Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

DEC 20 2006

07-AMCP-0067

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton
Richland, Washington 99354

Mr. Nicholas Ceto, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Blvd., Suite 115
Richland, Washington 99352

Addressees:

TRANSMITTAL OF REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN FOR THE 221-U FACILITY, DOE/RL-2006-21, DRAFT A

The purpose of this letter is to transmit the Remedial Design/Remedial Action Work Plan for the 221-U Facility, DOE/RL-2006-21, Draft A, to the U.S. Environmental Protection Agency and the State of Washington Department of Ecology for review as a primary document under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement). Transmittal by December 31, 2006, fulfills a legal commitment made in Record of Decision (ROD), 221-U Facility (Canyon Disposition Initiative), Hanford Site, Washington. Tri-Party Agreement Section 9.2, provides a 45-day period for lead regulatory agency review and response to this work plan. As required by Tri-Party Agreement Section 11.6, this letter also transmits a draft Tri-Party Agreement change control form for the disposition of the 221-U Facility.

The subject plan depicts an initial remedial action approach to meet the ROD requirements; however, as the design progresses, the U.S. Department of Energy, Richland Operations Office will utilize the value engineering process to optimize the design to meet requirements and leverage available resources to achieve Hanford clean-up objectives efficiently. Changes will be managed in accordance with Section 3.2.1, Change Management, of the work plan.

If you have questions, please contact me, or your staff may contact Matt McCormick, Assistant Manager for the Central Plateau, on (509) 373-9971.

Sincerely,

Keith A. Klein
Manager

AMCP:KDL

Attachments

cc w/attachs:
G. Bohnee, NPT
S. Harris, CTUIR
R. Jim, YN
T. M. Martin, HAB
K. Niles, ODOE
Administrative Record
Environmental Portal

cc w/o attachs:
R. H. Engelmann, FHI
J. E. Hyatt, FHI
M. B. Lackey, FFS
R. E. Piippo, FHI
J. R. Robertson, FHI

ATTACHMENT 1

DOE/RL-2006-21
DRAFT A

Remedial Design/ Remedial Action Work Plan for the 221-U Facility

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

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2006-21
DRAFT A

Remedial Design/Remedial Action Work Plan for the 221-U Facility

Date Published
December 2006

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

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Release Approval 12/06/2006
Date

CONTENTS

CONTENTS (cont)

APPENDICES

FIGURES

TABLES

This page intentionally left blank.

TERMS

ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (also known as Superfund)
CDI	Canyon Disposition Initiative
COC	contaminants of concern
CPP	CERCLA past-practice
CTA	container transfer area
CWC	Central Waste Complex
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ET	evapotranspiration
HAMMER	Hazardous Materials Management and Emergency Response
HEPA	high-efficiency particulate air
MEI	maximally exposed individual
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
RAO	remedial action objective
RAG	remedial action goal
RCRA	*Resource Conservation and Recovery Act of 1976*
RD/RAWP	Remedial Design/Remedial Action Work Plan
RMA	radiological materials area
ROD	record of decision
RPP	RCRA past practice
SAP	sampling and analysis plan
SWITS	*Solid Waste Information and Tracking System*
TEDE	total effective dose equivalent
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and/or disposal (unit)
WBS	work breakdown structure
WIDS	*Waste Information Data System* database
WIPP	Waste Isolation Pilot Plant

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1993, Professional Publications, Inc., Belmont, California.

REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN FOR THE 221-U FACILITY

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Hanford Site is a 1,517-km^2 (586-mi^2) Federal Facility located in southeastern Washington along the Columbia River (Figure 1-1). The Hanford Site is situated north and west of the cities of Richland, Kennewick, and Pasco, an area commonly known as the Tri-Cities. The region includes the incorporated cities of Richland, Pasco, and Kennewick, as well as surrounding communities in Benton, Franklin, and Grant counties. The Hanford Site was established during World War II, as part of the Manhattan Project, to produce plutonium for nuclear weapons. From 1943 to 1990, the primary mission of the Hanford Site was the production of nuclear materials for national defense.

The 200 West Area is a DOE-controlled area of approximately 8.3 km^2 (3.2 mi^2) near the middle of the Hanford Site (Figure 1-1). The 200 West Area is about 8 km (5 mi) from the Columbia River and 11 km (6.8 mi) from the nearest Hanford Site boundary. The area contains waste management facilities and former irradiated-fuel reprocessing facilities. The 200 West Area is located on an elevated, flat area, often referred to as the Central Plateau. There are no wetlands or floodplains in the 200 West Area.

The U Plant Area occupies approximately 0.76 km^2 (0.3 mi^2) within the 200 West Area. The U Plant Area includes the 221-U Facility, ancillary (or support) structures adjacent to the 221-U Facility, underground pipelines, soil waste sites, and the groundwater underlying the area (Figure 1-2). The groundwater beneath the U Plant Area has elevated levels of nitrates, technetium-99, and uranium due to past liquid discharges from the U Plant Area facilities and other 200 Area facilities. Monitoring and remediation of groundwater located under the U Plant Area are being addressed by the *Record of Decision for the 200-UP-1 Interim Remedial Measure*, EPA/541/R-97/048 (EPA 1997).

The 221-U Building is a large, concrete structure nominally 247 m (810 ft) long, 20 m (66 ft) wide and 24 m (77 ft) high; approximately 9 m (30 ft) of this height is below grade. The concrete walls and floor range from approximately 0.9 to 2.7 m (3 to 9 ft) thick. One large room extends the entire length with galleries on the other side of a dividing wall from this room. Covered processing cells reside below the deck in the large room. Because the building has this long, expansive room, it often is referred to as a "canyon building." Figure 1-3 is a cross-sectional sketch of the building.

1.1 PURPOSE

The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) identifies the U Plant (a synonym for the 221-U Facility complex) as a Section 8.0 key facility. Section 8.0 describes the decommissioning process that must be undertaken for key facilities. During the disposition phase of decommissioning, a project design report is prepared for remedial design/remedial action activities. The project design report defines the project scope, schedule, and cost and provides descriptions of specific tasks required to reach the facility end state. The intent of the report is to identify the basis and provide direction for preparation of detailed work packages or procedures used for conducting the project tasks. Project design reports are not identified in the Tri-Party Agreement as primary documents; however, Section 8.7.3 of the Tri-Party Agreement states that the lead regulatory agency will have approval authority in part over the project design report to ensure consistency with the final decision document.

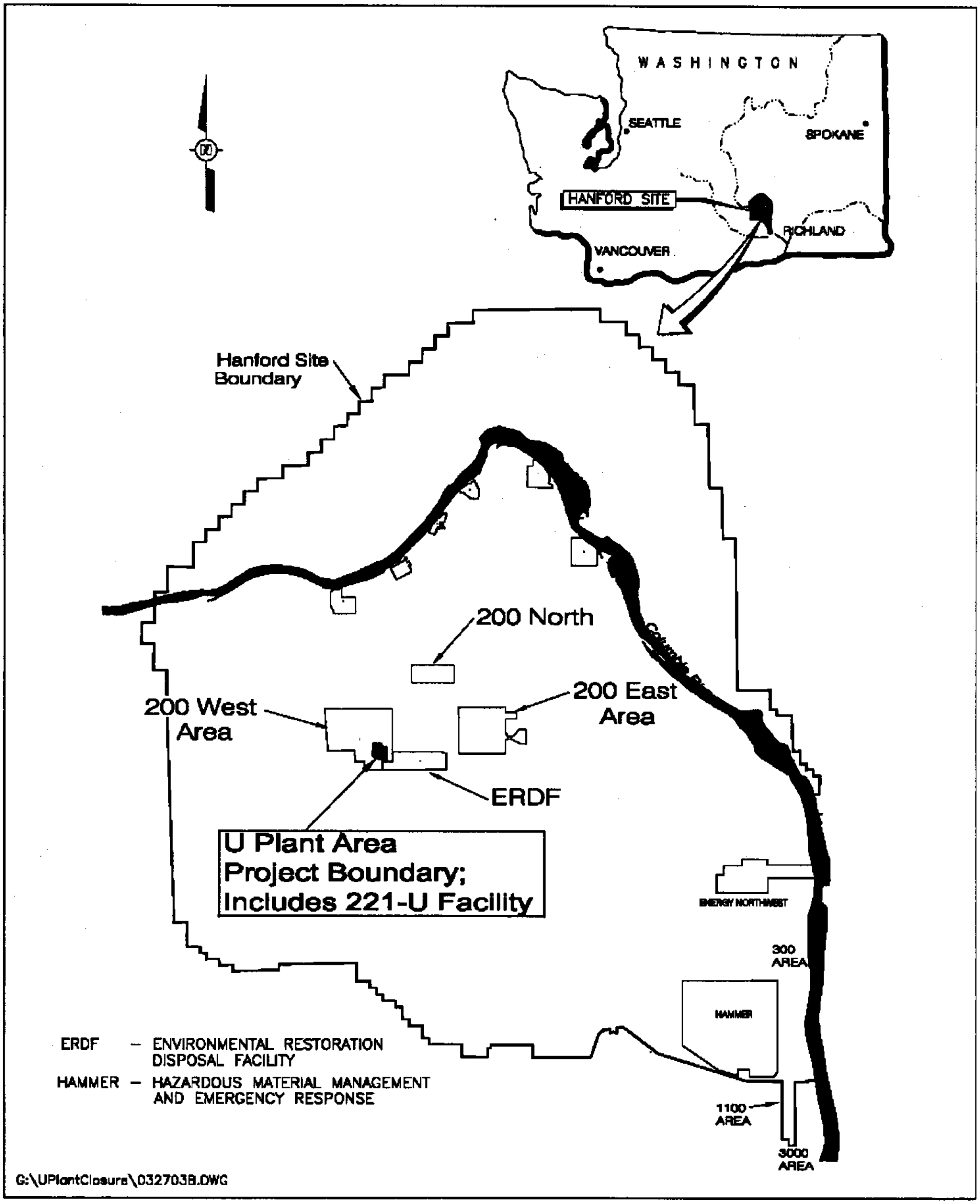

Figure 1-1. 200 East and 200 West Areas of the Hanford Site.

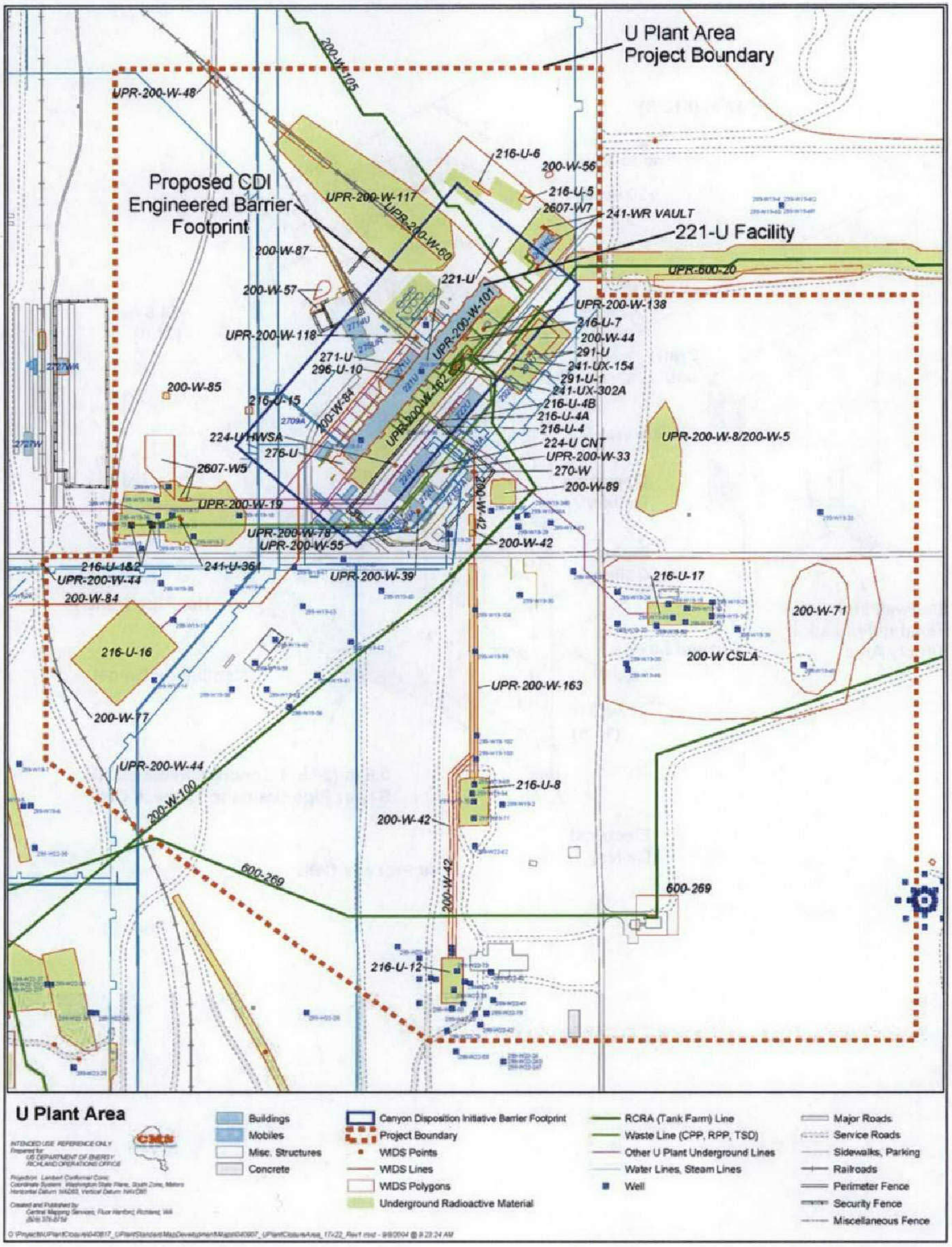

Figure 1-2. U Plant Closure Area.

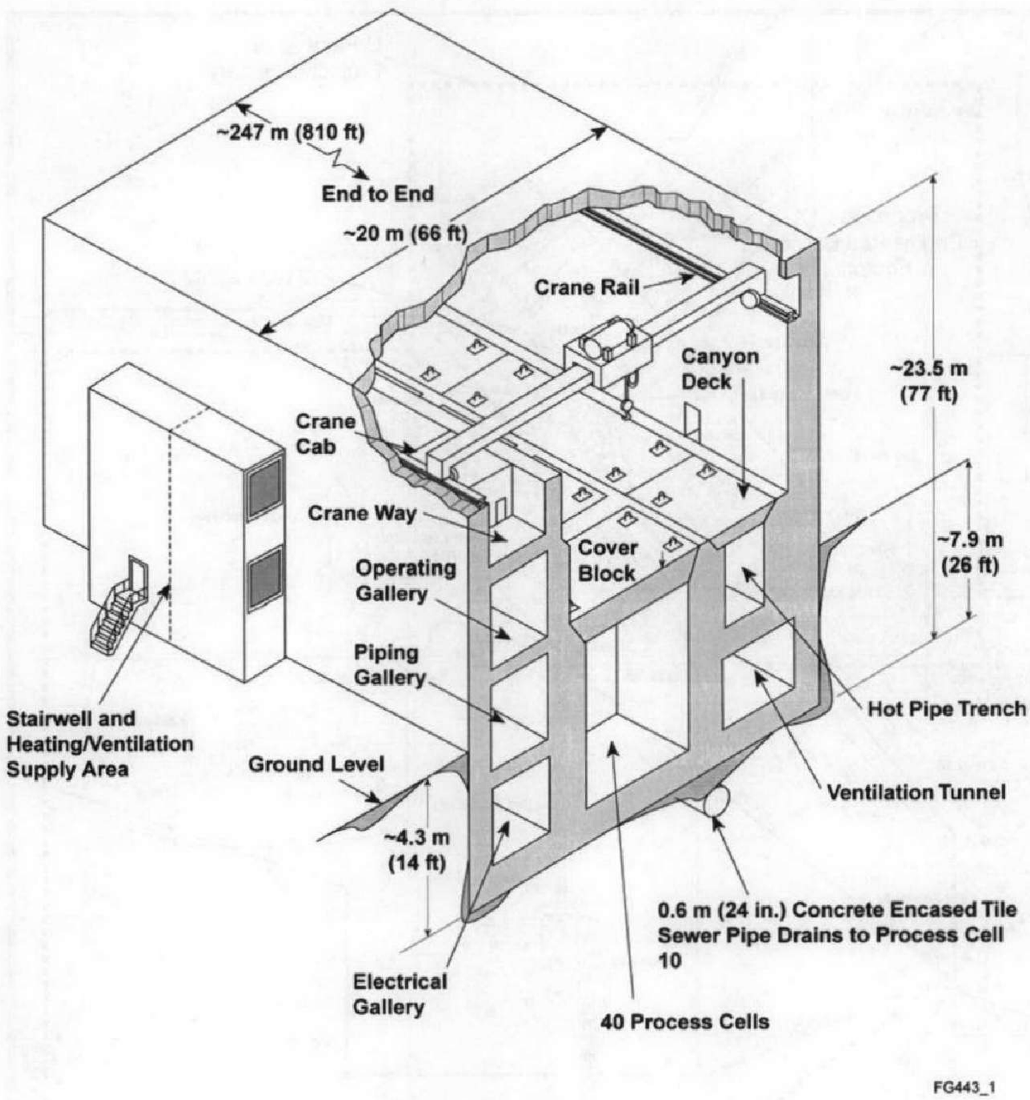

Figure 1-3. Cross Section of the 221-U Building.

Although U Plant is subject to these Section 8.0 requirements, the record of decision (ROD) for the 221-U Facility (*Record of Decision for the 221-U Facility (Canyon Disposition Initiative), Hanford Site, Washington* [EPA 2005]) contains a requirement that a remedial design/remedial action work plan (RD/RAWP) be developed for the facility. As noted in the ROD, the RD/RAWP is a primary document under the Tri-Party Agreement subject to U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) approval.

This RD/RAWP meets the intent of both the 221-U Facility ROD requirement for development of an RD/RAWP and the Tri-Party Agreement Section 8.0 requirement for the development of a project design report. Additionally, this RD/RAWP meets the requirements of Tri-Party Agreement Section 7.0 for preparation of an RD/RAWP.

This RD/RAWP describes the design and implementation of the remedial action process for remediation of the 221-U Facility pursuant to the ROD. The remedial design element of this document discusses the engineering phase during which technical drawings, specifications, and necessary supporting documents are developed to meet the remedial action objectives (RAO) identified in the ROD (EPA 2005). The remedial action element of this document addresses the construction or field implementation process (e.g., partial demolition of the structure, and engineered barrier construction).

1.2 SCOPE

This document discusses the remedial design and the remedial action associated with the 221-U Facility. A ROD (EPA 2005) was issued in October 2005, incorporating the actions and objectives outlined in the *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)* (DOE/RL-2001-29) (proposed plan). The ROD documents the selection of a final 221-U Facility remedial action pursuant to the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) process and based on information summarized in the *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE/RL-2001-11) (final feasibility study) and 221-U Facility Administrative Record.

The 221-U Facility final feasibility study addressed five alternatives for remedial action. The earlier Phase I feasibility study (DOE/RL-97-11) identified two additional alternatives that were not recommended for further study. These were Alternatives 2 (Decontaminate and Leave in Place) and 5 (Close in Place – Standing Structure), which were considered either not protective (Alternative 2) or not viable (Alternative 5). Only Alternatives 0 (as a baseline), 1, 3, 4, and 6 were carried forward into the final feasibility study and the proposed plan. These alternatives are as follows:

- Alternative 0: No Action
- Alternative 1: Full Removal and Disposal
- Alternative 3: Entombment with Internal Waste Disposal
- Alternative 4: Entombment with Internal/External Waste Disposal
- Alternative 6: Close in Place – Partially Demolished Structure.

The selected alternative for remediation of hazardous substances at the 221-U Facility is Alternative 6. Under the selected alternative, equipment on the canyon deck will be consolidated into the process cells and hot pipe trench; equipment, process cells, and other open areas will be filled with grout, the structure will be partially demolished, and the remaining structure will be buried under an engineered barrier.

The selection of Alternative 6 was based on the evaluation conducted in the final feasibility study (DOE/RL-2001-11) and the public review of the proposed plan (DOE/RL-2001-29). The selected remedy in the ROD includes the following components:

- Removal of waste from vessels and equipment in the facility that, if stabilized in place, would contain levels of transuranic isotopes greater than 100 nCi/g, in accordance with this RD/RAWP, and eventual disposal of that waste at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico

- Removal of liquids from the facility or treatment to remove liquids

- Partial removal of contaminated equipment and piping from the gallery side of the 221-U Building, as needed to facilitate demolition activities, and disposal of this waste at the Environmental Restoration Disposal Facility (ERDF) located on the Hanford Site's Central Plateau between the 200 West and 200 East Areas or other approved facilities

- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility

- Consolidation of contaminated equipment on the deck into the below-deck locations

- Grouting, to the maximum extent practical, of internal vessel spaces, as well as cell, gallery, pipe trench, drain header, and other spaces within the facility

- Demolition of the railroad tunnel, 271-U, 276-U, 291-U, and 292-U structures and the 291-U-1 and 296-U-10 stacks, and disposal of the resulting waste at the ERDF or other approved facilities, followed by stabilization of the former locations of these structures to support construction of the engineered barrier

- Removal of roof and wall sections of the 221-U Building down to approximately the deck level and placement on or near the deck

- Construction of an engineered barrier over the remnants of the canyon building (with the possible inclusion of minimally contaminated rubble, which does not contain hazardous waste, from the demolition of ancillary facilities as fill material)

- Planting of arid- and semiarid-adapted vegetation on the barrier to enhance evapotranspirative design of the barrier

- Institutional controls to ensure that the remedy is protected and changes in land use do not occur that could result in unacceptable exposures to residual contamination

- Postclosure care, including barrier inspection and maintenance

- Ongoing barrier performance and groundwater monitoring to ensure effectiveness of the remedial action and to support 5-year remedy reviews.

This RD/RAWP contains an estimated schedule for implementing the 221-U Facility remedial action. The cleanup work will be coordinated with other cleanup projects in the U Plant Area, as well as the 200 Area as a whole. The estimated schedule is consistent with the current Tri-Party Agreement milestone to complete 200 Area remedial actions by September 30, 2024 (Tri-Party Agreement Milestone M-16-00).

1.3 REPORT ORGANIZATION

Chapters 1.0 through 6.0, which comprise the main body of this report, provide the essential elements of this RD/RAWP. The contents of each chapter are briefly described in the following:

- Chapter 1.0, "Introduction," presents the purpose, scope, and description of the area, as well as an overview of the report's organization.

- Chapter 2.0, "Basis for Remedial Action," presents the RAOs and applicable or relevant and appropriate requirements (ARAR) relevant to the 221-U Facility remedial action.

- Chapter 3.0, "Remedial Action Management," presents the project team, cost and schedule, change management approach, remedial action planning (e.g., air emissions, health and safety), and site verification and closeout process for the selected alternative.

- Chapter 4.0, "Remedial Design Approach," presents the remedial design assumptions and design elements for the selected alternative.

- Chapter 5.0, "Remedial Action Approach," presents a summary of the demolition preparation, facility demolition, and surface barrier construction activities associated with the selected alternative.

- Chapter 6.0, "References," contains all reference information used for the main body of the report.

The appendices to this RD/RAWP present detailed discussions on a variety of issues associated with the remediation of the 221-U Facility and are as follows:

- Appendix A, "Guidance for Final Remedial Action Closure Report for the 221-U Facility"
- Appendix B, "Summary of Baseline Risk Assessment Methodology"
- Appendix C, "221-U Facility Public Involvement Plan"
- Appendix D, "Operations and Maintenance Plan Outline for the 221-U Facility."

This page intentionally left blank.

2.0 BASIS FOR REMEDIAL ACTION

This chapter describes the basis for the 221-U Facility remedial action (RAOs, cleanup levels, and ARARs). This chapter also provides a detailed description of the selected remedy.

2.1 JUSTIFICATION FOR THE REMEDIAL ACTION

The baseline risks of most of the 221-U Building constituents presented in Table 2-1 are greater than acceptable cancer risk levels (greater than the excess cancer risk range of 1×10^{-6} to 1×10^{-4}) and, for systemic toxicants, above acceptable exposure levels that the human population, including sensitive subgroups, may be exposed without adverse effect. Therefore, remedial action is necessary. A summary of the baseline risk assessment methodology is presented in the final feasibility study (DOE/RL-2001-11) and is incorporated as Appendix B of this RD/RAWP. Materials contaminated by these constituents include concrete, metallic waste, containerized materials, and miscellaneous debris currently contained within the structure of the 221-U Building. As the structure degrades with time, the risk of chemical or radiological release from the 221-U Building increases. Decreased structural stability would increase the potential for contaminant release due to man-made and natural disasters (e.g., earthquake). Additionally, infiltration of precipitation into the facility would eventually release contamination to the environment and potentially expose humans and biota to contaminants at the surface through direct exposure and through uptake of contaminated groundwater.

The response action selected in the ROD (EPA 2005) is necessary to protect human health and the environment from actual or threatened releases of hazardous substances. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

2.2 REMEDIAL ACTION OBJECTIVES AND CLEANUP LEVELS

The following sections discuss the RAOs, preliminary remediation goals (PRG), and remedial action goals (RAG) based on the ROD (EPA 2005). The RAOs are objectives for protecting human health and the environment. They were developed considering future land use, contaminants of concern (COC), ARARs, and potential exposure pathways. The PRGs provide a numerical interpretation of the RAOs, and for the purposes of this document, are considered synonymous with the term "cleanup level."

2.2.1 Remedial Action Objectives

RAOs for the 221-U Facility were developed based on protection of human health given the reasonably anticipated future land use and the conceptual site model, protection of the environment, protection of groundwater as a potential future drinking water source, protection of the Columbia River, ARARs, and worker safety.

The RAOs developed for the 221-U Facility are designed to be consistent with those developed for other components of the U Plant Area cleanup. They are as follows:

- **RAO 1:** Prevent unacceptable health and occupational risks to workers from physical, chemical, and radiological hazards posed by the 221-U Facility.

- **RAO 2:** Prevent unacceptable risk to human health, ecological receptors, or natural resources associated with external exposure to, ingestion of, inhalation of, and dermal contact with 221-U Facility contents at levels that exceed ARARs or risk-based criteria.

Table 2-1. Representative Baseline Risks of 221-U Facility Contaminants.

Contaminant	95% UCL of Contaminant Concentrations[a]		Human-Health Risk[b] (Industrial Scenario)
Nonradionuclides			
Antimony	2.96 +/– 0.14	mg/kg	HI = 0.07 +/– 0.02
Arsenic	50.3 +/– 23.3	mg/kg	HI = 2 +/– 1; ICR = 7.6×10^{-5} +/– 3.5×10^{-5}
Barium	387 +/– 196	mg/kg	HI = 0.07 +/– 0.04
Cadmium	5.54 +/– 0.33	mg/kg	HI = 0.33 +/– 0.01; ICR = 1.7×10^{-4} +/– 3.5×10^{-5}
Chromium	2,100 +/– 349	mg/kg	HI = 0.018 +/– 0.003
Lead	1,140 +/– 125	mg/kg	Not applicable[c]
Mercury	1,190 +/– 117	mg/kg	HI = 50 +/– 5
Selenium	0.225 +/– 0.053	mg/kg	HI = 0.0006 +/– 0.0001
Silver	24.7 +/– 1.9	mg/kg	HI = 0.062 +/– 0.005
Uranium	8,260 +/– 1,400	mg/kg	HI = 34 +/– 6
			HQ = 87 +/– 12
			Total ICR = 2.5×10^{-4} +/– 0.7×10^{-4}
Radionuclides			
Americium–241	$6.4 \times 10^{+6}$ +/– $3.1 \times 10^{+6}$	pCi/g	ICR > 10^{-2}
Cesium–137	$2.4 \times 10^{+8}$ +/– $0.4 \times 10^{+8}$	pCi/g	ICR > 10^{-2}
Cobalt–60	$9.4 \times 10^{+3}$ +/– $1.4 \times 10^{+3}$	pCi/g	ICR > 10^{-2}
Europium–154	$3.3 \times 10^{+5}$ +/– $0.9 \times 10^{+5}$	pCi/g	ICR > 10^{-2}
Neptunium–237	$7.1 \times 10^{+4}$ +/– $4.6 \times 10^{+4}$	pCi/g	ICR > 10^{-2}
Plutonium–238	$5.4 \times 10^{+2}$ +/– $0.8 \times 10^{+2}$	pCi/g	ICR = 3.9×10^{-5} +/– 0.5×10^{-5}
Plutonium–239	$1.4 \times 10^{+7}$ +/– $0.3 \times 10^{+7}$	pCi/g	ICR > 10^{-2}
Plutonium–240	$3.3 \times 10^{+6}$ +/– $0.6 \times 10^{+6}$	pCi/g	ICR > 10^{-2}
Strontium–90	$2.3 \times 10^{+8}$ +/– $0.6 \times 10^{+8}$	pCi/g	ICR > 10^{-2}
Thorium–230	$1.1 \times 10^{+1}$ +/– $0.2 \times 10^{+1}$	pCi/g	ICR = 4.5×10^{-6} +/– 0.6×10^{-6}
Uranium–234	$6.1 \times 10^{+3}$ +/– $2.2 \times 10^{+3}$	pCi/g	ICR = 2.7×10^{-4} +/– 1×10^{-4}
Uranium–235	$6.0 \times 10^{+2}$ +/– $3.6 \times 10^{+2}$	pCi/g	ICR = 1.9×10^{-3} +/– 1.1×10^{-3}
Uranium–238	$4.0 \times 10^{+3}$ +/– $1.1 \times 10^{+3}$	pCi/g	ICR = 2.8×10^{-3} +/– 0.8×10^{-3}
			Total ICR > 10^{-2}

[a] 95% UCL values for individual contaminants are calculated as described in *Statistical Guidance for Ecology Site Managers*, Ecology 92-54 (Ecology 1992). They were used to calculate risks as described in the *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE/RL-2001-11, Appendix A).
[b] Numerical values are not reported for risks greater than 10^{-2} because the linear equation for risk estimation is only valid for contaminant intakes resulting in calculated risks below 10^{-2}.
[c] Calculation of risk indices is not applicable to lead because lead is a neurotoxin with soil cleanup levels defined by the *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7-15-1 (EPA 1994).

>	=	greater than.
HI	=	hazard index.
HQ	=	hazard quotient = sum of hazard indices.
ICR	=	incremental cancer risk.
mg/kg	=	milligram per kilogram.
pCi/g	=	picocurie per gram..
UCL	=	upper confidence limit.

- **RAO 3:** Prevent the migration of contaminants to surface water and through the soil column to groundwater such that no further degradation of groundwater occurs due to leaching from the 221-U Facility.[1]

- **RAO 4:** Minimize physical, ecological, or cultural impacts caused by remediation of the 221-U Facility or by use of the 221-U Facility as a disposal facility.

2.2.2 Cleanup Levels for the 221-U Facility

Based on historical 200 Area operations and characterization information, a comprehensive list of potential contaminants was identified for the 221-U Facility. An initial set of contaminant-specific cleanup levels, or PRGs, was developed to define the specific cleanup goals that will result in achievement of the remedial action objectives. Each of the remedial alternatives discussed in the final feasibility study was evaluated against these PRGs as a part of the CERCLA decision-making process.

2.2.3 Remedial Action Goals

Generally, CERCLA RODs establish RAGs for the selected alternative based on the PRGs identified in the supporting feasibility study. However, the selected remedy for the 221-U Building did not establish RAGs. When a remedy is established that leaves contamination in place, the remedy is not based on cleaning up to RAGs, but rather on containing the contamination in such a fashion that it presents an acceptable level of risk to human health and the environment.

2.3 SELECTED REMEDY

Six different alternatives were evaluated for the remediation of the 221-U Facility, as documented in the 221-U Facility final feasibility study. The Tri-Parties (DOE, EPA, and Ecology) selected Alternative 6, Close In Place – Partially Demolished Structure, for implementation, as documented in the 221-U Facility ROD. The rationale for the selection and a summary of the construction component of the remedy are provided in Sections 2.3.1 and 2.3.2.

2.3.1 Summary of the Rationale for the Selected Remedy

The Tri-Parties selected Alternative 6 as the most appropriate remedial alternative based on the following.

- Alternative 6 satisfies the CERCLA threshold criteria.

- Alternative 6 represents the best balance of tradeoffs with respect to the CERCLA balancing and modifying criteria. In particular, Alternative 6 is more protective of remedial action workers and provides somewhat greater long-term effectiveness and permanence when compared to Alternative 1. It also provides somewhat greater long-term effectiveness and permanence than Alternatives 3 and 4 at a lower cost.

- Alternative 6 satisfies the statutory requirements as outlined by Section 121 of CERCLA.

[1] Protection of the Columbia River is achieved through protection of the groundwater. The 200 West Area is about 8 km (5 mi) from the Columbia River, and there is no surface water in the immediate vicinity of the 221-U Facility.

Other benefits that the selected remedy provides include the following.

- Alternative 6 is consistent with the anticipated future use of the 200 Area at the Hanford Site (i.e., industrial).
- Alternative 6 is consistent with the overall cleanup approach for the 200 Area at the Hanford Site, as embodied in the Tri-Party Agreement and past waste management decisions in the 200 Area (i.e., permanent disposal of remediation waste in the Hanford Site Central Plateau Core Zone).

2.3.2 Description of the Construction Component of the Selected Remedy

In accordance with the 221-U Facility ROD, the selected remedy for the 221-U Facility includes four primary components: demolition and barrier construction (the "construction" component), post-remediation care and environmental monitoring, institutional controls, and 5-year review. During the first component, the selected remedy will result in the treatment and encapsulation of wastes within the grouted, concrete structure of the lower portion of the canyon. The roof and upper walls of the canyon then will be demolished to approximately deck level, and the remains will be covered by a protective engineered barrier.

The construction component will consist of the following activities.

- Residual materials that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as the contents of a tank in process cell 30) will be removed and dispositioned prior to stabilization in accordance with the approved RD/RAWP. The material would be sent to the Hanford Site Central Waste Complex (CWC) for interim storage. This waste ultimately will be shipped to WIPP no later than September 30, 2024. Additional transuranic waste discovered during remedial activities will be removed and stored at the CWC and disposed of off the Hanford Site no later than September 30, 2024.
- Facility modifications will be made as necessary to support equipment removal and remediation activities. Such activities may include partial removal of contaminated equipment and piping from the gallery side of the 221-U Facility, cutting access openings into the canyon, refurbishment of the 221-U Facility roof covering (versus the underlying roof structure), refurbishment of railroad tunnel doors, and upgrades to the ventilation system to support work that will be performed within the facility as a part of the remedial action. Surface contamination will be addressed during these activities, as required.
- Demolition of attached structures (railroad tunnel, 276-U, 271-U, and the 296-U-10 stack) and impacted ancillary structures (291-U, 292-U, and the 291-U-1 stack) will be completed. The locations will be stabilized to support construction of the engineered barrier after removal of these structures. Dust and fugitive emissions associated with these actions will be controlled, such as by application of fixatives or spraying with water. Activities associated with this remedial action will not result in radioactive emissions that are greater than those reasonably achievable, and will not cause the total offsite dose resulting from Hanford Site emissions to exceed 10 mrem/yr. Details regarding emissions controls and monitoring can be found in Chapter 3.0 of this RD/RAWP.
- Existing contaminated equipment from the canyon deck will be size-reduced as necessary within the 221-U Facility and lowered into the process cells and hot pipe trench. However, size reduction activities will be minimized to the extent possible to limit worker exposure to contaminants.

- Cementitious grout will be pumped into the galleries, ventilation tunnel, cell drain header, process cells, and tanks containing residual materials to the maximum extent practical, to minimize the potential for void spaces and to reduce the mobility, solubility, and/or toxicity of the grouted waste. Grout amendments, such as fly ash or zeolite clays, and the cost-benefit of using a soil-cement grout mixture will be considered during final design for grouting activities to reduce the potential for leaching of radioactive isotopes, while maintaining desirable properties of Portland cement (e.g., a flowable, structural grout with good compressive strength).

- Waste generated during building preparation for demolition and from demolition of attached and impacted ancillary structures will be disposed of at the ERDF or other approved disposal locations. Minimally contaminated rubble, which does not contain hazardous waste, from other nearby CERCLA demolition activities, such as the ancillary structures, will be considered during remedial design for use as fill material in the engineered barrier.

- Surface contamination on the canyon walls, deck, and ceiling will be addressed (e.g., sprayed with fixatives) prior to initiation of canyon demolition activities. The upper part of the 221-U Facility will be demolished to approximately the level of the canyon deck. The concrete debris from building demolition will be placed on the canyon deck underneath the engineered barrier. Rubble or wall and ceiling sections that are minimally contaminated and do not contain dangerous waste may be used as fill alongside the canyon substructure under the barrier to limit impacts on soil borrow areas. Figure 2-1 shows a cross section of the facility prior to engineered barrier placement.

- The partially demolished building and concrete debris will be covered with an engineered barrier. See Figure 2-2 for an illustration of the extent of the engineered barrier. The footprint of the engineered barrier could be adjusted slightly to accommodate requirements for the remediation of nearby facilities, waste sites, and pipelines, as necessary. For example, coverage by the 221-U Facility engineered barrier also could be the preferred remedy for some facilities, waste sites, or pipelines as part of other ongoing CERCLA actions in the U Plant Area. For more detail, see the *Focused Feasibility Study for the 200-UW-1 Operable Unit* (DOE/RL-2003-23) and *Proposed Plan for the 200-UW-1 Operable Unit* (DOE/RL-2003-24). The main components of a sample engineered barrier are illustrated in Figure 2-3. The specific 221-U Facility engineered barrier design and layout would be developed during remedial design.

- The remedial design shall minimize maintenance and reconstruction needs, and the barrier will be designed to minimize the potential for earthquake-induced deformations and to provide long-term containment and protection of the waste from water infiltration for a performance period of at least 500 years. Additionally, the engineered barrier shall be designed to prevent recharge rates greater than 3.2 mm/yr (long-term average) to ensure the remedy is protective of groundwater and the Columbia River.

- Application of water spray and fixatives and minimizing the size of spoils piles will be used to control dust associated with engineered barrier construction.

When complete, the top of the engineered barrier will be seeded along with reseeding the disturbed areas in the vicinity of the 221-U Facility. Seeding of the barrier will be conducted to stabilize barrier materials and improve evapotranspiration (ET) rates, which will reduce barrier recharge rates. Reseeding of adjacent disturbed areas will be for surface stabilization and for reclamation purposes consistent with the expected future industrial land use. Seed selection will be based on multiple factors including native vegetation suited to soil type, fire resistance, moderately deep-rooted, and plants useful to Native Americans.

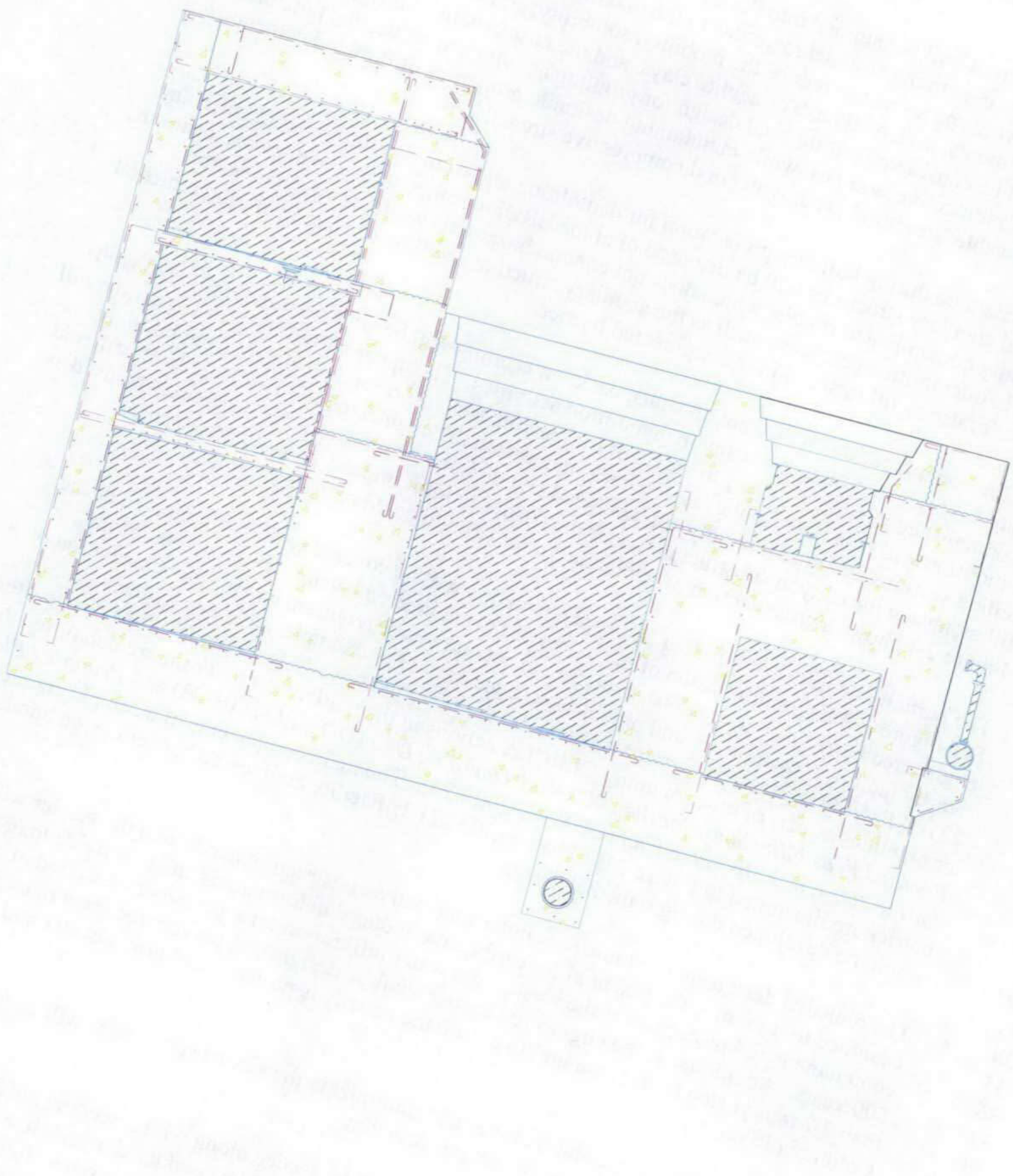

Figure 2-1. Cross Section of the Partially Demolished 221-U Building.

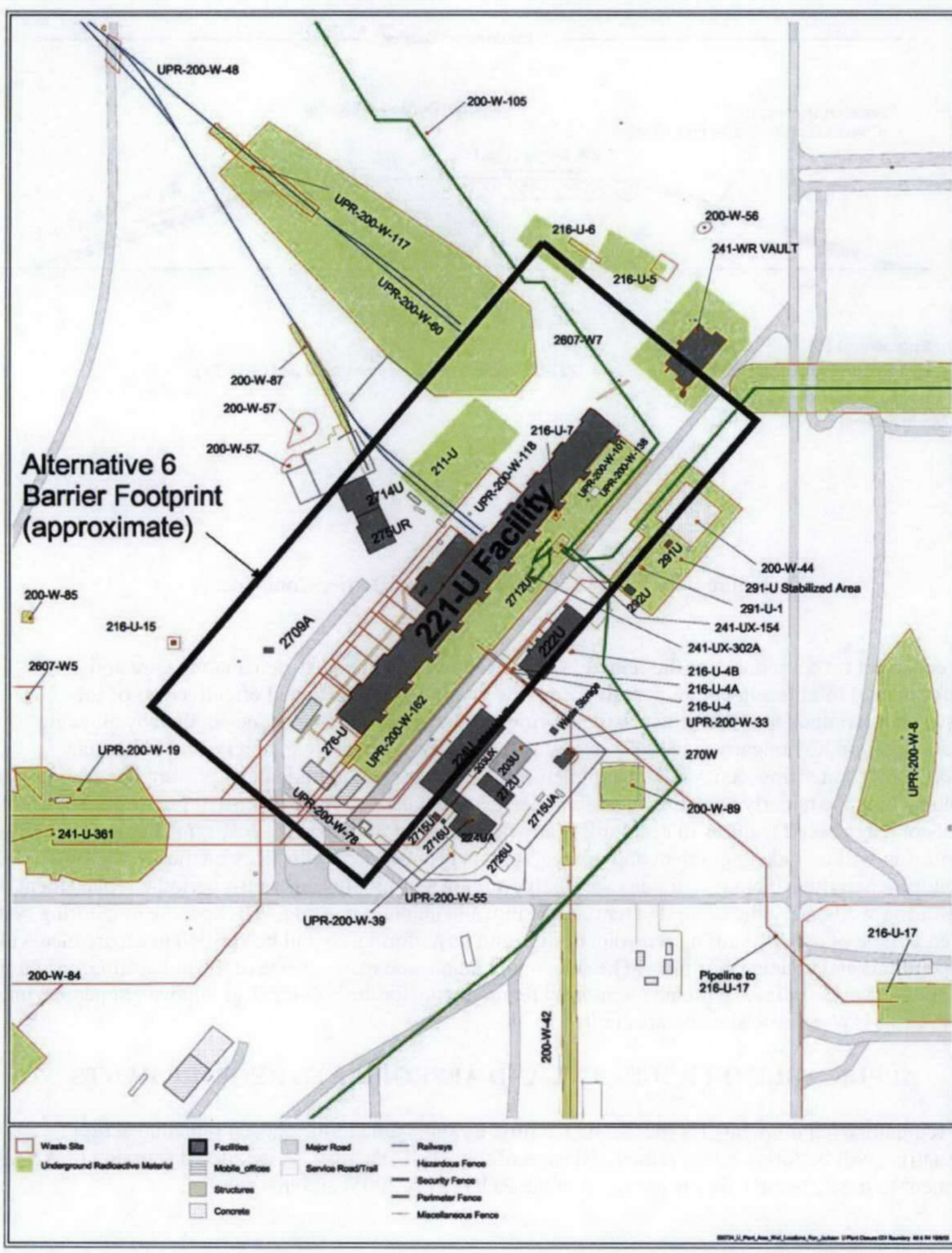

Figure 2-2. Approximate Footprint of the Engineered Surface Barrier for the Selected Remedy.

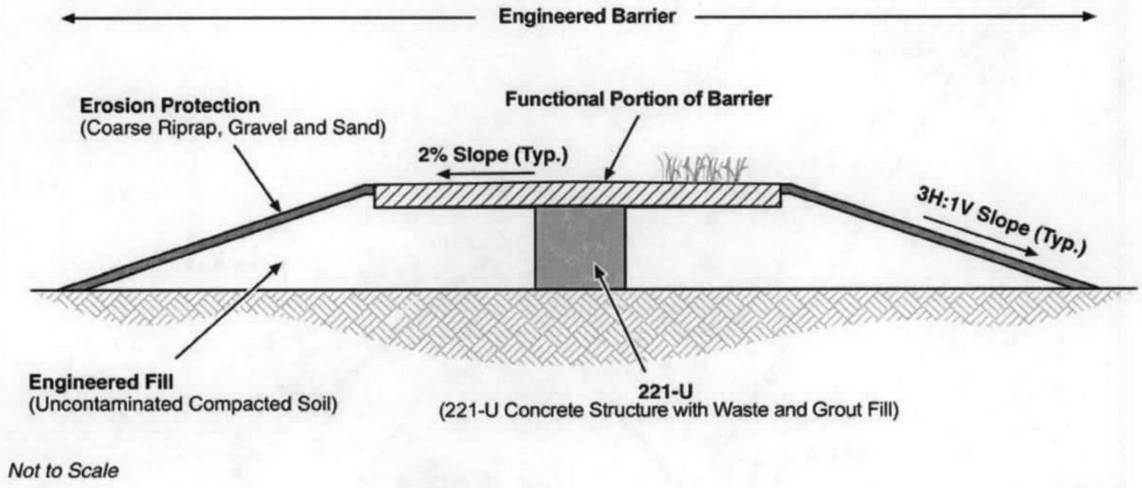

Figure 2-3. 221-U Facility Engineered Barrier Components.

The construction component of the remedy will be followed by the post-remediation care and environmental monitoring component to ensure the continued integrity and effectiveness of the construction component. Performance monitoring of the barrier will be conducted, thereby allowing various appropriate mitigative measures or best management practices (e.g., thickening of barrier, run-on/runoff water flow controls) to be implemented, if necessary, to mitigate or prevent percolating water from reaching the underlying waste. The final design of the engineered barrier will provide the specific details on engineered features to accomplish any performance monitoring. Post-remediation groundwater monitoring will include upgradient and downgradient groundwater wells. Key elements of groundwater monitoring activities include maintenance of all groundwater monitoring wells, periodic replacement of monitoring wells, periodic groundwater monitoring, and annual reporting. The specific monitoring system design will be established during remedial design, and its performance will be verified in accordance with an operations and maintenance plan. The design, operation, and maintenance of the monitoring system will be optimized to coordinate with the monitoring requirements for the 200-UP-1 groundwater operable unit and the 200-UW-1 waste site operable unit.

2.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The regulatory requirements for the 221-U Facility, as applicable to the chosen remedial action alternative, will be followed for remedial design of the 221-U Facility. A detailed discussion of ARARs pertinent to the 221-U Facility is provided in the ROD (EPA 2005) and in Table 2-2.

Table 2-2. ARARs for the Selected Remedy. (5 Pages)

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Safe Drinking Water Act of 1974, 42 USC 300 et seq.	National Primary Drinking Water Standards, 40 CFR 141, Subpart G	Relevant and appropriate	Establishes maximum contaminant levels for drinking water.	The selected remedy needs to ensure that migration of contaminants from the 221-U Facility to groundwater does not cause further degradation of the groundwater.
"Water Pollution Control/Water Resource Act of 1971," RCW 90.48 and RCW 90.54	"State Waste Discharge Permit Program," WAC 173-216	Relevant and appropriate	Identifies specific discharges prohibited under the program.	Relevant and appropriate to any stormwater discharged to an engineered structure as part of the selected remedy.
Clean Air Act Amendments of 1977, 42 USC 7401 et seq.	"National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," 40 CFR 61, Subpart H Specific subsections: 40 CFR 61.92 40 CFR 61.93	Applicable	Requires that emissions of radionuclides to the ambient air shall not exceed amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. Emissions from point sources shall be measured.	Applicable to the selected remedy because the 221-U Facility is a point source of radioactive emissions.
	"National Emission Standards for Asbestos, Standard for Demolition and Renovation," 40 CFR 61, Subpart M Specific subsections: 40 CFR 61.145(a)(1) 40 CFR 61.145(a)(5) 40 CFR 61.145(c) 40 CFR 61.150(a-c)	Applicable	Requires facilities to be inspected for the presence of asbestos prior to demolition; defines regulated asbestos-containing materials; and establishes removal, handling, and disposal requirements.	The selected remedy requires demolition of structural elements of the 221-U Facility that contain regulated asbestos-containing materials.
	"National Emission Standards for Asbestos, Standards for Active Waste Disposal Sites," 40 CFR 61, Subpart M Specific subsection: 40 CFR 61.154	Applicable	Establishes operating requirements for landfills that handle asbestos-containing wastes.	Applicable because of disposal of asbestos waste.
"Washington Clean Air Act of 1967," RCW 70.94 and RCW 43.21A	"Radiation Protection - Air Emissions," WAC 246-247 Specific subsections: WAC 246-247-040(3) WAC 246-247-040(4) WAC 246-247-075	Applicable	Requires emissions to be controlled to ensure that emission standards are not exceeded. Requires emissions from non-point and fugitive sources of airborne radioactive material to be measured.	Applicable because fugitive, diffuse, and/or point source emissions of radionuclides to the ambient air will result from implementation of the selected remedy.

Table 2-2. ARARs for the Selected Remedy. (5 Pages)

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
	"General Regulation for Air Pollution Sources," WAC 173-400 Specific subsection: WAC 173-400-040	Applicable	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.	Applicable to remedial actions at the site due to the generation of fugitive dust that will occur during demolition and other types of construction activities (e.g., construction of a barrier).
	Specific subsection: WAC 173-400-113	Applicable	Requires controls to minimize the release of air contaminants resulting from new or modified sources of regulated emissions. Emissions are to be minimized through application of best available control technology.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility acceptance requirements) that emits regulated air emissions. If such treatment is required, this requirement would be applicable.
	"Controls for New Sources of Toxic Air Pollutants," WAC 173-460 Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070	Applicable	Requires specific controls for new regulated air emissions.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility standards) that emits toxic air emissions. If such treatment is required, this requirement would be applicable.
Atomic Energy Act of 1954, as amended, 42 USC 2011 et seq.	"Licensing Requirements for the Land Disposal of Radioactive Waste," 10 CFR 61, Subparts C and D	Relevant and appropriate	Requires that radioactive waste disposal systems be designed to limit the annual dose equivalent beyond the facility boundary to specified values.	Relevant and appropriate to low-level waste left permanently onsite under the selected remedy.

Table 2-2. ARARs for the Selected Remedy. (5 Pages)

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Hazardous Waste Management Act of 1985," RCW 70.105	"Dangerous Waste Regulations," WAC 173-303 Specific subsections: WAC 173-303-016 WAC 173-303-017 WAC 173-303-070(3) WAC 173-303-073 WAC 173-303-077 WAC 173-303-170(3)	Applicable	Specifies how to identify dangerous waste. Establishes the management standards for solid wastes that are designated as dangerous or mixed wastes.	Applicable to identifying solid and dangerous wastes generated during 221-U Facility remedial actions. The management standards are applicable to the management and disposal of those wastes identified as dangerous/mixed waste.
	"Dangerous Waste Regulations," WAC 173-303 Specific subsection: WAC 173-303-140	Applicable or relevant and appropriate	Identifies dangerous wastes that are restricted from land disposal, describes requirements for state-only restricted wastes, and prohibits land disposal of restricted wastes unless treatment standards have been met. Incorporates Federal land disposal restrictions including provisions for treatability variances by reference.	Applicable to the disposal of dangerous and/or radioactive mixed waste that will be generated during implementation of the 221-U Facility selected remedy. They are ARARs to the in situ disposal of restricted waste pre-existing within the 221-U Facility. In accordance with the provisions of 40 CFR 268.44(h)(2)(i), "Land Disposal Restrictions," "Variance from a Treatment Standard," a treatability variance is granted for mercury associated with legacy waste in the facility.[a]
	"Dangerous Waste Regulations," WAC 173-303 Specific subsection: WAC 173-303-665	Applicable or relevant and appropriate	Specifies environmental performance standards, monitoring and testing, and postclosure care requirements for the disposal of waste in landfills.	The selected remedy will meet the alternative design standards of WAC 173-303-665(2)(j)(i) in lieu of the double liner and leachate collection and removal system provisions of WAC 173-303-665(2)(h) for waste disposed of within the 221-U Facility. A CERCLA ARAR waiver from the leachate detection provision of WAC 173-303-665(2)(j)(ii) is granted pursuant to 40 CFR 300.430(f)(1)(ii)(C)(3) because construction of a leachate detection system beneath the canyon is technically impracticable.[b]
"Solid Waste Management, Recovery, and Recycling Act of 1969," RCW 70.95	"Minimum Functional Standards for Solid Waste Handling" WAC 173-304 Specific subsections: WAC 173-304-190 WAC 173-304-200 WAC 173-304-460	Applicable	Establishes requirements for the management of solid waste.	Applicable to the onsite management and disposal of solid waste that will be generated during implementation of the selected remedy.

Table 2-2. ARARs for the Selected Remedy. (5 Pages)

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Toxic Substances Control Act of 1976, 15 USC 2601 et seq.	"Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," 40 CFR 761 Specific subsections: 40 CFR 761.50[b][7] 40 CFR 761.61[c]	Applicable	Identifies requirements applicable to the handling and disposal of PCB remediation waste, including PCB remediation waste that is also radioactive.	The risk-based disposal option of 40 CFR 761.61(c) has been selected, and EPA has determined that the selected remedy will not pose an unreasonable risk of injury to health or the environment.
"Water Well Construction," RCW 18.104	"Minimum Standards for Construction and Maintenance of Wells," WAC 173-160 "Rules and Regulations Governing the Licensing of Well Contractors and Operators," WAC 173-162	Applicable	Establishes minimum standards for design, construction, capping, sealing, and decommissioning of wells. Establishes qualifications for well contractors and operators.	Applicable to the installation of wells that will be required for groundwater monitoring.
Archeological and Historic Preservation Act of 1974, 16 USC 469a		Applicable	Requires that actions conducted at the site not cause the loss of any archeological and historic data. Mandates preservation of the data and does not require protection of the actual facility.	Archeological and historic sites have been identified within the 200 Area; therefore, substantive requirements of this standard are applicable to actions that might disturb these sites.
National Historic Preservation Act of 1966, 16 USC 470	"National Register of Historic Places," 36 CFR 60 Specific subsection: 36 CFR 60.4	Applicable	Requires that historically significant properties be protected and that agencies undertaking projects evaluate impacts to properties listed on or eligible for inclusion on the National Register of Historic Places. Establishes the criteria for evaluating properties for the National Register.	The 221-U Facility has been determined to be a contributing property to the Manhattan Historic District. Mitigation activities already have been completed, and no further action is required.

Table 2-2. ARARs for the Selected Remedy. (5 Pages)

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Endangered Species Act of 1973, 16 USC 1531 et seq., subsection 16 USC 1536[c]		Applicable	Prohibits actions by Federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect this resource.	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where remedial actions will occur.
Migratory Bird Treaty Act of 1918, 16 USC 703 et seq.	"Migratory Bird Treaty Act," 50 CFR 10-24	Applicable	Makes it illegal to pursue, hunt, take, capture, kill, possess, trade, or transport any migratory bird, part, nest, or egg included in the terms of the conventions between the United States and Great Britain, the United States and Mexico, and the United States and Japan.	Three species of birds protected under the "Migratory Bird Treaty Act" may nest on or near the 221-U Facility. If these bird species are impacted by the selected remedy, this act will be applicable. It is also applicable to endangered or threatened species that may be identified near borrow sites.
"Fish and Wildlife," RCW 77	"Department of Game Procedures," WAC 232-12	Relevant and appropriate	Defines the requirements that the Department of Game must take to protect endangered or threatened wildlife.	May be relevant and appropriate if endangered or threatened wildlife is identified near the 221-U Facility or borrow sites during wildlife surveys.

[a] The basis for the treatability variance is that it would be technically inappropriate to treat the mercury in the waste to the specified level or treatment standard due to (1) the location of the waste, (2) the risks to workers that would result from treating the waste to specified levels or standards, and (3) the planned alternative treatment that will be provided under the selected containment alternative.

[b] However, the engineered surface barrier that will be constructed will provide additional contaminant containment. This barrier will prevent or significantly limit the amount of water that can infiltrate into contaminated media, which, in turn, will reduce or eliminate leaching of contamination into the underlying vadose zone and groundwater. In addition, waste and debris in the facility will be grouted prior to barrier construction, providing an additional degree of protection against contaminant leaching. Performance monitoring of the barrier will be conducted to ensure that the barrier is performing as expected.

ARAR = applicable or relevant and appropriate requirement.
CERCLA = *Comprehensive Environmental Response, Compensation and Liability Act of 1980.*
EPA = U.S. Environmental Protection Agency.
PCB = polychlorinated biphenyl.

This page intentionally left blank.

3.0 REMEDIAL ACTION MANAGEMENT

Initiation of full-scale remedial action to accomplish the goals set forth in the 221-U Facility ROD will require completion of numerous interdependent tasks, which are illustrated in the schedule presented in Figure 3-1.

Remedial action management elements including the project team, cost and schedule, change management approach, remedial action planning, and site verification and closeout are described in the following sections.

3.1 PROJECT TEAM

The term "project team," in the strictest sense, means all individuals working to accomplish a particular project. According to this definition, there are numerous members of the project team. For the purpose of this discussion, the project team will be limited to the regulatory agencies, the DOE, and the contractor.

3.1.1 Regulatory Agencies

The EPA and Ecology are co-lead regulatory agencies for the CERCLA remediation activities at the 221-U Facility. The regulatory agencies are responsible for overseeing the activities to verify that applicable regulatory requirements are met.

3.1.2 U.S. Department of Energy

The DOE is the government agency responsible for the remedial actions throughout the 221-U Facility and the remaining Hanford Site and, as such, has assigned remedial project managers to each remediation project. DOE project managers are responsible for the management of their assigned activities, including scope, budget, schedule, and contracts. The DOE is the lead agency responsible for ensuring that all Federal and state ARARs are met during the remediation of the 221-U Facility.

3.1.3 Contractor

The contractor team is responsible for implementation of remedial actions in the Central Plateau area. Under the direction of the contractor manager of remedial action projects, project managers are assigned, consistent with the project management assignments of the DOE, to promote a single point-of-contact management philosophy. Each contractor project manager must develop, maintain, and oversee individual project teams. The project team will include all disciplines required to accomplish the remedial actions in a safe, efficient, and compliant manner.

3.2 PROJECT SCHEDULE AND COST

Schedule commitments associated with remediation of the 221-U Facility are shown in Figure 3-1. The cost estimate for implementation of the selected remedy is provided in Table 3-1. This estimate was prepared as part of the final feasibility study (DOE/RL-2001-11). The estimate was prepared with an accuracy of –30 percent to +50 percent to support evaluation of remedial alternatives and selection of a remedy. This cost estimate will be revised as remedial design progresses.

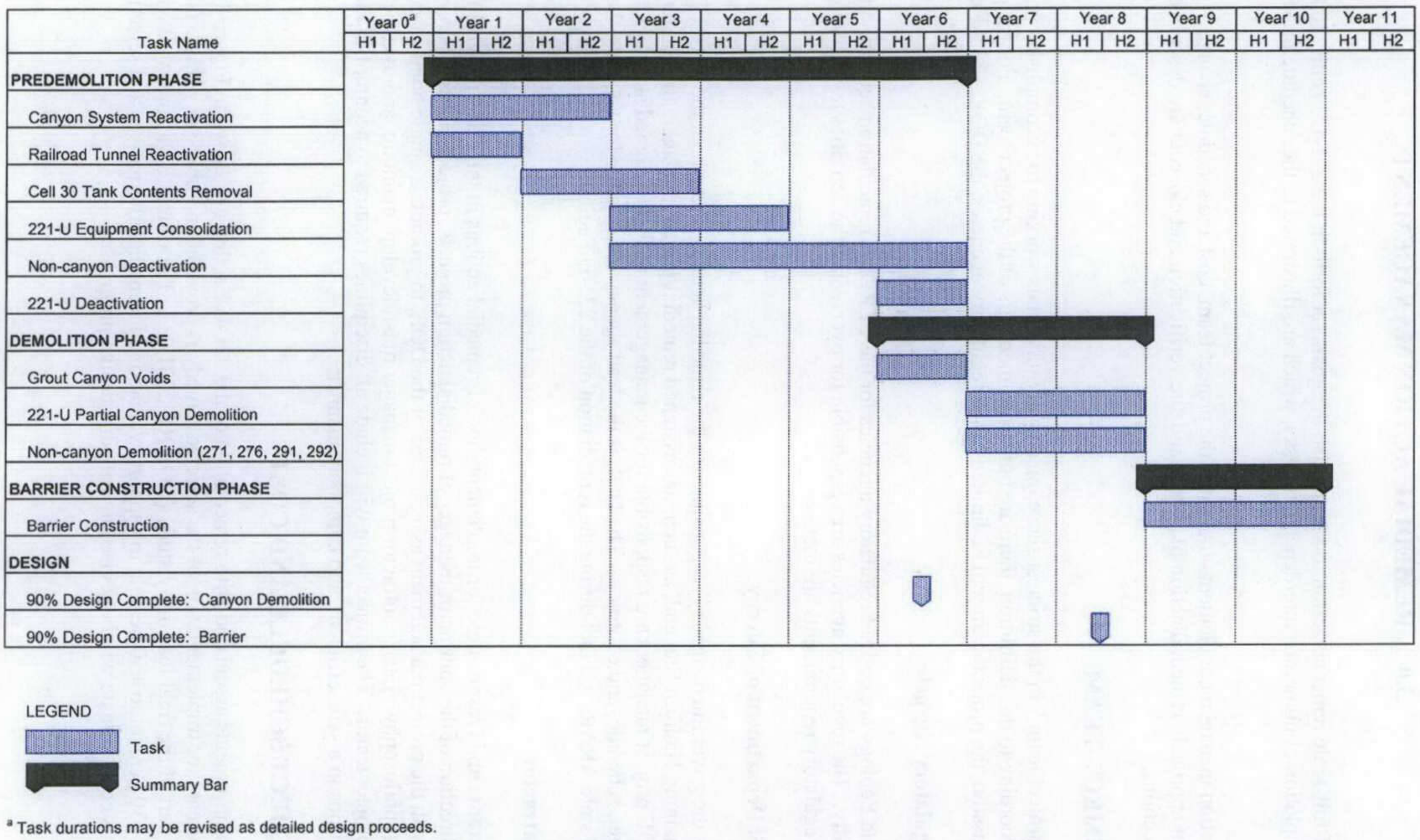

Figure 3-1. Schedule of Remedial Action Activities.

Table 3-1. 221-U Facility Remediation Total Project Cost Summary.

Project Phase	Dollar Amounts
Capital Cost Summary	
Predemolition Phase	
Assessment activities	700,000
Design activities	4,500,000
Removal of sludge and liquids from equipment	1,300,000
Establish infrastructure	1,600,000
Modify 221-U Facility	16,500,000
Disposition of external legacy structures	20,900,000
Disposition of waste sites within footprint	0
Demolition Phase	
Building demolition, removal, and disposal	10,700,000
Fill galleries with waste and grout	1,400,000
Fill operating deck area with waste and grout	0
Construct engineered clean fill	7,400,000
Construct external leachate collection system	0
Place external contaminated soil fill	0
Barrier Construction Phase	
Backfill 221-U Facility excavation void	0
Construct engineered barrier	4,100,000
Construct erosion protection on sideslopes	3,100,000
Revegetate	50,000
Closeout activities	200,000
Demobilization	50,000
Establish groundwater monitoring	300,000
Total capital costs (Undiscounted)	**72,800,000**
Operations and Maintenance Cost Summary	
Monitoring and inspections (Total)	49,000,000
Engineered barrier replacement (year 500 only)	4,100,000
Total Operations and Maintenance Cost (Undiscounted)	**53,100,000**
Overall Cost Summary	
Project Total Costs (Undiscounted)	**125,900,000**
Net Present-Worth Totals	**67,400,000**

NOTE: All cost estimates have an accuracy of −30% to +50%. Present-worth costs are based on a 3.2% real discount rate (*Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* [OMB Circular No. A-94, Appendix C]) and a 1,000-year period of performance. Total undiscounted costs are 2001 dollars for a 1,000-year period of analysis. All costs have been rounded.

Within the framework of the Tri-Party Agreement milestones and available funding levels, detailed working schedules are being developed for the 221-U Facility remedial action activities at several different levels, consistent with the project work breakdown structure (WBS). Near-term (less than 1 year) work is usually planned and scheduled at a detailed activity level, using logic ties to establish and maintain a true critical-path schedule. Logic-driven, critical-path schedules, commonly referred to as the critical-path method, are used to manage and control the daily progress of the work and provide early warning of problem areas. Higher level project schedules are periodically reviewed and updated to reflect progress as measured against the near-term critical-path schedules.

Detailed scope, schedule, and associated budgets are established at the project level in a lifecycle baseline for the contract period and outlying years. The baseline is updated periodically and typically outlines the planned scope, schedule, and budget for the contract period. The 221-U Facility baseline incorporates the scope, schedule, and budget to implement the selected 221-U Facility remedy.

3.2.1 Change Management

Three types of changes in the 221-U Facility remedial action could affect compliance with the requirements in the ROD: (1) a nonsignificant or minor change, (2) a significant change to a component of the remedy, and (3) a fundamental change to the overall remedy (*A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23P, EPA/540/R-98/031 [EPA 1998]).

A nonsignificant or minor change falls within the normal scope of changes occurring during the remedial design and remedial action processes. These types of changes usually arise during design and construction, when modifications are made to the functional specifications of the remedy to address issues such as performance optimization, new technical information, support agency/community concerns, and/or cost minimization (e.g., value engineering process). These changes may affect issues such as the type or cost of materials, equipment, facilities, services, and supplies used to implement the remedy. The change will not have a significant impact on the scope, performance, or cost of the remedy. These minor changes should be documented in the appropriate post-decision project file (e.g., through interoffice memoranda, log books). Nonsignificant changes will not impact the requirements of the ROD, nor will they impact the functional requirements. Examples of nonsignificant changes may include, but are not limited to, the following:

- The addition of waste sites or structures that are adjacent to and within the area required for the remediation addressed in the ROD

- Modifications to the remedial action schedule that do not impact agreed-upon milestones.

It may be determined that a significant change to the selected remedy as described in the ROD is necessary. A significant change generally involves a change to a component of a remedy that does not fundamentally alter the overall cleanup approach. These changes are defined as changes that significantly modify the scope, performance, or component cost for the remedy as presented in the ROD. All significant changes will be addressed in an explanation of significant difference. An example outline for an explanation of significant difference can be found in EPA/540/R-98/031, Section 7 (EPA 1998). Examples of significant changes may include, but are not limited to, the following:

- A significant increase or decrease in the total cost of site remediation (greater than +50 percent or more than –30 percent) addressed in the ROD

- A significant delay in the point in time when the remedial actions or objectives are met

- The addition of waste sites or structures for remediation in a manner that is consistent with the scope and role of action as described in the ROD.

A fundamental change is a change that does not meet the requirements set forth in the ROD or that incorporates remedial activities not defined in the scope of the ROD. These types of changes involve an appreciable change or changes in the scope, performance, and/or cost or may be a number of significant changes that together have the effect of a fundamental change. An example of a fundamental change is one that results in a reconsideration of the overall waste management approach selected in the original ROD. There are very few cases where there is a fundamental change to a ROD. However, should the situation arise, the ROD must be amended. Significant changes that fundamentally alter the remedy occur when the following situations arise:

- A final land use is defined that is not compatible with the ROD
- A change in the primary treatment method.

Determining the significance of the change is the responsibility of the DOE, EPA, and Ecology. The contractor project manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The contractor project manager will discuss the change with the DOE, and the DOE then will discuss the type of change that is necessary with the EPA and Ecology. Appropriate documentation will follow, in accordance with the requirements for that type of change.

3.3 REMEDIAL ACTION PLANNING

Post-ROD planning and scheduling for remediation projects follow a distinct pattern consistent with the work package level of the WBS. Planning elements at this level include development of the remedial design and solicitation of a remedial action contractor. Additional planning documentation includes, but is not limited to, field procedures, sampling and analysis plan, health and safety plan, technical specifications, safety analysis/hazard classification, and procurement documents. Some of the tiered planning documentation (e.g., site-specific investigations) may require approval by the lead regulatory agencies as specified in the Tri-Party Agreement. When reviews are required, the DOE will provide the documentation to the lead regulatory agencies for review and approval. Summary briefings and discussions may be held at unit managers' meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules, including those for procurement.

3.3.1 Field Procedures

Field procedures (e.g., sampling and industrial hygiene) provide guidance to site workers during field work execution. The procedures define the scope, operations, progression of field work, personnel control requirements, radiological posting requirements, and guidance on the analytical system. The procedures also provide contingency plans, should unexpected conditions arise. The field operations must be executed in compliance with these field procedures.

3.3.2 Sampling and Analysis Plans

The *Sampling and Analysis Plan for 221-U Facility* (DOE/RL-97-68) (SAP) provides direction for sampling to support waste characterization, worker health and safety, and site remediation. The SAP includes a quality assurance project plan that defines the strategy to control the quality and reliability of the analytical data and establish associated protocols for data management. Although the majority of the facility-specific sampling activities have been completed, additional facility characterization information may be required (e.g., characterization of process cells not previously accessed). Waste generated for disposal outside of the facility may also require characterization. Future sampling and analysis activities will be undertaken in compliance with the existing SAP (modified as necessary), or a new SAP will be prepared as needed.

3.3.3 Health and Safety Plan

The 221-U Facility health and safety plan is prepared in conjunction with the activity hazards classification. This plan provides guidance to all personnel on the site for health and safety concerns specific to the remediation site and action. All project field staff must comply with the health and safety plan at all times. All unescorted site visitors are required to read and sign the health and safety plan before they enter the construction area. Escorted visitors are briefed on health and safety concerns and must be escorted by the site superintendent or designee at all times when they are in the construction area.

3.3.4 Cultural and Natural Resources

A comprehensive archaeological resources review of the 200 Area conducted in 1987 and 1988 included an examination of a stratified random sample of the undisturbed portions of the 200 West Area. No significant surface archaeological sites were reported during that inventory. The only evaluated pre-Hanford historic site is the old White Bluffs freight road that crosses diagonally through the 200 West Area. The road, which originated as an Indian trail, has played a role in Native American migration as well as Euro-American immigration, development, agriculture, and Hanford Site operations. This property has been determined to be eligible for the National Register of Historic Places, although segments of the road that pass through the 200 West Area are considered to be noncontributing.

Manhattan Project and Cold War era buildings in the 200 East and 200 West Areas have been evaluated for National Register of Historic Places eligibility under the provisions of the *Programmatic Agreement Among the U.S. Department of Energy, Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington* (DOE/RL-96-77).

Fifty-eight properties have been determined eligible for the National Register as contributing properties within the Hanford Site Manhattan Project and Cold War Era Historic District and recommended for individual documentation. The 221-U Building was determined to be a contributing property within the Historic District, but was not selected for mitigation. Historic artifacts identified within the structure have been documented in photographs and selectively tagged for preservation. The list of 221-U Facility items tagged for removal and curation is as follows:

- CP0001-Exhaust Sand Filter Model for Emission Control (271-U basement)
- CP0005-Fluorescent lights (221-U, Section 11, Operating Gallery)
- CP0006-Enunciator Panel (221-U, Section 11, Operating Gallery)
- CP0008-Beckman Ionization Chamber (221-U, Section 13, Pipe Gallery).

The 222-U Laboratory/Office Building and the 241-WR Vault were the only properties selected for mitigation within the 221-U Facility complex. No items were tagged for removal from these structures; however, photographs were taken, and a narrative description was documented in accordance with the Historic District Treatment Plan (DOE/RL-97-56). The 222-U Laboratory/Office Building has been demolished under a separate CERCLA action.

3.3.5 Waste Management

Waste management activities will be performed for the 221-U Facility in accordance with the applicable ARARs identified in the ROD. The waste management requirements specified by the ARARs and other applicable guidance will be addressed in this section and in field procedures, as needed.

The selected remedy shall attain all waste management ARARs except for *Resource Conservation and Recovery Act of 1976* (RCRA) landfill minimum technological requirements for leak detection. In addition, RCRA land disposal restrictions and polychlorinated biphenyl (PCB) requirements shall be satisfied by meeting the substantive requirements for a treatability variance and a *Toxic Substances Control Act of 1976* risk-based determination for the management of PCBs as described below.

The WAC 173-303-665(2)(h), "Dangerous Waste Regulations," "Landfills," requires new landfills to have two or more liners and a leachate collection and removal system. Under WAC 173-303-665(2)(j), an alternative design can be used if the following criteria are met: The proposed alternative design and operation together with location characteristics will prevent the migration of any dangerous constituents into the groundwater or surface water at least as effectively as the liners and leachate collection and removal system; and the alternative design will allow detection of leaks of dangerous constituents through the top liner at least as effectively.

The in-place disposal of waste currently in the 221-U Facility under the selected remedy will not include liners and a leachate collection and removal system and will satisfy these RCRA landfill minimum technological requirements by satisfying and waiving part of the substantive requirements for an alternative design at WAC 173-303-665(2)(j). Waste will be grout-encapsulated within the canyon, and an engineered barrier will be constructed to provide additional contaminant containment. Modeling predicts that no contaminants will migrate out of the grout and concrete monolith and to groundwater within 1,000 years. Computer-aided modeling has been performed to demonstrate that, once encapsulated in grout and contained within the canyon structure, contaminants currently identified in the 221-U Facility will not migrate into the accessible environment including the soils around or under the facility for the duration considered for normal liner performance. This approach will prevent the migration of any dangerous constituents into the groundwater or surface water at least as effectively as the liners and leachate collection and removal system. Details of this demonstration are provided in the final feasibility study (DOE/RL-2001-11).

The in-place disposal of waste currently in the 221-U Facility under the selected remedy, however, will not satisfy WAC 173-303-665(2)(j)(ii) alternative landfill minimum requirements for leak detection. This requirement is being waived in accordance with 40 CFR 300.430(f)(1)(ii)(C)(3), "Remedial Investigation/Feasibility Study and Selection of Remedy," because, from an engineering standpoint, it is technically impracticable to construct a leak detection system beneath the canyon building. (The bottom of the structure is approximately 9 m [30 ft] below grade.) Again, modeling predicts that no contaminants will migrate out of the grout and concrete monolith and to groundwater within 1,000 years. Performance monitoring of the engineered barrier will allow for application of mitigative or preventative action (e.g., increasing barrier thickness) to impede water from reaching the underlying waste. Additionally, groundwater monitoring will be performed to monitor the effectiveness of the remedial action.

Land-disposal-restricted waste that will remain in the facility includes liquid and sludge that exhibits characteristics (primarily toxicity, such as for mercury or lead) that cause the waste to designate as dangerous waste. Under the selected remedy, in lieu of treatment pursuant to land disposal restriction provisions (e.g., to remove toxic characteristics or thermally treat mercury), alternative treatment will be provided to mitigate risk associated with disposal of this waste within the canyon. For disposal of waste currently located within the 221-U Facility, the selected remedy will satisfy RCRA land disposal restrictions by meeting substantive criteria for a treatability variance in accordance with

40 CFR 268.44(h)(2)(i), "Land Disposal Restrictions," "Variance from a Treatment Standard," because it will be technically inappropriate to treat mercury contained in sludge with the specified treatment method (incineration, retorting, or roasting) considering the limited incremental benefit when weighed against the significant increase in worker risk from radiological exposure. Under the selected remedy, alternative treatment (macroencapsulation with grout and ultimate containment within the 221-U Facility canyon structure) will be provided.

To meet *Toxic Substances Control Act of 1976* ARARs under the selected remedy, DOE will use the risk-based disposal option. EPA has made a risk-based determination for the purpose of demonstrating there is no unreasonable risk of injury to human health or the environment associated with the management and disposal of PCB remediation waste in the 221-U Facility, in accordance with the substantive requirements of 40 CFR 761.61(c), "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," "PCB Remediation Waste." The determination was based on the small amount of PCBs identified in the 221-U Facility, the low volatility of the PCBs, and the protectiveness that will be provided via macroencapsulation of the PCBs in grout and in the concrete monolith of the canyon structure.

3.3.5.1 Projected Waste Streams

One or more of the following waste streams may be generated by the 221-U Facility remedial action for disposal outside the structures being remediated. The waste streams may fall into any combination of the following categories: radioactive, mixed, hazardous, dangerous, suspect radioactive, suspect dangerous, suspect mixed, and nonregulated:

- Miscellaneous solid waste (e.g., piping, soil, concrete, rubber, glass, paper, personal protective equipment, cloth, plastic, metal)

- Decontamination fluids and tank fluids/heels

- Equipment and construction materials (such as hand and power tools and machinery, sampling equipment, decommissioning materials)

- Nondangerous/nonradiological solid waste (e.g., paper, wood, construction debris, metal, plastic, glass).

3.3.5.2 Waste Categories

Wastes will be separated into broad categories, as described in the following subsections. Depending on the levels of contamination encountered, some materials classified as contaminated may require special handling.

- Low-Level Waste will be defined as any radioactive waste not designated as spent fuel, high-level waste, or transuranic waste. The low-level waste will include step-off pad wastes, soft waste, material used in decontamination, process items that have been partially decontaminated, and waste packages. This low-level waste will be mainly solid in form, although some liquid and sludge waste may be generated during the project activities. Low-level waste removed from the structures being remediated will be shipped to the ERDF (Figure 1-1). This waste also may be packaged and temporarily placed in storage within the 221-U Facility Remedial Action Area prior to shipment. The tentatively identified configuration of this remedial action area is shown in Figure 3-2.

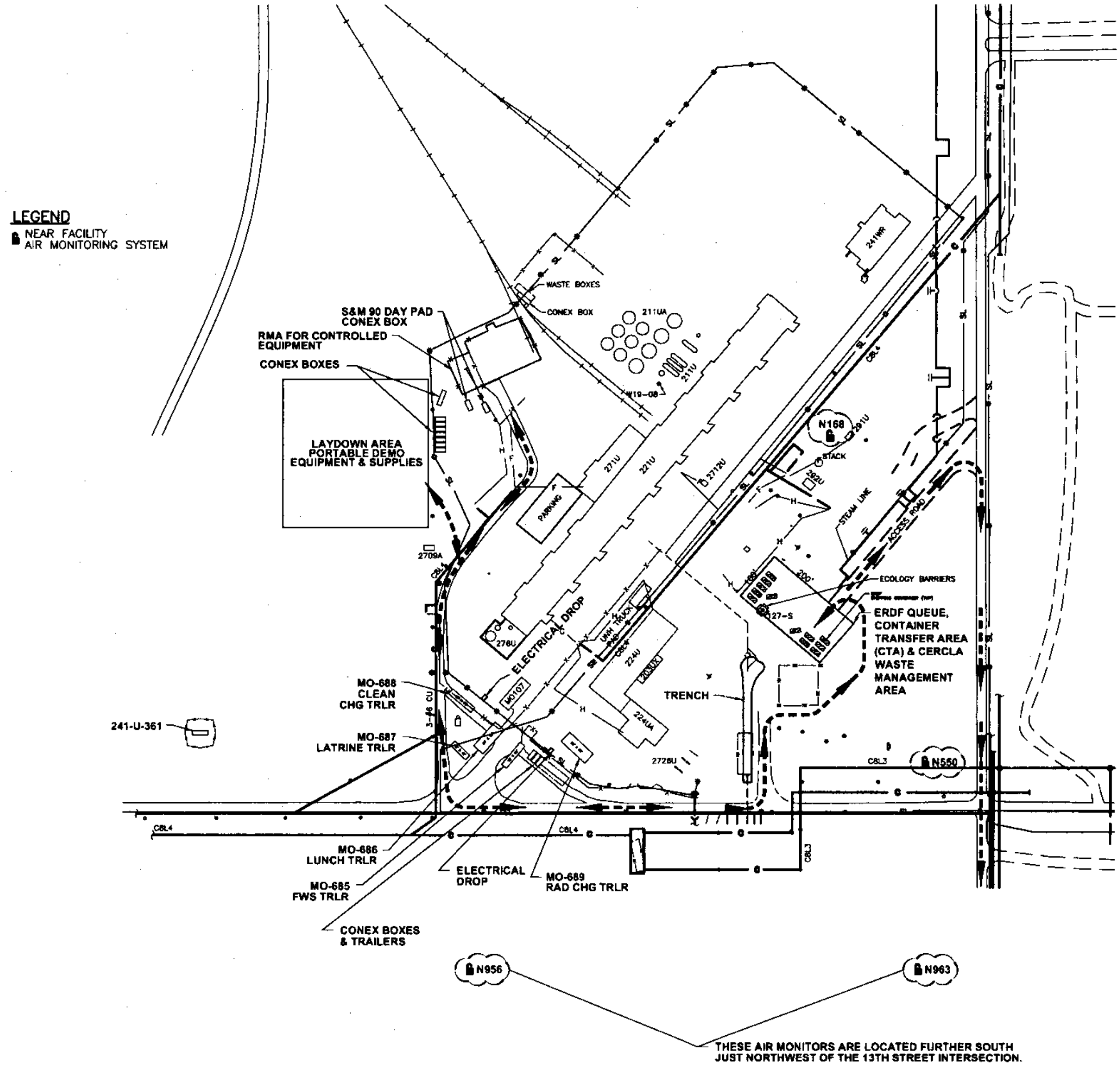

Figure 3-2. Tentatively Identified 221-U Facility Remedial Action Area.

- Transuranic Waste will be wastes that after stabilization contain greater than 100 nCi/g of transuranic isotopes (e.g., the contents of a tank in cell 30). This waste will be removed from the facility and dispositioned to the CWC for interim storage.

- Dangerous Waste sources are expected to be from the use of acids and cleaning solutions in specific nonradiological, surface decontamination efforts, as well as mercury switches and lead-based paints. With a viable waste minimization program and the substitution of non-regulated material, the portion of this waste stream that has not become radioactively contaminated should be a minor source of dangerous waste. This regulated dangerous waste may be in either liquid or solid form.

- Mixed Waste is another minor waste stream that can be expected. Hazardous substances that are shipped from the site will be classified as either dangerous waste or mixed waste (if radioactive). The source of this waste stream likely will be remaining contaminant residues (e.g., lead) on radioactively contaminated facility equipment and surfaces and the chemicals/materials used for decontamination.

- PCB Waste may be in existing coatings on the facility's interior surfaces (e.g., walls, ceilings). In addition, light ballasts and other equipment may contain some level of PCBs. Consequently, some of the waste streams discussed above also may be contaminated with PCBs.

- Non-Regulated Bulk Waste is expected (e.g., building rubble and radiologically released metal and concrete) resulting from the remediation of the 221-U Facility.

3.3.6 Onsite Determination

The preamble to 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," states that when noncontiguous facilities are reasonably close to one another and wastes at these sites are compatible for a selected treatment or disposal approach, CERCLA Section 104(d)(4) allows the lead agency to treat these related facilities as one site for response purposes and, therefore, allows the lead agency to manage waste transferred between such noncontiguous facilities without having to obtain a permit. The 221-U Facility site addressed by this final action ROD and ERDF are reasonably close to one another, and the wastes are compatible for the selected disposal approach. Therefore, the sites (ERDF and 221-U Facility) are considered to be a single site for response purposes.

3.3.6.1 Waste Characterization

All waste generated as a result of project activities for disposal outside the structures being remediated will be or have been characterized in accordance with the SAP (DOE/RL-97-68) (or a new SAP as needed) and waste acceptance criteria.

3.3.6.2 Waste Designation

Waste profiles and designations will be developed on an as-needed basis throughout the project. The characterization criteria identified in the SAP, Section 3.6.5.3 (or a new SAP as needed) will provide the rationale and strategy for conducting sampling and analysis activities in support of waste designation. The SAP contains sampling, analysis, and radiological survey requirements to support waste designation and disposal decisions during all phases of the remedial action project. The characterization data will be used to prepare waste profile summaries for evaluations against waste acceptance criteria to determine appropriate disposal options.

3.3.6.3 Waste Minimization and Recycling

By using waste separation and segregation, waste generation can be kept to a minimum. Waste will be segregated at the 221-U Facility as generated, which will minimize the volume of regulated waste. Wastes will be separated into the following categories: low-level, transuranic, mixed, dangerous, PCB and non-regulated bulk.

Hazardous waste minimization will be considered in the selection of decontamination agents and solutions used in the 221-U Facility.

Materials will be recycled, reused, or reclaimed whenever practicable and economically feasible. Introduction of clean materials into a contamination area and contamination of clean materials will be minimized to the extent practicable. During all phases of waste management, emphasis will be placed on source reduction to eliminate or minimize the volume of waste generated.

All materials released off site for disposal/recycle must be certified to be free of contamination in accordance with DOE guidance for nonreal property. Materials with no or de minimis levels of CERCLA hazardous substances are not considered CERCLA waste and, therefore, are not subject to the 40 CFR 300.440, "Procedures for Planning and Implementing Off-site Response Actions," offsite acceptability determination.

3.3.6.4 Waste Handling and Storage

Waste generated from the 221-U Facility remedial activities for disposal outside the structures being remediated will be stored in designated waste storage areas and identified by signs reading "CERCLA WASTE MANAGEMENT AREA." Incompatible wastes will be separated within the designated waste storage areas to prevent commingling of the wastes.

Packages containing radioactive waste will be staged in radiological materials areas for shipment to the ERDF or to the CWC.

All waste storage will meet the ARARs identified in the ROD. Appropriate areas will be established, in which waste is staged and, if necessary, temporarily stored before shipment. These waste staging and storage areas reside within the CERCLA Remedial Action Area, as identified in Figure 3-2. The exact location(s) of such areas may differ from the locations depicted in Figure 3-2. These waste staging and storage areas are necessary for implementation of the remedial action.

Stored wastes shall be inspected weekly to verify container integrity, legibility of markings and labels, and proper placement of signs. Container inspections will be documented on the appropriate checklist. An inventory of the waste generated will be maintained. A waste specialist or designee will inspect all waste containers as they are filled. Before any waste shipment, the containers must be properly sealed and checked for leaks or other damage. A final inspection will be performed at the time of shipment.

3.3.6.5 Waste Treatment

Treatment of waste streams could be necessary to provide for safe transport and effective disposal, and to address land disposal restrictions. The waste treatment could occur onsite either at the 221-U Facility or the ERDF, as practical, in accordance with the substantive requirements of WAC 173-303 and the applicable disposal site waste acceptance criteria. Onsite waste treatments could include solidification, separation, elementary neutralization, amalgamation, size reduction, or repackaging, and will be implemented using the criteria identified or the process described below. In the event waste cannot be treated onsite, an offsite search will be conducted to determine whether the waste can be effectively treated offsite. Once an offsite location is found, an offsite determination will be requested.

Solidification

Solidification is a technique that physically limits the mobility of dangerous waste by reducing or eliminating free liquids in the waste.

The following criteria apply to meet treatment by solidification.

- The solidified waste must meet the paint filter liquids test, specified as Method 9095 of *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, document number SW-846 (EPA 1986a), for assessing the amount of free liquid in the waste. The waste specialist or designee must ensure that the solidification technique used can solidify all waste in the container or tank to this standard. In most cases, this will mean ensuring adequate mixing of the waste with the solidification material.

- The waste must be solidified using a non-biodegradable solidification material.

Separation

Separation through decanting (solid-liquid systems) is the process of actively separating materials having differing specific gravities. The clarified supernatant is removed and the solids are preferentially concentrated in a smaller fraction of the liquid.

Separation through sedimentation or clarification is the settling out by gravity of solid particles suspended in a liquid.

Separation through oil skimming or phase separation is the equivalent of decanting, but for liquid-liquid systems where the liquid phases are immiscible and/or have differing specific gravities.
The following criteria apply to meet treatment by separation.

- Ensure that ignitable or reactive waste treatment in tanks complies with WAC 173-303-640(9)(a), "Tank Systems."

- No processes that generate toxic or flammable gasses or volatilize dangerous waste materials directly to the air may be used.

Elementary Neutralization

Elementary neutralization means the process of neutralizing wastes that are dangerous wastes only because they exhibit the characteristic of corrosivity as defined by one or more of the following properties:

- An aqueous waste with a pH less than or equal to 2, or greater than or equal to 12.5

- A liquid that corrodes steel at rates and under conditions specified in WAC 173-303-090(6)(ii), "Dangerous Waste Characteristics"

- A solid waste that when mixed with an equal weight of water results in a solution, the liquid portion of which has either a pH less than or equal to 2, or greater than or equal to 12.5.

The following criteria apply to meet treatment by elementary neutralization.

- Elementary neutralization must be conducted in accumulation tanks or containers.

- The treatment residuals must exhibit either: (a) a pH of greater than 2 and less than 12.5 prior to onsite management or disposal, or (b) a pH that meets the requirements of a delegated municipality or local solid waste authority.

- Elementary neutralization must not pose a risk to human health and the environment.

- The resulting treatment residuals must be managed and disposed of in accordance with state and local regulations.

Mercury Amalgamation

Mercury amalgamation is the chemical process used to bind elemental mercury waste with another chemical for stabilization, and must meet the following criterion.

- Elemental mercury waste may be combined with a solid amalgam for waste stabilization prior to disposal. After treatment by mixing the amalgam and the elemental mercury, there can be no freestanding liquids.

Size Reduction

The selected remedial action requires consolidation of items on the 221-U Building canyon deck into below-deck locations. Some of the items may need to be disassembled or cut into smaller pieces to ensure that they will fit into the canyon cells/pipe trench or in an approved waste container; therefore, this is considered a treatment.

Consolidation will result in the encapsulation of wastes within the grouted, substantial structure of the canyon building. Additionally, removal of items from the canyon deck to below-deck locations will result in a reduction in the final height of the engineered surface barrier required to cover the partially demolished canyon structure at the conclusion of the remedial action.

Repackaging

Waste may need to be repackaged for a variety of reasons (e.g., due to void space issues or the need to remove a waste component from the already packaged container). Waste treatment may also occur offsite, and will receive prior offsite determination approval.

3.3.6.6 Waste Disposal

As stated previously, it is anticipated that most of the low-level and mixed low-level waste and debris from the remedial action that is shipped from the site will be disposed of at the ERDF, which is designed to meet RCRA minimum technical requirements for land disposal. The ERDF can also accept some asbestos and PCB waste. The criteria for ERDF's acceptance of waste are presented in the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI-00139). Dangerous waste that does not meet the ERDF waste acceptance criteria will be disposed of at a permitted offsite facility, with an approved offsite determination.

Transuranic waste will be packaged and shipped to the CWC in accordance with the *Hanford Site Solid Waste Acceptance Criteria* (HNF-EP-0063) for future shipment to WIPP.

3.3.6.7 Returned Sample Waste

Screening and analysis of both solids and liquids may be conducted for the 221-U Facility, at offsite or onsite laboratories or at a radiological counting facility. Unused sample portions will be returned to the project for disposal with the remainder of the waste streams, and associated laboratory waste from offsite analyses will be managed by the applicable laboratory in accordance with contract specifications. Waste from field screening and onsite laboratories will be managed depending on whether it has been altered. Altered samples will be contained and disposed of at the 200 Area Effluent Treatment Facility, ERDF, or other appropriate facilities as authorized by the EPA, depending on waste designation. Unaltered liquid waste generated during sample screening and analysis that does not exceed collection criteria limits may be discharged to the ground near the point of generation; if it exceeds the collection criteria, it may be disposed of at the Effluent Treatment Facility, ERDF (if stabilized), or other appropriate facilities.

Some liquids may be neutralized and/or stabilized to meet the disposal facility's waste acceptance criteria. Pursuant to 40 CFR 300.440, EPA approval is required before unused samples or waste can be returned from offsite laboratories. Approval of this RD/RAWP constitutes EPA remedial project manager approval for shipment of offsite and onsite laboratory sample waste back to the 221-U Facility.

3.3.6.8 Equipment and Construction Materials

Equipment and construction materials that become contaminated with CERCLA hazardous substances will be decontaminated either with a three-bucket wash or with a high-temperature and high-pressure wash (180 °F and greater than 1,000 lbf/in^2) in a wash basin capable of retaining rinsate, as needed. All water used for decontamination activities will be potable (e.g., Hanford Site potable water). Rinsate will be managed accordingly through applicable treatment, packaging, storage, and disposal. If contamination is determined to be fixed for any equipment or materials, the radiological control technician and task manager will make the decision to remove the contamination using more aggressive methods or to dispose of the equipment. If equipment is to be dispositioned, a declaration-of-excess form will be completed and the material will be packaged accordingly.

3.3.6.9 Waste Disposal Records

Original copies of all sampling records, waste inventory documentation, and waste container certification forms will be forwarded to the assigned waste specialist to be included in the waste file and to initiate waste tracking in the *Solid Waste Information Tracking System* (SWITS). The completed waste files will be included in the receiving facilities' project file following final waste disposition.

3.3.7 Air Emissions

The (Federal) *Clean Air Act of 1990* and RCW 70.94, "Public Health and Safety," "Washington Clean Air Act," require regulation of air pollutants. The 221-U Facility remedial action would have the potential to generate both radioactive and nonradioactive airborne emissions.

3.3.7.1 Nonradioactive Emissions

Under WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," requirements are established for the regulation of emissions of criteria/toxic air pollutants. The primary nonradioactive emissions resulting from this remedial action will be fugitive particulate matter. In accordance with WAC 173-400-040, "General Standards for Maximum Emissions," reasonable precautions must be taken to (1) prevent the release of air contaminants associated with fugitive emissions resulting from materials handling, demolition, or other operations; and (2) prevent fugitive dust from becoming airborne from fugitive sources of emissions. The use of treatment technologies that would result in emissions of toxic air pollutants that would be subject to the substantive applicable requirements of WAC 173-460 are not anticipated to be a part of this remedial action. Treatment of some waste encountered during the remedial action may be required to meet ERDF waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques such as macroencapsulation or grouting, and WAC 173-460 would not be considered an ARAR. If more aggressive treatment is required that would result in the emission of regulated air pollutants, the substantive requirements of WAC 173-460-113(2) and WAC 173-460-060 and would be evaluated to determine applicability.

Emissions to the air will be minimized during implementation of the remedial action through use of standard industry practices such as the application of water sprays and fixatives and use of temporary confinement enclosures. These techniques are considered to be reasonable precautions to control fugitive emissions as required by the regulatory standards.

The Federal implementing regulations also contain requirements for managing asbestos material associated with demolition and waste disposal (40 CFR 61, Subpart M, "National Emission Standards for Asbestos").

3.3.7.2 Emissions of Radionuclides

In accordance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," radionuclide airborne emissions from the facility will be controlled so as not to exceed amounts that would cause an exposure to any member of the public of greater than 10 mrem/yr effective dose equivalent. The same regulation addresses point sources (i.e., stacks or vents) emitting radioactive airborne emissions, requiring monitoring of such sources with a major potential for radioactive airborne emissions, and requiring periodic confirmatory measurement sufficient to verify low emissions from such sources with a minor potential for emissions. Under state implementing regulations, the Federal regulations are paralleled by adoption, and in addition require added control of radioactive airborne emissions where economically and technologically feasible (WAC 246-247-040, "Radiation Protection - Air Emissions," "General Standards," (3) and (4) and associated definitions).

The substantive aspect of these requirements, as low as reasonably achievable (ALARA) based on best or reasonable control technology, will be addressed by ensuring that applicable emission-control technologies (those successfully operated in similar applications) will be used when economically and technologically feasible (i.e., based on cost/benefit). Additionally, the substantive aspect of the requirements for monitoring fugitive or non-point sources emitting radioactive airborne emissions (WAC 246-247-075(8), "Radiation Protection - Air Emissions," "Monitoring, Testing and Quality Assurance") will be addressed by sampling the effluent streams and/or ambient air as appropriate using reasonable and effective methods.

3.3.7.2.1 Radionuclide Airborne Source Information

There is a potential for particulate radioactive airborne emissions to result from the remedial action activities. The potential radionuclide emissions were calculated for the remedial action activities identified in Section 2.3.2. The emission calculations are divided into three parts. The first part is the minor emission activities such as canyon reactivation, size reduction of items on the canyon deck, and item consolidation activities, monitored through the 291-U-1 Stack. The second part involves a major emission activity while material is being removed from a tank in cell 30, which also will be monitored from the 291-U-1 Stack, and the last part of the remedial action activity will result in minor fugitive emissions from grouting and demolition activities, which will be monitored using the near-facility monitoring system.

The primary radionuclides detected include Am-241, Pu-239, Pu-240, Np-237, Cs-137, U-234, U-235, U-238, and Sr-90. Other radionuclides listed in DOE/RL-2001-11 also may be encountered during the remedial action activities.

The distance to the Laser Interferometer Gravitational Wave Observatory receptor is 18,310 m east-southeast of the 200 West Area. This is the nearest public location where the hypothetical maximally exposed individual (MEI) might be located. Dose factors used specific to this location were taken from *Calculating Potential-to-Emit Releases and Doses for FEMPs and NOCs* (HNF-3602). The following tables (Tables 3-2, 3-3, and 3-4) identify the unabated potential-to-emit from the remedial action, the best available radionuclide control technology resultant emissions, and the respective total effective dose equivalent (TEDE) values for the MEI based on the selected remedy.

Table 3-2. Dose Calculations for Canyon Reactivation and Size Reduction Activities.

Nuclide[a]	Radionuclide Inventory (Ci)[b]	40 CFR 61, Appendix D, Release Factor	Unabated Release Rate (Ci/yr)	HEPA Filter Factor (Sand Filter – Based on a 99.95% Efficiency)	Abated Release Rate (Ci/yr)	200 West Area ≥40 m (291-U-1 Stack) Dose-per-Unit Release Factor (mrem/Ci)	Unabated Dose to MEI (mrem/yr)	Abated Dose to MEI (mrem/yr)
Am-241	1.80	1.0E-03	1.80E-03	2,000	9.00E-07	1.1E+01	1.98E-02	9.90E-06
Sr-90	108	1.0E-03	1.08E-01	2,000	5.40E-05	8.7E-03	9.40E-04	4.70E-07
						TEDE Totals:	2.07E-02	1.04E-05

[a] Am-241 and Sr-90 were used as worst-case isotopes for the calculations.
[b] Radionuclide inventory includes curies currently present in the facility, as well as curies that may be introduced into the facility, and/or removed from the facility on a calendar year basis. Values were obtained from the *ALARA Review for the 221-U Characterization* (BHI-01240, Appendix A). The beta/gamma surface contamination level used was 1,500,000 dpm/100 cm^2 and the alpha surface contamination level used was 25,000 dpm/100 cm^2. It was estimated that approximately 40,000 cm^2 of contaminated surface was disturbed every hour, and that 4,000 hours of work that may disturb the surface would be completed within a year. The normal amount of work hours was doubled to account for any potential releases from undisturbed areas.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."

HEPA = high-efficiency particulate air.
MEI = maximally exposed individual.
TEDE = total effective dose equivalent.

The TEDE to the MEI for canyon reactivation and size reduction activities is 1.04E-05 mrem/yr.

Table 3-3. Dose Calculations for Removal of Material from a Tank in Cell 30.

Nuclide	Radionuclide Inventory (Ci)[a]	40 CFR 61, Appendix D, Release Factor	Unabated Release Rate (Ci/yr)	HEPA Filter Factor (Sand Filter – Based on a 99.95% Efficiency)	Abated Release Rate (Ci/yr)	200 West Area ≥40 m (291-U-1 Stack) Dose-per-Unit Release Factor (mrem/Ci)	Unabated Dose to MEI (mrem/yr)	Abated Dose to MEI (mrem/yr)
Np-237	1.06E-01	1.0E-03	1.06E-04	2,000	5.30E-08	1.0E+01	1.06E-03	5.30E-07
Pu-239	1.45E+02	1.0E-03	1.45E-01	2,000	7.25E-05	7.0E+00	1.02E+00	5.08E-04
Pu-240	3.74E+01	1.0E-03	3.74E-02	2,000	1.87E-05	7.0E+00	2.62E-01	1.31E-04
Am-241	6.55E+01	1.0E-03	6.55E-02	2,000	3.28E-05	1.1E+01	7.21E-01	3.60E-04
Sr-90[b]	1.08E+02	1.0E-03	1.08E-01	2,000	5.40E-05	8.7E-03	9.40E-04	4.70E-07
						TEDE Totals:	2.01E+00	1.00E-03

[a] Radionuclide inventory includes curies currently present in the facility, as well as curies that may be introduced into the facility, and/or removed from the facility on a calendar year basis. Alpha isotopic values are taken from the *Disposition of Transuranic Contaminated Residual Materials at U Plant* (D&D-23017). After publication of that document, it was determined that the values in the document underestimated the actual tank inventory; therefore, for this calculation, the values in the document were multiplied by a factor of 2.66 to account for the increased estimated volume of material in the tank.
[b] An estimated value for Sr-90 was added to the calculation based on the surface contamination level information from the *ALARA Review for the 221-U Characterization* (BHI-01240, Appendix A).

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."

HEPA = high-efficiency particulate air.
MEI = maximally exposed individual.
TEDE = total effective dose equivalent.

The TEDE to the MEI for the removal of the material from the tank in cell 30 is 1.00E-03 mrem/yr.

Grouting of the canyon, partial demolition of the canyon, and demolition of non-canyon structures (e.g., 292-U) will generate diffuse and fugitive emissions of radionuclides. Emissions and dose information related to these activities are provided in Table 3-4.

Table 3-4. Dose Calculations for Grouting and Demolition Activities.

Nuclide	Radionuclide Inventory (Ci)[a, b]	40 CFR 61, Appendix D, Release Factor	Abated and Unabated Release Rate (Ci/yr)	200 West Area <40 m Dose-per-Unit Release Factor (mrem/Ci)	Unabated and Abated Dose to MEI (mrem/yr)
Pu-239	2.32E-03	1.0E-03	2.32E-06	1.1E+01	2.55E-05
Pu-240	1.48E-04	1.0E-03	1.48E-07	1.1E+01	1.63E-06
Am-241	1.48E-04	1.0E-03	1.48E-07	1.7E+01	2.52E-06
Sr-90	1.08E+02	1.0E-03	1.08E-01	1.1E-02	1.19E-03
				TEDE Totals:	1.22E-03

[a] Radionuclide inventory includes curies currently present in the facility, as well as curies that may be introduced into the facility, and/or removed from the facility on a calendar year basis. Alpha isotopic values are based on calculated ventilation tunnel inventories documented in *Disposition of Transuranic Contaminated Residual Materials at U Plant* (D&D-23017) and then multiplied by a factor of 4 to provide a bounding value for inventory that could be associated with demolition of the canyon and associated non-canyon structures.
[b] An estimated value for Sr-90 was added to the calculation based on the surface contamination level information from the *ALARA Review for the 221-U Characterization* (BHI-01240, Appendix A).

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."

MEI = maximally exposed individual.
TEDE = total effective dose equivalent.

The TEDE to the MEI for the grouting and demolition activities is 1.22E-03 mrem/yr.

3.3.7.2.2 Emission Controls

Based on analysis of the potential emissions and analysis of available control technologies, the following controls have been selected for use during the remedial action.

For the canyon reactivation and size reduction activities and the removal of the material from the tank in cell 30:

- Because the air flow will be going through the 291-U-1 Stack, the sand filter will be used as an emission control.

- Fixatives will be applied to contaminated walls, flooring, debris, and equipment, as needed, to minimize airborne contamination during the remedial action activities for fugitive emissions and dust within the canyon. Fixative application techniques may include spraying, brushing on, pouring, or some other method, as necessary.

- Once they are staged, even inside the canyon, the waste packages will remain closed except during packaging and waste inspection activities.

- Vacuum cleaners and portable exhausters may be used to support the remedial action and will be equipped with high-efficiency particulate air (HEPA)-type filters.

- Temporary contamination-control structures may be used with or without a portable HEPA-type-filtered exhauster(s) during some portion of the remedial action activities, as needed.

For the grouting of the canyon and demolition of canyon walls/roofing and several ancillary structures:

- Water will be applied, as needed, during any demolition activities, for suppression of fugitive emissions and dust.

- Fixatives will be applied to contaminated structures and/or debris and equipment, as needed, to minimize airborne contamination during the remedial action activities for fugitive emissions and dust. Fixative application techniques may include spraying, brushing on, pouring, or some other method, as necessary.

- Fixatives or cover material (e.g., gravel) will be applied to disturbed contaminated soils associated with the remedial action, when field activities will be inactive for more than 24 hours.

- If the overnight sustained wind speed is predicted to be greater than 32 km/h (20 mi/h) based on the Hanford Meteorological Station morning forecast, fixative or cover material will be applied, as needed. This will allow the project enough time, if necessary, to prepare for the application of dust-control measures. If a fixative already has been applied, and contaminated items will remain undisturbed, further use of fixatives will not be needed. The fixatives or other controls will not be applied when contaminated items are frozen, or when it is raining or snowing, or other freezing precipitation is falling at the end of work operations.

- Once they are staged, the waste packages will remain closed except during packaging and waste inspection activities within the CERCLA remedial action area.

- Vacuum cleaners and portable exhausters may be used to support the remedial action and will be equipped with HEPA-type filters.

- Temporary contamination-control structures may be used with or without a portable HEPA-filtered exhauster(s) during some portion of the remedial action activities, as needed.

3.3.7.2.3 Monitoring

For the canyon reactivation and size reduction activities

The calculated unabated annual dose combined for the canyon reactivation and size reduction activity during the remedial action is below 0.1 mrem/yr TEDE to the MEI; therefore, this activity is not subject to continuous emissions monitoring as required by 40 CFR 61.93, "Emission Monitoring and Test Procedures." Periodic confirmatory measurement will be provided, however, as required by 40 CFR 61.93. The 291-U-1 Stack will be run continuously with quarterly samples collected for analysis to meet the periodic confirmatory measurement requirement.

For the removal of the material from the cell 30 tank:

Stacks or vents with the potential to provide in excess of 0.1 mrem/yr effective dose equivalent to the MEI must be monitored as major sources in accordance with 40 CFR 61.93(b) emission monitoring and test procedures and WAC 246-247-075. The U Plant canyon exhaust stack (291-U-1) will operate as a major source during activities involving removal and packaging of waste from the cell 30 tank. The existing stack has not been qualified or approved as compliant with the engineering and quality assurance requirements for effluent flow rate measurement and continuous emissions sampling as listed for a major source in the cited regulations. Upgrade of the existing stack to meet the requirements is not practical, from a cost/benefit or technical standpoint for the brief duration of work involving the cell 30 tank. Hence, a request for prior EPA approval will be processed for alternative effluent flow rate measurement procedures or site selection and sample extraction procedures. The request will demonstrate as required that:

(i) It can be shown that the requirements of 40 CFR 61.93(b)(1) or (2) are impractical for the effluent stream.

(ii) The alternative procedure will not significantly underestimate the emissions.

(iii) The alternative procedure is fully documented.

It is expected that the existing methods and equipment related to the stack flow measurement and emissions sampling will be accepted as an alternative.

The cited regulations also require an annual inspection, and cleaning where necessary, of the emissions sampling equipment. This will be conducted during operation of the stack as a major source.

For the grouting of the canyon and demolition of canyon walls/roofing and several ancillary structures:

The calculated unabated annual dose combined for the grouting and demolition activity during the remedial action is below 0.1 mrem/yr TEDE to the MEI; therefore, this activity is not subject to continuous emissions monitoring as required by 40 CFR 61.93. Periodic confirmatory measurement will be provided, however, as required by 40 CFR 61.93. Alternative monitoring techniques have been considered, and near-facility monitors are sufficient to meet the periodic confirmatory measurement requirement.

Near-Facility Monitoring Stations N168, N550, N956, and N963 (Figure 3-2) will be used for the remedial action activities. The Hanford Site protocol established for near-facility monitors will be followed for data collection, sampling frequencies, sample analysis, and data reporting (*Environmental Monitoring Plan United States Department of Energy Richland Operations Office* [DOE/RL-91-50]).

Air monitor downtime will be minimized, and all four designated air monitors shall be operated, as required. However, if a designated air monitor is out of operation for more than 48 hours during normal working times (excluding weekends and holidays, when work activities are not being conducted), where there is a potential for radiological emissions, the DOE, EPA, and Ecology will be notified. If two or more downwind, designated air monitors are out of operation during normal work operations, activities where there is a potential for radiological emissions shall be temporarily suspended until operation of at least two downwind, designated air monitors are restored or backup equipment is deployed and operational.

3.3.8 Operations and Maintenance Plan

An operations and maintenance plan will be prepared for the 221-U Facility. This plan will address long-term institutional controls and monitoring requirements. An outline of this plan is included in Appendix D of this RD/RAWP.

3.3.9 Procurement

Procurement activities include preparing requests for proposals, soliciting qualified remedial action contractors, awarding a subcontract, coordinating submittals, negotiating change orders, and receiving and controlling remedial action contractor requests for payment.

3.3.10 Quality Control

Construction and remedial action quality control will be performed in accordance with the contractor's quality control program. Such a program may include the following:

- A summary of responsibilities and authorities of the organizations and key personnel involved in the design and construction of facility remediation
- The qualifications of the quality assurance personnel to demonstrate that they possess the training and experience necessary to fulfill their identified responsibilities
- The observations and tests that will be used to monitor construction, and the frequency of the performance of these activities
- The sampling activities, sample size, sample locations, frequency of testing, acceptance and rejection criteria, and plans for implementing corrective measures as addressed in the plans and specifications
- Descriptions of the reporting requirements for quality assurance activities (including such items as daily summary reports, schedule of data submissions, inspection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation) and descriptions of the provisions for the final storage of all records, consistent with overall requirements of the contractor records management program.

3.3.11 CERCLA Closeout Documentation

In support of completion of the 221-U Facility remedial action, a remedial action report will be prepared for the facility. The report will provide the needed documentation for verification of the remedial action at the facility and to support the eventual deletion of the Site from the National Priorities List (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List"). Guidance found in Appendix A of this report provides one method to satisfy this requirement. At a minimum, the following documentation is required for the facility:

- Description of current facility condition
- Basis for reclassification
- Analytic data or data references (if applicable).

Additional information on documenting the attainment of RAOs is included in the following subsections.

3.3.12 Attainment of Remedial Action Objectives

The selected remedy for the 221-U Facility will result in protection of human health and the environment. The remedial action will allow the site to be used consistent with the projected future industrial use of the 200 Area Central Plateau Core Zone. Future use of the site, while unlikely, could include light industrial activities (such as warehousing) in the vicinity of, but not on top of, the engineered barrier, so long as such activities do not impact barrier performance. The potential pathways of human and ecological exposure to facility contaminants will be severed primarily through use of an engineered barrier and institutional controls, as well as through the containment of contaminants in the grouted and the substantial concrete structure of the 221-U Facility. Threats to groundwater from these contaminants will be controlled through treatment by and encapsulation in grout within the remaining 221-U Facility structure, and through construction and maintenance of the engineered barrier.

3.3.12.1 Residual Risks Post-Achievement of Remedial Action Objectives

Acceptable human-health risk levels are attained through containment of residual contamination and severing of exposure pathways. The effectiveness of the remedy is protected by limiting land use to industrial activities that conform to institutional controls. The potential incremental cancer risk from contaminated soils, structures, and debris with respect to metals and organics is reduced from greater than 10^{-2} to at least as low as 1×10^{-5}. The potential incremental cancer risk from contaminated soils, structures, and debris with respect to radionuclides is reduced from greater than 10^{-2} to at least as low as 10^{-4} (approximate risk equivalent to 15 mrem/yr dose above background). Residual non-carcinogenic risks are reduced to acceptable levels by breaking the exposure pathways, and by macroencapsulation in grout.

3.3.13 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through remedial actions to reduce or eliminate risks associated with exposure to contaminated structures, wastes, and debris. Implementation of this remedial action will not pose unacceptable short-term risks toward site workers that cannot be mitigated through acceptable remediation practices. Containment of contaminated structures, waste, and debris and the use of institutional controls will prevent exposure under anticipated future land use. Containment of contaminated waste and debris also will prevent further groundwater and surface water degradation.

The quantitative baseline risk assessment for an industrial exposure scenario associated with radionuclides at the 221-U Facility estimated excess cancer risks greater than 1×10^{-2} and non-carcinogenic health risks with a hazard index greater than 1. Remediation of the facility will occur principally to contain and reduce exposure to contaminated structures, wastes, and debris that pose a risk of release. The incremental residual cancer risks at this site after implementation of this remedy are estimated to be less than 10^{-4} (industrial land-use scenario) for exposure to these contaminants. Remedy implementation will reduce the non-carcinogenic health risks to below a hazard index of 1. In addition, contaminant migration will be reduced to levels that provide protection of groundwater and the Columbia River.

A response action at the 221-U Facility is justified by the risk to human health. Because the objective of the selected remedy is to sever exposure pathways (including pathways to ecological receptors), the selected remedy is anticipated to be protective of ecological receptors.

3.3.14 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

Grout encapsulation of the waste will effectively solidify liquids in the facility and chemically stabilize the dangerous characteristics of the waste. As noted in the *Statutory Interpretative Guidance on the Placement of Bulk Liquid Hazardous Waste in Landfills*, OSWER Policy Directive 9487.00-2A, EPA/530-SW-86-016 (EPA 1986b), a Portland cement-based treatment process is especially effective in the chemical stabilization of wastes with high levels of toxic metals because at the pH of the cement mixture, most multivalent cations are precipitated as hydroxide or carbonate minerals of very low solubility. The Portland cement-based process is also effective in removing liquids because the reaction of the anhydrous cement powder and water (liquids) incorporates the water into the solid mineral species.

Chemical stabilization using fine-grained siliceous (pozzolanic) material (e.g., fly ash) also can provide effective treatment of liquids prior to landfilling. In addition, fly ash has been demonstrated to strongly adsorb most radionuclides.

The primary objectives of grouting activities are to provide structural stability, prevent subsidence, and provide effective chemical and physical stabilization; therefore, a flowable grout will be used. Grouting will help ensure the following results:

- Effective chemical reaction with the waste to transform free liquids into solids

- Production of a monolithic block with sufficient structural integrity to prevent human and biological intrusion into the waste

- Significant reduction of waste constituent mobility/solubility (as a result of grout encapsulation, and as a result of effectively limiting the potential for atmospheric waters to percolate into and subsequently mobilize contaminants), and/or toxicity (through chemical stabilization as discussed previously).

Thus, the selected remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site.

4.0 REMEDIAL DESIGN APPROACH

The construction component of the selected 221-U Facility remedy includes performing remedial design and construction activities and furnishing necessary facilities, equipment, labor, materials, supplies, and tools. The scope also includes engineering services to locate and detail proposed support areas (such as laydown areas, support facilities, and air monitors), and engineering support during field activities. The following subsections provide a summary of the construction component design elements for the selected alternative.

4.1 BUILDING CHARACTERIZATION

The nature and extent of contamination for Alternative 6, Close in Place – Partially Demolished Structure, was evaluated through the review of historical documents, operating history, and existing characterization data. The Phase I feasibility study (DOE/RL-1997-11) identified the need for further characterization of the 221-U Facility and legacy equipment on the canyon deck and in the process cells to support development and evaluation of alternatives in the final feasibility study. Near the completion of the Phase I feasibility study, the characterization needs and investigative strategy were developed and then documented in the *Data Quality Objectives Summary Report for the 221-U Canyon Disposition Alternatives* (BHI-01091) in September 1997. Implementation of the data quality objectives was developed and documented in the SAP (DOE/RL-97-68) in February 1998. Complete results of the environmental characterization effort are presented in the *Final Data Report for the 221-U Facility Characterization* (BHI-01565).

Additional characterization activities may be required for facility locations not previously characterized and/or for waste disposed of outside of the facility. Additional characterization activities will be undertaken in accordance with an approved SAP. The *Guidance for the Data Quality Objectives Process*, EPA/600/R-96/055, EPA QA/G-4 (EPA 2000), will be used to support the development of any SAP revisions or new SAP needed for the project. The data quality objectives process is a strategic planning approach that provides a systematic process for defining the criteria that a data collection design should satisfy. Using the data quality objectives process ensures that the type, quantity, and quality of environmental data used in decision-making will be appropriate for the intended application.

4.2 DESIGN DEVELOPMENT

Remedial design for the 221-U Facility remedial action includes all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to procure a remedial action contractor to perform the work. The extent of contamination has been developed and used to assess the performance requirements for the barrier (i.e., drainage flux) to demonstrate attainment of RAO 3.

Project plans (such as SAPs for collection of design samples) will define the data gathering requirements to verify worker health and safety. Project procedures will define the "how to" of obtaining data and controlling the site activities. Scope of work, design drawings, and specifications will provide the necessary tools to procure a remedial action contractor. If requested, the DOE will provide the remedial design to the lead regulatory agencies for review in phases as the details of design become available for the various remedial action activities required to complete the overall remediation of the 221-U Facility. Summary briefings and discussions may be held at the unit managers' meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules for issuing contract documents.

The following process will be followed to implement the above requirement and may be modified at the 200 Areas unit managers' meetings.

- If requested, the DOE will provide the draft remedial design packages and design schedule to the lead regulatory agencies at the unit managers' meetings or will deliver the packages and schedule to the local field office.

- The lead regulatory agencies review period generally is 2 weeks. If the review period requires a longer schedule because of the complexity of the project, the DOE and the lead regulatory agencies will agree to the extended review period, as necessary. To minimize impacts to the schedule, the need for additional review time should be communicated early in the process.

- Review comments and issues will be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, will be documented in the unit managers' meetings, letters, or other forums, as agreed.

- If requested, the DOE will provide a copy of the final remedial design packages, with comments incorporated, to the lead regulatory agencies at the unit managers' meetings, will deliver the packages to the local field office, or will transmit the package electronically.

A graded approach will be implemented as part of the design process to meet the support facilities and infrastructure requirements. Commercial design standards and practices will be followed wherever possible. Following is a list of typical design inputs:

- Site walkdown
- Review of historical data
- Cultural/ecological review
- Hazard classification
- Sampling data
- Volume calculation
- As-built drawings
- Engineering test results for soil and building materials
- Grout formulation test results.

As appropriate, these design and preconstruction inputs, and others that may be defined during preparation of the design, will be incorporated into the applicable design media (e.g., project drawings, technical specifications, statement of work) during the remedial design process.

4.3 DESIGN IMPLEMENTATION

4.3.1 Predemolition and Demolition Activities

Before engineered barrier construction activities begin, numerous above- and below-ground utilities and interferences must be dispositioned. The conduct of predemolition and demolition activities includes furnishing labor, materials, equipment (except for ERDF bulk-waste disposal containers and other containers for radioactive/dangerous waste disposal), incidentals for demolition, removal, sorting, handling, industrial hygiene monitoring, size reduction, containerization, associated transportation, and storage of demolished materials in accordance with the contract documents.

Site-specific predemolition and demolition activities may include, but are not limited to, the following tasks:

- Removal of waste from a tank in cell 30 that, if stabilized in place, would contain levels of transuranic isotopes greater than 100 nCi/g; and eventual disposal of that waste at WIPP

- Removal of liquids from the facility or treatment to remove liquids

- Partial removal of contaminated equipment and piping from the gallery side of the facility, as needed to facilitate demolition activities, and disposal of this waste at the ERDF or other approved facility

- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility

- Consolidation of contaminated equipment on the deck into below-deck locations

- Grouting, to the maximum extent practical, of internal vessel spaces, as well as cell, gallery, pipe trench, drain header, and other spaces within the facility as well as demolition rubble, as necessary

- Demolition of the railroad tunnel, 271-U, 276-U, 291-U, and 292-U structures and the 291-U-1 and 296-U-10 stacks, and disposal of the resulting waste at the ERDF or other approved disposal facilities (or use of the resulting waste as barrier fill material if the waste is minimally contaminated and does not contain hazardous wastes)

- Stabilization of the former locations of these structures to support construction of the engineered barrier

- Demolition of roof and wall sections of the 221-U Facility down to approximately the deck level and use of the resulting rubble as fill material for the engineered barrier.

Design activities to accomplish these tasks may include design of facility support systems, waste packaging, grout sources, water supply systems, grout mixing and delivery systems, grout placement methodology, canyon structural analysis, demolition of the structure (including blasting limitations and take-down sequencing), borrow areas, haul roads, earthwork, engineered barrier, and runoff controls. Also included are consolidation requirements for demolition debris and soil under the engineered barrier. These predemolition and demolition activities will be planned and undertaken using detailed execution plans and/or implementing procedures and work documents.

4.3.2 Engineered Barrier Design Factors

Engineered barriers are designed to isolate wastes from the environment (i.e., air, waterways, groundwater, plants, animals, and humans). The degree of isolation is based on acceptable risk factors to receptors that are consistent with established land and groundwater use. Factors to be considered in preparation of surface barriers include, but are not limited to, the following:

- Effects of arid climate conditions on performance

- The potential impacts of long-term climatic changes on long-term engineered barriers

- Toxicity, mobility, and volume of contaminants to be contained

- Land and waste form compressibility and settlement

- Depth of waste below the ground surface and depth to groundwater

- Barrier material engineering and chemical properties including, but not limited to, permeability, moisture retention, grain size, and leachability.

A typical engineered barrier design employs natural geologic materials that can contribute a variety of important functions to the overall barrier performance, such as precipitation storage, drainage, biointrusion control, side-slope stability, and erosion control. At the Hanford Site, suitable engineered barrier materials (e.g., fine- and course-grained soil) are available at approved borrow-source locations. Other materials such as pea gravel and basalt riprap may need to be imported from offsite locations.

While barrier design technology does not yet have a long history, important progress in understanding barrier performance in semiarid and arid climates is occurring (e.g., *Alternative Cover Assessment Project Phase I Report* [Publication No. 41183]; *Technology Overview Using Case Studies of Alternative Landfill Technologies and Associated Regulatory Topics* [ITRC 2003]; "Evaluation of Evapotranspirative Covers for Waste Containment in Arid and Semiarid Regions in the Southwestern USA" [Scanlon et al. 2005]; "Multiple-Year Water Balance of Soil Covers in a Semiarid Setting" [Fayer and Gee 2006]). Ongoing design and modeling work across the United States and at the Hanford Site indicates there is great promise for simple ET barriers patterned after natural analog sites (i.e., sites where the naturally deposited soil types and layers are evaluated and used as a basis for the barrier design). In semiarid and arid climates, such as at the Hanford Site, the simple ET-type barriers appear to provide a high level of protection over a long time period (greater than 1000 years) against excessive water infiltration into a covered waste site. Additionally, such barriers typically are of significantly simpler design (as compared to prescriptive RCRA Subtitle C compacted clay barriers), can be designed and constructed at lower costs, do not develop desiccation cracks during normal wetting and drying cycles (unlike compacted clay barriers), and require minimal maintenance. As a result, it is highly likely that the final design of the 221-U Facility barrier will include the use of a simple ET barrier (e.g., monolithic fill or capillary barrier; Figure 4-1).

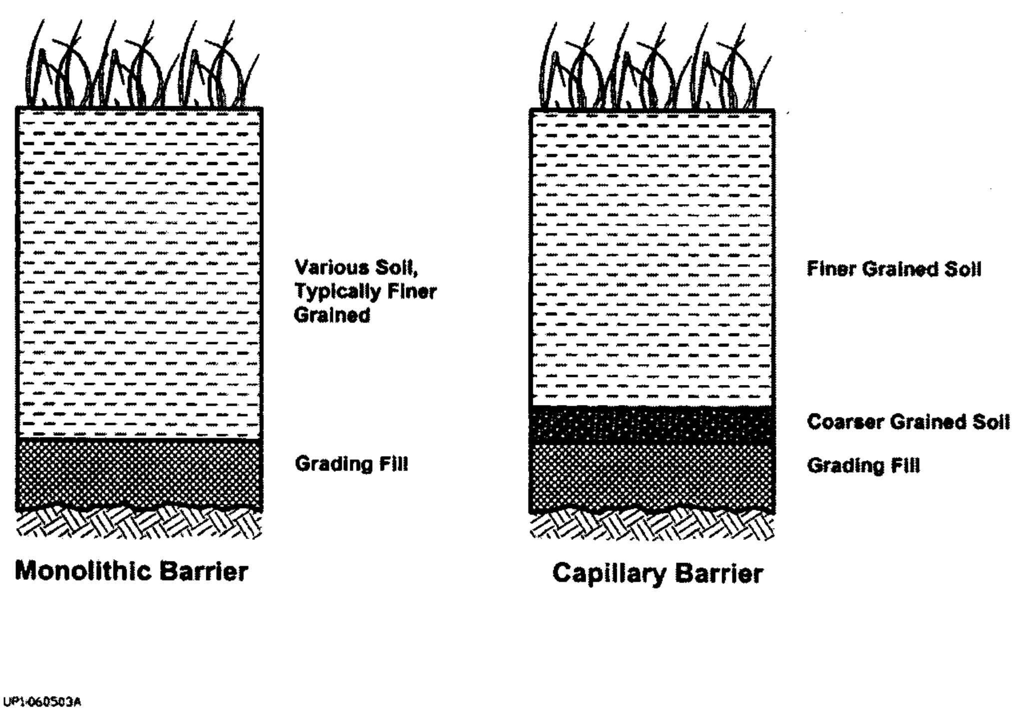

Figure 4-1. Conceptual Monolithic and Capillary Barrier Designs.

However, because detailed design of the 221-U Facility barrier has not yet begun, the type or thickness of barrier to be employed has not been finally determined. Because the barrier surface will be abruptly elevated above the surrounding terrain, there is an increased potential for wind and water erosion, and an additional allowance in functional barrier thickness may be required. Water storage and other hydraulic properties of candidate soils need to be evaluated to determine the amount (thickness) of soil needed for anticipated weather patterns. To bound the cost of these uncertainties, cost information provided in this RD/RAWP relies on information developed for the final feasibility study (DOE/RL-2001-11), which assumed the use of a modified RCRA Subtitle C barrier to support development of cost and material need projections. Because the modified RCRA Subtitle C barrier is much more complex than a monolithic fill or capillary barrier, using the cost data for a modified RCRA Subtitle C barrier design will provide an upper bound to the estimate. (See Section 3.5.) As barrier design proceeds, this RD/RAWP will be revised to reflect updated design information.

Section 4.2 of the final feasibility study describes various barrier design concepts at length. Even though the study establishes that the use of a simple ET barrier could be substantiated for the 221-U Facility, it defers to a version of the modified RCRA Subtitle C barrier design based on guidance given in an earlier feasibility study (*Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas* [DOE/RL-93-33]). Subsequent studies and reports (several noted above) have demonstrated that, in semiarid and arid climates, a simple monolithic or capillary ET barrier can perform better than a multilayered barrier that uses a clay layer as a redundant component.

As stated previously, it is highly likely that the final design of the 221-U Facility barrier will include the use of a simple ET barrier similar to that shown in Figure 4-1. Of the simple ET barriers, a monolithic barrier has one major advantage over barriers that contain multiple layers: its ability to functionally self-heal after subsidence or after a seismic event. Not only is the monolithic barrier better able to accommodate differential settlements or subsidence relative to that of a multi-layered barrier, but also a single fine-soil layer simplifies construction and maintenance, eliminates the need for graded filters or a drainage layer at the base of the functional barrier to divert interflow water laterally, and has a lower cost.

Generally, a capillary ET barrier will provide greater water storage capacity for a given thickness of fine-soil than a monolithic barrier; however, a capillary ET barrier relies on maintaining the planar textural interface between the graded filter layers and the fine-soil. This planar interface can be disrupted by differential settlements, subsidence, or eluviation of soil particles into the underlying soil horizon. This is an important consideration for applications with void space or solid wastes that are susceptible to subsidence. If the capillary break is compromised, the performance of the barrier diminishes.

As mentioned earlier, given the same soil type, to have an equivalent water storage capacity, the monolithic barrier will require additional soil thickness relative to that of a capillary barrier. If the thickness of the soil required for water-holding capacity exceeds the rooting depth of surface vegetation, then the water removal capacity of plants diminishes. However, the additional thickness can also be advantageous in providing increased intruder protectiveness. Shrubs that are native to the Hanford Site, when mature, can have a rooting depth in excess of 180 cm ("Soil Water Withdrawal and Root Characteristics of Big Sagebrush" [Sturges 1977]). Therefore, a monolithic barrier could be 180 cm thick, and the native plant community would still be able to remove water stored within the fine-soil profile via plant transpiration.

Several analytical studies have been performed recently that used computer modeling and simulations to predict the performance of a 100-cm thick silt-loam capillary barrier at the Hanford Site. These models used input data specific to the Site (e.g., weather, plant community, soil properties). One study, developed for the Integrated Disposal Facility at the Site, concluded that if the capillary barrier has mature native vegetation, it would have a long-term average recharge rate of 0.1 mm/yr (*Recharge Data Package for the 2005 Integrated Disposal Facility Performance Assessment* [PNNL-14744]). This is well below the 3.2 mm/yr recharge rate noted in Section 2.3.2 of this RD/RAWP as the performance goal for the barrier. However, the analysis (modeling) was based on using a source of silt-loam soil that is no longer available to the Hanford Site. A replacement source of silt-loam soil was recently sampled and tested and has been found to have a slightly lower water storage capacity (*Hydrology and Vegetation Data Package for 200-UW-1 Waste Site Engineered Surface Barrier Design* [PNNL-15464]). Because a monolithic barrier would have to be slightly thicker than a capillary ET barrier to achieve the same level of performance using the same soil, having to use a soil that has a slightly lower water storage capacity would require an additional increase in thickness. Moreover, with the increased potential for wind erosion due to the 221-U Facility barrier surface being abruptly elevated above the surrounding terrain, to achieve a life expectancy of 500 or even 1,000 years, an even greater increase in thickness may be required for the 221-U Facility monolithic barrier over that of the Integrated Disposal Facility capillary barrier design, which will be at grade.

To reduce wind and precipitation impact erosion, the top 30 cm of the ET barrier likely will have pea gravel blended into the silt-loam. Through wind tunnel tests, the addition of 10-mm (3/8-in.) diameter pea gravel blended at 15 weight percent into the top 30 cm of the silt-loam soil reduces the amount of soil loss appreciably without significantly affecting moisture retention or plant propagation capabilities of the silt-loam (*Soil Erosion Rates Caused by Wind and Saltating Sand Stresses in a Wind Tunnel* [PNL-8478]). As the surface deflates, more and more of the pea gravel becomes exposed, forming a "desert pavement" that armors the surface against further erosion. (As the gravel admixture is merely a supplement to the silt-loam, it is not considered as a separate layer in either the capillary or monolithic barriers.) In blending the pea gravel within the top 30 cm of the barrier, the natural process of the soil and any resultant desert pavement being turned over or tilled by burrowing animals and insects is approximated.

Also, because wind and water erosion potential is a function of the surface slope, the silt-loam surface should be as flat as possible while still allowing for drainage during extreme precipitation events. The slope of the functional portion of the barrier will be set to a nominal 2 percent grade, which is steep enough to provide for coherent drainage from the covered area, yet shallow enough to limit exposure of the surface to wind shear (DOE/RL-93-33).

With everything above being considered, it is anticipated that a monolithic ET barrier for the 221-U Facility disposition would be in the realm of 120 cm thick. Table 4-1 presents the typical design layers of the functional portion of an engineered monolithic ET barrier for the 221-U Facility (as depicted in Figure 4-2).

Table 4-1. Typical Layers of the Functional Portion of an Engineered Monolithic Evapotranspiration Barrier.

Layer No.	Thickness, cm (in.)	Layer Description	Specifications	Function
1	30 (12)	Silt-loam with pea gravel admix	Silt-loam containing 15 wt.% pea gravel and limiting compaction to 80% to 85% relative density as determined by standard Proctor test. The pea gravel typically is blended with the silt with a pug mill prior to placement to produce a homogeneous layer. However, it may be possible that placement of a thin layer of pea gravel and subsequent tilling could produce the same results.	The silt-loam material was identified for optimal water retention properties and should provide a good rooting medium for cover vegetation. Relative density of the silt-loam should be maintained below 85% to facilitate plant growth. The pea gravel has proven in wind tunnel and precipitation impact tests to minimize wind and water erosion of the silt-loam without significantly affecting its moisture retention or plant propagation capabilities.
2	90 (36)	Silt-loam	Silt-loam compacted to approximately 85% relative compaction as determined by standard Proctor test. A maximum of 90% relative compaction also will be specified to augment root penetration.	Same as Layer 1. Collectively, Layers 1 and 2 provide a sufficiently thick soil layer to store water inputs from precipitation events for subsequent removal by evapotranspiration processes. Layers 1 and 2 also provide an adequate rooting depth for the native Hanford Site plant community.
3	Variable	Engineered fill	Clean, granular material compacted to 95% to 98% relative compaction as determined by standard Proctor test.	This layer forms the basic shape/slopes of the barrier and provides a stable subgrade for constructing the overlying layers.

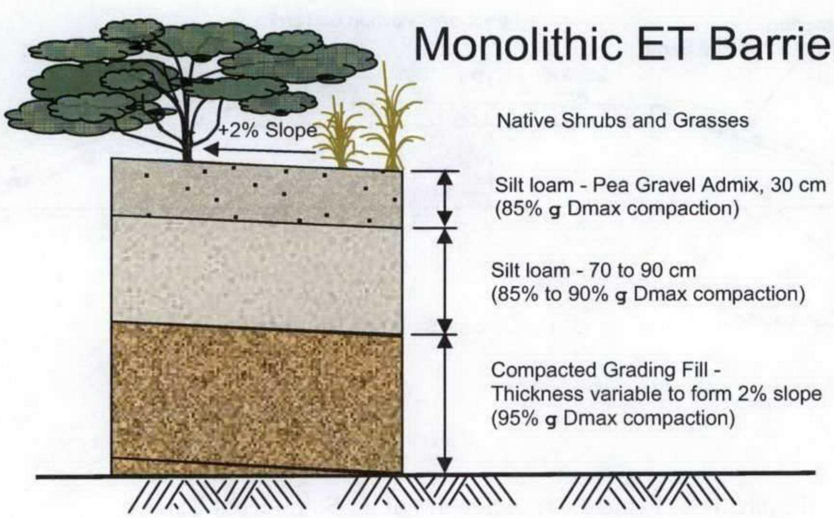

Figure 4-2. Typical Cross Section of the Functional Portion of an Engineered Monolithic Evapotranspiration Barrier.

Vertical cutoff barriers (redundant low permeability layers) or capillary breaks are important design features that will be evaluated during remedial design. The remedial design analysis of the barrier system will be based on the best available data for the specific geologic conditions near the 221-U Facility. Runoff/discharge controls for all expected meteorological patterns, including storms and snowfalls, also will be addressed during remedial design. The remedial design analysis also will include consideration of lessons learned and technical progress from the ongoing site-wide studies of the composite effects of leaving waste on the Hanford Site (composite analysis work). The infrastructure to support sophisticated modeling of subsurface transport of contaminants and barrier performance is being continuously improved and compared to data from field demonstrations and actual installed barriers (*Water Balance Measurement and Computer Simulations of Landfill Covers* [Dwyer 2003]). The remedial design efforts will take advantage of updates in the modeling tools and data sources as they become available.

4.3.2.1 Technical Specifications and Design Drawings

Technical specifications for the engineered barrier will be prepared to support solicitation of a remedial action contractor. Construction of the barrier will require transportation of materials and revegetation. Each technical specification will establish quality and workmanship requirements and define how quality is measured.

Design drawings will be prepared to support solicitation of a remedial action contractor for barrier construction and, together with the technical specifications, make up the technical requirements of the remedial action activities. A typical engineered barrier cross section for the 221-U Facility is provided as Figure 4-3. A cross section of the functional portion of a typical monolithic fill engineered barrier is provided as Figure 4-2. A cross section of a typical side slope erosion protection layer is provided as Figure 4-4. It should be noted that the side slopes will be designed in accordance with the guidance given in the *Design of Erosion Protection for Long-Term Stabilization: Final Report* (NUREG-1623). Actual materials and thicknesses will be determined during detailed design and could be different from that shown herein.

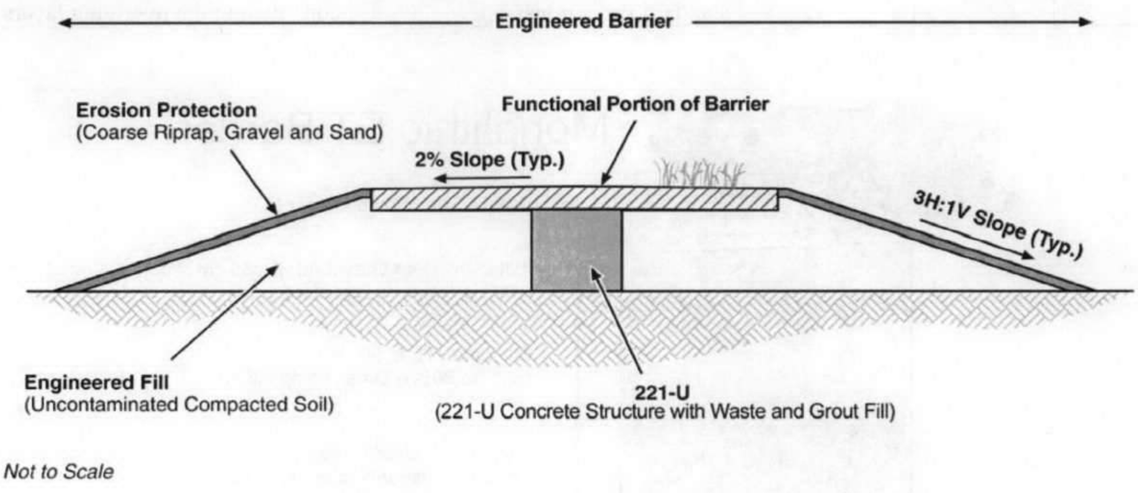

Figure 4-3. Typical Cross Section of an Engineered Barrier.

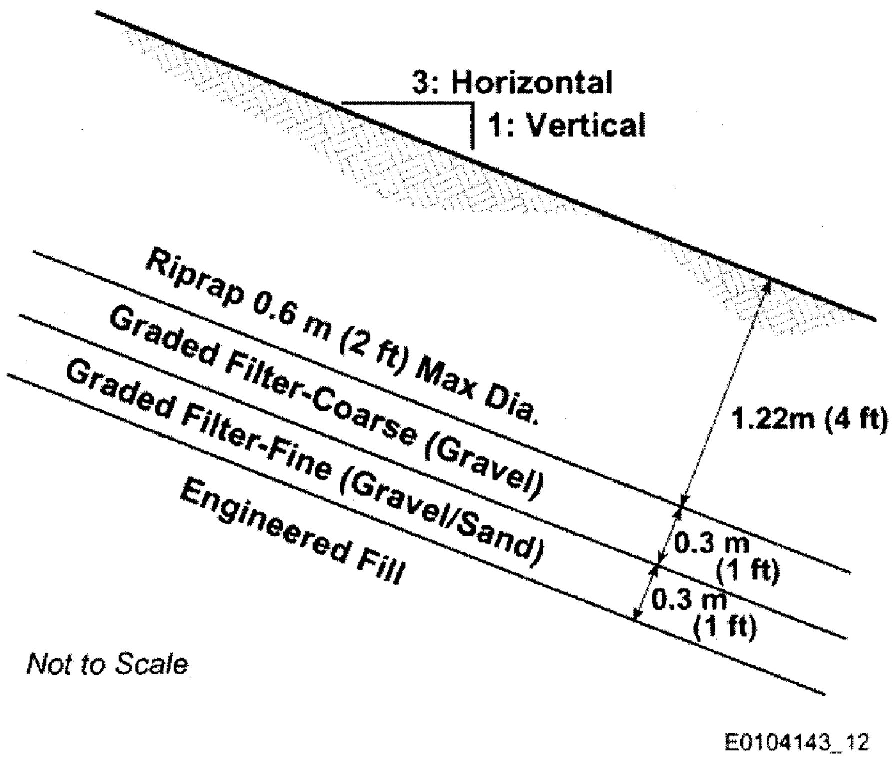

Figure 4-4. Cross Section of a Typical Erosion Protection Layer at the Sideslope of the Barrier.

4.3.2.2 Construction Quality Assurance Plan

A construction quality assurance plan will be developed and implemented to ensure that the barrier is constructed in accordance with the design and specifications. This plan will be in compliance with Tri-Party Agreement Section 7.8 and with the *Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities,* OSWER Policy Directive No. 9472.003, EPA/530-SW-86-031 (EPA 1986c).

4.3.2.3 Design Life

The performance period for the remediated 221-U Facility is 1,000 years. For cost estimating purposes, the barrier was assumed in the final feasibility study (DOE/RL-2001-11) to have a design life of 500 years, necessitating replacement in kind after 500 years to achieve the 1,000-year performance period. However, barrier reconstruction/replacement at 500 years is a conservative assumption and may not be required. Natural analogs and recent barrier design work suggest that such reconstruction is not likely to be required if a simple evapotranspirative barrier design is implemented with proper erosion protection measures incorporated into the design (e.g., gravel admix on the surface, riprap side slopes). Performance expectations are that a barrier that mimics natural analogs will work with nature and behave as the analog does. Because simple ET barrier designs are likely to be very similar to natural soil structures, minimal maintenance should be required.

Construction and initial maintenance will proceed for several years following partial demolition of the facility. Cost estimates provided in the final feasibility study include a number of barrier surveillance and maintenance activities (e.g., quarterly visual inspections for barrier erosion, plant community survival, settlement, subsidence, displacement, cracking), but after a period of roughly 50 years, the facility is expected to be self-maintaining.

4.3.2.4 Engineered Barrier Components

The engineered barrier components described in this RD/RAWP are of a monolithic ET barrier concept. As 221-U Facility barrier design work proceeds, this RD/RAWP will be revised to reflect updated design information.

The functional portion of the engineered barrier has a minimum surface slope of 2 percent for drainage, and uses evapotranspiration to remove water stored within the fine-soil of the barrier. The thickness of the barrier is based on the water storage capacity of the fine-soil and anticipated weather patterns for the Hanford Site. A cross section of the functional portion of a typical engineered barrier is shown in Figure 4-2. Note that simple ET designs mimic natural analogs and generally are self-healing if subsidence occurs. In contrast, complex multilayer barriers with clay or asphalt layers could tend to develop cracking from subsidence, seismic movement, or wetting/drying cycles.

Any geosynthetics used in the construction of the engineered barrier are used as construction aides and are not to be considered as a functional portion of the barrier because the long-term (500-year) performance of geosynthetics could not be extrapolated from existing data.

4.3.2.5 Barrier Stability Analysis

Appendix D of the final feasibility study (DOE/RL-2001-11) addresses barrier stability, including erosion protection, seismic design, and acceptable factors of safety. The engineered barrier used in the stability analyses is a 24-m (80-ft) high barrier that would have been required if remedial action Alternatives 3 or 4 had been selected for the 221-U Facility. The barrier was assumed to be a modified RCRA C barrier for the purposes of cost and material need estimations required in the final feasibility study. The finished environmental barrier for the selected remedial alternative (Alternative 6) will be roughly 11 m (35 ft) high and likely will be a simpler ET barrier, such as shown in Figures 4-2 and 4-3. The stability analysis results provided in Appendix D of the final feasibility study are considered bounding for the lower barrier required under the selected alternative. Analyses specific to the lower barrier required for the selected alternative will be completed as remedial design proceeds.

4.3.2.6 Final Design Package

The design of the 221-U Facility engineered barrier will draw on ongoing barrier design and modeling work across the United States and at the Hanford Site. The analysis will include evaluation of the effects of extreme storm events, range fires, and other natural phenomena that might occur during the life of the barrier and that might have an effect on performance. The design and size of the functional portion of the barrier and the size of the barrier footprint will be driven primarily by the need to provide a barrier to intrusion into the grouted waste remaining onsite at the conclusion of the 221-U Facility remedial action. However, the 221-U Facility barrier is being identified in other Hanford Site CERCLA response action documentation as a potential remedy for nearby contaminated soil sites. As a result, barrier design may need to factor in provision of a barrier function at these adjacent sites, resulting in expansion of the final barrier footprint.

A design package consisting of final technical specifications, calculations, and "issued for bid" drawings stamped by a Registered Professional Engineer licensed in the state of Washington will be completed before the initiation of engineered barrier construction activities.

5.0 REMEDIAL ACTION APPROACH

The selected 221-U Facility remedy, as documented in the ROD, is Alternative 6, Close in Place – Partially Demolished Structure. The remedial action work scope includes performing structural demolition and barrier construction activities and furnishing necessary facilities, equipment, labor, materials, supplies, and tools. The following subsections provide a summary of the remedial action approach.

The selected remedy for the 221-U Facility includes four primary components: demolition and barrier construction (the "construction component"), post-remediation care and environmental monitoring, institutional controls, and 5-year review. The construction component of the remedy is further divided into a predemolition phase, a demolition phase, and a barrier construction phase. Key activities associated with each phase are as follows:

- Address hazards: Identify and control health, safety, and environmental hazards throughout the duration of the remedial action

- Predemolition phase:

  – Reactivate and/or upgrade as necessary the 221-U Building cranes, electrical system/lighting, ventilation system, and railroad tunnel

  – Remove liquid from a tank in cell 30 that, if stabilized in place, would contain levels of transuranic isotopes greater than 100 nCi/g, and treat as necessary to meet receiving facility waste acceptance criteria

  – Remove other liquids as practical, if found, from the facility or provide treatment to remove liquids

  – Size reduce (as necessary) and consolidate contaminated equipment located on the canyon deck into below-deck locations (e.g., into the process cells)

- Demolition phase:

  – Partially remove contaminated equipment and piping from the gallery side of the facility, as needed to facilitate demolition activities

  – Grout, to the maximum extent practical, internal vessel spaces, as well as cell, gallery, pipe trench, drain header, and other spaces within the facility as well as demolition rubble, as necessary

  – Demolish the 271-U, 276-U, 291-U, and 292-U structures and the 291-U-1 and 296-U-10 stacks, and dispose of the resulting waste at the ERDF or other approved disposal facilities (or use the waste as barrier fill material if it is minimally contaminated and does not contain hazardous waste)

  – Demolish the railroad tunnel buttresses to the degree necessary

- Stabilize and/or fill depressions at the former locations of these structures to support construction of the engineered barrier

- Demolish the roof and wall sections of the 221-U Facility down to approximately the deck level and use the resulting rubble as fill material for the engineered barrier

- Barrier construction phase (Figure 2-2):

  - Construct an engineered barrier in accordance with an approved remedial design over the building and demolition debris

  - Seed/plant the engineered barrier surface with native grasses and shrubs to stabilize barrier materials and improve ET rates

  - Seed the disturbed areas in the immediate vicinity of the 221-U Facility with native grasses and shrubs for surface reclamation purposes consistent with the expected future industrial land use.

The remedial action approach to completing each of the construction component activities, to conducting post-remediation care and environmental monitoring, and to implementing institutional controls is described in the paragraphs that follow.

5.1 ADDRESS HAZARDS

Implementation of the selected 221-U Facility remedy will require the identification and mitigation of potential hazards to personnel and the environment. This section addresses these predecessor activities to remedy implementation.

5.1.1 Hazard Identification

The potential personnel and environmental hazards associated with the selected remedy are a combination of high hazards normally encountered during routine operations and hazards involving the nonroutine activities of large-scale demolition and construction operations. The hazards are both industrial and radiological in nature.

Industrial hazards associated with the selected remedy will be similar to those that are encountered on any large-scale construction and demolition project, including unique hazards associated with demolition operations that include crane operation, concrete sawing, and excavator operation. Typical hazards will include moving machinery, falling, tripping, cutting, sound exposure, and dust inhalation. The risk of injury due to these hazards is addressed in national Occupational Safety and Health Administration and Washington Industrial Safety and Health Administration safety regulations, as well as the Hanford Site-specific procedures that implement the codes. Compliance with the applicable safety codes, regulations, and procedures will mitigate the risk posed by industrial hazards.

High radiation areas and very high radiation areas will be encountered during equipment consolidation and waste removal activities. For example, approximately 25 percent of the cells have equipment and materials that have high radiation levels that exceed 1,000 mrem/h. The maximum gamma dose rate in cell 30 was 190,000 mrem/h (BHI-01565). Also, the most significant radiological hazard anticipated during operational activities will be the generation of airborne contamination.

5.1.2 Hazard Control

Hazard mitigation will involve the implementation of physical and administrative controls that address protection of both personnel and the environment. Access to the worksite will be administratively controlled through use of a site-entry procedure. Physical controls may include installation of a perimeter fence, as necessary. The site-entry procedure will require either training or escorts for site visitors.

Initially, remedial activities will be conducted and controlled using surveillance and maintenance contractor operations and maintenance procedures and radiological work packages. These surveillance and maintenance contractor documents establish the frequency and activities necessary to monitor, control, and thereby preclude potential health and safety impacts and equipment failure. Surveillance and maintenance contractor documents also describe the preventive maintenance and instrument calibrations required to maintain the remaining active equipment. The radiation protection procedures, radiation work permits, and radiological condition assessments describe the radiological control activities such as posting, access control, work place air monitoring, and radiological surveys.

Access to the local work site will be controlled and maintained with barriers and signs warning personnel of the specific work site hazards. Heavy equipment will use audible warning signals when backing up. Personnel will wear hard hats, safety glasses, and safety shoes as a minimum and any additional safety equipment as required by job-specific requirements. Administrative controls will include the implementation of programmatic plans, procedures, job safety analyses, and applicable work permits to operate hazardous equipment and enter hazardous areas.

Specific hazard control activities will include, but not be limited to, readiness evaluations, hazard classifications, waste designations, waste profiles, a health and safety plan, and site-specific waste management instructions. Integral to these activities will be hazardous material and radioactivity surveys that will be undertaken prior to initiating significant action in the facility (e.g., crane upgrades, waste removal).

Mitigation of airborne contamination can be accomplished as needed with local exhaust ventilation of the decontamination equipment, personal protective equipment, the existing facility exhaust system, and/or administrative controls and physical controls. Decontamination or fixing of loose or smearable contamination will be performed prior to any removal/demolition activities, as needed. Radiological limits for worker protection are provided in 10 CFR 835, "Occupational Radiation Protection."

Nonroutine activities will require special procedures and equipment so that the risk of exposure is properly mitigated. Safety criteria will be determined on a case-by-case basis; however, criteria will require that exposures be ALARA. Administrative controls will include radiation work permits, exposure limits, and escort requirements. Physical controls will include barriers, postings, and personnel surveys. In accordance with site procedures, administrative and physical controls applicable to this project will be defined in job-specific work plans and procedures. Compliance with the job-specific work practices and procedures will ensure that personnel exposures do not exceed allowable limits.

During demolition activities, implementing a combination of procedural and physical controls will mitigate dispersion of contaminants. Procedural controls typically will consist of wind-speed restrictions on work activities. Also, demolition techniques will be controlled to minimize contamination dispersion. Physical controls will include spray fixatives (e.g., water sprays and chemical coagulants), minimizing the size of the work area, guniting/grouting, and/or covering with clean fill. Radiation air monitoring during demolition will be performed on the work site perimeter to confirm the effectiveness of airborne contamination control.

The potential for water migration also will be mitigated by implementing a combination of procedural and physical controls. Procedural controls will consist of work restrictions during significant precipitation or wind events if the potential for contaminant migration exists. Physical controls will include a combination of temporary shelters and/or sealing products. Demolition activities will be scheduled to occur after contamination control measures have been implemented.

Personnel and equipment leaving the site present a risk of contaminant migration. This risk will be mitigated by procedural and physical measures. Work procedures will require equipment used on the site and exposed to dangerous/radioactive wastes to be decontaminated before the equipment is released. Personnel working at the site will wear proper protective clothing. Protective clothing exposed to dangerous/radioactive wastes will be controlled in accordance with Hanford Site procedures. Personnel leaving radiologically contaminated areas will require an exit survey before leaving.

5.2 PREDEMOLITION PHASE

To prepare the 221-U Facility for demolition, various canyon systems will have to be reactivated and/or upgraded, waste treated in and/or removed from the facility, and equipment consolidated into below-deck locations. These activities are described in more detail in the following sections.

5.2.1 Prepare Facility for Use

The building must be put in a safe condition for remedial activities. This will require radiological surveys, fixing or removing contamination, a building inspection for industrial safety concerns, and equipment repairs or upgrades. It is assumed that the 271-U Building will be needed for support. Minimal 271-U Building/equipment repairs or upgrades may be needed, and the building will be maintained in a safe condition.

5.2.2 Establish Infrastructure

Implementation of the selected remedy will rely heavily on the existing 221-U Facility Complex infrastructure. Mobilization activities, including preparation of staging areas, and some modification of the existing building, equipment, and utilities will be necessary.

The existing utilities will be used to support remedial activities, when possible. It is envisioned that the existing road network within the complex will be used, and water and electrical services will be modified as required to support the remedial activities and engineered barrier placement. The existing road network surrounding the 221-U Facility will adequately accommodate heavy equipment during demolition operations, as well as waste-hauling traffic to the ERDF. Additional spurs off paved roadways for heavy equipment access will be constructed, as required. The railroad tunnel will be reactivated to support equipment access to the canyon and waste removal.

Immediately prior to demolition of 271-U, water mains and sewer pipelines located within the engineered barrier footprint will be sealed (or verified as previously sealed) at the outer edge of the engineered barrier. Temporary water lines will be installed, as required, for sanitary requirements, fire-suppression systems, decontamination operations, and dust control. Main transformers for electric power to the 221-U Facility will be relocated outside of the perimeter of the engineered barrier prior to barrier construction. Temporary 480-V electrical lines and panels will be installed in the building, as required, for lighting, ventilation, and equipment operations.

The selected remedy will require administrative offices, change rooms, tool rooms, lunchroom, restrooms, and storage rooms. Mobile office units and 271-U will provide project support space. A construction perimeter fence will be installed as needed to control access into and out of the work zone. Existing telephone and electrical lines will be used to support office and clerical requirements. Existing Hanford Site fire protection and ambulance services will be adequate for emergency response.

Personnel staging areas will be provided for the support facilities. Equipment storage, decontamination areas, survey tents, container storage, and other staging requirements also will be included in the layout of support requirements.

5.2.3 Modify Facility

Facility modifications will primarily involve disconnecting and blanking utility and electrical lines where they are no longer required and installing temporary utilities that will be required to support planned actions. The *221-U Facility Reactivation Engineering Study* (CP-29430) addresses ventilation, electrical, lighting, and crane requirements for the remedial action and concludes that limited modifications to the 221-U Facility are necessary to accomplish waste removal, equipment consolidation, and decontamination activities. The canyon cranes will be upgraded, the electrical and lighting systems will be enhanced, and the railroad tunnel will be reactivated to support waste removal and equipment consolidation activities.

The existing main bridge crane will be recertified for use to support equipment handling within the canyon. At the same time, modifications and repairs will be made to the cranes, to improve efficiency and facilitate safe working conditions.

Additional 480-V electrical service requirements will be installed, as necessary, to support portable ventilation requirements and selected decontamination equipment, such as air compressors for pneumatic tools and temporary greenhouse structures. In addition, 480-V electrical service may be installed to support decontamination/disassembly/size reduction operations.

The railroad tunnel will be reactivated for use. Part of the railroad tunnel work could include construction of a truck door at the tunnel's connection to the 221-U Facility (cell 3). This door will allow access to the building without disrupting ventilation of the canyon.

If required to support safe working conditions, a new roof covering may be installed to prevent precipitation from entering the building.

The change room at the northeast end of the operating gallery may be renovated and established as the main access and egress point for canyon operations. Water and drain lines for the change room facility can tie into the active systems in the 271-U Office Building.

5.2.4 Remove Cell 30 Liquid

A tank in the 221-U Facility cell 30 contains liquid with elevated levels of transuranic isotopes that must be shipped to the CWC, and ultimately to WIPP. The tank contains less than 200 gal of crusted liquid with a pH less than 1.0. There are high concentrations of nitrates, transuranic isotopes (more than 200,000 nCi/g before stabilization), cesium, and strontium. A 30 mL sample bottle had a contact radiation dose rate of 17,500 mR/h. The in-cell dose rates are likely to be very high; most of the activities to handle the liquid will need to be accomplished remotely. Stabilization of this liquid likely will involve neutralization and solidification prior to packaging and shipment to the CWC. These activities will be undertaken only after completion of extensive work planning, preparation, and readiness evaluation.

5.2.5 Consolidate Contaminated Equipment in 221-U Building

A large volume of contaminated equipment resides on the canyon deck and in the process cells. Some of the equipment on the canyon deck will be reduced in size and volume as needed to facilitate consolidation into below-deck locations (the process cells and pipe trench). Minimizing size reduction activities will significantly reduce worker exposure.

An optimization study (*221-U Facility Canyon Equipment Size Reduction Engineering Study* [D&D-29932]) for dispositioning the canyon deck equipment concludes that extensive size reduction is not required to fit all of the equipment into the cells and pipe trench. Much of the size reduction will be for agitators and pumps with long tubular sections that can be readily sheared into shorter sections as required. There are also a number of work platforms and lifting fixtures that may require mechanical saws and/or shears for effective size reduction. In general, large tanks will not require size reduction.

The optimization study identifies a variety of size reduction technologies that may be used. The study recommends that the bulk of the size reduction activities be performed using shears that can be mounted on the cranes and or on a skid-steer loader. Hand-held equipment that could also prove helpful includes but is not limited to abrasive cutters, mechanical saws, and nibblers.

The large equipment will be dispositioned into the cells using the existing canyon cranes. A skid-steer loader or a light fork lift may prove helpful in handling the smaller, miscellaneous equipment. Mobile lifting frames may be used to disposition the smaller items.

Disposition of canyon equipment involves radiological and industrial hazards such as the following:

- Exposure to radiological contamination and elevated dose rates
- Fire hazards associated with cutting equipment
- Exhaust inhalation hazards from motorized equipment
- General industrial hazards (e.g., falls, trips, high temperature, noise).

The above hazards will be addressed through proper application of the work planning process.

Administrative and engineering controls will be required to reduce worker exposure from external and internal exposure sources.

5.3 DEMOLITION PHASE

During the demolition phase of the 221-U Facility remedial action, canyon voids will be grouted, the railroad tunnel will be dispositioned, interior canyon building surface contamination will be addressed, and the external area surrounding the canyon will be prepared to provide access to canyon demolition equipment. Finally, the roof and upper walls of the canyon structure itself will be demolished to near deck-level. These activities are described in more detail in the following sections.

5.3.1 Grout Canyon Voids

Cementitious grout will be pumped into the galleries, cell drain header, process cells, tunnels, trenches, and tanks containing residual materials to the maximum extent practical, to minimize the potential for void spaces and to reduce the mobility, solubility, and/or toxicity of the grouted waste. A cementitious grout will be developed using fillers and admixtures as needed to optimize mechanical, structural, and chemical properties while reducing the potential for leaching of radioactive isotopes. Addition of grout amendments such as fly ash or zeolite clays and the cost-benefit of using a soil-cement grout mixture will be considered during detailed design for grouting activities.

The volume of void space, grout formulation, and method of grout emplacement will be determined during the detailed design effort. The grout will be formulated to reduce the potential for shrinkage, ungrouted voids, and leaching of radioactive isotopes.

5.3.1.1 Grout 221-U Building Process Cells

Following completion of legacy equipment consolidation activities, the canyon process cells will be filled with cementitious grout to encapsulate equipment in the cells and to provide support for the engineered barrier placed above. The flowable grout fill will be directed into equipment within the cells to minimize voids to the maximum extent practical. Grout will be pumped in lifts at a controlled rate to maintain loading on the cell walls to a structurally safe level and to disperse the heat of hydration over an acceptable time period. Placement of the final lift of grout will be carefully controlled to minimize the potential for void spaces under the cover blocks.

5.3.1.2 Grout Cell Drain Header

The cell drain header will be filled with cementitious grout as a part of the canyon cell grouting effort. This grouting will close off interconnections between the cells. Flowable grout will fill the 0.6-m (24-in.) diameter void space and encapsulate any contamination present in the pipe. Grout will be pumped into the cell drain header. Drainage openings in each process cell will act as air vents, and permit the grout to flow into the process cell drains.

5.3.1.3 Grout 221-U Building Galleries

The three 221-U Building galleries contain piping, electrical runs, and instrumentation. Some equipment in these galleries contains low levels of radiological and chemical contamination, as well as asbestos. The 221-U Facility ROD states that contaminated equipment and piping in the galleries will be partially removed as necessary to facilitate remedial action demolition activities. The ROD contains an illustration indicating that legacy equipment will be removed from the canyon operating gallery, and that the operating gallery will be partially demolished, leaving only a heavily-reinforced, thick concrete stub wall, which divided the operating gallery from the canyon deck, above the canyon deck level. Following issuance of the ROD, the assumption that the operating gallery would be partially demolished was further evaluated in the *221-U Facility Demolition Study* (D&D-29971).

The demolition study concluded that the equipment in all three canyon galleries should be grouted in place and the operating gallery left intact to lower worker exposure to hazardous working conditions that would exist if gallery piping and equipment were manually removed, to lower dust emissions that would be associated with partial demolition of the operating gallery, and to lower significantly the cost of demolition. Any contaminants that might be left within the galleries would be effectively encapsulated within the grouted monolith of the remediated canyon and buried beneath the engineered barrier. As documented in the demolition study, leaving the operating gallery intact and grouting the gallery equipment in place will not significantly raise the final facility elevation or that of the engineered barrier.

Each of the three canyon galleries will be filled with cementitious grout to encapsulate equipment inside and to provide support for the engineered barrier placed above. The galleries likely will be filled from lowest elevation (electrical gallery) to highest elevation (operating gallery). Grout will be pumped at a rate to maintain loading on the gallery walls to a structurally safe level and to disperse the heat of hydration over an acceptable time period. The flowable grout fill will be pumped under low pressure to fill voids.

5.3.1.4 Grout Hot Pipe Trench

The hot pipe trench is assumed to be contaminated. The trench contains intertwined piping that runs at varying elevations in the hot pipe trench, leaving some room for placement of canyon deck equipment that is only a few feet tall. If needed, some of the piping could be size reduced in place to make additional room for long thin pieces of legacy equipment from the canyon deck. After completion of legacy equipment consolidation activities, the trench will be filled with cementitious grout.

5.3.1.5 Grout Ventilation Tunnel

Once the 221-U Building ventilation is shut off, the ventilation tunnel will be grouted to eliminate voids in the building structure. Free-flowing cementitious grout will be used to fill the ventilation tunnel to the maximum extent practical. The grout will be placed at a controlled rate to allow time for heat dissipation during grout curing. It is estimated that the ventilation tunnel will require approximately 2,300 m^3 (3,000 yd^3) of grout.

5.3.2 Disposition Railroad Tunnel

The tunnel, which allowed train access into cell 3, extends approximately 46 m (150 ft) westward from the northwest side of the canyon building. The tunnel is a reinforced concrete structure with a soil cover about 1.5 m (5 ft) thick. There are unreinforced wing-wall retaining structures at the end of the tunnel. The tunnel is assumed to have light surface contamination that can be fixed in place with fixative application.

The portion of the railroad tunnel that extends beyond the external wall of the canyon will be dispositioned. The tunnel walls and retaining structures will be left in place or demolished, as necessary to support follow-on demolition and disposition activities, and the remaining depression will be backfilled with grout or fill materials to improve demolition equipment access to the 221-U Facility.

5.3.3 Fix Contamination on 221-U Building Interior Surfaces

Surface contamination on the canyon walls, canyon decks, and ceiling will be addressed to prepare the canyon for the start of demolition activities. Likely methods of addressing surface contamination are to cover the surface with fixatives or grout before demolition of the upper canyon structure begins.

5.3.4 Modify External Area

The following modifications will be performed to support partial demolition of the 221-U Building. The legacy structures that are physically attached to 221-U Building and any structures remaining within the engineered barrier footprint must be removed. The remediation status of waste sites within the footprint of the engineered barrier will be verified to ensure that these sites have either been remediated in accordance with an applicable decision document or that the decision document identifies the selected remedy as burial beneath an engineered barrier. In addition, electrical and water utilities within the footprint of the engineered barrier will be isolated, blanked, and/or re-routed.

Waste generated from demolition of attached and impacted ancillary structures will be shipped to the ERDF or other approved locations. Minimally contaminated rubble, which does not contain hazardous waste, from other nearby CERCLA demolition activities, such as the ancillary structures, will be considered during remedial design for use as fill material in the engineered barrier. Decontaminating and recycling steps may be included to support DOE waste minimization goals if economically feasible.

5.3.4.1 Demolish the 276-U Solvent Recovery Facility

The 276-U Solvent Recovery Facility, attached to the southwest end of the 221-U Building, is composed of walkways, vessels, and associated piping set in an open-concrete basin. Demolition will involve removing the walkways, vessels, and aboveground piping. The concrete basin and underground piping will be left in place. Pipe penetrations associated with this structure will be cut, sealed, and capped. Drains will be sealed with concrete. Contaminated concrete surfaces will be decontaminated, or the contamination will be fixed.

5.3.4.2 Demolish the 271-U Office Building

This building is a concrete framed structure built against the northwest face of the 221-U Building. It consists of a basement, three floors above the basement, and a reinforced concrete slab roof. The 271-U Building has nominally 1- or 2-ft-thick walls. The building perimeter walls are of concrete masonry supported on the basement walls, and there are interior masonry walls inside the building. The third floor served as a chemical makeup area with floor slabs up to 0.3 m (1 ft) thick that support chemical vessels. Additional building features to be included in the demolition are the 296-U-10 roof stack, an elevator, a second floor vault, and mechanical equipment in the basement. This building can be taken down using conventional demolition equipment. It is anticipated that rubble resulting from the demolition of this structure will be consolidated into the building's basement. This rubble can be grouted or compacted with soil as a base for the engineered barrier.

5.3.4.3 Disposition Remaining Structures, Piping, Wells, and Waste Sites

The 291-U and 292-U aboveground structures and the 291-U-1 Stack will be demolished as part of the 221-U Facility remedial action. Details of the demolition methodology and emission controls will be developed as the remedial design progresses. The former locations of these structures then will be stabilized to support construction of the engineered barrier. Prior disposition (by other projects) of any other aboveground structures within the footprint of the engineered barrier will be verified to ensure that remedial or removal actions are implemented as required.

Piping, wells, and waste sites within the footprint of the engineered barrier will be dispositioned by other projects prior to placement of the engineered barrier. Completion of these disposition activities will be verified as part of this remedial action.

5.3.4.4 Prepare Working Area Adjacent to 221-U Building

The areas adjacent to the 221-U Building will be prepared (e.g., shaped and compacted) to provide a firm working area for canyon structure demolition equipment access.

5.3.5 Partially Demolish the 221-U Building

The preceding paragraphs describe actions required to prepare the 221-U Building for partial demolition. Equipment within the building will have been dispositioned, void spaces filled with grout, contamination on exposed surfaces inside the canyon addressed, and the surrounding area prepared to support canyon demolition. Waste generated during building preparation for demolition will have been emplaced at the ERDF or other approved facilities. This section describes the actions required to partially demolish the 221-U Building.

The 221-U Facility demolition study (D&D-29971) was commissioned to examine the technical, environmental, regulatory, nuclear safety, and financial feasibility of demolishing the canyon down to approximately the deck level. The basis for this study included engineering investigations and preliminary evaluations of alternatives along with the results of an informal value engineering session. The study provides recommendations regarding demolition alternatives and final facility configurations of the demolished canyon shell. The conclusions of the study are summarized in the following paragraphs. The demolition techniques described in the following paragraphs may be modified as detailed design progresses.

Ten stairwells on the southeast side of the 221-U Building are of thick-wall, lightly reinforced, concrete construction. Eight stairwells on the northwest side of the 221-U Building are of light construction. If contamination is found in the stairwells, it will be fixed in place prior to demolition. The stairwells will be demolished using conventional demolition techniques. The resulting rubble will be grouted or compacted with soil as a base for the engineered barrier.

Before demolition, the inner walls of the canyon structure above the deck level will be decontaminated, or the contamination will be addressed with fixative or encapsulated in grout. The canyon stairs, roof, and walls will be demolished down to approximately the deck level using a hybrid approach. This approach relies on large tracked excavators using universal processor type shears with concrete cracking jaws to crush the concrete and cut the reinforcing steel. Universal processors are available with a concrete crushing jaw opening of 72 in. These jaws can break even the 5-ft thick walls in the upper portion of the structure. However, such challenging use of the jaws may increase equipment maintenance requirements significantly, resulting in diminished productivity and increased worker hazard associated with equipment change-outs. Should this occur, it may become necessary to employ other means to pre-soften roof and wall areas of thicker and stronger construction. Pre-splitting of such areas could be completed safely and efficiently with expanding grout or controlled blasting. Explosives have proven over the years to provide reliable and safe results for concrete demolition. If explosives are required, small-diameter holes could be drilled for placement of charges, and blasting would be accomplished with a small quantity of high-velocity explosives. Dust emissions could be effectively controlled by covering the structure with geotextiles, blast mats, water spray, and fixatives as needed.

Debris resulting from stair, roof, and wall demolition will be allowed to fall to the deck and ground around the structure for eventual burial beneath the engineered barrier. Use of this rubble as barrier fill will limit impacts on soil borrow areas that will be used to supply material for the engineered barrier. The deck may be covered with expanded (highly compressible) grout that can absorb the impact of debris as it lands on the deck. After the structure above the work area has been removed, the rubble will be graded, compacted, and/or otherwise stabilized. Controls (e.g., water sprays and brattices) will be employed to minimize releases of contaminated dust to the air, and air monitoring will be conducted to confirm the effectiveness of controls.

5.4 BARRIER CONSTRUCTION PHASE

This function will consist of constructing the engineered barrier over the building, demolition debris, and nearby waste sites. This function will also involve restoring the excavated and disturbed sites (including laydown and equipment staging areas) to a grade consistent with the natural surface topography. The engineered barrier will be designed to prevent recharge rates greater than 3.2 mm/yr long-term average in order to mitigate, or eliminate, the potential for contaminants to migrate to groundwater.

5.4.1 Engineered Barrier Components

The engineered barrier for this remedial action consists of three parts: engineered fill, engineered barrier, and erosion protection (Figure 2-3). This application of an engineered barrier is unique in that the top of the barrier is approximately 35 ft above the surrounding grade. This affects the seismic event factors used for barrier design and consequently the barrier layout as described below.

A preliminary two-dimensional stability analysis was completed for the engineered barrier. The controlling factor for this analysis was to select a barrier layout that can remain functional after enduring a design seismic event. This analysis was key in determining the physical layout of the engineered barrier geometry. Briefly, the analysis finding was that the engineered barrier must be as flat as possible. Therefore, the functional portion of the barrier is sloped at a nominal 2 percent. In addition, the barrier must extend out far enough from the 221-U Building that a potential crack (estimated to be 5 cm [2 in.] or less), due to movement in the 3 horizontal to 1 vertical (H:V) side slope (e.g., from a seismic event), will be outside the area requiring infiltration protection from the barrier. With these layout steps addressed, the engineered barrier can provide the required containment during a minimum 500-year life. Detailed design information for the engineered barrier will be developed during the final design phase.

5.4.1.1 Engineered Fill

The engineered fill will be clean, compacted, granular material, which will be placed in lifts. Its source is assumed to be a Hanford Site borrow pit within 24 km (14.9 mi) of the 221-U Building. Borrow materials for the engineered barrier will be taken from approved areas of the Hanford Site including, but not limited to, Area C (fine grained soils) and the ERDF (sand and gravelly sand). Soil properties for these and other borrow sites can be found in PNNL-15464. The use of minimally contaminated rubble, which does not contain hazardous waste, from other nearby CERCLA demolition activities (such as the ancillary facilities), suitable for use as compacted soil fill material in the engineered barrier, will be considered during the final design phase to decrease the amount of borrow materials needed. The approximate extent of the engineered fill and engineered barrier is shown in Figure 2-2. Final design of the engineered fill will determine the compaction requirements and the material specifications.

Where fill material consists mostly of rubble or very large particles, finer grained fill soils may gradually settle into the open pores or spaces of the coarser material, which eventually may cause localized subsidence. To counteract subsidence, graded filters may be required. These filters likely will consist of commercially available gravels, with the gradation selected on the ability to bridge the openings in the previously placed material.

5.4.1.2 Engineered Infiltration Barrier

The engineered barrier will be designed to prevent unintentional human and biotic intrusion, minimize potential human and biotic exposures, and control potential contaminant migration by preventing water infiltration. The infiltration barrier thickness will be up to 4.6 m (15 ft), which effectively breaks the pathway for direct contact with contaminants.

The barrier performance period is 1,000 years. The barrier will be designed to provide protection against water infiltration and biotic intrusion for at least 500 years. For cost estimating purposes, the barrier was assumed in the final feasibility study to have a design life of 500 years, necessitating replacement in kind after 500 years to achieve the 1,000-year performance period. However, barrier reconstruction and/or replacement at 500 years is a conservative assumption and may not be required to provide containment of the 221-U Building for 1,000 years, particularly if a simple ET barrier is used. The remedial design will evaluate barrier options that will minimize maintenance and reconstruction needs. The barrier will be vegetated to control soil erosion and promote transpiration. The total volume of material that will be required for the engineered barrier will be determined during final design.

5.4.1.3 Erosion Protection

The top of the engineered barrier will be sloped at a nominal 2 percent; the top layer will be vegetated and likely will consist of pea gravel admix. Therefore, once vegetation is established, erosion from precipitation and wind should not be a concern. To reduce the volume of the engineered fill while providing stability during a seismic event, it is likely that a 3H:1V side slope will be selected for the engineered fill. This slope will require placement of a basalt riprap-type layer for erosion protection. The erosion protection layer may include gravel and sand filter layers to carry the runoff safely to the outer toe of the engineered barrier.

5.4.2 Revegetate Site

The excavations from demolition activities will be backfilled, and fill contours will match adjacent contours. Areas disturbed by demolition activities will be prepared for surface restoration. If required under the industrial land use for the 200 Areas, the majority of restoration will be application of an approved native seed mixture with input from various interested local tribal nations.

5.4.3 Clean Up Complex

Before leaving the complex, the demolition contractor will clear the site of unnecessary project-related equipment and materials.

5.5 SUSTAIN POST-REMEDY CONFIGURATION

Closure of the complex for this remedial action will require institutional controls and maintenance of a monitoring system. Institutional controls can consist of both physical and legal barriers to prevent access to contaminants. In addition, certain activities will need to be prohibited so that the groundwater and Columbia River water quality are protected. Post-remediation care will include periodic inspections and maintenance to verify the success of the revegetation effort.

A closeout report will be prepared for regulatory agency approval. The final remedial action closeout report is discussed further in Appendix A of this RD/RAWP.

5.5.1 Establish Institutional Controls

Institutional controls are non-engineering instruments, such as administrative and/or legal controls, that are designed to prevent exposure to contamination by limiting land or resource use. Cleanup at the 221-U Facility site is based on the assumption that the remedy will effectively isolate contaminants and break exposure pathways. However, the land use will be restricted indefinitely due to an industrial land-use designation for the Hanford Site's 200 Area and the probability of residual contamination remaining after remedial actions above levels that would allow for unrestricted use. In addition, groundwater use will be restricted for the foreseeable future until drinking water standards are achieved. The groundwater is contaminated primarily with radionuclides and some hazardous chemicals (e.g., carbon tetrachloride) from releases from other units in the Hanford Site's 200 West Area. Human exposure to residual contamination must be limited to those levels calculated to be protective under the industrial exposure scenario. In addition, certain activities will be prohibited to ensure that the remedy is protected and that the groundwater and Columbia River water quality are protected as well. Hence, institutional controls are an integral part of the selected remedy.

The DOE is responsible for implementing, maintaining, reporting on, and enforcing the land-use controls required under the 221-U Facility ROD (EPA 2005). Although the DOE may later transfer these procedural responsibilities to another party, by contract, property transfer agreement, or through other means, DOE will retain ultimate responsibility for remedy integrity. The current implementation, maintenance, and periodic inspection requirements for the institutional controls at the Hanford Site are described in approved work plans and in the *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE/RL-2001-41), which was prepared by DOE and approved by EPA and Ecology in 2002. One requirement listed in the Sitewide Institutional Controls Plan is the commitment to notify EPA and Ecology immediately upon discovery of any activity that is inconsistent with the land-use designation of a site.

The Sitewide Institutional Controls Plan has been amended to include the institutional controls required by the 221-U Facility ROD (EPA 2005). The institutional controls required during implementation of the construction phase of this remedial action will be incorporated into contractor operations and maintenance procedures.

The following institutional controls are required through the time of completion of the construction component of the remedy:

- The DOE will control access to prevent unacceptable exposure of humans to contaminants at the 221-U Facility site addressed in the scope of the 221-U Facility ROD (EPA 2005) until remedy construction is complete. Visitors entering any site areas are required to be badged and escorted at all times.

- No intrusive work will be allowed at the 221-U Facility site unless the EPA and Ecology have approved the plan for such work and that plan is followed.

- The DOE will prohibit well drilling at the 221-U Facility site except for monitoring, characterization, or remediation wells authorized by EPA and Ecology.

- Groundwater use at the 221-U Facility site is prohibited, except for limited research purposes and monitoring and treatment authorized in EPA- and Ecology-approved documents. This prohibition applies until drinking water standards are achieved and EPA and Ecology authorize removal of restrictions. Decision documents for the 200-UW-1 source operable unit and 200-UP-1 groundwater operable unit as well as the Sitewide Institutional Controls Plan will contain the institutional controls and implementing details prohibiting well drilling and groundwater use in the U Plant Area and portions of the 200 West Area as defined in those decision documents.

- The DOE will post and maintain warning signs along access roads to caution site visitors and workers of potential hazards from the 221-U Facility site.

- In the event of any unauthorized access to the site, such as trespass, the DOE will report such incidents to the Benton County Sheriff's Office for investigation and evaluation of possible prosecution.

5.5.2 Maintain Monitoring System

Performance monitoring of the barrier will be conducted to allow implementation of appropriate measures/best management practices, as necessary, to impede percolating water from reaching the underlying waste. The final design of the engineered barrier will provide the specific details on any engineered features to accomplish performance monitoring. Groundwater monitoring will be performed to monitor the effectiveness of the remedial action.

Groundwater monitoring for the 221-U Facility will be integrated and defined in a 221-U Facility operations and maintenance plan. This plan will encompass the 221-Facility and will integrate the monitoring needs associated with the various projects (such as 200-UP-1 Operable Unit groundwater monitoring, the U Plant Area, ancillary facilities) and other monitoring requirements for the selected remedy (such as barrier performance monitoring). Additional integration will be accomplished for the

221-U Facility specific to the institutional controls required with the preferred remedy, as well as needs associated with these various other projects.

Post-remediation care will comply with the following functions as defined in WAC 173-303-665(6). (The functions were selected as being representative of the post-remediation requirements of other applicable regulations.)

- Limit access to the environmental barrier.
- Maintain the integrity and effectiveness of the final cover (engineered barrier), including making repairs to the barrier, as necessary, to correct the effects of settling, subsidence, erosion, or other events.
- Maintain and monitor the groundwater monitoring systems.
- Prevent run-on and runoff from eroding or otherwise damaging the final cover (engineered barrier).
- Protect and maintain surveyed benchmarks.

Post-remediation care will consist mainly of periodic inspections to identify erosion, settling, or intrusion by burrowing creatures. Any of these items can lead to infiltration of the barrier. If settling is identified, the resultant depressions will be filled and reseeded as necessary.

Construction and initial maintenance will proceed for several years following closure of the facility. Cost estimates provided in the final feasibility study include a number of barrier surveillance and maintenance activities (e.g., quarterly visual inspections for barrier erosion, settlement, subsidence, displacement, cracking), but after a period of roughly 50 years, the facility is expected to be self-maintaining.

6.0 REFERENCES

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

10 CFR 61, Subpart C, "Performance Objectives," Title 10, *Code of Federal Regulations*, Part 61, Subpart C, as amended.

10 CFR 61, Subpart D, "Technical Requirements for Land Disposal Facilities," Title 10, *Code of Federal Regulations*, Part 61, Subpart D, as amended.

10 CFR 835, "Occupational Radiation Protection," Title 10, *Code of Federal Regulations*, Part 835, as amended.

36 CFR 60, "National Register of Historic Places," Title 36, *Code of Federal Regulations*, Part 60, as amended.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Title 40, *Code of Federal Regulations*, Part 61, as amended.

40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," Title 40, *Code of Federal Regulations*, Part 61, as amended.

40 CFR 61, Subpart M, "National Emission Standards for Asbestos," Title 40, *Code of Federal Regulations*, Part 61, Subpart M, as amended.

40 CFR 141, "National Primary Drinking Water Regulations," Title 40, *Code of Federal Regulations*, Part 141, as amended.

40 CFR 141, Subpart G, "National Primary Drinking Water Regulations: Maximum Contaminant Levels and Maximum Residual Disinfectant Levels," Title 40, *Code of Federal Regulations*, Part 141, Subpart G, as amended.

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

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Title 40, *Code of Federal Regulations*, Part 300, as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List," Title 40, *Code of Federal Regulations*, Part 300, as amended.

40 CFR 430, "Remedial Investigation/Feasibility Study and Selection of Remedy," Title 40, *Code of Federal Regulations*, Part 430, as amended.

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

50 CFR 10-24, "Migratory Bird Treaty Act," *Code of Federal Regulations*, as amended.

Archeological and Historic Preservation Act of 1974, 16 USC 469a, et seq.

Atomic Energy Act of 1954, 42 USC 2011, et seq.

BHI-00139, 2002, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 4, Bechtel Hanford, Inc., Richland, Washington.

BHI-01091, 1998, *Data Quality Objectives Summary Report for the 221-U Canyon Disposition Alternatives*, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI-01240, 2000, *ALARA Review for the 221-U Characterization*, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI-01565, 2001, *Final Data Report for the 221-U Facility Characterization,* Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Clean Air Act of 1990, 42 USC 7401, et seq., Pub. L. 101-549.

Clean Air Act Amendments of 1977, 42 USC 7401, et seq.

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

CP-29430, 2006, *221-U Facility Reactivation Engineering Study*, Rev. 0, Fluor Hanford, Richland, Washington.

D&D-23017, 2006, *Disposition of Transuranic Contaminated Residual Materials at U Plant*, Rev. 0, Fluor Hanford, Richland, Washington.

D&D-29932, 2006, *221-U Facility Canyon Equipment Size Reduction Engineering Study*, Rev. 0, Fluor Hanford, Richland, Washington.

D&D-29971, 2006, *221-U Facility Demolition Study*, Rev. 0, Fluor Hanford, Richland, Washington.

DOE/RL-91-50, 2000, *Environmental Monitoring Plan United States Department of Energy Richland Operations Office,* Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-93-33, 1996, *Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-77, 1996, *Programmatic Agreement Among the U.S. Department of Energy, Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford site, Washington*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-97-11, *Phase I Feasibility Study for the Canyon Disposition Initiative (221-U Facility)*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-97-56, *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-97-68, 1998, *Sampling and Analysis Plan for 221-U Facility*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-11, 2004, *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-29, 2004, *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-41, 2002, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-23, 2005, *Focused Feasibility Study for the 200-UW-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-24, Reissued, 2005, *Proposed Plan for the 200-UW-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Dwyer, S. F., 2003, *Water Balance Measurement and Computer Simulations of Landfill Covers*, Dissertation – University of New Mexico, Albuquerque, New Mexico.

Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Ecology 92-54, Toxics Cleanup Program, Washington Department of Ecology, Olympia, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

Endangered Species Act of 1973, 16 USC 1531, et seq.

EPA, 1986a, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, SW-846, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available on the Internet at www.epa.gov/SW-846/main.htm.

EPA, 1986b, *Statutory Interpretative Guidance on the Placement of Bulk Liquid Hazardous Waste in Landfills*, EPA/530-SW-86-016, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., OSWER Policy Directive 9487.00-2A.

EPA, 1986c, *Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities*, EPA/530-SW-86-031, Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Policy Directive No. 9472.003.

EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7-15-1, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1997, *Record of Decision for the 200-UP-1 Interim Remedial Measure*, EPA/541/R-97/048, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1998, *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23P, EPA/540/R-98/031, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2000, *Guidance for the Data Quality Objectives Process,* EPA/600/R-96/055, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2005, *Record of Decision for the 221-U Facility, (Canyon Disposition Initiative), Hanford Site, Washington*, U.S. Environmental Protection Agency, Washington, D.C.

Fayer, M. J., and G. W. Gee, 2006, "Multiple-Year Water Balance of Soil Covers in a Semiarid Setting," *J Environ Qual* 35:366-377.

HNF-3602, 2002, *Calculating Potential-to-Emit Releases and Doses for FEMPs and NOCs*, Rev. 1, Fluor Hanford, Richland, Washington.

HNF-EP-0063, 2005, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 12, Fluor Hanford, Richland, Washington.

ITRC, 2003, *Technology Overview Using Case Studies of Alternative Landfill Technologies and Associated Regulatory Topics*, Interstate Technology & Regulatory Council, Washington, D.C.

Migratory Bird Treaty Act of 1918, 16 USC 703, et. seq.

National Historic Preservation Act of 1966, 16 USC 470, et seq.

NUREG-1623, 2002, *Design of Erosion Protection for Long-Term Stabilization: Final Report,* Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle Safety and Safeguards, Washington, D.C.

OMB Circular No. A-94, 2002, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs,* Office of Management and Budget, Washington, D.C., as revised.

PNL-8478, 1993, *Soil Erosion Rates Caused by Wind and Saltating Sand Stresses in a Wind Tunnel*, Pacific National Laboratory, Richland, Washington.

PNNL-14744, 2004, *Recharge Data Package for the 2005 Integrated Disposal Facility Performance Assessment*, M. J. Fayer, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-15464, 2005, *Hydrology and Vegetation Data Package for 200-UW-1 Waste Site Engineered Surface Barrier Design,* Pacific Northwest National Laboratory, Richland, Washington.

Publication No. 41183, 2002, *Alternative Cover Assessment Project Phase I Report*, prepared by the Desert Research Institute for the U.S. Environmental Protection Agency, Washington, D.C.

RCW 18.104, "Businesses and Professions," "Water Well Construction," Title 18, Chapter 104, *Revised Code of Washington*, as amended, Washington State, Olympia, Washington.

RCW 43.21A, "State Government – Executive," "Department of Ecology," Title 43, Chapter 21A, *Revised Code of Washington*, as amended, Washington State, Olympia, Washington.

RCW 70.94, "Public Health and Safety," "Washington Clean Air Act," Title 70, Chapter 94, *Revised Code of Washington*, as amended, Washington State, Olympia, Washington.

RCW 70.95, "Public Health and Safety," "Solid Waste Management -- Reduction and Recycling," Title 70, Chapter 95, *Revised Code of Washington*, as amended, Washington State, Olympia, Washington.

RCW 70.105, "Public Health and Safety," "Hazardous Waste Management," Title 70, Chapter 105, *Revised Code of Washington*, as amended, Washington State Department of Ecology, Olympia, Washington.

RCW 77, "Fish and Wildlife," Title 77, *Revised Code of Washington*, as amended, Washington State, Olympia, Washington.

RCW 90.48, "Water Rights – Environment," "Water Pollution Control," Title 90, Chapter 48, *Revised Code of Washington*, as amended, Washington State Department of Ecology, Olympia, Washington.

RCW 90.54, "Water Rights – Environment," "Water Resources Act of 1971," Title 90, Chapter 54, *Revised Code of Washington*, as amended, Washington State Department of Ecology, Olympia, Washington.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

Safe Drinking Water Act of 1974, 42 USC 300, et seq.

Scanlon, B. R., R. C. Reedy, K. E. Keese, and S. F. Dwyer, 2005, "Evaluation of Evapotranspirative Covers for Waste Containment in Arid and Semiarid Regions in the Southwestern USA," *Vadose Zone Journal* 4:55-71.

Sturges, D. L., 1977, "Soil Water Withdrawal and Root Characteristics of Big Sagebrush," *American Midland Naturalist*, Vol. 98, No. 2.

Toxic Substances Control Act of 1976, 15 USC 2601, et seq.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-162, "Rules and Regulations Governing the Licensing of Well Contractors and Operators," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-216, "State Waste Discharge Permit Program," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

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

WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 232-12, "Department of Game Procedures," *Washington Administrative Code*, as amended, Washington State Department of Fish and Wildlife, Olympia, Washington.

WAC 246-247, "Department of Health," "Radiation Protection - Air Emissions," *Washington Administrative Code*, as amended, Washington State Department of Health, Olympia, Washington.

Waste Information Data System Report, Hanford Site database.

APPENDIX A

GUIDANCE FOR FINAL REMEDIAL ACTION CLOSURE REPORT FOR THE 221-U FACILITY

This page intentionally left blank.

CONTENTS

TERMS

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (also known as Superfund)
FRACR	final remedial action closure report
O&M	operations and maintenance

APPENDIX A

GUIDANCE FOR FINAL REMEDIAL ACTION CLOSURE REPORT FOR THE 221-U FACILITY

A1.0 INTRODUCTION

This appendix provides an annotated outline and guidance for preparing final remedial action closure reports (FRACR) for the verification/closure of the 221-U Facility. It contains closure guidance for the remedy identified in Chapter 1.0 in the main text of this remedial design/remedial action work plan.

This appendix provides a brief organizational overview of the FRACR for the 221-U Facility.

A2.0 FINAL REMEDIAL ACTION CLOSURE REPORT FOR THE 221-U FACILITY

An FRACR covering the 221-U Facility will be prepared after the facility has been remediated, the required institutional controls are in place, and the monitoring program defined in the operations and maintenance (O&M) plan (pending) has been implemented and initial results have been collected. The FRACR will address the 221-U Facility and will contain the information outlined in the sections below.

A2.1 INTRODUCTION

This section will present a general statement indicating that the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) (also known as Superfund) action for the 221-U Facility has been successfully completed, and will include details regarding the remedial action performed at the 221-U Facility.

A2.2 SUMMARY OF SITE CONDITIONS

This section will present site background, a description of the CERCLA response action completed (including remedial investigation/feasibility study results, removal actions, records of decision), design criteria, and cleanup activities performed), community involvement activities, and a description of redevelopment potential at the site.

A2.3 DEMONSTRATION OF CLEANUP ACTIVITY QUALITY ASSURANCE/QUALITY CONTROL

This section documents that the quality assurance and quality control plan was implemented and that remedial action was performed consistent with the record of decision, and provides the results of onsite inspections. As appropriate, design plans, specifications, and O&M are included in the evaluation.

This section also will document that a construction quality assurance plan, prepared in compliance with the *Hanford Federal Facility Agreement and Consent Order Action Plan*, Section 7.8 (Ecology, EPA, and

DOE 1989) and *Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities,* OSWER Policy Directive No. 9472.003, EPA/530-SW-86-031 (EPA 1986), was implemented to ensure that the barrier was constructed in accordance with the design and specifications.

A2.4 MONITORING RESULTS

This section will present sufficient data to demonstrate that the remedy is performing to design specifications. These data will be collected as described in the barrier monitoring plan for the 221-U Facility (pending).

A2.5 SUMMARY OF OPERATION AND MAINTENANCE

This section will describe any required O&M activities; and ensure that necessary O&M plans are in place and sufficient, that any necessary institutional controls are in place, and that required O&M activities will be done by specified parties.

A2.6 SUMMARY OF REMEDIATION COSTS

This section will report the estimated costs documented in the record of decision, the construction contract cost (where appropriate), and the total remedial action cost at the time of the FRACR, and provide an estimate of annual O&M costs.

A2.7 FIVE-YEAR REVIEW

This section will state whether a 5-year review is required, and (if so) when. This section also provides a summary of lessons learned from recent 5-year reviews previously completed.

A2.8 PROTECTIVENESS DETERMINATION

The FRACR forms the basis for deletion of a site from the National Priorities List (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List"); therefore, this section includes an assurance that protection of human health and the environment has been achieved. Contained herein is a statement concluding that the implemented remedy achieves the required degree of cleanup for all pathways of exposure and that no further Superfund response is needed to protect human health and the environment.

A2.9 PUBLIC PARTICIPATION

There are no public participation requirements identified either in regulations or U.S. Environmental Protection Agency guidance with regard to FRACRs per se. The FRACR is, however, included in the Deletion Docket made available for review during the 30-day public comment period following publication of the Notice of Intent to delete the site from the National Priorities List (40 CFR 300, Appendix B). Approved FRACRs are to be provided to the Natural Resources Damages Trustees within 1 week of completion.

A2.10 REFERENCES/BIBLIOGRAPHY

This section will provide a complete citation of all relevant reports.

A3.0 REFERENCES

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List," Title 40, *Code of Federal Regulations*, Part 300, as amended.

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

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

EPA, 1986, *Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities,* EPA/530-SW-86-031, Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Policy Directive No. 9472.003.

This page intentionally left blank.

APPENDIX B

SUMMARY OF BASELINE RISK ASSESSMENT METHODOLOGY

This page intentionally left blank.

CONTENTS

FIGURE

TABLES

TERMS

COPC	contaminant of potential concern
CSF	cancer slope factor
EPA	U.S. Environmental Protection Agency
HI	hazard index
HQ	hazard quotient
HSRAM	*Hanford Site Risk Assessment Methodology* (DOE/RL-91-45)
ICR	incremental cancer risk
IRIS	*Integrated Risk Information System*
MCL	maximum contaminant level
RESRAD	RESidual RADioactivity
UCL	upper confidence limit

APPENDIX B

SUMMARY OF BASELINE RISK ASSESSMENT METHODOLOGY

B1.0 EVALUATION OF POTENTIAL HUMAN HEALTH RISK

Human health risk caused by radionuclide and nonradionuclide contaminants of potential concern (COPC) at the 221-U Facility was evaluated using, respectively, the RESidual RADioactivity (RESRAD) model and the *Hanford Site Risk Assessment Methodology* (HSRAM) (DOE/RL-91-45).

The RESRAD model was developed by Argonne National Laboratory (*Manual for Implementing Residual Radioactive Materials Guidelines Using RESRAD* [ANL 1993]) to implement U.S. Department of Energy guidelines for allowable residual radioactive material in soil. The U.S. Environmental Protection Agency (EPA) evaluated this model for use in performing dose assessments to support the EPA guidance limit for radiation dose from contaminated sites of 15 mrem/yr above background (*Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination*, OSWER No. 9200.4-18 [EPA 1997]). The RESRAD determinations include calculation of radionuclide risk using cancer slope factors (CSF) from the EPA *Integrated Risk Information System* (IRIS).

The HSRAM was written to provide instructions for determining risk at the Hanford Site, consistent with current regulations and guidance. It reproduces essential elements of the *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final* (EPA 1989a) and the *Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC* (Ecology 2001), administered by the Washington State Department of Ecology.

B1.1 HUMAN HEALTH RISK DETERMINATION

The RESRAD model determines the radiological risk and dose, based on the activity (concentration) of radionuclides present in soil or other materials. The HSRAM (DOE/RL-91-45) provides methodology and equations for calculation of nonradiological carcinogenic and noncarcinogenic risk (and radiological risk, if necessary). Risk assessment calculations will be based on a 30-year exposure duration in accordance with EPA guidance (EPA 1989a).

B1.1.1 Calculation of Incremental Cancer Risk

The incremental cancer risk (ICR) is calculated from the following general formula:

$$ICR = (\text{Daily Intake})\ CSF$$

where CSF is the cancer slope factor with units of 1/mg/kg/day.

As applicable, the EPA provides separate values for the CSF for the inhalation and oral ingestion pathways (CSFi and CSFo, respectively). These are obtained from the IRIS. Calculation of ICR of nonradionuclides from the 221-U Facility was performed using the formula provided in WAC 173-340-740(3)(b)(iii)(B)(II), Equation 740-2, adapted to calculate risk for given soil concentrations. Incremental cancer risks are reported in Table B-1. Uncertainty in the values of the ICR reflects the uncertainty in the 95 percent upper confidence limit (95% UCL) values of the contaminants.

B1.1.2 Calculation of Hazard Quotients and Hazard Index

The hazard index is the sum of the chemical-specific hazard quotients for noncarcinogenic chemicals in a pathway or at a site (based on the same scenario). The hazard quotient is calculated from the following general formula:

$$\text{Hazard Quotient} = \frac{\text{Daily Intake}}{\text{RfD}}$$

where RfD is the reference dose in units of mg/kg/day that must be exceeded before an adverse effect is manifested.

As applicable, the EPA provides separate reference doses for the inhalation and oral ingestion pathways (RfDi and RfDo, respectively). These are obtained from the IRIS. Calculation of hazard quotients (noncancer risk) of nonradionuclides from the 221-U Facility was performed using the formula provided in WAC 173-340-740(3)(b)(iii)(B)(I), Equation 740-1, adapted to calculate the hazard quotient for given soil concentrations. Individual hazard quotients for noncancer risks are reported in Table B-1 with the hazard index (total hazard quotient) for the facility. Uncertainty in the values of the hazard quotient and hazard index reflects the uncertainty in the 95% UCL values of the contaminants.

B1.1.3 Determination of 221-U Facility Site Risk

Based on historical information, process knowledge, and previous studies, waste constituents that may appear in the 221-U Facility were grouped into the following general categories:

- Acids/bases
- Fission/activation products
- General construction waste
- Metals
- Solvents
- Polychlorinated biphenyls
- Petroleum hydrocarbons
- Transuranics
- Uranium.

These categories include the major chemical and radiological COPCs that may occur in the 221-U Facility environmental media. An extensive characterization effort was undertaken in 2000. General locations where samples were taken are indicated in Figure B-1. Available information on constituent concentrations is summarized in Section 2.4 of the *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE/RL-2001-11). Human health risk values were calculated using the 95% UCL on the mean.

B1.2 RESRAD CALCULATION METHODOLOGY

For the RESRAD model, the exposure pathways considered in the industrial scenario for estimating doses from radionuclides are external gamma exposure, inhalation, and ingestion of contaminated solids and soil. The selected exposure pathways are consistent with the recommendations provided by the RESRAD user's manual (ANL 1993), with the exception of the radon gas exposure pathway. Exposure to radon gas is not a pathway in the industrial scenario because radon is not a COPC at the 221-U Facility.

To use the RESRAD model, appropriate input parameters must be available. Although the RESRAD model provides default values, site-specific input parameters normally are used to obtain representative results. The site-specific and default input parameters used in this evaluation are presented in Tables B-2 and B-3.

B1.2.1 Direct Exposure to Radionuclides

The parameters of the exposure pathways described in Appendix B of the final feasibility study (DOE/RL-2001-11) were used with the RESRAD model to evaluate the risks due to activities (concentrations) of individual radionuclides at the 221-U Facility for the industrial scenario. The values of all input parameters used in the RESRAD calculations are presented in Tables B-2 and B-3. For the risk calculation runs, times of 1, 10, 100, and 1,000 years were used.

After the software was run, the RESRAD file for radiological risk was accessed by saving the RESRAD output document "intrisk.rep" as a Microsoft® Word document. The values provided in the table titled "Total Excess Cancer Risk for Initially Existent Radionuclides and Pathways and Fraction of Total Risk at t = 0.0E+00 years" under the column "All Pathways" was examined. The values in the subcolumn labeled "risk" are the ICRs due to individual radionuclides and the total ICR due to all radionuclides. The total ICR in the current time frame (at t = 0.0E+00 years) is reported in Table B-1 for the industrial exposure scenario. Uncertainty in the values of the ICR reflects the uncertainty in the 95% UCL values of the contaminants.

B1.2.2 Protection of Groundwater and the Columbia River

Groundwater beneath the 200 Areas has been contaminated by discharges from numerous facilities. One of the goals of remedial action at the 221-U Facility is to prevent further degradation of groundwater beneath the facility and thereby protect the Columbia River. The RESRAD model was used to predict potential impacts to groundwater from the contaminants at the 221-U Facility, as described in Appendix B of the final feasibility study (DOE/RL-2001-11).

B1.3 RESULTS OF HUMAN HEALTH RISK DETERMINATION

The range of risks for contaminants at the 221-U Facility for which data were available is tabulated in Table B-1. There is high uncertainty in these risk determinations because the numerical values are not known to represent the entire 221-U Facility, and exposure pathways are incomplete unless the facility is removed from institutional controls.

® Microsoft is a registered trademark of Microsoft Corporation, Redmond, Washington.

The risk evaluation indicates that lead, mercury, and uranium at the 221-U Facility present unacceptable hazard quotients due to their chemical toxicity. All of the radionuclides evaluated in Table B-1 present unacceptable ICRs greater than 10^{-4}. Most of the radionuclides present ICRs greater than 10^{-2}.

B2.0 REFERENCES

ANL, 1993, *Manual for Implementing Residual Radioactive Materials Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

Baes, C. F., and R. D. Sharp, 1983, "A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models," *Journal of Environmental Quality* 12(1):17-28.

DOE/RL-91-45, *Hanford Site Risk Assessment Methodology*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-11, *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Ecology 92-54, Toxics Cleanup Program, Washington Department of Ecology, Olympia, Washington.

Ecology, 2001, *Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC*, Publication No. 94-06, Amended February 12, 2001, Washington State Department of Ecology Toxics Cleanup Program, Olympia, Washington.

EPA, 1978, *Radionuclide Interactions with Soil and Rock Media, Volume I: Processes Influencing Radionuclide Mobility and Retention, Element Chemistry and Geochemistry, Conclusions and Evaluation*, EPA 520/66-78-007a, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989a, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989b, *Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples*, EPA/540/2-89/057, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7-15-1, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1997, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination*, OSWER No. 9200.4-18, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001, *EPA and Ecology Comments on the Canyon Disposition Initiative Final Feasibility Study*, (CCN 092224 to John Sands, U.S. Department of Energy, from Matt Mills, Washington State

Department of Ecology and Craig Cameron, U.S. Environmental Protection Agency, August 29, 2001), U.S. Environmental Protection Agency, Region 10 Hanford Project Office, Richland, Washington.

Integrated Risk Information System, a database available through the EPA National Center for Environmental Assessment. Available on the Internet at http://www.epa.gov/iris/ .

PNL-7660, 1989, *Compilation of Data to Estimate Groundwater Migration Potential for Constituents in Active Liquid Discharges at the Hanford Site*, Pacific Northwest Laboratory, Richland, Washington.

WAC 173-340, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

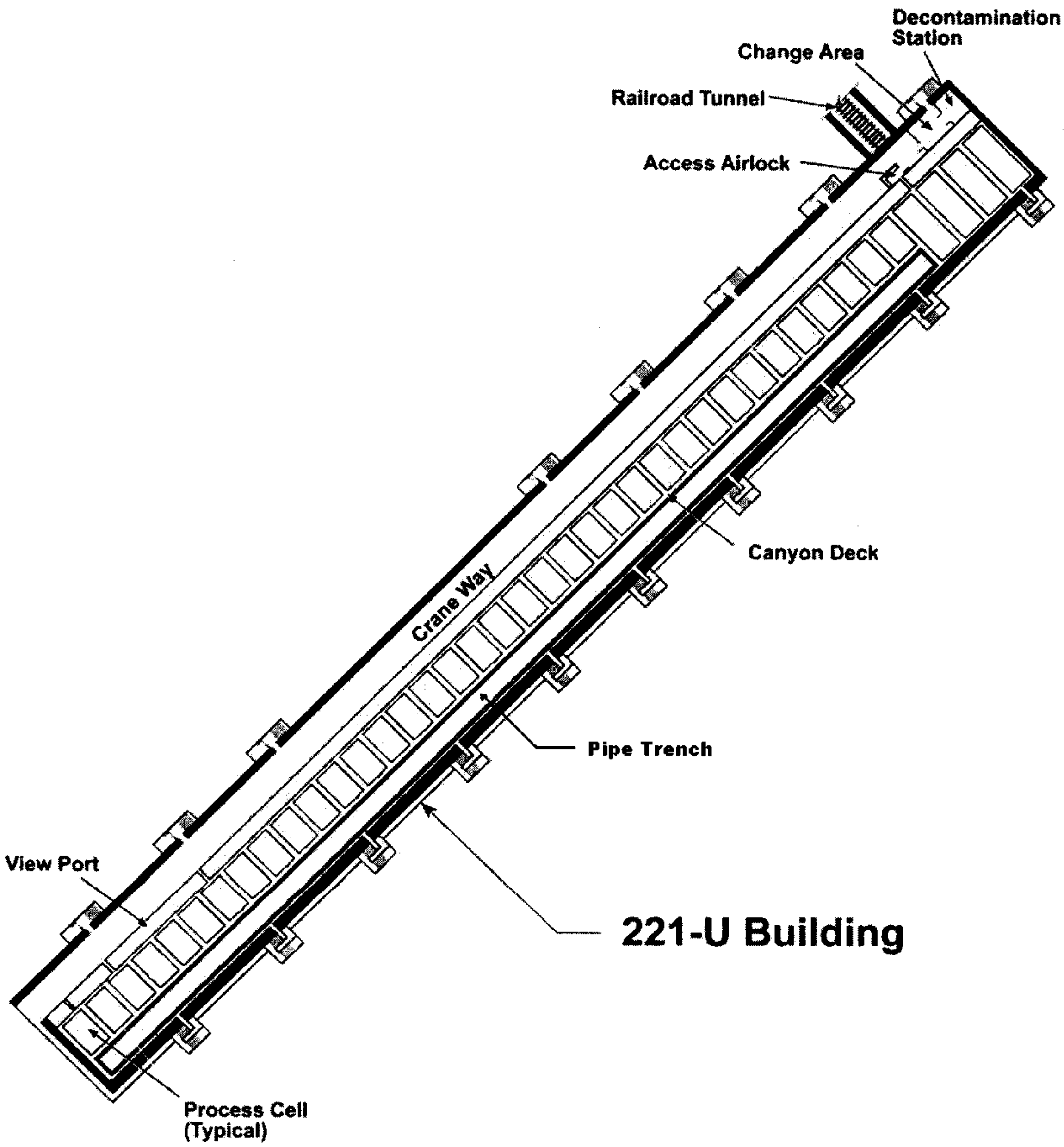

Figure B-1. General Sampling Locations.

Table B-1. Human Health Risks for 221-U Facility Contaminants.

Contaminant	95% UCL of Contaminant Concentrations[a]	Human Health Risk[b] (Industrial Scenario)
Nonradionuclides		
Antimony	2.96 +/- 0.14 mg/kg	HI = 0.07 +/- 0.02
Arsenic	50.3 +/- 23.3 mg/kg	HI = 2 +/- 1; ICR = 7.6×10^{-5} +/- 3.5×10^{-5}
Barium	387 +/- 196 mg/kg	HI = 0.07 +/- 0.04
Cadmium	5.54 +/- 0.33 mg/kg	HI = 0.33 +/- 0.01; ICR = 1.7×10^{-4} +/- 3.5×10^{-5}
Chromium	2,100 +/- 349 mg/kg	HI = 0.018 +/- 0.003
Lead	1,140 +/- 125 mg/kg	Not applicable[c]
Mercury	1,190 +/- 117 mg/kg	HI = 50 +/- 5
Selenium	0.225 +/- 0.053 mg/kg	HI = 0.0006 +/- 0.0001
Silver	24.7 +/- 1.9 mg/kg	HI = 0.062 +/- 0.005
Uranium	8,260 +/- 1,400 mg/kg	HI = 34 +/- 6
		HQ = 87 +/- 12
		Total ICR = 2.5×10^{-4} +/- 0.7×10^{-4}
Radionuclides		
Americium-241	$6.4 \times 10^{+6}$ +/- $3.1 \times 10^{+6}$ pCi/g	ICR = 1.4×10^{0} +/- 0.7×10^{-2}
Cesium-137	$2.4 \times 10^{+8}$ +/- $0.4 \times 10^{+8}$ pCi/g	ICR = 1.5×10^{-1} +/- 0.2×10^{-1}
Cobalt-60	$9.4 \times 10^{+3}$ +/- $1.4 \times 10^{+3}$ pCi/g	ICR = $2.4 \times 10^{+3}$ +/- $0.5 \times 10^{+3}$
Europium-154	$3.3 \times 10^{+5}$ +/- $0.9 \times 10^{+5}$ pCi/g	ICR = 3.8×10^{0} +/- 1×10^{0}
Neptunium-237	$7.1 \times 10^{+4}$ +/- $4.6 \times 10^{+4}$ pCi/g	ICR = 3.2×10^{-1} +/- 0.2×10^{-1}
Plutonium-238	$5.4 \times 10^{+2}$ +/- $0.8 \times 10^{+2}$ pCi/g	ICR = 3.9×10^{-5} +/- 0.5×10^{-5}
Plutonium-239	$1.4 \times 10^{+7}$ +/- $0.3 \times 10^{+7}$ pCi/g	ICR = 1.2×10^{0} +/- 0.2×10^{0}
Plutonium-240	$3.3 \times 10^{+6}$ +/- $0.6 \times 10^{+6}$ pCi/g	ICR = 2.7×10^{-1} +/- 0.5×10^{-1}
Strontium-90	$2.3 \times 10^{+8}$ +/- $0.6 \times 10^{+8}$ pCi/g	ICR = $2.5 \times 10^{+1}$ +/- $0.6 \times 10^{+1}$
Thorium-230	$1.1 \times 10^{+1}$ +/- $0.2 \times 10^{+1}$ pCi/g	ICR = 4.5×10^{-6} +/- 0.6×10^{-6}
Uranium-234	$6.1 \times 10^{+3}$ +/- $2.2 \times 10^{+3}$ pCi/g	ICR = 2.7×10^{-4} +/- 1×10^{-4}
Uranium-235	$6.0 \times 10^{+2}$ +/- $3.6 \times 10^{+2}$ pCi/g	ICR = 1.9×10^{-3} +/- 1.1×10^{-3}
Uranium-238	$4.0 \times 10^{+3}$ +/- $1.1 \times 10^{+3}$ pCi/g	ICR = 2.8×10^{-3} +/- 0.8×10^{-3}
		Total ICR > 10^{-2}

[a] 95% UCL values for individual contaminants are calculated as described in *Statistical Guidance for Ecology Site Managers*, Ecology 92-54 (EPA 1992).

[b] Numerical values are not reported for risks greater than 10^{-2} because the linear equation for risk estimation is only valid for contaminant intakes resulting in calculated risks below 10^{-2}.

[c] Calculation of risk indices is not applicable to lead because lead is a neurotoxin with soil cleanup levels defined by the *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7-15-1 (EPA 1994).

>	=	greater than.
HI	=	hazard index.
HQ	=	hazard quotient = sum of hazard indices.
ICR	=	incremental cancer risk.
mg/kg	=	milligram per kilogram.
pCi/g	=	picocurie per gram.
UCL	=	upper confidence limit.

Table B-2. Summary of Distribution Coefficient Values.

Constituent	Distribution Coefficient,[a] K_d (mL/g)	Reference[b]
Antimony	1.4	EPA 1978
Arsenic	3	Baes and Sharp 1983
Beryllium	200	ANL 1993
Cadmium	30	PNL-7660
Chromium (total)	200	PNL-7660
Chromium (VI)	0	PNL-7660
Lead	30	PNL-7660
Mercury	30	PNL-7660
Petroleum hydrocarbons	50	PNL-7145[c]
Phthalates	100	PNL-7145[c]
Polycyclic aromatic hydrocarbons	300	PNL-7145[c]
Polychlorinated biphenyls	530	EPA 1989b
Americium-241	300	DOE/RL-2000-35
Carbon-14	0	ANL 1993
Cesium-137	1,500	DOE/RL-2000-35
Cobalt-60	1,200	DOE/RL-2000-35
Europium-152	300	DOE/RL-2000-35
Europium-154	300	DOE/RL-2000-35
Europium-155	300	DOE/RL-2000-35
Plutonium-239/240	200	DOE/RL-2000-35
Strontium-90	20	DOE/RL-2000-35
Technetium-99	0	DOE/RL-2000-35
Thorium-228	1,000	DOE/RL-2000-35
Thorium-232	1,000	DOE/RL-2000-35
Tritium (H-3)	0	DOE/RL-2000-35
Uranium (Total)	2[d]	EPA 2001

[a]The K_d values listed are based on these contaminants of concern in native soils and do not take into account the enhanced K_d realized post-grouting.

[b]See Section B2.0 of this appendix for complete references.

[c]Partition coefficients for organic compounds in soils have been calculated from the relationship K_d (partition coefficient) = 0.001 × K_{oc} (soil organic carbon-water partitioning coefficient).

[d]As the work being performed by MSE Technology Applications, Inc., for the U.S. Department of Energy, Richland Operations Office progresses to develop a comprehensive geochemical model that will address uranium mobility in the vadose zone and groundwater aquifer, use of a specific K_d value will be reevaluated.

Table B-3. RESRAD Determination of Soil Concentrations for Groundwater Protection.

Radionuclide	Input (pCi/g)	Peak Year	Groundwater MCL (pCi/L)	Drinking Water Concentration at Peak Year from "concent.rep" (pCi/L)	Soil Preliminary Remediation Goal to meet Groundwater MCL (pCi/g)
Carbon-14	1,000	1	2,000	1.34E+05	1.49E+01
Technetium-99	1,000	1	900	1.46E+05	6.16E+00
Tritium (H-3)	1,000	1	20,000	1.34E+05	1.50E+02

(Soil lookup value, pCi/g, to meet groundwater MCL) = (Input soil activity) X (Groundwater MCL) / (Isotope drinking water concentration at peak year in RESRAD file "concent.rep")

MCL = maximum contaminant level.

RESRAD = RESidual RADioactivity.

This page intentionally left blank.

APPENDIX C

221-U FACILITY PUBLIC INVOLVEMENT PLAN

This page intentionally left blank.

CONTENTS

This page intentionally left blank.

APPENDIX C

221-U FACILITY PUBLIC INVOLVEMENT PLAN

C1.0 OVERVIEW

This plan outlines the proposed public information and involvement activities to be conducted during the 221-U Facility remedial design and remedial action phases of the project. The *Record of Decision for the 221-U Facility, (Canyon Disposition Initiative), Hanford Site, Washington* (EPA 2005) selected the remedial action as:

- Alternative 6: Close in Place – Partially Demolished Structure.

C2.0 PUBLIC INVOLVEMENT PLANNING

This public involvement plan outlines the strategy to provide information and identify opportunities to involve Tribal Nations, stakeholders, and the public during the remedial design and remedial action processes. The Tri-Parties (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology) recognize the importance of early, frequent, and regular opportunities to involve the public and consider their input in Hanford Site cleanup decisions.

C2.1 ACTIONS TO INFORM/INVOLVE THE TRIBAL NATIONS, STAKEHOLDERS, AND THE PUBLIC DURING REMEDIAL DESIGN

The following outlines the basic framework of informational/involvement activities planned for the remedial design stage of the project.

- Update the Hanford Advisory Board's River and Plateau Committee on remedial action progress; the Committee will identify the information to provide to the full Board.

- Provide government-to-government consultations with the Tribal Nations during remedial design, periodically during remedial actions, and/or when pertinent information becomes available. The U.S. Department of Energy, Richland Operations Office will concurrently transmit documents to the Native American Tribes, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

- Provide documents and brief representatives from the state of Oregon as outlined in their Memorandum of Understanding (MOU) (ODOE 2004) with the DOE.

- Provide ongoing information on the project to the public through *Hanford Update* articles. The *Hanford Update* can be found on the TPA website under Hanford Updates Archive http://www.hanford.gov/?page=102&parent=91.

- Prepare a fact sheet to describe the 221-U Facility remedial action strategy that will be sent to members of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA, and DOE 1989 (Tri-Party Agreement) highly interested mailing list.

C2.2 ACTIONS TO INFORM/INVOLVE THE TRIBAL NATIONS, STAKEHOLDERS, AND THE PUBLIC DURING REMEDIAL ACTION

The following outlines the basic framework of informational/involvement activities planned for the remedial action phase.

- Update the Hanford Advisory Board's River and Plateau Committee on remedial action progress; the committee will identify the information to provide to the full Board

- Provide government-to-government consultation with the tribal nations.

- Provide a briefing to representatives from the state of Oregon in accordance with their MOU (ODOE 2004).

- Provide a presentation to the Natural Resource Trustee Council (as needed or requested).

- Provide ongoing information on the cleanup action to the public through *Hanford Update* articles.

- Prepare a fact sheet to describe the 221-U Facility remedial action progress that will be sent to members of the Tri-Party Agreement highly interested mailing list.

C3.0 REFERENCES

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

EPA, 2005, *Record of Decision for the 221-U Facility, (Canyon Disposition Initiative), Hanford Site, Washington*, U.S. Environmental Protection Agency, Washington, D.C.

ODOE, 2004, *Memorandum of Understanding,* U.S. Department of Energy – Richland Operations Office to the Oregon Department of Energy, January 13, 2004, Richland, Washington.

APPENDIX D

OPERATIONS AND MAINTENANCE PLAN OUTLINE FOR THE 221-U FACILITY

This page intentionally left blank.

CONTENTS

This page intentionally left blank.

APPENDIX D

OPERATIONS AND MAINTENANCE PLAN OUTLINE FOR THE 221-U FACILITY

D1.0 INTRODUCTION

The operations and maintenance (O&M) plan describes the activities and procedures mandated to satisfy requirements of the *Record of Decision 221-U Facility (Canyon Disposition Initiative) Hanford Site, Washington* (EPA 2005). The O&M plan satisfies the requirements of 40 CFR 300.435(f), "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Design/Remedial Action, Operation and Maintenance," and *Operation and Maintenance in the Superfund Program* (OSWER Directive 9200.1-37FS [EPA 2001]). As stated in 40 CFR 300.435(f), the O&M plan measures "initiated after the remedy has achieved the remedial action objectives and remediation goals in the record of decision and is determined to be operational and functional, except for ground – or surface-water restoration…". "A remedy becomes 'operational and functional' either one year after construction is complete, or when the remedy is determined concurrently by U.S. Environmental Protection Agency and the State to be functioning properly and is performing as designed, whichever is earlier."

Specific site inspection, maintenance, reporting, and record keeping comprise the scope of the O&M activities. Institutional controls are in place for the Hanford Site. The following section provides a general outline for the O&M plan and may be modified or expanded as necessary when the O&M plan is prepared.

D2.0 OPERATIONS AND MAINTENANCE PLAN OUTLINE

1. **Introduction**
    a. Purpose
    b. Organization
    c. Roles and Responsibilities
2. **Background**
    a. Hanford Site Background
    b. 221-U Facility Background
    c. Remedial Action
        i. Alternative 6: Close in Place – Partially Demolished Structure

3. Regulations and Permits

a. Remedial Action Objectives

b. Compliance with Applicable or Relevant and Appropriate Requirements

4. Environmental Monitoring

a. Groundwater Monitoring

i. Groundwater Monitoring Requirements

ii. Data Evaluation and Reporting

b. Air Emissions Monitoring

i. Air Emissions Monitoring Requirements

ii. Data Evaluation and Reporting

c. Radiological Monitoring

i. Radiological Monitoring Requirements

ii. Data Evaluation and Reporting

d. Ecological Monitoring

i. Ecological Monitoring Requirements

ii. Data Evaluation and Reporting

e. Engineered Barrier Performance Monitoring

i. Engineered Barrier Performance Monitoring Requirements

ii. Data Evaluation and Reporting

5. Inspections

a. Institutional Controls

b. Surface Elevation/Wind Erosion Inspection

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

c. New Release of Hazardous Substances

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

d. Wind and Water Erosion; Run-on/Runoff

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

e. Biointrusion

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

f. Vegetation

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

g. Subsidence

i. Purpose

ii. Performance Requirements

iii. Locations

iv. Inspection Frequency

h. Maintenance

i. Revegetation

ii. Recontouring

iii. Biointrusion

iv. Other

6. Notifications and Submittals

7. Emergency Response

8. Annual Operations Report

9. Five-Year Reviews

a. Notification when Planning the Five-Year Review

b. Review Schedule

c. Review Team

d. Community Involvement

e. Data Required to be Reviewed

f. Interviews Required

g. Site Inspection

h. Five-Year Review Report

i. Assessing the Protectiveness of the Remedy

10. Records Management

11. References

12. Appendix A – Groundwater Monitoring Plan

13. Appendix B – Air Monitoring Plan

14. Appendix C – Vadose Monitoring Plan

15. Appendix D – Radiological Monitoring Plan

16. Appendix E – Ecological Monitoring Plan

17. Appendix F – Engineered Barrier Performance Monitoring Plan

18. Appendix G – Barrier Inspection and Maintenance Plan

19. Appendix H – Emergency Response Plan

D3.0 REFERENCES

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Title 40, *Code of Federal Regulations*, Part 300, as amended.

EPA, 2001, *Operation and Maintenance in the Superfund Program*, OSWER 9200.1-37FS, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2005, *Record of Decision 221-U Facility (Canyon Disposition Initiative) Hanford Site, Washington,* U.S. Environmental Protection Agency, Richland, Washington.

This page intentionally left blank.

DISTRIBUTION

Onsite

1	U.S. Department of Energy Richland Operations Office DOE Public Reading Room	H2-53
1	Pacific Northwest National Laboratory Hanford Technical Library	P8-55
2	Lockheed Martin Information Technology Administrative Record Document Clearance	H6-08 H6-08

This page intentionally left blank.

ATTACHMENT 2

Change Number DRAFT M-85-06-01	Federal Facility Agreement and Consent Order **Change Control Form** Do not use blue ink. Type or print using black ink.	Date December 14, 2006

Originator L. D. Romine **Phone** (509) 376-4747

Class of Change

[X] I - Signatories [ ] II - Executive Manager [ ] III - Project Manager

Change Title

Establish Hanford Federal Facility Agreement and Consent Order (HFFACO) M-85 series milestones for the disposition of the 221-U Facility.

Description/Justification of Change

Agency approval of this change package authorizes the establishment of one new Major milestone and two interim milestones for the disposition of the 221-U Facility. The 221-U Facility is designated as a Key Facility in Section 8 of the HFFACO and has entered into the Section 8 disposition phase. (Continued on page 2.)

Impact of Change

The disposition of the 221-U Canyon Facility remedy will result in protection of human health and the environment based on the exposure assumptions contained in the 200 Area industrial use scenario.

Affected Documents

The HFFACO, as amended, and Hanford Site internal planning, management, and budget documents (e.g., USDOE and USDOE contractor Baseline Change Control documents; Multi-Year Work Plan; Sitewide Systems Engineering Control Documents, and Project Management Plans).

Approvals

_______________ _______________ ___ Approved ___ Disapproved
DOE Date

_______________ _______________ ___ Approved ___ Disapproved
EPA Date

_______________ _______________ ___ Approved ___ Disapproved
Ecology Date

Description/Justification Continued.

In 1996, the Tri-Parties signed an agreement in principle to document the agreement that a CERCLA process would be used to evaluate alternatives for the disposition of the U Plant canyon (221-U Facility) as a prototype for the Canyon Disposition Initiative. A final record of decision (ROD) was signed in 2005 to document the result of the CERCLA evaluation, which was the selection of the "Close in Place – Partially Demolished Structure" alternative.

The selected 221- U Facility remedy includes (but is not limited to) the following components to complete disposition:

- Removal of waste from vessels and equipment in the facility that, if stabilized in place, would contain levels of transuranic isotopes greater than 100 nCi/g, in accordance with an approved Remedial Design/Remedial Action (RD/RA) work plan, and eventual disposal of that waste at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico;

- Consolidation of contaminated equipment on the deck into below-deck locations (e.g., the process cells);

- Grouting of internal vessel spaces, as well as cell, gallery, pipe trench, drain header, and other spaces within the facility;

- Removal of roof and wall sections of the 221-U Facility down to approximately the deck level;

- Construction of an engineered barrier over the remnants of the canyon building.

The milestones contained in this change package highlight the near-term activities required to implement the selected disposition of the 221-U Facility, which will mitigate the potential threat to human health and the environment from radionuclides and hazardous substances at the facility, and allow for future negotiations highlighting later facility disposition activities that incorporate project experience gained during the conduct of near-term activities.

Shaded text is added, ~~strikethrough~~ text is deleted.

Milestone	Description	Date
M-085-00	COMPLETE DISPOSITION OF THE 221-U FACILITY THIS MAJOR MILESTONE WILL BE COMPLETE WHEN THE 221-U FACILITY LEGACY WASTE HAS BEEN CONSOLIDATED INTO BELOW-DECK LOCATIONS, GROUTING ACTIVITIES HAVE BEEN COMPLETED, AND THE FACILITY HAS BEEN PARTIALLY DEMOLISHED AND COVERED WITH A SURFACE BARRIER.	TBD, but no later than 09/30/2024
M-085-10	COMPLETE 90 PERCENT DESIGN FOR DISPOSITION OF MATERIAL IN 221-U BUILDING CELL 30. THIS INTERM MILESTONE WILL BE COMPLETE UPON COMPLETION OF 90 PERCENT ENGINEERING DESIGN FOR DISPOSITION OF MATERIAL CURRENTLY IN REDOX VESSEL D-10, LOCATED IN 221-U BUILDING CELL 30.	09/30/2009
M-085-15	COMPLETE OPERABILITY ASSESSMENT OF REQUIRED CANYON EQUIPMENT; AND PROPOSE MILESTONES FOR REMAINING 221-U FACILITY DISPOSITION ACTIVITIES. THIS INTERM MILESTONE WILL BE COMPLETE WHEN PROPOSED REMAINING 221-U FACILITY DISPOSITION MILESTONES ARE SUBMITTED TO EPA AND ECOLOGY. THE MILESTONES WILL BE BASED ON UPDATED PLANNING INCORPORATING THE RESULTS OF PROJECT EXPERIENCE GAINED DURING INITIAL CANYON DISPOSITION ACTIVITIES. THESE INITIAL ACTIVITIES WILL FOCUS ON INCREASING CONFIDENCE IN PROJECT COSTS AND SCHEDULE AND WILL INCLUDE VALIDATION OF KEY PLANNING ASSUMPTIONS AND EVALUATION OF PROJECT RISKS IDENTIFIED AS A RESULT OF IMPLEMENTATION OF DOE ORDER 413.3. THE OPERABILITY ASSESSMENT WILL INCLUDE: o REACTIVATION, REPAIR, AND CERTIFICATION OF CRANE AND ASSOCIATED EQUIPMENT o ASSESSMENT OF REQUIRED LIFTING AND RIGGING COMPONENTS o DETAILED DISPOSITION PLANNING FOR ITEMS ON CANYON DECK.	09/30/2012