely handled mixed waste and is being stored in B-Cell. It will be packaged and treated as necessary for transport to an appropriately permitted storage location.

7.2.1.1.4 Oil-Absorption Material. An absorption material was used to sorb window oil that leaked into B-Cell when the inner pane of the north B-Cell window cracked in July 1994. The window oil has been recovered and designated as mixed waste by process knowledge. It is being stored in D-Cell until it is packaged/treated as necessary for transport to an appropriately permitted storage location. D-Cell will be considered closed once this drum has been examined to verify that it has not leaked and removed.

7.2.1.1.5 Elemental Lead. This material is located mainly in rack counterweights and rack wall-mounting through-tubes. It is collected during rack size-reduction, and in most cases, it can be decontaminated or shielded to allow packaging and shipment as contact-handled mixed waste. It is designated as mixed waste from process knowledge. From FY 1989 through FY 1994, a total of 0.5 m³ (18 ft³) was decontaminated with aqueous solutions, packaged, and shipped as contact-handled mixed waste. An additional 0.1 m³ (4 ft³) of contact-handled mixed waste has been collected and is in a satellite accumulation area awaiting collection of the remaining contact-handled mixed waste of this type. As additional equipment is removed, and the waste is collected, the elemental Pb will be packaged and shipped to the CWC.

7.2.2 HLV Interim Removal Action Plan

The HLV-IRA Plan was initiated as a result of preliminary discussions with Ecology and EPA. The overall goal is to implement a preliminary treatment strategy that will remove and stabilize the inventory of liquid waste from the 324 HLV Tanks. Within a relatively short time (1 calendar year), the waste will be transferred into the D-Cell and stabilized by evaporation and isotope separations to solids that permitted TSD's are capable of accepting. The two major radioactive isotopes in the waste are ⁹⁰Sr and ¹³⁷Cs. In the planned treatment scenario, the Sr will be recovered as a solid for re-use in the medical-isotope program. The Cs will be captured on an ion-exchange resin, which will be removed through existing disposition pathways. Any remaining liquid mixed waste will be evaporated in-cell.

The purpose of this task is to remove the high-activity mixed waste currently stored in Tanks 104, 105, and 107. The solutions will be evaporated in D-Cell, and the resulting solid waste will be disposed of as contact-handled mixed waste, remotely handled LLW, and contact handled LLW.

Each treatment residue will be reviewed to ensure that planned processes will meet treatment criteria. This verification will also be used to designate the treatment residues as hazardous or nonhazardous waste. Operational approval will be obtained from the DOE, Ecology, and EPA for the process design. Any comments and concerns will be addressed at this stage of development. The next task will be to verify the integrity of the process piping to be used for batch-transfer of high-activity mixed-waste solutions from Tanks 104, 105, and 107 to an evaporation system that will be installed in D-Cell. Once the system has been designed and the piping tested, a system will be fabricated and demonstrated in a "cold" environment to verify process operations. Any necessary alterations will be made to the evaporation system, and then the system will be installed in the D-Cell.

Tank 104 will be used as the primary receiver and transfer tank for all HLV Tank solutions transferred to the evaporation system in D-Cell. To perform batch transfers, solutions will be steam jetted from Tank 104 to Tank 112 in B-Cell and then vacuum transferred to the evaporation-system vacuum-transfer vessel in D-Cell. The solutions will be chemically adjusted, and the precipitates will be collected and evaporated to dryness. Obtaining samples of vault tank waste and rinse solutions after they are transferred to Tank 104 is also planned. The Tank 104 sample system is located in Room 145.

As the final step, a rinse solution will be added to each tank. The rinse solutions will then be jetted to Tank 104, which will be jetted to Tank 112 in B-Cell. The solution will then be vacuum transferred into the vacuum transfer vessel in D-Cell. The first and second rinses will be processed through final stage, including all aspects of filtration, separation, and evaporation. The third rinse from each tank will be sampled. If below regulatory limits, this rinse solution will be used as a final rinse for Tank 104, the transfer line, Tank 112, and/or the process system tanks in D-Cell. If during any stage in the rinse cycle, the samples indicate concentrations of characteristic material (Pb, Cr, Cd, and Ba) above regulatory limits, the rinse will be transferred to the processing system in D-Cell through the previously used piping. The rinses will be processed so the hazardous components are collected for disposal. An additional rinse will be added to any tank above the regulatory limits and the rinse sequence continued, including testing interior tank jets and sampling. When the samples from all tanks indicate no remaining mixed waste, the rinse solution will be allowed to evaporate. At this point, the closure plan will be initiated.

7.3 SAMPLING AND ANALYSIS CRITERIA

The following sampling and analysis plan has been prepared to evaluate the contamination, if any, remaining in B-Cell or the HLV tanks. This section is not applicable to D-Cell because the drum of mixed waste will be removed, and if there is no evidence of damage or deterioration, decontamination of D-Cell will not be necessary.

7.3.1 Sampling Design

This section discusses the details and design of the sampling program. Subjects addressed include sampling objectives, sampling parameters, sampling activities, sampling procedures, and data quality.

7.3.1.1 Objectives. The objectives of this sampling plan are listed as follows.

- Determine whether B-Cell surfaces are contaminated with mixed waste constituents.
- Identify and quantify any specific dangerous waste constituents that are present
- Assess the potential for clean closure.

7.3.1.2 Analytical Parameters. Analytical parameters, methods, and specific analytical and sampling procedures are based on knowledge of the operations and materials associated with the B-Cell. The plan was developed to determine the presence of dangerous-waste contaminants that are regulated by Ecology.

A list of the potential contaminants of concern, the cleanup levels, and the analytical method for each constituent are provided in Table 7-2. Two types of analyses will be performed: inductively coupled plasma atomic emission spectroscopy (ICP/AES), and toxicity characteristic leaching procedure (TCLP). The analyses will follow the types of EPA methods described in SW-846. Detection limits will be equal to those specified as achievable by each method.

7.3.1.3 Sampling Activities. Sampling will be conducted to evaluate the type and extent of contamination, if any, in the B-cell. Sampling will be conducted following decontamination of the B-cell surfaces. Ceilings, walls, and floors will be gridded into 1-m squares for controlled random sampling. Computer-generated random numbers, listed in Table 7-3, will be wipe-sampled.

Table 7-2. Clean-Closure Criteria for the HLV Tanks and REC

Dangerous-Waste Description	Dangerous-Waste Designation Limit (mg/L)	Analytical Method	Detection Limit ($\mu\text{g/L}$)
D005 - Ba	100.0	ICP	2
D006 - Cd	1.0	ICP	4
D007 - Cr	5.0	ICP	7
D008 - Pb	5.0	ICP	42
D010 - Se	1.0	ICP	75
D011 - Ag	5.0	ICP	7

Table 7-3. Computer-Generated Random Numbers

Sampling Location	Random Numbers			
West Wall	1	7	18	22
East Wall	35	44	48	56
North Wall	11	18	52	56
South Wall	3	26	72	75
Ceiling	8	12	42	X
Floor	3	5	39	X

B-Cell sampling tasks are presented below:

- Select sampling locations (Figure 7-1)
- Wipe-sample all surfaces in specified areas
- In areas of suspected contamination (e.g., areas of cracks, stains, and known prior leaks), additional sampling will be conducted
- Conduct analytical testing of samples
- Evaluate results for closure.

HLV sampling tasks are as follows:

- Collect samples of tank rinsates
- Conduct analytical testing of samples
- Evaluate results for closure.

7.3.1.4 B-Cell Sampling Procedure. Sampling procedures for determining whether dangerous wastes are present in B-Cell are described in this section. Sampling procedures will be conducted in conformance with existing EPA guidelines.

Toxicity characteristic leaching procedure (TCLP) extraction fluid No. 2 will be used as the wipe solvent. It is a reference solvent intended for measuring the concentration of constituents introduced or mobilized into the environment (i.e., onto the wipe). It is a desirable choice because a more aggressive solvent, such as nitric acid, may dissolve the metal substrate.

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Figure 7-1. Randomly Selected Sampling Locations

An analysis of the wipe sampling, by the acid leachate method (EPA's SW-846 Method 3050) is recommended. This method would put all of the gathered constituents into solution for analysis. Analyses are performed by EPA protocols. Thus, the analysis represents the amount of material that is environmentally mobile from a 100-cm² area of the medium samples.

The processes that have occurred in the REC may have contaminated the surfaces of the ceiling, walls, and floors. The objective of sampling the surfaces in the B-Cell is to determine the extent of residual contamination remaining following decontamination. Wipe

samples will be collected according to EPA sampling techniques. The ceiling, walls, and floors will be marked into 1-m² sections. Randomly selected sections will be wiped with a filter paper prepared with TCLP extraction fluid No. 2 and analyzed for constituents listed in Table 7-2. The surface within each 100-cm² area will be carefully wiped, utilizing vertical strokes, starting at one end and progressing to the other (Figure 7-2).

The filter paper will be held with clean manipulators to prevent contamination. Manipulators will be cleaned before each wipe sample. Care will be taken to wipe the surface only once throughout the sampling effort. After the area has been wiped, the filter will be folded with the exposed side in and then folded over to form a 90-degree angle in the center. The filter will be placed into an appropriate container, angle first, and immediately sealed.

Figure 7-2. Wipe-Sampling Technique

This sampling is nonroutine and necessitates the following requirements:

- Sample the surface without sampling the substrate
- Provide for a qualitative and quantitative measure of chemicals on the metal surfaces without the benefit of a reference baseline
- Evaluate contamination on the metal surfaces without unnecessarily including constituents from the metal (i.e., dissolution of the metal surface).

7.3.1.5 B-Cell Sampling Locations. Samples will be collected in randomly selected locations except where authoritative sampling is warranted (e.g., in areas where contamination is more likely). Areas of suspected contamination will be subject to authoritative sampling, and locations will be identified at the time of sampling. All surfaces will be visually inspected before sample collection to identify cracked areas and other areas of potential contamination. Cracked areas will be mapped, and sampling in these areas will be biased. In addition to cracked areas, any potential pathways through the surface, such as seams, will be sampled.

For developing sampling locations, the B-Cell has been divided into six sections: four walls, the ceiling, and floor areas. The surface areas were gridded into 1-m² units (Figure 7-1). Grid areas to be sampled were selected randomly. The use of a random-sampling strategy for the surface wipe samples will ensure that data obtained will be representative of the population from which the samples were taken. The sampling results for locations that are less than 1-m² will be adjusted to account for the actual area sampled. A minimum of 5% of the gridded areas was selected for sampling. However, areas where contamination is more likely to have occurred will be selected for authoritative sampling because of the higher potential for contamination. The computer-generated, random sampling locations are included in Figure 7-1. The number and location of each type of sample are presented in Table 7-4.

Table 7-4. Sampling Locations

Location	Number of Samples
B-Cell	
Ceiling	3
Walls	4 each
Floor	3
Areas of potential contamination and pathways (biased)	Variable
QA/QC samples	
Field duplicates	1/day or /20 samples
Equipment blanks	1/day
Field blanks	1/day
Wipe samples	1/gridded area

7.3.1.6 HLV Tank Sampling Procedure and Location. Sampling will be conducted to evaluate the type and extent of contamination, if any, remaining in the HLV tanks. Samples from the HLV tanks may be obtained using the HLV sample station. However, due to the high dose rates to the operating personnel and the very cumbersome operations caused by the high radiation levels, sample of the HLV tank flushes will be obtained from Tank 112 in B-Cell. (Tank 112 is used during the transfer of tank liquids to D-Cell.) The sample system is very similar for both options except sampling from Tank 112 is done remotely by the operator so the radiation dose to the operator is very low. After the sample is taken from Tank 112, it is loaded in a shielded cask for transport to the analytical facilities. The sampling system, in both cases, is performed by recirculating the tank contents through the sampling line and sample container for approximately 5 minutes with the assistance of an air jet. After the jet is turned off, the sample container contains about 10 to 15 ml of sample. The sample container is removed from the sample station, capped, and placed in the transfer tray. The transfer tray is loaded into a clamshell for double containment and then loaded into the transfer cask.

7.3.1.7 Data Quality. To ensure quality data, all of the sampling procedures employed will be conducted in conformance with EPA guidelines. All laboratory analyses will be in accordance with minimum quality-control criteria and standard EPA methods from the most recent edition of SW-846. Sampling procedures and analysis modifications may be necessary, however, because of radiological considerations. The analytical laboratory will submit all analytical and QA/QC procedures to PNNL for approval before the samples are analyzed. The EPA guidelines for reporting accuracy and precision and for determining the practical quantitation limit specified in the analytical methods will be met.

Sample quality will be ensured through the use of field duplicates, equipment blanks, and field blanks. Each of these sample types is discussed in Section 7.3.9. Quality control of records and documentation will be accomplished by following procedures outlined in SW-846. Sampling records to be kept on file include field notes, daily memoranda, records of meetings and activities concerning the sampling program, and chain-of-custody records. The types of records and documentation required for all samples are described in Section 7.3.9

7.3.2 Modification to Sampling and Analysis Plan

Unanticipated or changing conditions sometimes prevent the optimal aspects of sample design. Factors adversely influencing sampling efforts can include equipment malfunction or breakdown, improper equipment, and physical barriers. When modifications to the planned activity are necessary, the modifications will be recorded in the field logbook along with circumstances requiring the action. The field logbook will be reviewed and signed by the project manager at least daily. This procedure will provide an accurate record of modifications and PNNL approval obtained, while 1) allowing sampling to proceed safely, and 2) maintaining efficient manpower and equipment usage.

7.3.3 Evaluation of Data

Analytical results from the sampling will be compiled, evaluated, and summarized in the following manner:

- Evaluate the QC of the sample handling and sample analyses to assess the reliability of the data
- Conduct the statistical evaluation of the analytical data (Section 7.3.5)
- Prepare summary statistics for constituents as described in Section 7.3.5
- Test the significance of location effects on analytical results using analysis of variance
- Compare the sample results with the established cleanup levels
- If differences in mean concentration are found to exist between samples and cleanup levels, or if insufficient data are available for statistical comparison of results for a constituent, then the following actions will be taken to redefine the cleanup levels:
 - Examine results for comparison with accepted regulatory standards on a constituent-by-constituent basis
 - Make assessments as to whether the levels of various chemical constituents are of a health and/or environmental concern.

7.3.4 Statistical Treatment of Data

All data collected will be analyzed and tabulated for evaluation using the methods described in SW-846. Other guidance documents and statistical references may be used where applicable. Laboratory data will be provided to Ecology upon completion of sampling and analysis. Data for individual constituents will be summarized and will include the following information:

- Method detection limit
- Limit of quantitation
- Total number of samples
- Number of less-than-detection-limit samples
- Mean values
- Standard deviation
- Coefficient of variation
- Method precision
- Method accuracy
- Minimum value

- Maximum value
- Median value.

The data will be interpreted by qualified scientists and statisticians. Data evaluation will be based on statistical criteria and professional judgment, as appropriate.

7.3.5 Assessment of Data Reliability

Data reliability will be assessed by evaluating the sample handling and analysis QC. Sample-handling QC will be evaluated by reviewing field documentation and results of QA samples. The review will be conducted to verify that decontaminated equipment was used, that cross-contamination was minimized, that samples were preserved properly, and that chain-of-custody of the samples was not broken.

To assess the reliability of the results, analytical data received from any sampling performed at the 324 Building REC and HLV Tanks will be scrutinized against the QC report provided by the contractor's laboratory. Chemical analytical results for the inorganic chemical analysis laboratory will be checked, as summarized below:

- Holding times are acceptable
- Contractual detection limits are below those required by EPA
- Laboratory blanks and replicates are within established QC limits
- Sample spikes are within QC limits.

7.3.6 Reporting

After completion of the sampling effort, verification documents will be provided for actual sample locations, number of samples, and specific methods used for collection, if different than those provided in this Closure Plan. Data received from the laboratory will be reviewed, analyzed, and summarized, statistically. The results will be used to provide clean-closure evaluations.

7.3.7 Sampling Equipment, Containers, and Preservation

This section describes the equipment, containers, and preservation methods used for sample collection.

7.3.7.1 Sampling Equipment. Sampling equipment to be used will be appropriate to the spectrum of media that may be encountered. The following is a list of media that may be sampled:

- Metal surfaces (walls and floor)
- Chemical-resistant coatings

- Concrete surfaces (ceiling)
- Aqueous HLV tank rinses..

Filter paper will be used as sampling equipment in all phases of the investigation. Additional equipment and supplies will be procured as required to perform necessary sampling.

7.3.7.2 Sample Containers and Preservation. Sample containers will be chosen based on their compatibility with the samples, resistance to leaking or breakage, and ability to seal tightly. They must possess the required volume for an optimum sample. Containers for collecting and sorting samples will be made of high-density plastic or glass appropriate for the constituents to be analyzed. The containers will have tight, screw-type lids with Teflon cap liners for glass bottles.

All samples will be packaged according to PNNL sample-handling procedures. Samples will not be held in excess of specified holding times. Because the samples will be collected from radiation zones, they must be checked by a radiation-control technician before removal from the site according to standard operation procedures and the Hanford Site Radiation Control Manual. This requirement also will be included in the site-specific health and safety plan (HASP), when a plan is developed. A dose assessment will be conducted for those sampling activities occurring in radiation zones. This assessment will be used to develop a plan to keep doses as low as reasonably achievable (ALARA) during sampling activities. The ALARA requirement will be achieved in a manner that will not compromise the validity of the sample. All deviations from SW-846 protocols, including sample size, will be documented with a justification for the deviation.

7.3.8 Sample Quality Control

The required QC procedures will be followed to the extent necessary to adequately control sampling activities. The frequency of collecting QC samples is presented in Table 7-4.

7.3.8.1 Field Quality Control. Field QC will be accomplished through the use of various sampling duplicates and blanks, as described below. The QC samples will be collected once a day or every 20 samples, whichever is greater. Duplicate samples are two separate samples taken from the same sampling point in the field and placed into separate containers. The duplicates will be used as an indication of the repeatability of the analytical data.

Equipment blanks serve as a check on sampling-device cleanliness. An equipment blank consists of distilled water that is transported to the site, opened in the field, and poured over or through the sampling collection device, collected in a sample container, and returned to the laboratory for analysis. The analytical results from the blanks will be used to assess the adequacy of decontamination procedures. This assessment is made during data validation. The rinsates will be collected daily and will be analyzed for the same analytes as the samples that are collected that day.

1 Field blanks consist of pure deionized, distilled water, which will be transferred to a
2 sample container at the site and preserved appropriately. They are used to check for possible
3 contamination originating with the reagent or the sampling environment and will be collected
4 daily. Field blanks will be taken only when field decontamination procedures are used.
5 Field blanks consist of filter paper pads that have been laboratory-prepared with TCLP
6 extraction fluid No. 2 and placed in a sample container. These blanks will be analyzed to
7 determine whether contaminants were introduced by the pad or preparation solution.
8

9 Wipe-sampling QC will be handled in a distinct manner. Duplicates will consist of one
10 confirmatory wipe sample taken from each of the gridded areas as an indication of the
11 thoroughness of the wiping technique. These randomly selected samples will be taken by
12 wiping the previously wiped area a second time.
13

14 **7.3.8.2 Field Logbook.** The personnel conducting sampling will maintain an official log-
15 book during the effort. The field logbook will be bound and have consecutively numbered
16 pages. All information pertinent to the sampling must be recorded in the logbook in a
17 legible fashion. If changes are necessary, they will be indicated by a single line drawn
18 through the affected text. The individual responsible for the change will initial and date the
19 entry. Each day's activities or separate sampling episodes must be signed. The logbook
20 should be protected, stored in a safe file or other repository, and kept as a permanent record.
21 The following types of information should be included in the logbook entries:
22

- 23
- Maps, sketches, drawings, or other definitive site description
 - Location of all sampling points, including reference points and scale
 - 25 • Sample method
 - 26 • Date and time of collection
 - 27 • Collector's name
 - 28 • Number, type, and volume of samples taken
 - 29 • Identification number for each sample
 - 30 • Field observations
 - 31 • Laboratory of destination
 - 32 • Field measurements, including results of the radiation survey
 - 33 • Signature of recording personnel.
 - 34

35 The following are additional items that may be included:
36

- 37 • Name and address of field contact
- 38 • Type/purpose of sampling
- 39 • Sample transportation method
- 40 • Photographs of site for site-location verification.
- 41

42 **7.3.8.3 Sample Labels.** Sample labels will be prepared according to the procedures out-
43 lined in SW-846. Labels will be securely attached to each sample to prevent misidentifica-
44 tion. They may be adhesive labels or tags and will be affixed to the proper sample

containers before or at the time of collection. All information will be completed at the time of collection. Indelible pencil or ink should be used. Each label should contain at least the following information:

- Site contractor
- Collector's name
- Date and time collected
- Sample number
- Sample location.

7.3.8.4 Sample Seals. Sample seals will be used to prevent and/or detect tampering with samples between the time of collection and the beginning of analysis. Seals will be applied to the sample containers before leaving the sample location. The seals will be attached in such a manner that the seal must be broken to open the container.

7.3.8.5 Chain-of-Custody Record. To ensure the integrity of the samples from collection through analysis to final disposition, documentation is necessary to trace sample possession and handling. This documentation takes the form of a record that provides a history of all people having custody of the sample, including the following situations:

- In a person's physical possession
- In view of a person
- Secured so tampering is impossible
- Placed in an area restricted to authorized personnel.

A chain-of-custody record will be completed and will accompany all samples from collection to analysis. Multiple copies will be required, and at least one copy must be maintained by the sampling supervisor. The following information should be included:

- Contractor
- Sample number
- Date and time collected
- Sample type
- Number of containers
- Collector's signature
- Signature of person receiving possession/date/time
- Inclusive dates of possession
- Condition of samples upon receipt.

7.3.8.6 Sample-Analysis Request. The sample-analysis request form is designed to accompany the samples to the laboratory and to designate the analyses to be performed on each sample. The form also provides a check to ensure that all samples have been received

and that correlation between sample analysis and sample number is finalized and complete.
The information provided on this form includes the following:

- Contractor
- Company contact
- Collector
- Sample number
- Sample type
- Analysis requested
- Date and time collected
- Laboratory sample custodian.

7.3.8.7 Laboratory Receipt and Logging of Sample. In the laboratory, a sample custodian will be assigned to receive the samples. Upon receipt of a sample, the custodian will inspect the condition of the sample and the sample seal, verify the information on the sample label and seal against that on the chain-of-custody record, assign a laboratory number, log in the sample in the laboratory logbook, store the sample in a secured sample-storage room or cabinet, and report missing or damaged samples immediately. The results of a radiation survey exhibiting activity greater than 200 counts/min will be provided to the laboratory performing analyses of samples. Samples exhibiting activity greater than 200 counts/min will be sent only to approved laboratories.

7.3.8.8 Decontamination. This section discusses personnel, equipment, and sample containers decontamination procedures.

7.3.8.8.1 Personnel Decontamination Procedures. A decontamination area will be established at a central location. Procedures for personnel decontamination are provided in the sitewide HASP. In addition, the 324 Building REC and HLV Tanks HASP will be prepared before sampling activities are initiated.

7.3.8.8.2 Equipment Decontamination. Extreme care is necessary in field sampling to ensure that sampling equipment does not cross contaminate samples. To prevent this source of contamination, freshly cleaned or disposable sampling equipment will be used. When equipment must be reused in the field, it will be cleaned as thoroughly as practical. Decontamination wash water will be placed in containers, appropriately labeled, and designated for disposal. Whenever possible, equipment will be cleaned in the laboratory according to specified procedures.

7.3.8.8.3 Sampling Container Decontamination Procedures. Containers are purchased pre-cleaned from the factory and are kept under strict chain-of-custody to preserve the integrity of the samples from collection through disposal. After analysis, sample containers will be disposed of properly.

7.3.8.9 Sample Disposition. After all analyses have been completed as requested, reports will be reviewed for anomalous data. Requests for reanalysis or data checks will be made as

1 soon as possible. At the certified completion of all analyses, the samples will be returned to
2 the collector and will be properly disposed of or archived.

5 7.3.9 Analytical Procedures

6
7 Laboratory staff will analyze samples for all constituents in accordance with the current
8 EPA requirements in SW-846 where practical. Radiological considerations may require
9 modification of analytical procedures. The EPA-specified detection limits are goals, while
10 the actual detection limits will be presented in the analytical certification reports.

13 7.3.10 Laboratory Quality Assurance/Quality Control

14
15 The contractor laboratory will ensure the integrity and validity of test results by imple-
16 menting an internal QC program. The program will meet the QC criteria of applicable EPA
17 guidelines in SW-846. A system of reviewing and analyzing the results of samples will be
18 maintained to detect problems caused by contamination, inadequate calibrations, miscalcula-
19 tions, improper procedures, or other factors. Standard methods will be used whenever
20 possible. Alternative methods that are developed or adapted will be tested and completely
21 documented per the requirements of SW-846. All methods and method changes will be
22 approved by an onsite PNNL representative.

23
24 The QC procedures for laboratory analyses will include (as appropriate to each analysis
25 and as specified in Section 1.2 of SW-846) evaluation of blanks, random matrix spikes,
26 internal standards, surrogates, standard calibration curves, and other QC samples as appro-
27 priate for determination of the QA/QC for each analytical method. Quality control proce-
28 dures specific to individual methods will be documented in the laboratory's analytical
29 procedures, and QC data will be included with each batch of samples analyzed.

30
31 The EPA guidelines for determining and reporting accuracy, precision, and detection
32 limits of the analytical methods will be met. The analytical laboratory will provide tabulated
33 information representative of accuracy, precision, and detection limits for at least the period
34 over which the analyses were performed. Information on accuracy and precision can be
35 determined from matrix spike and/or surrogate spike recoveries of standard reference
36 samples or EPA control samples, if appropriate. Accuracy and precision will be reported in
37 a manner similar to that indicated in SW-846. The upper and lower limits of the standard
38 working range used for the analysis will be reported in a form comparable to Form XIII
39 (SW-846; ONE-32).

40
41 Representative lower limits of detection will not exceed EPA requirements for detection
42 limits. Detection limits can be reported as one of the following:

- 43 • The lower limit of the standard (linear) working range used for the analysis
- 44 • The low-concentration standard used in the calibration, provided that this concentration
- 45 does not exceed EPA requirements
- 46
- 47

- Detection limits and/or quantitation limits for each analyte calculated from measured standard deviation of the average background noise using the criteria outlined in SW-846 (ONE-15; THREE-2), for either the interpolated background beneath analyte peaks in the low-concentration calibration standards, or at the peak spectral positions in a reagent blank.

The analytical laboratory will specify the definition of lower limit of detection used. Detection limits will be regarded as the lower limits of reportable concentrations of an analyte. Concentrations less than or equal to these limits will be reported as less than or equal to detection limits (e.g., <1.0 mg/kg). Representative precision at the detection limits will also be determined and reported in a similar manner as precision for the mid-range. Precision at the lower limit of detection, as defined above, will be determined from replicate analyte peak measurements for the low-concentration calibration standards or for the samples used in establishing the lower limit of detection. Representative detection limits and associated precision on the lower limit of detection will be reported for each analyte in a form comparable to Form VIII (SW-846; ONE-25).

A duplicate and a blank sample will be processed with each sample batch or after every 20 samples, whichever is more frequent. Quality control samples prepared in the same matrix and in the same manner as a mixed calibration standard (at 10 times the instrument detection limits or in the mid-range of the working-standard calibration) will be analyzed after every 10 samples. Spike recovery will be calculated by the method detailed in the *Annual Book of ASTM Standards*, Volume 11.01, Section 11.5.4, Method D 3856. Analytical data on blanks, duplicates, and control samples will be reported in the same manner as samples. All measurements must be representative of the sampling media and sampling conditions. Care will be taken that duplicate samples are representative of the original sample.

7.3.11 Site Safety

Site safety is divided into four sections: the health and safety plan specific for this closure, radiological contamination control for this closure, site-wide personnel training, and site-wide standards safety procedures.

7.3.11.1 Health and Safety Plan. A HASP is required for all dangerous-waste sampling sites. It is intended to contain information pertinent to field assignments and to be a guide in unusual situations or emergencies. A site-specific version of the general RCRA/CERCLA investigation health and safety manual will be used as the HASP for sampling in the REC and HLV Tanks. The site-specific HASP will be reviewed and approved before initiating sampling activities.

1 **7.3.11.2 Contamination Control.** Because sampling is to be undertaken within a radio-
2 logical control area, standard onsite radiation work procedures and the site-specific HASP
3 will be followed. In addition, the following activities will occur:
4

- 5 • Decontamination
- 6
- 7 - All modifications to decontamination procedures will be approved by the field-team
- 8 leader and the site-safety officer.
- 9
- 10 - Modifications will be recorded in the appropriate logbooks.
- 11
- 12 • Disposal
- 13
- 14 - Excess sample material and rinse water will be containerized. Rinse water also will
- 15 be containerized.
- 16
- 17 - Articles, such as protective clothing, that have been soiled with potentially contam-
- 18 inated material, equipment decontamination rinsate, and other waste generated during
- 19 sampling will be temporarily placed in plastic-lined containers.
- 20

21 In accordance with WAC 173-303-200(2), the containers will be stored in satellite accu-
22 mulation areas. When waste is generated, the major risk(s) will be marked on the container.
23 Sampling and analysis will be conducted as needed to complete waste designation. When a
24 container is full, it will be marked with the accumulation date (drum fill date). If the con-
25 taminants are found to be dangerous, arrangements will be made for proper disposal of
26 stored material within a 90-day period. If dangerous contamination is not found, materials
27 will be laundered or disposed of according to WAC 173-303, DOE Orders, and 40 CFR 261.
28

29 **7.3.11.3 Personnel Training.** All personnel involved with the closure activities at the
30 324 Building REC and HLV Tanks will receive a minimum level of dangerous-waste
31 training. Personnel responsibilities are as follows:
32

- 33 • Managers and supervisors will be responsible for supervising, coordinating, and directing
- 34 the closure activities and personnel.
- 35
- 36 • Metal operators and samplers will be responsible for sampling, packaging, labeling, and
- 37 handling of dangerous waste; both nonradioactive and radioactive material.
- 38
- 39 • Health Physics Technicians will be responsible for surveying for radiological
- 40 contamination.
- 41
- 42 • Crafts personnel will be responsible for specialized work. The various crafts include
- 43 carpenters, electricians, ironworkers/riggers, heavy-equipment operators, crane opera-
- 44 tors, millwrights, pipefitters, and painters.
- 45

1 A number of training courses have been specified for personnel performing sampling and
2 related activities. The required courses and activities are as follows:

- 3
- 4 • Occupational Safety and Health Administration, 24-Hour Dangerous-Waste Worker
- 5 Training
- 6
- 7 • Radiation-worker training
- 8
- 9 • A 3-day, on-the-job training session under the supervision of an experienced person
- 10 before full responsibilities may be assumed.
- 11
- 12 • First aid training is desirable, but not mandatory, for work on the Hanford Site.
- 13
- 14 • In addition, all personnel involved in closure activities are required to review this waste
- 15 sampling and analysis plan and the PNNL emergency/contingency plan.
- 16

17 **7.3.11.4 Standard Safety Procedures.** The following safety procedures will apply each
18 time sampling is conducted:

- 19
- 20 • No personnel will be at the site without a designated "buddy."
- 21
- 22 • One of the people at the site will be designated to be in charge.
- 23
- 24 • Personal protective equipment will be worn as specified. Approved deviations will be
- 25 entered in the field logbook and signed by the cognizant engineer and the site safety
- 26 officer.
- 27
- 28 • Field work will be planned before sampling.
- 29
- 30 • Equipment needed for work will be inventoried and inspected before the site visit to
- 31 ensure that all equipment is present and in operable condition.
- 32
- 33 • A pre-job/safety meeting will be conducted before sampling.
- 34
- 35

36 **7.4 REMOVAL OF DANGEROUS WASTE RESIDUE**

37

38 Initiation of the closure plan and successful clean closure is based on the assumptions
39 that: 1) The BCCP will be successful in removing the inventory of waste from B-Cell and
40 the drum of dangerous waste from D-Cell, leaving B-Cell with visibly clean walls, ceiling,
41 and floor, and 2) the inventory-removal plan for the HLV tanks will be conducted
42 successfully, including the triple rinsing of each tank.

43

44

7.4.1 Contaminated Material to be Removed

The liquid waste will be removed, and the HLV Tanks will be triple rinsed. Sampling and analysis of the final rinse liquid will verify that contamination concentrations have been reduced sufficiently to meet the clean-closure standard.

When all the major pieces of equipment and any remaining dispersible debris have been sealed in containers and moved out of B-Cell, a final HEPA vacuum will be deployed in-cell to containerize any remaining dispersible debris. The loose and fixed contamination remaining on exposed surfaces will be removed by the decontamination methods described in Section 7.7.

7.4.2 Verification Sampling

Sampling (as described in Section 7.3) will be conducted following the decontamination process to evaluate the effectiveness of decontamination and determine if B-Cell has been cleaned to below the clean-closure levels.

The wipe samples collected from the surfaces after decontamination of B-Cell will be analyzed by the TCLP and ICP methods described in Section 7.3.9. Results from these analyses showing that the wipe samples are below the clean-closure levels will lead to a determination that B-Cell is clean closed.

7.5 INTEGRITY ASSESSMENT OF THE UNITS

An integrity assessment will be conducted to determine if any unit has been compromised. This section describes the integrity-assessment methodologies for each unit being closed.

7.5.1 HLV Tanks

The integrity assessment of the HLV tanks will be conducted by remote visual inspection with a fiberoptic camera and lens placed in the vault. The visual inspection will include looking for stains or other indications that a tank may have leaked. This inspection method will require pre-deployment engineering; however, it is deemed more practical and achievable than other possible inspection methods. Other inspection methods were considered for the vault (i.e., swipe sampling of vault, direct visual inspection of the vault); however, the high radiation and extremely complicated piping scheme in the vault make those methods impracticable. If the visual inspection of the vault reveals no stains or other indication of a leaking tank, it will be determined that the HLV tanks have maintained integrity.

7.5.2 D-Cell

The drum of dangerous waste in D-Cell will be visually inspected to determine if it has leaked. The drum will be lifted and turned so that the entire area of the drum can be inspected for leaks or breaches. If the drum has no leaks or breaches, it will be determined that the D-Cell is clean closed once the drum of waste is removed to another Hanford Site TSD unit.

7.5.3 B-Cell

Selected methods may be used individually and or in tandem to conduct the integrity assessment of the B-Cell liner. Each of the methods described has been effective in high-radiation zones and has been adapted for remote operation. B-Cell has 15.2 cm (6 in.) of concrete beneath the liner and 1.2 m (4 ft) of concrete outside the liner walls, which will act as secondary containment if the cell liner is breached. Should the integrity assessment determine that the cell liner has been breached, an investigation into the extent of contamination will be undertaken. This closure plan will be revised in accordance with the investigation.

Video cameras will be used for visual inspection. An initial radiation survey will measure the surface and background radiation and identify hot-spots on or beneath the liner, indicative of a breach. Hot spots identified in the radiation survey will be inspected with a dye penetrant, which will provide visual enhancement of the area. If no indication of a breach is found, it will be determined that the B-Cell has maintained integrity. If a definitive determination of integrity cannot be made, then the non-destructive examination (NDE) ultrasonic and eddy current techniques will be used to determine surface and sub-surface "flaws" in the liner. A description of each technique is provided in the following sections.

7.5.3.1 Radiation Survey. A radiological survey uses simple radiation detection equipment, to detect radioactive hot spots. These hot spots may indicate that the liner has been breached, and radioactive material has leaked onto the concrete. Measurements with a shielded and collimated dose-rate probe, such as an ionization chamber, will provide an indication of the relative amounts of ^{137}Cs on the walls, ceilings, and floor. The measured dose rate will provide data to the WISE or computer code, and the results of the calculations will indicate whether the residual contamination guides have been met.

A number of supplementary techniques may be used. One method for measuring ambient dose rates is to position strings of thermoluminescent dosimeters (TLDs) or other passive dosimeters inside a plastic tube placed at strategic locations for a known time. This technique is widely used to characterize complex radiation fields, such as those encountered in high radiation areas in nuclear power plants, and in radiation therapy, where small TLDs are placed in anatomic models.

1 The radiation survey currently planned for B-Cell will be similar to that used in C-Cell,
2 which was previously decontaminated to remove radioactive contaminants. A medium-range
3 detector will be engineered for use in-cell, and hot spots will be noted on radiation survey
4 sheets.

5
6 **7.5.3.2 Liquid Penetrant.** If any hot spots are detected during the radiation survey, liquid
7 penetrant inspection will be used to detect defects that break the surface of the B-Cell liner.
8 This method has been proven effective in C-Cell cleanout and decontamination when liquid-
9 penetrant inspection revealed that no macroscopic cracks breached the liner, but pitting had
10 occurred.

11
12 Liquid-penetrant inspection is used to reveal such defects as cracks, laminations, laps,
13 and zones of surface porosity. To achieve good visibility, the liquid will be colored with a
14 bright and persistent (usually red) dye or tagged with a fluorescent marker.

15
16 The liquid penetrant will be applied using engineered remote devices. The liquid pene-
17 trant will be applied to the area being inspected in B-Cell by spraying to form a film of pene-
18 trant over the surface, which will penetrate into the surface defect. The excess penetrant will
19 be removed from the surface in a uniform manner for effective inspection. The surface will
20 be sprayed with chalk dust suspended in a volatile carrier fluid. Penetrant liquid remaining
21 in defects will be slowly drawn by capillary action into the pores of the chalk. The spread of
22 penetrant in the "developer" will magnify the apparent width of the defect. The chalk may
23 be omitted if a fluorescent penetrant is used. After an optimum developing time, the com-
24 ponent surface will be inspected for indications of penetrant "bleedback." Liquid-penetrant
25 inspection is usually carried out in strong light; therefore, fluorescent-penetrant inspection
26 may be more suitable in B-Cell. The latter technique causes the penetrant to emit visible
27 light, and defects are brilliantly outlined.

28
29 **7.5.3.3 Ultrasonic Testing.** Ultrasonic inspection detects internal defects and small surface
30 cracks. This technique measures the thickness and determines the location, size, and nature
31 of defects. Sound waves are elastic waves that can be transmitted through both fluid and
32 solid media. An ultrasonic impulse is generated within the substance being tested, and a
33 transducer in contact with the material is used to detect discontinuities in the signal. The
34 nature of the discontinuities is directly related to the type and extent of the defect.

35
36 Ultrasonic inspection can determine the exact position of internal defects and can distin-
37 guish the type of defect from the various types of signal response received. Since the ultra-
38 sonic inspection will be performed by remote operation, the probe will be suspended from
39 the overhead crane with a specially built platform to provide grid movement along the walls
40 and the floor. Probes designed for high radiation levels are commercially available.

41
42 **7.5.3.4 Eddy Current Testing.** Electrical eddy currents or magnetic effects are induced in
43 the material being tested, and an assessment of the effects can lead to conclusions about the
44 nature and condition of the surface being examined. These highly versatile techniques may
45 be used to detect surface and subsurface defects in the B-Cell liner.

1 When a coil carrying an alternating current is placed in proximity to a conductive mate-
2 rial, a secondary or eddy current is induced in the material. The induced currents produce a
3 magnetic field in opposition to the primary magnetic field surrounding the coil. This inter-
4 action between fields causes a back electromotive force in the coil, and hence a change in
5 the coil impedance value. If a material is uniform in composition, the impedance value of a
6 search coil placed close to the surface should be the same at all points on the surface, apart
7 from some variation observed close to the edges of the sample. A discontinuity in the
8 surface will alter the distribution and magnitude of eddy currents in the vicinity, and the
9 consequent reduction in the magnetic field will change the coil impedance value.

10
11 The coils will be mounted in an inspection probe. A coil is frequently wound around a
12 ferrite core, and, although the search coil is generally protected by a plastic casing, the end
13 of the ferrite core often projects beyond the plastic case. Eddy-current test probes do not
14 need coupling fluid between them and the test piece, and little if any surface preparation is
15 necessary.

16
17 This inspection would be performed remotely, and the probe would be suspended from
18 the overhead crane; a specially built platform would provide grid movement along the walls
19 and the floor. Eddy current is used remotely and in high-radiation areas.

20 21 22 **7.6 DECONTAMINATION OF THE HLV TANKS**

23
24 The HLV tanks will be decontaminated by the flushing/rinsing method, which is part of
25 the PMP HLV-IRA Plan described in Section 7.2. The tanks will be triple rinsed, and the
26 final rinsate will be analyzed to determine if the remaining contaminant concentrations are
27 below the clean-closure levels. Once clean-closure levels have been met, the HLV Tanks are
28 considered clean closed.

29 30 31 **7.7 DECONTAMINATION OF D-CELL**

32
33 After the integrity assessment has verified that the drum is intact, the drum containing
34 dangerous waste will be removed from D-Cell. Since the only dangerous waste in D-Cell is
35 the drum, and there is no evidence that it has been damaged or has deteriorated, decontami-
36 nation of D-Cell will not be necessary. After the drum has been removed, D-Cell will be
37 considered clean closed.

38 39 40 **7.8 DECONTAMINATION OF B-CELL**

41
42 The interior of B-Cell will be decontaminated using the following techniques:

- 43 • Low-pressure foam
- 44 • High/ultrahigh-pressure water wash.
- 45

The actual step-by-step decontamination activities will be specified in the operations work plan and will address each area of concern. These decontamination methods were selected to clean B-Cell after evaluating several decontamination methods as described in the *Feasibility Study for Clean Closure of the 324 Building REC and HLV* (FSCC) with consideration of the following technical concerns: 1) removing highly dispersible loose surface contamination while minimizing the spread and recontamination of cleaned areas, 2) removing embedded or fixed contamination that adheres to or penetrates the surfaces, 3) achieving the negotiated clean-closure level for surfaces, and 4) minimizing waste. If these decontamination methods are not effective, more aggressive methods described in the FSCC will be evaluated.

The 'operational work plan' is a generic term for the implementation procedures used to provide specific field directions to workers actually performing the decontamination. The general decontamination information is included in Sections 7.6, 7.7, and 7.8 of this Closure Plan. The actual decontamination work plan will specify sufficient detail for field implementation of the items addressed in these sections. Development of the operational work plan will take place just before the work begins.

Since radiation levels are expected to preclude cell entry at any time, decontamination will require some form of remote operation. For the low-pressure foam and high/ultrahigh-pressure wash methods, the existing manipulators coupled with long wands will be sufficient. For the B-Cell walls and floor, a manually guided and video-monitored pan-tilt mechanism will be used in conjunction with the overhead crane. For the areas above the overhead crane and the crane track ledges, an electronically controlled arm may be needed. The arm will be mounted on a platform suspended from the overhead crane to reach over the crane to the upper and lower areas of the cell.

Sampling (as described in Section 7.3) will be conducted following the cleaning process to determine the effectiveness of the cleaning procedure and the appropriate disposal options for the secondary waste.

7.8.1 Low-Pressure Foam

Low-pressure foam cleaning removes surface contamination without manual or robotic scrubbing. The foam is created by mixing a commercially available alkaline jet-engine cleaner with a foam stabilizer and water. The mixture is pumped through a low-pressure nozzle onto the walls of the cell, allowed to soak for 30 to 60 minutes, and rinsed off with clean water. Repeated applications may be performed. Because the foam does not require a precise methodical application method, the existing B-Cell manipulator arms are adequate to apply the foam.

Foam cleaners tend to blanket the surface contamination, minimizing recontamination from splashing. The foam is an effective means for removing loose surface contamination, but it does not remove significant amounts of fixed contamination. The alkaline chemicals should assist in removing the dangerous constituents. In decontamination chambers, hazard-

ous metals have been removed from stainless steel with alternating acid and alkaline baths. The major advantages of foam cleaning are its simplicity, low cost, and ease of application with existing manipulators.

Alkaline foam cleaning was used in the decontamination of C-Cell with excellent success. Decontamination factors as high as 3.6 were achieved on initial applications. After five applications, the decontamination factor fell to zero, primarily because the remaining contamination was fixed. A high/ultrahigh-pressure water wash removed the remaining contamination.

Secondary waste generated by low-pressure foam is a concern; however, utilization rates established in the cleanup of C-Cell show that only 14,023 L (3700 gal) of secondary waste will be generated. That waste will be contained, designated, and disposed of by approved pathways.

Alkaline foam cleaning will be followed by a more aggressive high/ultrahigh-pressure water-wash decontamination method to remove any remaining fixed contamination for final decontamination of B-Cell.

7.8.2 High/Ultrahigh-Pressure Water Wash

After the alkaline foam is used in B-Cell, the high/ultrahigh-pressure water wash will be used to remove the remaining contaminants. The term "high-pressure water wash" refers to water pressure greater than 100 psi. High-pressure water wash enhances the cleaning ability of the water by introducing a mechanical force to release the contaminants from the surface and flush them away. High-pressure water wash is effective for removing adhering or slightly embedded fixed contamination. A high/ultrahigh-pressure water-wash decontamination system manufactured by Admac (55,000 psi) is installed in B-Cell.

Abrasives may be used with high-pressure wash systems to improve performance. High- and ultrahigh-pressure wash for cleaning purposes may also use chemicals and hot solutions to clean surfaces. Use of abrasive chemicals or elevated temperature will be evaluated and incorporated if deemed necessary. If more aggressive cleaning is required, other methods described in the FSCC will be evaluated for use.

The high/ultrahigh-pressure water wash decontamination system manufactured by Admac was used for final decontamination of C-Cell and reduced radioactive contaminants from an average of 36,360 mrad/h to an average of 149 mrad/h.

Approximately 7959 L (2100 gal) of liquid will be collected, designated, and managed appropriately for each wash conducted in B-Cell.

7.9 SECONDARY WASTE MANAGEMENT

Secondary waste issues were addressed, in the FSCC, during the evaluation of each decontamination method. The Alkaline low-pressure foam followed by the high/ultrahigh-pressure wash will generate 14,023 and 7959 L (3700 and 2100 gal) of secondary waste, respectively. This secondary waste will be analyzed for the parameters in Table 7-2 and managed accordingly. If the secondary waste is designated as dangerous, it will be disposed of by an existing pathway that meets all applicable treatment or disposal requirements. Sampling (as described in Section 7.3) will be conducted following the cleaning process to determine the effectiveness of the cleaning procedure.

The sample analytical results will be evaluated to determine the disposal options for each waste stream. In general, secondary waste disposal will be based on the following criteria:

- If the material is a dangerous waste, it will be transported and disposed of offsite at a permitted TSD facility.
- If the material is not dangerous but a LLW, it will be disposed of onsite in the 200 Area (low-level burial grounds).
- If the material is a mixed waste, it will be transferred to the CWC for storage and eventual disposal as a solid waste.
- If the material is not dangerous and is not a LLW, it will be disposed of onsite in the 200 Area.

7.10 OTHER ACTIVITIES REQUIRED FOR CLOSURE

If a unit can not be clean closed and is closed with wastes in place, the unit will be monitored and maintained in accordance with the Postclosure Plan described in Chapter 8.

In addition, all equipment used during closure activities will be decontaminated and/or disposed of according to regulatory requirements.

7.11 SCHEDULE FOR CLOSURE

Closure of the 324 Building REC and HLV Tanks will begin upon notification by Ecology of Closure Plan approval. Closure will proceed according to the schedule presented in Figure 7-3.

Figure 7-3. Closure Schedule

7.12 EXTENSION FOR CLOSURE TIME

The planned closure period is expected to exceed 180 days because all decontamination and sampling activities must be performed remotely. Therefore, an extension for closure is requested.

7.13 AMENDMENT OF CLOSURE PLAN

The closure plan for the 324 Building REC and HLV Tanks will be amended whenever 1) changes in operating plans for facility design affect the closure plan, 2) the expected year of closure changes, 3) in conducting final closure activities, unexpected events require a modification of the closure plan. This plan may be amended any time before certification of final closure of the 324 Building REC and HLV Tanks.

If an amendment to the approved closure plan is required, DOE-RL will submit a written request to Ecology asking Ecology to authorize a change to the approved plan. The written request will include a copy of the closure-plan amendment in accordance with WAC 173-303-610(3).

7.14 CERTIFICATION OF CLOSURE AND SURVEY PLAT

7.14.1 Certification of Closure

Within 60 days of completing the closure activities in this plan, DOE-RL will submit a certification of closure to Ecology. The certification will be signed by both DOE-RL and an independent professional engineer registered in the State. Certification will state that the facility has been closed in accordance with the approved closure plan. The certification will be submitted by registered mail or an equivalent delivery service. Documentation supporting the closure certification will be retained and furnished to Ecology upon request. The DOE-RL will self-certify the certification of closure by signing a document containing the following verbiage or verbiage similar to the following.

I, the undersigned, the owner and operator of the 324 Building REC and HLV Tanks, hereby certify that I have reviewed the approved 324 Building REC and HLV Tanks Closure Plan and, to the best of my information and belief, all closure activities were performed in accordance with the specification identified in the approved closure plan. (Signature and date).

The DOE-RL will engage an independent professional engineer registered in the State of Washington to certify that the 324 Building REC and HLV Tanks have been closed in accordance with the approved closure plan. The DOE-RL will require the engineer to sign a document containing the following verbiage or verbiage similar to the following.

I, the undersigned, an independent registered professional engineer, hereby certify that I have reviewed the approved Closure Plan for the 324 Building REC and HLV Tanks and, to the best of my information and belief, all closure activities were performed in accordance with the specification identified in the approved closure plan. (Signature, date, professional engineer license number, business address, and telephone number).

7.14.2 Survey Plat

If clean closure is not attained, the owner or operator will submit to the local zoning authority, or to the authority with jurisdiction over local land use, a survey plat indicating the location and dimensions of the 324 Building REC and HLV Tanks. The EPA will also be provided with a survey plat. The plat will show the facility location with respect to permanently surveyed benchmarks and will be prepared and certified by a professional land surveyor. The plat will also contain a note, prominently displayed, stating the owner's obligation to restrict disturbance of the surveyed area.

8.0 POSTCLOSURE PLAN

This closure plan proposes clean closure for the 324 Building REC and HLV Tanks. However, if any of the 324 Building REC and HLV Tanks cannot be clean closed, or underlying concrete and soils have been contaminated by waste generated during past-practice operations, postclosure care will be required. Postclosure care for each dangerous waste unit subject to the requirements of WAC 173-303-610(1)(b) must begin after completion of closure of the unit and continue for 30 years after that date. Postclosure care must consist of at least groundwater monitoring and reporting and maintenance and monitoring of waste-containment systems. If clean closure of the REC or HLV units is not achieved, a post-closure plan will be developed.

9.0 BIBLIOGRAPHY

9.1 DOCUMENTS

- A.T. Kearney, Inc. 1994. *Mixed Waste Management Plan for the 324 Building Radiochemical Engineering Cells (REC) and Tank Vaults, Final Report*, Richland, Washington.
- American Society of Testing and Materials (ASTM). 1986. *Annual Book of ASTM Standards, Method D 3856, Section 11.5.4, Volume 11.01*, Philadelphia, Pennsylvania.
- Battelle Northwest Laboratory (BNWL). 1965. *Chemical and Materials Engineering Laboratory Operating Manual*. BNWL-MA-18, Battelle Northwest Laboratory, Richland, Washington.
- Bechtel Hanford. 1994. *300-FF-2 Operable Unit Technical Baseline Report*, BHI-00012, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.
- Bodson, F. 1992. *SG Tube Evaluation by Ultrasonic Testing*, Nucl. Plant J., September-October, 1992, pp. 96.
- Bond, W.R., J.N., Hartley, J.E. Mendel, J.L. McElroy, and R.J. Thompson. 1971. *Waste Solidification Program, Volume 8: Spray Solidification Performance During Final Radioactive Tests in Waste Solidification Engineering Prototypes*. BNWL-1583, Pacific Northwest Laboratory, Richland, Washington.
- Flores, E.A., J.T. Fulton, S.W. Gajewski, J.H. Jarrett, M.H. Schlender, W.A. Ross, and P.J. Weaver. 1994. *Radiochemical Engineering Cells and High Level Vault Tanks Mixed Waste Compliance Status*, PNL-10370, Pacific Northwest Laboratory, Richland, Washington.
- Hull, B., and J. Vernon. 1988. *Non-Destructive Testing*, Springer-Verlag, Inc., New York, New York.
- ICF, 1987, *RCRA Guidance Manual for Subpart G Closure and Post-Closure Care Standards and Subpart H Cost Estimating Requirements*, EPA/530-SW-87-010, ICF Incorporated, Washington, D.C.
- Jarrett, J.H. 1995. *B-Cell Cleanout Project Status Report*, Pacific Northwest Laboratory, Richland, Washington.
- Katayama, Y.B., L.K. Holton, Jr., G.N. Buck, J.F. Hutchens, and M.S. Culverhouse. 1990. *Advance Remote Decontamination Techniques Reduce Costs and Radiation Doses*, Pacific Northwest Laboratory, Richland, Washington.

- 1 McElroy, J.L., J.N. Hartley, M.R. Schwab, R.J. Thompson, and R.F. Drager. 1971.
2 *Waste Solidification Program, Volume 7: Phosphate Glass Solidification Performance During*
3 *Final Radioactive Tests in Waste Solidification Engineering Prototypes.* BNWL-1541,
4 Battelle Northwest Laboratory, Richland, Washington.
- 5
6 McElroy, J.L., K.J. Schneider, J.N. Hartley, J.E. Mendel, G.L. Richardson, R.W. McKee,
7 and A.G. Blasewitz. 1972. *Waste Solidification Program Summary Report, Volume 11:*
8 *Evaluation of WSEP High Level Waste Solidification Processes.* BNWL-1667, Battelle
9 Northwest Laboratory, Richland, Washington.
- 10
11 Pacific Northwest Laboratory (PNL). 1993. *Technical Program Plan (TPP) For The 324*
12 *and 325 Building Hot Cell Restoration Program,* Richland, Washington.
- 13
14 Pacific Northwest Laboratory (PNL). 1994a. *324 Building Authorization Basis, Supplement*
15 *For B-Cell Holdup Material and Cleanout Operations,* Richland, Washington.
- 16
17 Pacific Northwest Laboratory (PNL). 1994b. *Safety Analysis Report For 324 Building,*
18 Richland, Washington.
- 19
20 Reece, W.D., S.D. Miller, and L. A. Sigalla. 1989. *Development of the WISE and*
21 *SIMPLE Codes for Estimating Radioactive Waste Inventory and Shielding.* NP-6226-CCML,
22 Electric Power Research Institute, Palo Alto, California.
- 23
24 Rey, G., ed. 1966. *Waste Solidification Engineering Prototypes Technical Manual.*
25 BNWL-MA-19, Battelle Northwest Laboratory, Richland, Washington.
- 26
27 Ross, W.A., M.C. Bierschbach, J.S. Dukelow, Jr., M.D. McKinney, and J.R. Young.
28 1995. *Selection and Evaluation of Alternatives Evaluation of Alternatives For The Removal*
29 *of Solid Remote-Handled Mixed Wastes From The 324 Building,* Pacific Northwest
30 Laboratory, Richland, Washington.
- 31
32 Science Applications International Corporation (SAIC). 1993. *Integrity Assessment Plan For*
33 *PNL 300 Area Radioactive Hazardous Waste Tank Systems, Final Report,* Richland,
34 Washington.
- 35
36 Scientific Ecology Group, Inc. (SEG). 1995. *Feasibility Study of Clean Closure of the*
37 *324 Building Radiochemical Engineering Cells and High Level Vault Tanks,* Richland,
38 Washington.
- 39
40 Surma, J.E. 1995. *Project Management Plan for Nuclear Facilities Management 300 Area*
41 *Compliance Program, 324 High Level Vault Interim Removal Action Project,* Pacific
42 Northwest Laboratory, Richland, Washington.
- 43

- 1 U.S. Department of Energy-Richland Field Office (DOE-RL). 1989. Draft Remedial
2 Investigation/Feasibility Study Work Plan for the 300-FF-5 Operable Unit, Hanford Site,
3 Richland, Washington, DOE/RL 89-14, Richland, Washington.
4
- 5 U.S. Department of Energy (DOE). 1994. *Decommissioning Handbook*, Office of
6 Environmental Restoration, Washington, D.C.
7
- 8 U.S. Department of Energy (DOE). 1995. *Hanford Site Waste Management Units Report*,
9 DOE/RL-88-30, Revision 4, Volumes 1 and 2, Richland, Washington.
10
- 11 U.S. Environmental Protection Agency (EPA). 1986. *Test Methods for Evaluating Solid*
12 *Waste - Physical/Chemical Methods*, SW-846, 3rd Edition, Office of Solid Waste and
13 Emergency Response, Washington, D.C.
14
- 15 U.S. Department of Energy-Richland Field Office (DOE-RL). 1989. *Draft Remedial*
16 *Investigation/Feasibility Study Work Plan for the 300-FF-5 Operable Unit, Hanford Site,*
17 *Richland, Washington*, DOE/RL 89-14, Richland, Washington.
18
- 19 U.S. Environmental Protection Agency (EPA). 1986. *Test Methods for Evaluating Solid*
20 *Waste - Physical/Chemical Methods*, SW-846, 3rd ed., Washington, D.C.
21
- 22 U.S. Environmental Protection Agency (EPA). 1987. *A Compendium of Superfund Field*
23 *Operation Methods*, EPA/540/P-87/001, Office of Emergency and Remedial Response,
Washington, D.C.
25
- 26 U.S. Environmental Protection Agency (EPA). 1995. *Guidance for Data Quality*
27 *Assessment*, EPA QA/G-9, Quality Assurance Management Staff, Washington, D.C.
28
- 29 Vargo, G.J., J.S. Durham, and L.W. Brackenbush. 1995. *Review of Alternative Residual*
30 *Contamination Guides For The 324 Building B-Cell Cleanout Project, Phase 1*, Pacific
31 Northwest Laboratory, Richland, Washington.
32
- 33 Washington State Department of Ecology (Ecology). 1994. *Guidance for Clean Closure of*
34 *Dangerous Waste Facilities*, Olympia, Washington.
35
- 36 Washington State Department of Ecology, U.S. Environmental Protection Agency, and
37 U.S. Department of Energy (Ecology, EPA, and DOE). 1992. *Hanford Federal Facility*
38 *Agreement and Consent Order*, Vol. 1 and 2, Olympia, Washington.
39
- 40 Washington State Department of Ecology, U.S. Environmental Protection Agency, and
41 U.S. Department of Energy (Ecology, EPA, and DOE). 1994. *Hanford Federal Facilities*
42 *Agreement and Consent Order*, Vol. 1 and 2, Olympia, Washington.
43
- 44 Washington State Department of Ecology (Ecology). 1994. *Guidance for Clean Closure of*
45 *Dangerous Waste Facilities*, #94-111, Olympia, Washington.

Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy (Ecology, EPA, and DOE). 1995. *Tentative Agreement on Facility Transition Tri-Party Agreement Negotiations*, Olympia, Washington.

Weaver, J.P. 1994. *324 Building REC & HLV Interim Waste Management Plan*, Pacific Northwest Laboratory, Richland, Washington.

Weaver, P.J. 1995. *Mixed Waste Analysis Plan for the Radiochemical Engineering Cells (REC) and High Level Vault Tanks (HLV)*, Pacific Northwest Laboratory, Richland, Washington.

Wheelwright, E.J., W.J. Bjorklund, L.M. Browne, G.H. Bryan, L.K. Holton, E.R. Irish, and D.H. Siemens. 1979. *Technical Summary: Nuclear Waste Vitrification Project*. PNL-3038, Pacific Northwest Laboratory, Richland, Washington.

9.2 CODE OF FEDERAL REGULATIONS

40 CFR 261, "Identification and Listing of Hazardous Waste," Title 40, *Code of Federal Regulations*, Part 261, as amended, U.S. Environmental Protection Agency, Washington, D.C.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Title 40, *Code of Federal Regulations*, Part 264, as amended, U.S. Environmental Protection Agency, Washington, D.C.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Title 40, *Code of Federal Regulations*, Part 265, as amended, U.S. Environmental Protection Agency, Washington, D.C.

40 CFR 268, "Land Disposal Restrictions," Title 40, *Code of Federal Regulations*, as amended, U.S. Environmental Protection Agency, Washington, D.C.

9.3 FEDERAL AND STATE ACTS

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, Public Law 96-510, 94 Stat. 2767, 42 USC 9601 et seq.

Resource Conservation and Recovery Act of 1976, as amended, Public Law 94-580, 90 Stat. 2795, 42 USC 6901 et seq.

1 **9.4 WASHINGTON ADMINISTRATIVE CODES**

2
3 WAC 173-303, *Dangerous Waste Regulations*, Washington State Department of Ecology,
4 Olympia, Washington.

5
6 WAC 173-340, *Model Toxics Control Act Cleanup Regulations*, as amended, Washington
7 State Department of Ecology, Olympia, Washington.

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