DOE/RL-2016-16
Revision 0

Engineering Evaluation/Cost Analysis for the REDOX Complex

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Executive Summary

This document presents, for public review and comment, the results of an engineering evaluation/cost analysis (EE/CA) for the proposed non-time-critical removal action alternatives at the Reduction-Oxidation (REDOX) Complex in the Hanford Site 200 West Area. The REDOX Complex was used for chemical separation of plutonium from irradiated fuel rods from 1952 through 1967. These operations resulted in contaminated buildings and structures within the complex, including the 202S Building (which includes the Canyon, Silo, and Annex), 276S Hexone Storage Tanks (276-S-141 and 276-S-142), and 293S Nitric Acid and Iodine Recovery Building. A removal action is required to mitigate potential threats to human health and the environment (HHE) posed by contamination associated with these buildings and structures. Section 2.2 provides a detailed list of all structures within the scope of this EE/CA.

Four removal action alternatives were developed and evaluated in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).[1] With the exception of the No Action alternative, the proposed alternatives offer a combination of actions to prevent or reduce the risk of release of hazardous substances including surveillance and maintenance (S&M), hazard abatement, demolition preparation, demolition, and grouting.

Removal action alternatives and their estimated costs are summarized in Table ES-1. The cost estimates represent present-worth cost for the four alternatives based on present-day (2016) dollars (estimates are based on the best available information on anticipated scope). This cost estimates include major costs that apply to all of the alternatives, as well as alternative-specific costs. The major costs are summarized in this EE/CA.

Built in the 1950s and unoccupied since the mid-1960s, the REDOX buildings/structures in the scope of this EE/CA have severely degraded. Spread of contamination has been observed throughout the buildings and will intensify as the facilities continue to degrade. A CERCLA record of decision is not anticipated until the 2032 time frame, and if not timely addressed, the degrading conditions at the REDOX Complex could present

[1] Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

an imminent threat to HHE. The proposed actions in this EE/CA target reducing the complexity of future maintenance tasks and the increase in S&M costs, as the costs are expected to rise. The actions also target maintaining a skilled workforce at the Hanford Site that is experienced in contaminated deactivation and decommissioning work, which will be needed when major funding becomes available in the future. Many of the activities recommended in this EE/CA can be accomplished with available funds identified through efficiencies or with new funding.

Table ES-1. Proposed Alternatives for the REDOX Complex Removal Action

Alternative	Removal Action Description	Present-Worth Cost
1	No Action	$0
2	Surveillance and Maintenance of REDOX Complex Structures Hazard Abatement of the 202S Canyon Demo Prep of the 202S Silo Service Area Demolition of the 276S Hexone Storage Tanks and 293S Building Grouting of the Belowgrade Areas of the 293S Building	$148.1 million
3	Alternative 2 actions *plus*: Demo Prep of the 202S Annex and Canyon Abovegrade	$176.5 million
4	**Alternative 3 actions *plus:*** **Demolition of the 202S Annex**	**$180.7 million**

Notes: Accuracy range of the cost estimate is -30 percent to +50 percent. No sensitivity analyses were performed, and the following factors could impact costs: levels of contamination, amount of equipment in the buildings, and differing structural design.

Bold signifies the recommended alternative.

demo prep = demolition preparation

REDOX = Reduction-Oxidation (Complex)

All alternatives were evaluated against established removal action objectives (RAOs) and compared in terms of effectiveness, implementability, and cost. Based on its efficacy in meeting these criteria, Alternative 4 was selected as the recommended removal action alternative. Alternative 4 provides the best combination of actions to protect workers, the public, and the environment while meeting RAOs. Alternative 4 is both technically and administratively feasible and will also support future remedial decisions and characterization activities at the REDOX Complex.

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Terms

ACM	asbestos-containing material
AM	action memorandum
AMU	aqueous makeup unit
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CWC	Central Waste Complex
demo prep	demolition preparation
DOE	U.S. Department of Energy
DOE-RL	DOE-Richland Operations Office
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
HCA	high contamination area
HCP EIS	*Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE/EIS-0222-F)
HHE	human health and the environment
HSTF	Hexone Storage and Treatment Facility
MCC	motor control center
N/A	not applicable
NCP	National Contingency Plan
NPL	National Priorities List
NTCRA	non-time-critical removal action
OU	operable unit
PCB	polychlorinated biphenyl
RAO	removal action objective
RAWP	removal action work plan
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation (Complex)

ROD	record of decision
RWP	radiological work permit
S&M	surveillance and maintenance
SAP	sampling and analysis plan
SWP	special work permit
TBC	to be considered
TBD	to be determined
TMV	toxicity, mobility, or volume
TPA	Tri-Party Agreement
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
TRU	transuranic
TSD	treatment, storage, and/or disposal
WIPP	Waste Isolation Pilot Plan

1 Introduction

This engineering evaluation/cost analysis (EE/CA) has been prepared in accordance with the National Contingency Plan (NCP) (40 CFR 300.415(b)(4)(i), "National Oil and Hazardous Substances Pollution Contingency Plan," "Removal Action") to assist the U.S. Department of Energy (DOE) in identifying the most effective removal action alternative for placing the Reduction-Oxidation (REDOX) Complex in a configuration that is protective of human health and the environment (HHE) in the near term. The REDOX Complex structures addressed in this EE/CA include the 202S Building (including the Canyon, Silo, and Annex) and the 293S Nitric Acid and Iodine Recovery Building (293S Building), as well as waste management from closure of the *Resource Conservation and Recovery Act of 1976* (RCRA) 276S Hexone Storage Tanks (276S Hexone Storage and Treatment Facility [HSTF]). Section 2.2 provides detailed descriptions of the buildings, substructures, and areas within the scope of this EE/CA. The development of this EE/CA satisfies environmental review requirements and provides for stakeholder involvement while offering a framework for selecting the removal alternative. An Administrative Record for documentation of the removal action will be established.

This non-time-critical removal action (NTCRA) is consistent with the joint DOE and EPA, 1995, *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*, which establishes the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) NTCRA process as the preferred approach for decommissioning surplus DOE facilities. Under this policy, an NTCRA may be taken when DOE determines that the action will prevent, minimize, stabilize, or eliminate a risk to HHE. When DOE determines that a CERCLA NTCRA is necessary, DOE is authorized to evaluate, select, and implement the removal action that DOE determines is most appropriate to address the potential risk posed by the release or threat of release of hazardous substances. This policy states, in part:

> *Although the full range of CERCLA response actions may be applicable to decommissioning activities, NTCRAs should be used for decommissioning, consistent with this Policy. The alternative approaches available to conduct decommissioning projects typically are clear and very limited. This often will eliminate the need for the more thorough analysis of alternatives required for remedial actions. NTCRA requirements provide greater flexibility to develop decommissioning plans that are appropriate for the circumstances presented. Statutory time and dollar limits on removal actions do not apply to removal actions conducted by DOE, which increases the scope of projects that may be addressed by DOE removal action. Most importantly, NTCRAs usually will provide benefits to worker safety, public health, and the environment more rapidly and cost effectively than remedial actions. For these reasons, DOE may exercise removal action authority to conduct decommissioning whenever such action is authorized by CERCLA, the NCP, and Executive Order 12580.*

Performance of this removal action will place the buildings/structures and debris in a configuration that is protective of HHE. Without decommissioning these buildings/structures and cleaning up debris, a potential threat of release of hazardous substances exists; without action, adverse threats to HHE eventually could occur. As the lead federal agency, DOE has determined that a removal action is an appropriate means to support the final end state and achieve environmental review requirements. The U.S. Environmental Protection Agency (EPA) concurs that NTCRA is warranted to place these excess buildings/structures and debris in a configuration that is protective of HHE. This NTCRA will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action, as required by the NCP (40 CFR 300.415(d)).

This EE/CA identifies the objectives of the removal action and analyzes the effectiveness, implementability, and estimated cost of the proposed action to satisfy these objectives. This EE/CA also proposes to mitigate the threat to site workers, the public, and the environment by disposing generated waste at the Environmental Restoration Disposal Facility (ERDF). In accordance with Executive Order 12580, *Superfund Implementation*; and Section 7.2.4 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereafter referred to as the Tri-Party Agreement [TPA] Action Plan), DOE proposes to perform hazard abatement and limited demolition at the REDOX Complex as detailed in this EE/CA. This EE/CA was provided to EPA, the lead regulatory agency for this action, in September 2016 (16-AMRP-0279, "Proposal to Perform Hazard Abatement and Demolition Activities at the REDOX Complex"). The Washington State Department of Ecology (Ecology) is the permitting authority for the closure decision of the 276S Hexone Storage Tanks. The tanks will be closed in accordance with Section 6.0 of Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (hereafter referred to as the Tri-Party Agreement [TPA]); WAC 173-303, "Dangerous Waste Regulations;" and WA7890008967, *Hanford Facility Resource Conservation and Recovery Act of 1976 (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereafter referred to as the Hanford Facility RCRA Permit).

Removal action taken pursuant to this NTCRA will be conducted in compliance with DOE et al., 2012, *Hanford Federal Facility Agreement and Consent Order Public Involvement Plan*, and public participation requirements established in the NCP (40 CFR 300.415(n)) and any applicable DOE policies. This EE/CA will undergo a 30-day public comment period. After the public comment period, a written response to significant comments will be provided in accordance with 40 CFR 300.820(a), "Administrative Record File for a Removal Action." After considering the comments received from the public, DOE will confer with EPA in the issuance of an action memorandum (AM). The AM will identify the selected alternative, which may be the alternative recommended or one of the other alternatives discussed in this EE/CA.

1.1 Purpose and Scope

This EE/CA evaluates the proposed alternatives for meeting the DOE goal of reducing the risk to HHE at the REDOX Complex by removing or stabilizing waste. The REDOX Complex buildings are located within the 200 West Area on the Hanford Site Central Plateau. DOE, in consultation with Ecology and EPA, will use this EE/CA as the basis for selecting removal actions to mitigate potential risks to HHE. Development of an AM, which will document the selected removal action alternative, will be based upon this EE/CA and public comments. A removal action work plan (RAWP) will be prepared to document cleanup standards and removal action methods.

1.2 Regulatory Overview

The President of the United States is given authority by CERCLA Section 104, "Response Authorities," when there is a threat to public health or welfare of the United States or to the environment, to take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of contaminants into the environment. This authority is delegated to DOE, as the CERCLA lead agency by the NCP (40 CFR 300, Subpart B, "Responsibility and Organization for Response"), through Executive Order 12580. Expedited response actions are addressed by Section 7.2.4 in the TPA Action Plan (Ecology et al., 1989b), which cites and is consistent with Executive Order 12580.

In anticipation of the National Priorities List (NPL) designation (40 CFR 300, Appendix B, "National Priorities List"), DOE, EPA, and Ecology (also referred to collectively as the Tri-Parties) entered into the TPA (Ecology et al., 1989a), which established a procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions at the Hanford Site. The TPA ensures compliance with remedial and/or removal action requirements under CERCLA and other environmental regulations including closure and post-closure requirements under RCRA. Section 8.0 of the TPA Action Plan (Ecology et al., 1989b) outlines the approach for identifying structures that present sufficient potential environmental concern for which coordination of the decommissioning process with cleanup activities under the TPA would be deemed necessary.

The 276S Hexone Storage Tanks are a permitted treatment, storage, and/or disposal (TSD) unit. In accordance with Section 6.0 of the TPA (Ecology et al., 1989a) and WAC 173-303, a closure plan was prepared for the REDOX Complex 276-S-141 and 276-S-142 Hexone Storage Tanks in 2010 (DOE/RL-2009-112, *Hexone Storage and Treatment Facility Closure Plan*). The closure plan presented the process to close HSTF under WAC 173-303-610, "Closure and Post-Closure." Ecology will approve the closure plan after the public review and comment period has been completed, and the closure plan will then be included in the Hanford Facility RCRA Permit. Any waste generated under this removal action at these TSD units will be disposed at ERDF under the authority of this removal action.

Appendix J, "Central Plateau Facilities," of the TPA Action Plan (Ecology et al., 1989b) lists facilities that are not fully addressed under Sections 6.0 or 7.0 of the TPA (Ecology et al., 1989a) and that have been determined by the Tri-Parties, in accordance with Section 8.0, to be subject to removal or remedial action under CERCLA. Each facility listed in Appendix J that has undergone an evaluation, as required by Section 8.1.4 of the TPA Action Plan (Ecology et al., 1989b), is designated as a Tier 1 facility, Tier 2 facility, or neither. Facilities that have not yet been evaluated as required by the TPA Action Plan (Section 8.1.4) are identified as tier to be determined (TBD). The buildings/structures in this EE/CA not included in Appendix J or designated as a tier TBD will be subject to a facility evaluation and, with concurrence from the lead regulatory agency, will be added to Appendix J.

This EE/CA constitutes the facility evaluation, as required by Section 8.1.4 of the TPA Action Plan (Ecology et al., 1989b) for the 293S Building. The 293S Building is recommended for designation as a Tier 2 facility based on the level of contamination contained within the structure. The 202S Building (including the Canyon, Silo, and Annex) is already designated as a Tier 1 facility in Appendix J of the Tri-Party Agreement Action Plan. Approval of a change to Appendix J is to be completed in accordance with Section 12.0 of the TPA (Ecology et al., 1989a).

As documented in Appendix J of the TPA Action Plan (Ecology et al., 1989b), DOE and EPA have determined that the ultimate CERCLA response action for the 202S Building will be a remedial action. However, the TPA (Ecology et al., 1989a) does not preclude DOE from undertaking an interim CERCLA removal action to address potential threats of releases from the REDOX Complex. Any removal action undertaken pursuant to this EE/CA and the resulting AM will be consistent with the final remedial action decisions and will contribute to the efficient performance of any anticipated long-term remedial action, as required by NCP regulations (40 CFR 300.415(d)).

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2 Site Characterization

This chapter provides a general site description and background for the REDOX Complex, as well as a more detailed description of the areas of the REDOX Complex included in the scope of this EE/CA. This chapter also provides information about previous shutdown activities and current conditions that justify a removal action.

2.1 Site Description and Background

The buildings/structures in the scope of this NTCRA are located within the REDOX Complex in the 200 West Area of the Hanford Site. The REDOX Complex includes a main Canyon facility and a number of support structures. It is located approximately 36 km (22 mi) north-northwest of Richland, Washington, in an industrialized portion of the 200 West Area. Highway 240 is southwest of the REDOX Complex, and the Columbia River is north-northeast (Figure 2-1).

Public access to the Hanford Site is currently restricted and controlled at the Wye Barricade on Route 4 and the Yakima and Rattlesnake Barricades on State Highway 240. Unauthorized access to the REDOX Complex is prohibited. The complex buildings/structures are locked, and a 1.8 m (6 ft) cyclone fence encloses the immediate areas.

This EE/CA covers the 202S Building (including the Canyon, Silo, and Annex) and the 293S Nitric Acid and Iodine Recovery Building (293S Building), as well as waste management from closure of the RCRA 276S HSTF (276S Hexone Storage Tanks). The term “REDOX Complex” refers to all structures contained within the REDOX Implementation Area. Appendix B provides a description of the REDOX Implementation Area, and Figures B-1 and B-2 illustrate the area boundary and structures within the implementation area. Many of the buildings/structures within the REDOX Complex have been, or will be, demolished under DOE/RL-2010-22, *Action Memorandum for General Hanford Site Decommissioning Activities*. The closest operational building is the 222S Laboratory and associated support structures. The 222S Laboratory and its support facilities are not included in the scope of this EE/CA.

2.1.1 Background

The 202S Canyon Building (REDOX), also known as S Plant within the 200-CR-1 Operable Unit (OU), was constructed between 1950 and 1952 and began operations in 1952. It was the first large-scale, continuous flow, solvent extraction process plant in the United States. REDOX operated for the recovery of plutonium from irradiated fuel rods. Shutdown activities began in 1967 and were completed in 1969, at which point the REDOX Complex was transferred to long-term surveillance and maintenance (S&M) (HNF-13830, *Documented Safety Analysis for the Reduction-Oxidation Facility*).

2.1.2 Physical Setting

The Hanford Site encompasses approximately 1,517 km^2 (586 mi^2) in southeastern Washington State (Figure 2-1). It is north of the confluence of the Columbia, Yakima, and Snake Rivers. The Columbia River flows east through the northern part of the Hanford Site and, turning south, forms the eastern boundary. The Yakima River runs along part of the southern boundary and joins the Columbia River at the City of Richland, which bounds the Hanford Site on the southeast.

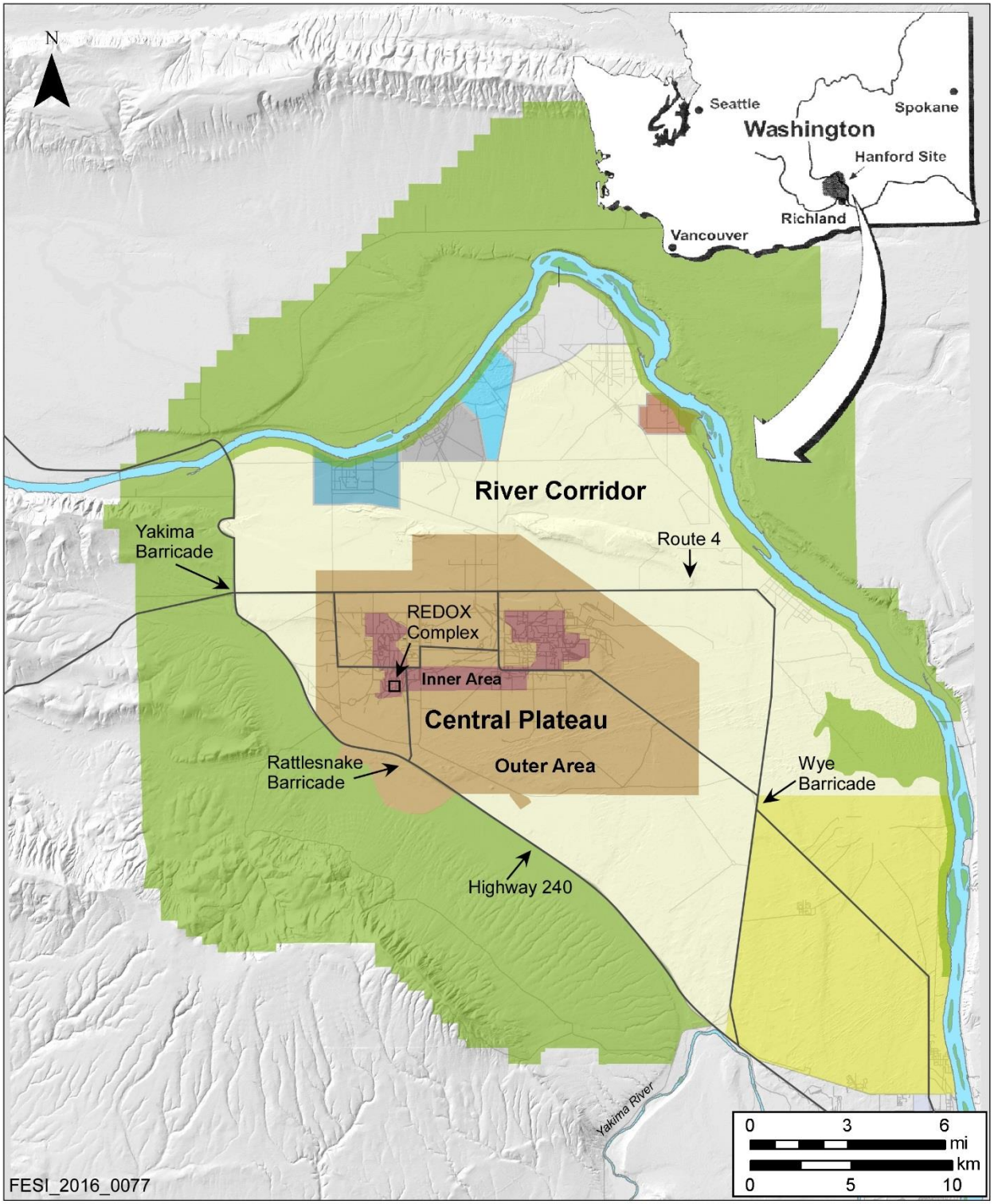

Figure 2-1. Hanford Site and REDOX Complex Location

The Hanford Site lies east of the Cascade Mountains and has a semiarid climate caused by the rain shadow effect of the mountains. Climatological data are monitored at the Hanford Meteorological Station, which is located between the 200 East and 200 West Areas. Weather stations are located throughout the Hanford Site. The seasonal average winter temperature (December through February) is 0.9°C (33.7°F), and the seasonal average summer temperature (June through August) is 23.2°C (73.7°F). The average normal maximum temperature is 33.1°C (91.6°F) in July, and the average normal minimum temperature is -4.1°C (24.6°F) in January (PNNL-15160, *Hanford Site Climatological Summary 2004 with Historical Data*). Average annual precipitation is 17.73 cm (6.98 in.). Most precipitation occurs during late autumn and winter, with more than half of the annual amount occurring from November through February.

2.1.3 Geology and Hydrology

The Hanford Site lies in a sediment-filled basin on the Columbia Plateau in southeastern Washington. The REDOX Complex is located in the 200 West Area, which is in the Pasco Basin, a topographic and structural depression in the southwest corner of the Columbia Basin physiographic subprovince. Generally, this subprovince is characterized as relatively flat, low-relief hills with moderately incised river drainages.

The Columbia Basin subprovince is underlain by the Columbia River Basalt Group, which consists of a thick sequence of Miocene basalt flows that can be greater than 3 km (1.8 mi) thick in the Pasco Basin. The suprabasalt sediments are approximately 169 m (555 ft) thick and consist primarily of the Pliocene Ringold Formation fluvial and lacustrine deposits and Pleistocene Hanford formation flood deposits. The surface elevation at the REDOX Complex is approximately 207 m (680 ft) above mean sea level. Regional soil in the Hanford Site area is highly permeable. Soil in the 200 West Area is characterized as predominantly silty sand and gravelly sand.

Groundwater generally occurs under confined conditions within the sedimentary interbeds associated with the basalt sequence and under unconfined conditions within the overlying sedimentary section (uppermost aquifer). Regional groundwater flow in the 200 West Area is toward the north, east, and southeast, occurring primarily within the Ringold Formation. Depth to groundwater in the 200 West Area ranges from 79 m (260 ft) in the southeast corner to 103 m (337 ft) in the northwest corner. The average depth to groundwater near the REDOX Complex is 141.7 m (465 ft). The primary source of aquifer recharge on the Hanford Site is precipitation. Estimates of recharge from precipitation range from 0 to 10 cm/yr (0 to 4 in./yr) and are largely dependent upon soil texture and the type and density of vegetation. The Columbia River, located approximately 11.3 km (7 mi) north of the REDOX Complex, is the primary discharge area for both the unconfined and confined aquifers.

The Columbia River and its tributary (the Yakima River) are the primary Hanford Site surface water features. Other noted surface water features are Columbia River shoreline springs, springs on the Fitzner/Eberhardt Arid Lands Ecology Reserve on Rattlesnake Mountain, and West Lake. West Lake, which is about 5.2 ha (12.85 ac) and less than 0.91 m (3 ft) deep, is the only natural lake on the Hanford Site.

Two ephemeral creeks, Cold Creek and Dry Creek, traverse the uplands of the Hanford Site southwest and south of the 200 West Area. The confluence of the two creeks is 5 km (3 mi) southwest of the 200 West Area. Both creeks are upgradient from the REDOX Complex and should not be affected by activities addressed in this EE/CA.

2.1.4 Anticipated Future Land Use

The reasonably anticipated future land use for the portion of the Inner Area where the 200-CR-1 OU is located is designated as industrial.

DOE worked for several years with cooperating agencies to define land-use goals for the Hanford Site. The cooperating agencies and stakeholders included the National Park Service, Tribal Nations, the states of Washington and Oregon, local/county and city governments, economic and business development interests, environmental groups, and agricultural interests. Drummond, 1992, *The Future for Hanford: Uses and Cleanup: The Final Report of the Hanford Future Site Uses Working Group*, was an early product of the efforts to develop land-use assumptions. The report recognized that the Central Plateau would be used for waste management activities for the foreseeable future. Following the report, DOE issued DOE/EIS-0222F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS), the associated Record of Decision (ROD) in 1999 (64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)") and a supplement analysis in 2008 (DOE/EIS-0222-SA-01, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*).

The HCP EIS (DOE/EIS-0222F) analyzed the potential environmental impacts of alternative land-use plans for the Hanford Site and considered the land-use implication of ongoing and proposed activities. Under the preferred land-use alternative selected in the HCP EIS ROD (64 FR 61615), the Central Plateau was designated for industrial-exclusive use, defined as areas "suitable and desirable for management of hazardous, dangerous, radioactive, and nonradioactive waste, as well as related activities." The 2008 supplemental analysis reconfirmed the land-use designations in the HCP EIS (DOE/EIS-0222F) and clarified that the comprehensive land-use plan will remain in effect as long as DOE retains legal control of some portion of the Hanford Site, which is expected to be longer than 50 years.

The area designated as the Central Plateau in the Drummond (1992) report and the HCP EIS (DOE/EIS-0222F) is only a portion of the area now commonly known as the Central Plateau. The current 195 km^2 (75 mi^2) area encompassed by the Central Plateau also includes a portion of the land known in previous documents as all other areas, with a designated land use of conservation (mining). The Inner Area portion of the Central Plateau (described in Section 1.3) is contained within the area designated for industrial/industrial-exclusive land use. At approximately 25 km^2 (10 mi^2), the Inner Area covers about half of the industrial-exclusive area and is defined by DOE as the final footprint area of the Hanford Site that will be dedicated to permanent waste management and containment of residual contamination.

2.1.5 Cultural Resources

A Section 106 cultural resource review (*National Historic Preservation Act of 1966*) would be conducted to address removal action activities. The removal action activities would be performed in areas that have been extensively disturbed by past construction activities. Buildings/structures that require cultural resource review will be evaluated using a Historic Property Inventory Form or Expanded Historic Property Inventory Form. As appropriate, walkthroughs of the structures would be conducted before demolition to finalize all mitigation requirements. Cultural resource review documentation for any specific building/structure would be finalized before removal action activities begin. Tagged artifacts (if they can be removed) would be collected for long-term curation. Tagged artifacts that cannot be removed would be photographed or documented. At the time of removal, assessments would be made regarding options and the feasibility of long-term curation of tagged artifacts.

Hanford Site structures have been evaluated for their National Register of Historic Places eligibility as part of DOE/RL-97-56, *Hanford Site Manhattan Project and Cold War Era Historic District Treatment*

Plan. Some buildings/structures have been determined to be contributing properties to the Manhattan Project/Cold War Era Historic District, with mitigation in the form of documentation required. DOE/RL-97-56 also requires that walkthroughs of these structures be completed to identify artifacts that are of educational and interpretive value.

2.1.6 Ecological Resources

The land area around the structures addressed by this NTCRA has been disturbed by construction and site operations. Because most of the proposed action would occur in previously disturbed areas, the potential for affecting sensitive ecological resources is expected to be minimal. Ecological reviews would be conducted before work begins to identify areas where the potential exists for adverse impacts to sensitive or rare biological resources, consistent with existing routine procedures (DOE/RL-95-11, *Ecological Compliance Assessment Management Plan*).

The buildings/structures have the potential to support nesting by migratory birds; therefore, building-specific surveys must be conducted at each building/structure prior to beginning removal action activities. Project engineers would consult with the ecological compliance staff well in advance of planned removal action activities to allow for sufficient surveys. If nesting migratory birds are observed, removal action activities would be delayed until after the end of the nesting season. Appropriate mitigation efforts will be implemented to reduce the disturbance. Structures may also have the potential to provide roosting habitat for various species of bats. Communal roost sites for many bat species are considered a high conservation priority for the Washington Department of Fish and Wildlife. Surveys for bats would be performed at each building/structure prior to commencement of removal action activities, and appropriate mitigation would be developed if any bats are found.

No plant or animal species listed as threatened or endangered under the federal *Endangered Species Act of 1973*, or candidates for such protection, are known to be in the vicinity of the structures planned to undergo removal action activities. Very little native or natural habitat is present near the buildings/structures planned to undergo removal action activities. Care will be taken to avoid or minimize damage to any native vegetation, especially shrubs near the buildings/structures.

Impacts on ecological resources would continue to be mitigated in accordance with DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*.

2.2 REDOX Complex Description

This section describes the REDOX Complex building/structures within the scope of this EE/CA and summarizes the processes that occurred at these locations. The buildings/structures include the 202S Building (including the Canyon, Silo, and Annex), 276S Hexone Storage Tanks, and 293S Nitric Acid and Iodine Recovery Building. The REDOX Complex contains buildings, tanks, ventilation systems, and other structures that were used during REDOX operations (Figure 2-2). Some of these buildings/structures have been included in previous removal actions. Table 2-1 lists the REDOX Complex buildings/structures subject to the removal actions proposed in this EE/CA.

Figure 2-2. REDOX Complex Structures

Table 2-1. REDOX Complex Buildings/Structures within the Scope of This EE/CA

Structure Identification	Building/Structure Name
202S	REDOX (including Canyon, Silo, and Annex)
276-S-141 276-S-142	276S Hexone Storage Tanks
293S	Nitric Acid and Iodine Recovery Building

2.2.1 202S Building

The 202S Building and support buildings were designed to separate uranium, plutonium, and neptunium as individual product streams from fission products in the irradiated fuel. The 202S Building was constructed in 1950. The building consists of three major substructures: Canyon, Silo, and Annex. The Canyon and Silo are large, heavily shielded metal and concrete structures. The Annex is also a concrete structure that is made up of three subsections: north, southwest, and east. The 202S Building is approximately 142 m (468 ft) long, 49 m (161 ft) wide, and 25.3 m (83 ft) high, with 18.3 m (60 ft) abovegrade.

Figures 2-3 and 2-4 provide cross-sectional views of the 202S Building along the west-east and north-south building axes. S&M activities are performed in accordance with the current S&M plan (e.g., DOE/RL-98-19, *Surveillance and Maintenance Plan for the 202-S Reduction Oxidation (REDOX) Facility*). Figures 2-5 through 2-9 provide plan view illustrations of the building by gallery levels (one through five). Major areas of the 202S Building addressed in the NTCRA are described in the following subsections.

2.2.1.1 202S Canyon

The 202S Canyon is a large, multistory, concrete structure with reinforced concrete walls. The Canyon is 95 m (311 ft) long, 12.5 m (41 ft) wide, and 25.3 m (83 ft) high, with 18.3 m (60 ft) abovegrade. The Canyon, which lies on an east-west axis, contains all of the equipment used for preparing radioactive column feeds, solvent distillation, waste concentration and neutralization, and treatment of process gaseous waste. Abovegrade areas include the Canyon Deck, North and South Pipe Galleries, North and South Operating Galleries, and South Crane Cab Gallery. Approximately half of the building is constructed belowgrade, with processes performed below the Canyon Deck for shielding purposes (Figure 2-4). Belowgrade areas include the North and South Sample Galleries and the Storage Gallery (located on the south side of 202S). The process cells, Wind Tunnel, and Hot Pipe Trench are belowgrade and below the Canyon Deck.

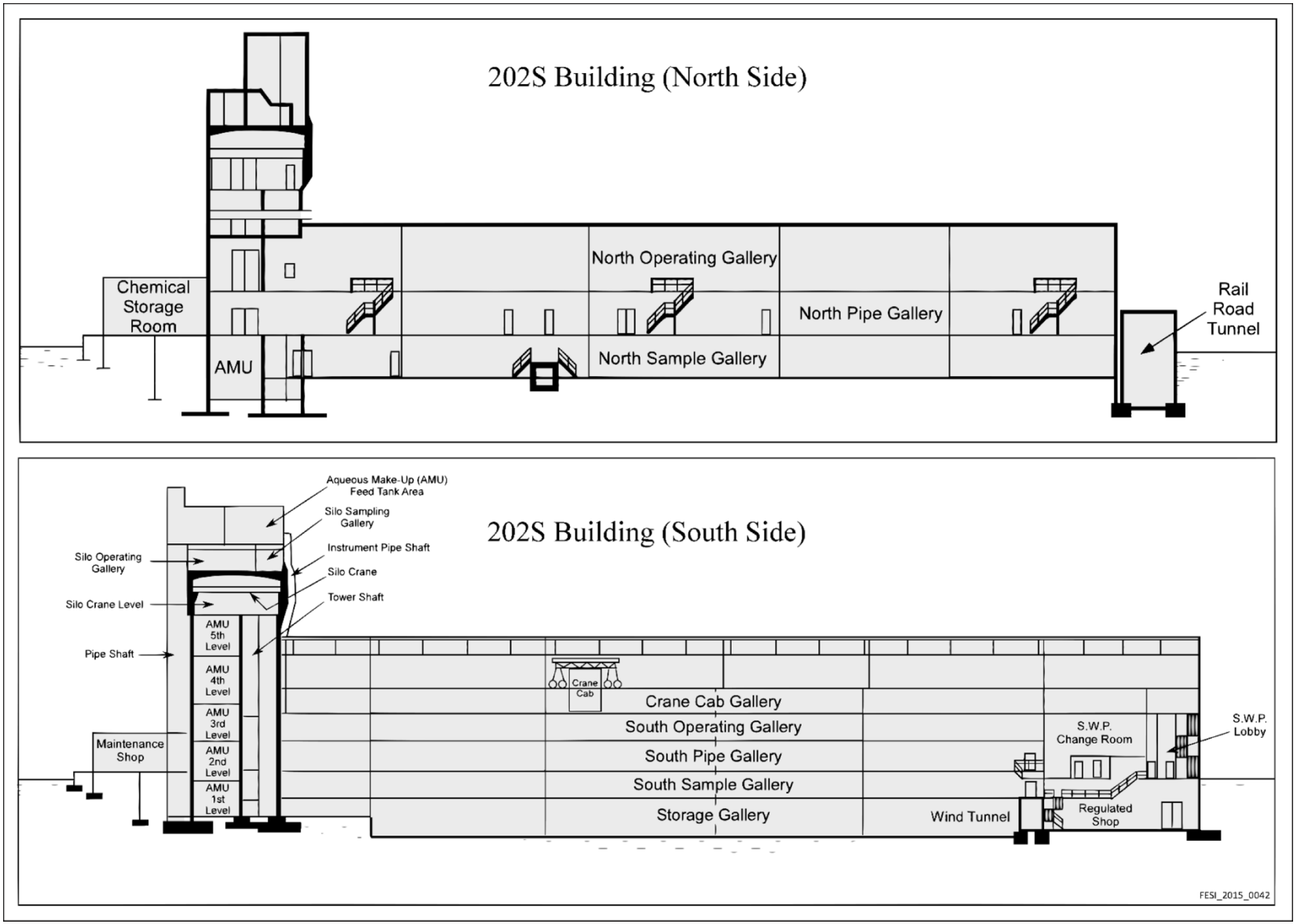

Figure 2-3. 202S Building Elevation West to East

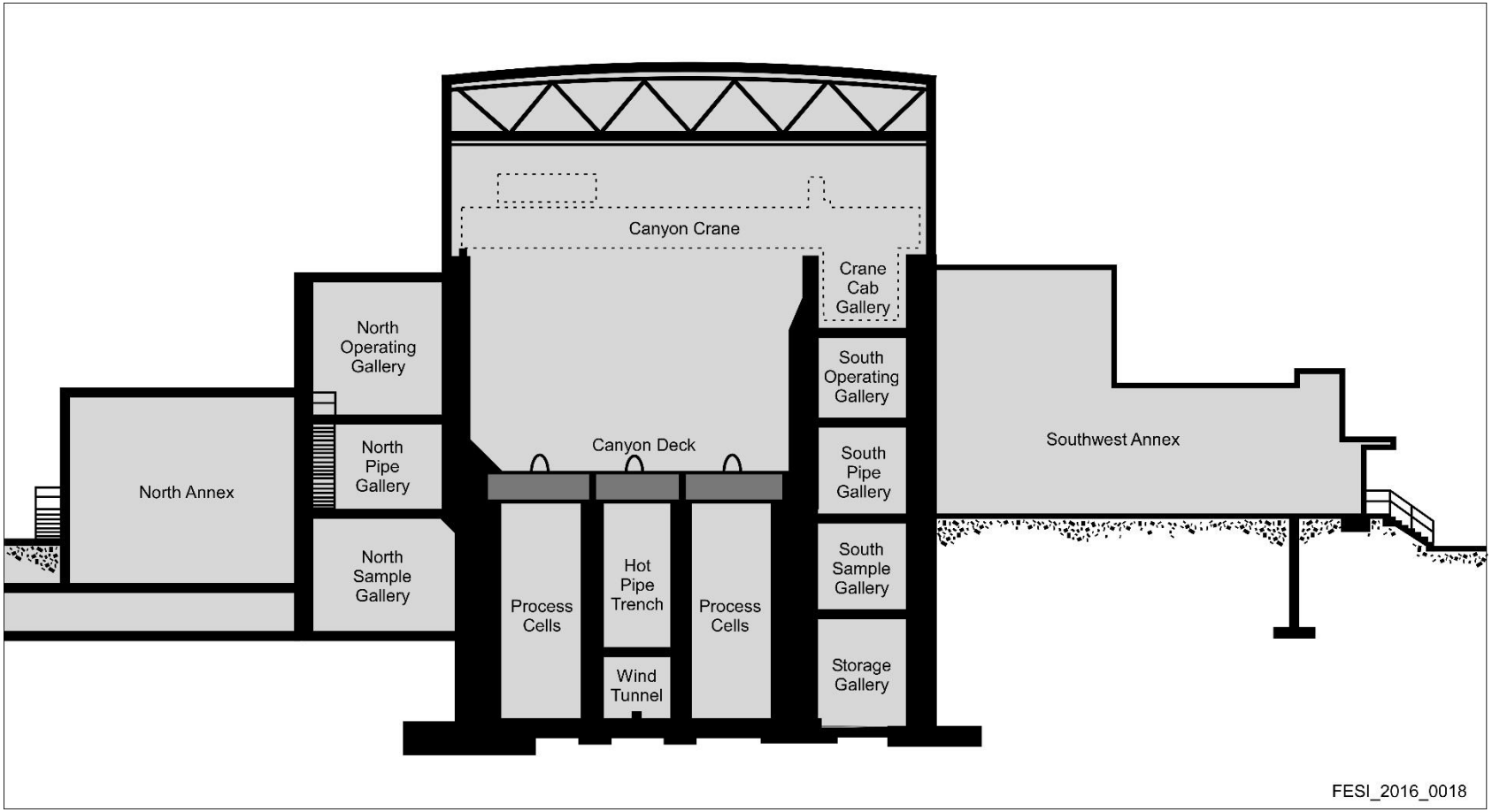

Figure 2-4. 202S Building Cross Section North to South (Facing East)

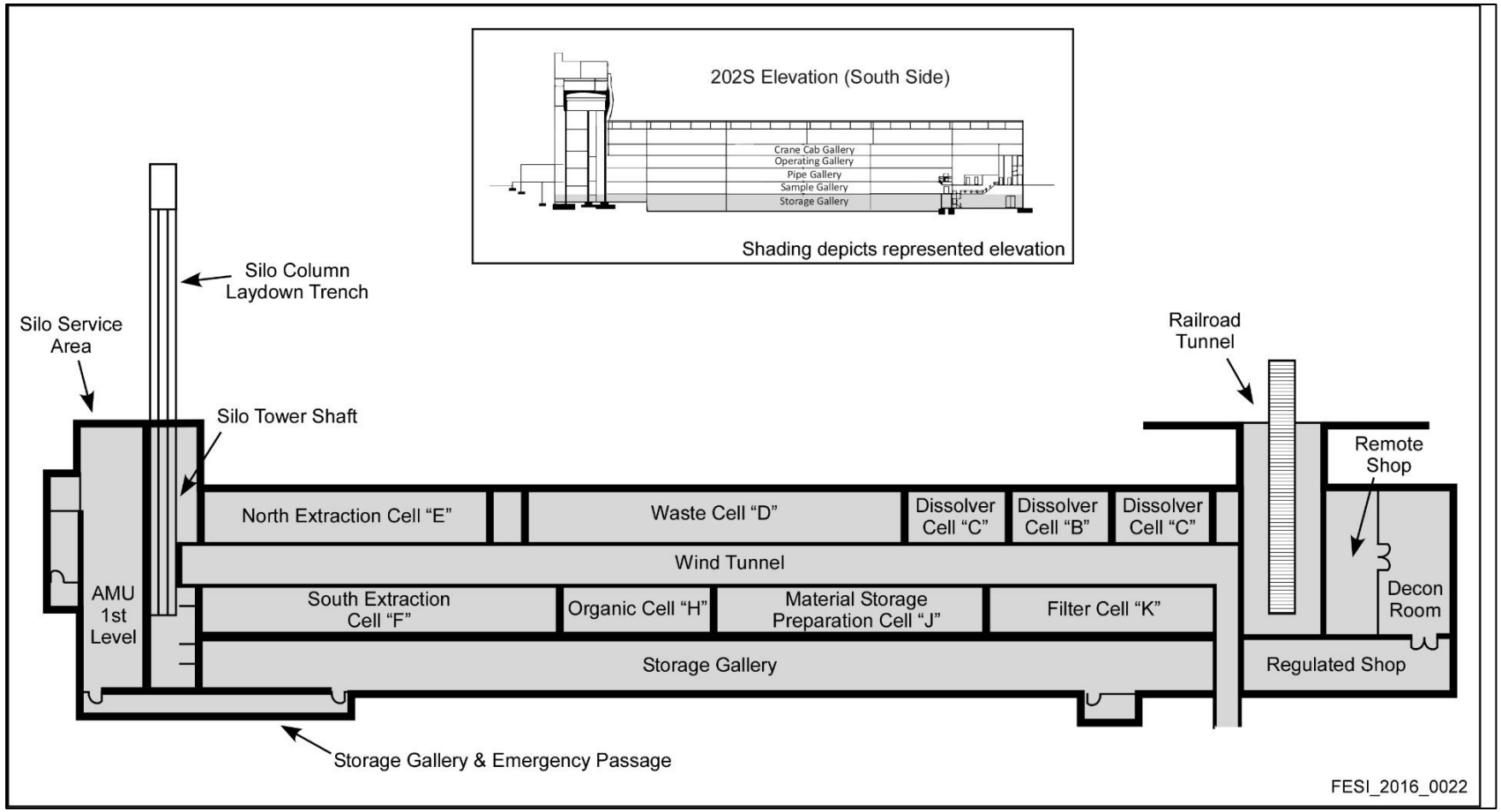

Figure 2-5. 202S Building Plan View Storage Gallery Floor Level

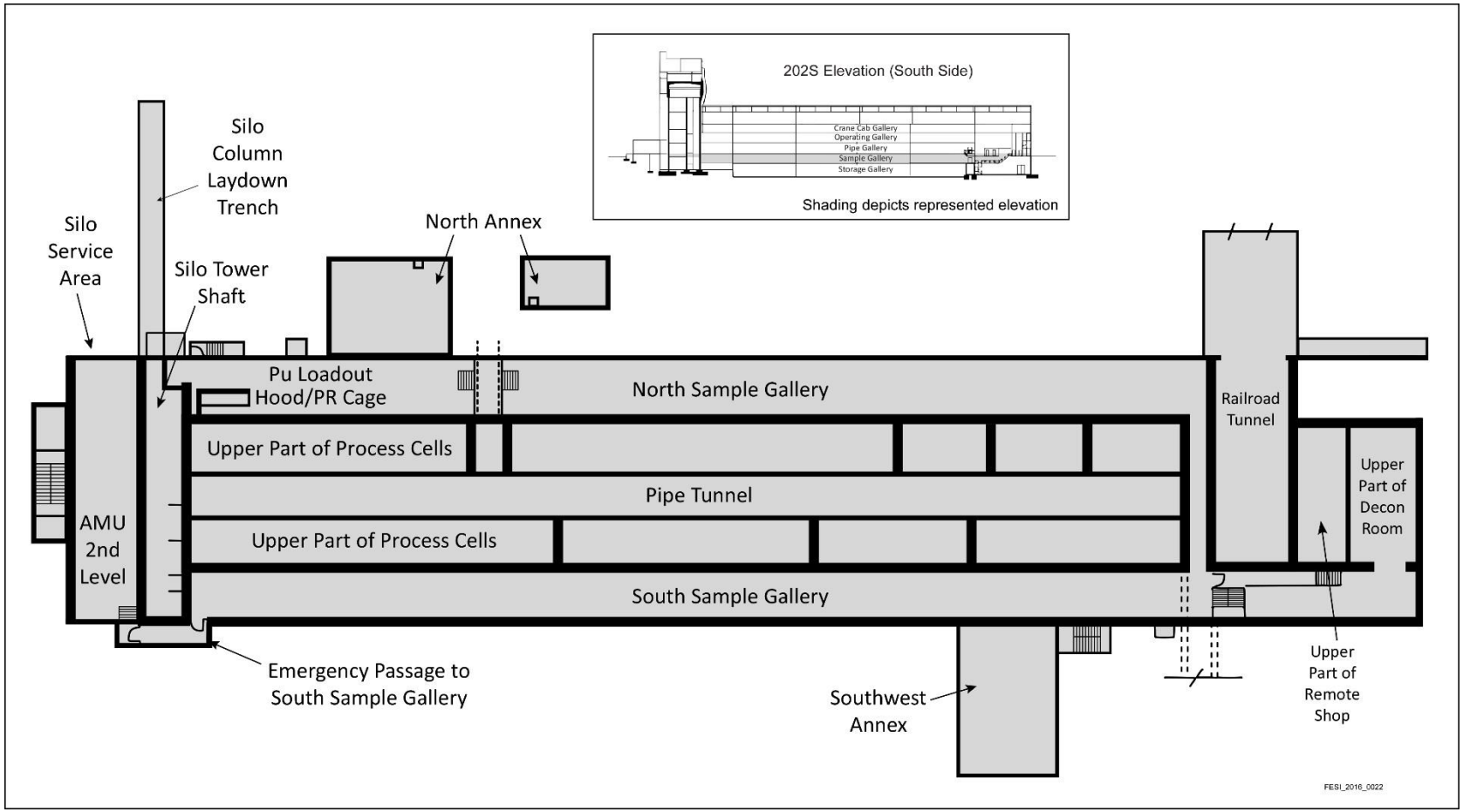

Figure 2-6. 202S Building Sample Gallery Floor Level

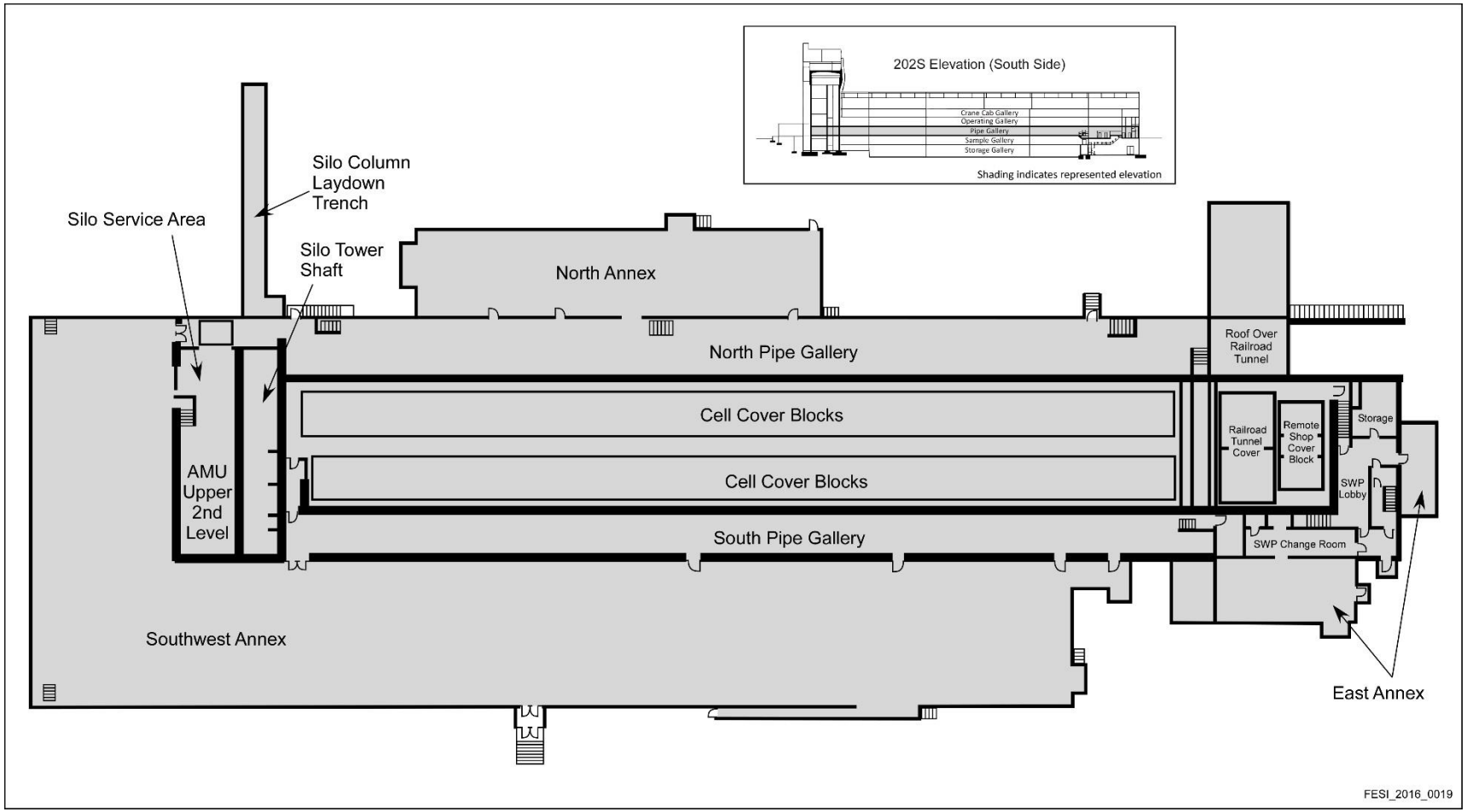

Figure 2-7. 202S Building Pipe Gallery Floor Level

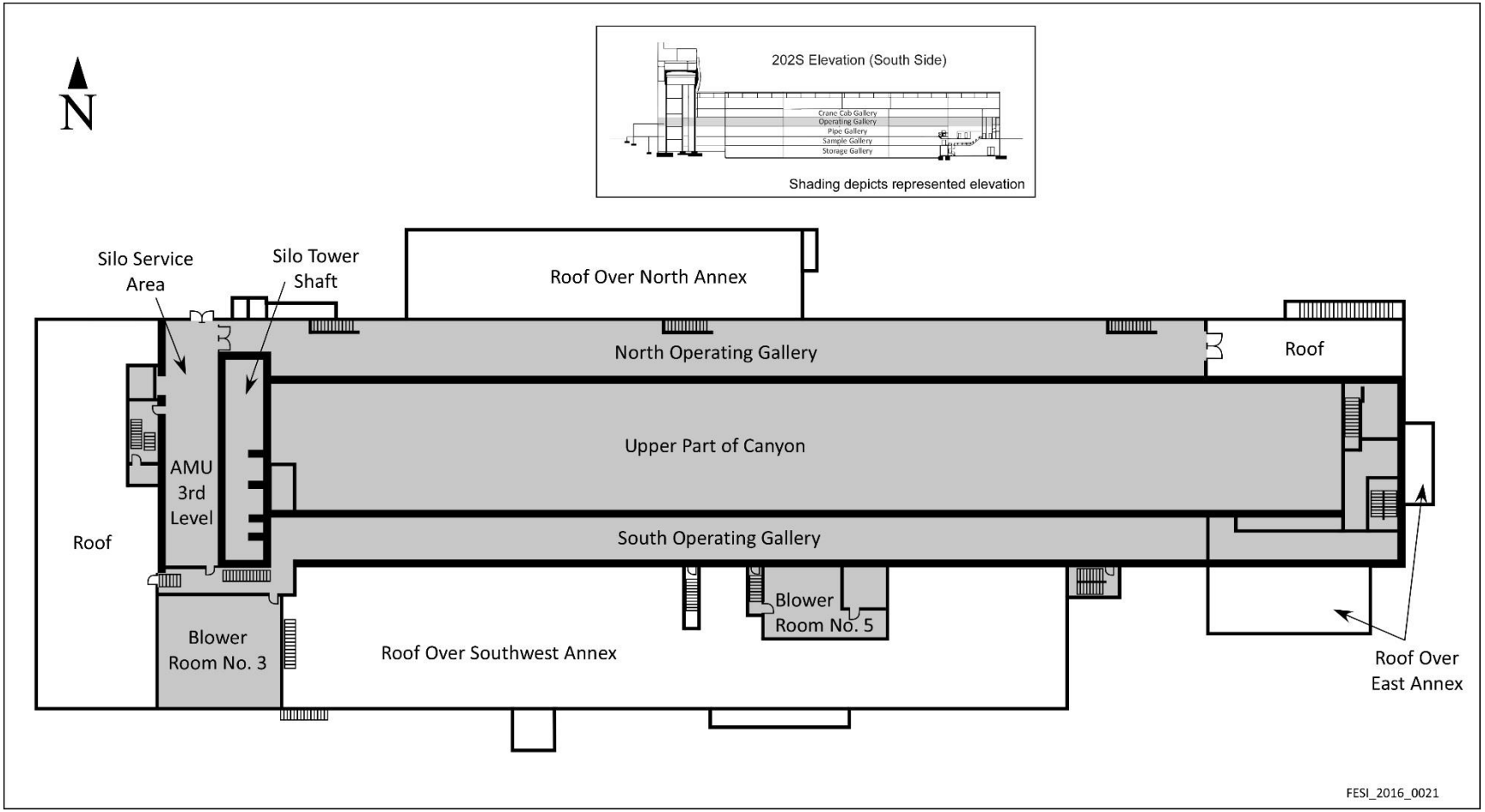

Figure 2-8. 202S Canyon Building Operating Gallery Floor Level

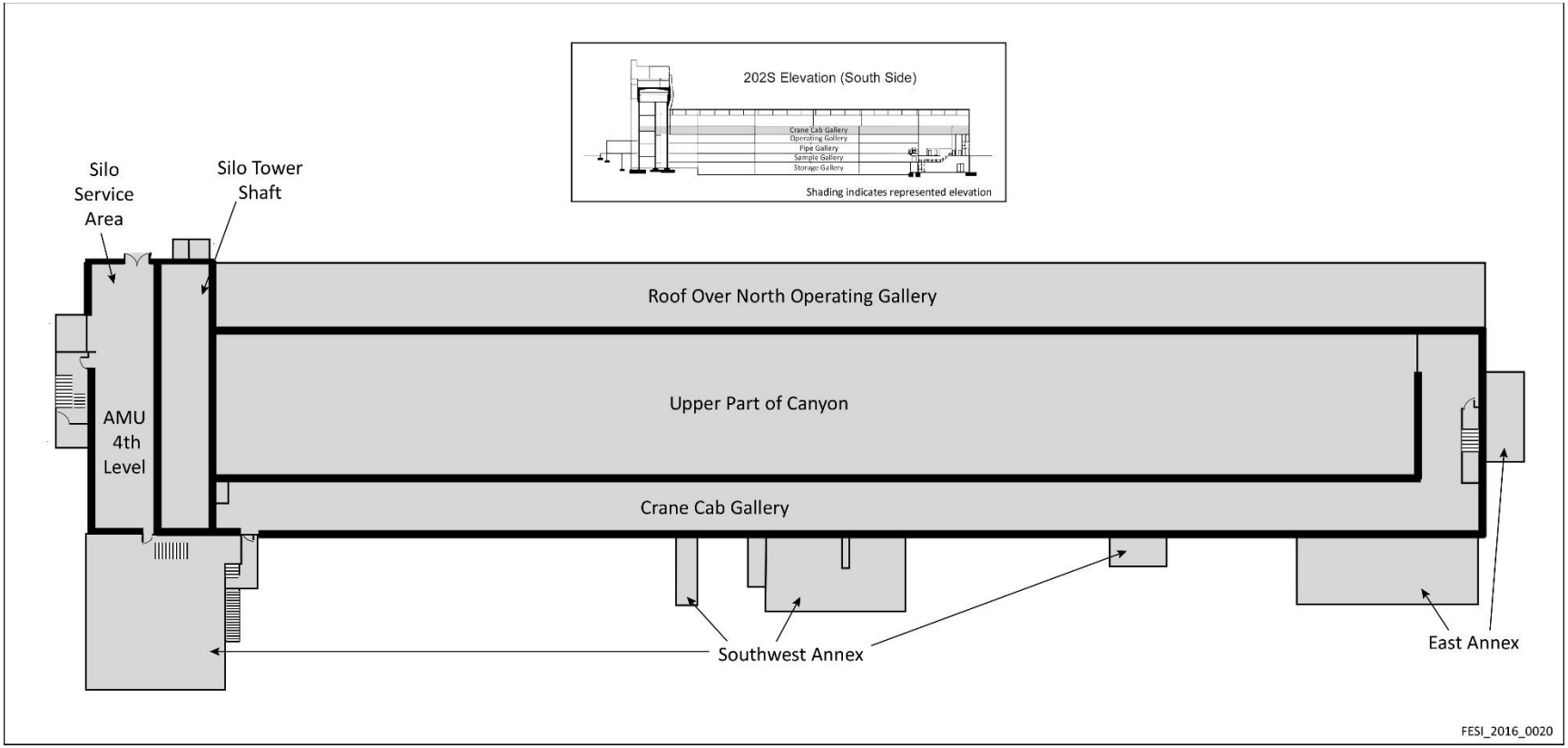

Figure 2-9. 202S Building Crane Cab Gallery Floor Level

2.2.1.1.1 Canyon Deck

One large room, referred to as the Canyon Deck, extends the entire length of the building, with walls separating it from galleries on the north and south sides, and the floor separating it from the process cells and Hot Pipe Trench. The Canyon Deck floor consists of removable cell cover blocks measuring 1.2 m (4 ft) thick.

The cover blocks are stepped to eliminate the direct path of radiation streaming and sky shine. The cover blocks are removable by crane to access and install equipment in the process cells located below the Canyon Deck. Because the crane has been deactivated, the highly contaminated process cells are not currently accessible (Figure 2-3).

2.2.1.1.2 Crane Area

The Canyon has two cranes. The largest is electrically driven and operates on tracks running lengthwise on both sides of the Canyon. This crane has a 60 ton capacity main hoist, a 10 ton rotating auxiliary hook, and two dual-auxiliary hoists of 0.5 and 1 ton capacities. The 60 ton crane was operated via an attached crane cab that hung below the crane and was located behind a shielding wall. The area behind the shielding wall is referred to as the Crane Cab Gallery and is located on the south side of the Canyon, directly above the South Operating Gallery. The crane was used to remove the cover blocks and move equipment between the Canyon Deck, process cells, and Railroad Tunnel. It was operated remotely from the Crane Cab Gallery. The second crane has a 2 ton capacity, is electrically operated, and is mounted on a monorail running cross-wise at the east end of the Canyon. This crane is used for servicing the main crane.

2.2.1.1.3 Process Cells

The process cells contain deactivated processing equipment formerly used in spent fuel separations. Nine process cells are located in two parallel rows with a concrete Hot Pipe Trench and Wind Tunnel between the rows, separated by 0.6 m (2 ft) thick concrete walls for shielding. The nine process cells are identified by letters, as follows:

- Cell A – dissolver cell
- Cell B – dissolver cell
- Cell C – dissolver cell
- Cell D – waste cell (treatment)
- Cell E – north extraction cell
- Cell F – south extraction cell
- Cell G – organic cell (recovery)
- Cell H – metal solution preparation cell
- Cell J – filter cell

Process cells A, B, and C were used for dissolving slugs received from the 100 Areas. Cell D was a waste treatment cell that was used for the neutralization and concentration of waste solutions. Cells E and F were extraction cells that handled the solutions pumped to and from the solvent extraction columns. Cell G was used for decontamination and purification of organic solvent. Cell H was a metal solution preparation cell that prepared feed solution. Cell J was a filter cell used for decontamination of process offgases.

While preparing for shutdown, all process equipment and piping were flushed to remove contamination; however, residual chemicals from past processing are expected to remain. The process cells are estimated to contain the majority of the chemical and radiological inventory remaining in the 202S Canyon.

2.2.1.1.4 Hot Pipe Trench

The Hot Pipe Trench contains a network of transfer piping used to convey product and waste streams between process cells during operations. The Hot Pipe Trench was flushed during shutdown activities to remove and reclaim any product; however, residual contamination is expected to remain.

2.2.1.1.5 Wind Tunnel

During operations, the Wind Tunnel provided exhaust ventilation to all process cells and the Silo Tower Shaft. Process equipment discharged offgases directly into the Wind Tunnel.

2.2.1.2 Galleries

Sample, operating, and pipe galleries are located along the north and south sides of the Canyon. A storage gallery is located below all other galleries on the south side of the Canyon. The galleries contain instrumentation, tanks, and piping that supplied processing areas. Galleries contained water services and supplied air and gases for instrumentation and processes. Tanks and instruments in the sample and pipe galleries were connected to process cells by connectors mounted on the gallery walls of the cells. Figures 2-5 through 2-9 provide plan-view illustrations of the REDOX galleries.

2.2.1.2.1 Storage Gallery

The Storage Gallery was used to store support equipment and material. The gallery is located on the south side of the building and is the lowest gallery level (Figure 2-6).

2.2.1.2.2 Sample Galleries

The two sample galleries in the 202S Canyon, the North Sample Gallery and the South Sample Gallery, are located on the north and south sides of the Canyon, respectively. The sample galleries were used to collect radioactive process samples from the process equipment through highly shielded sample boxes on the walls shared between the galleries and the Canyon. Solutions and products were collected using vacuum jets from process streams. The sampling equipment remains in the galleries, and the internal configuration is unknown. In addition to sample boxes, numerous chemical lines run overhead and miscellaneous equipment remains (e.g., carts, tanks, and lead bricks). The elevation of the sample galleries is depicted in Figure 2-6.

North Sample Gallery. On the west end of the North Sample Gallery, there is a rise with steps known as the Waste Line Tunnel (also called the Hump) that runs beneath the gallery. The Hump houses pipelines that diverted waste to the 240-S-151 Diversion Box, north of the 202S Building. The area west of the Hump contains more sample boxes and chemical lines, as well as the Plutonium Loadout Hood.

The Plutonium Loadout Hood, also referred to as the Product Receiver Cage, is located at the west end of the North Sample Gallery (Figure 2-6). The Plutonium Loadout Hood is an “L”-shaped enclosure for housing equipment that was used for concentrating the plutonium product solution prior to shipment. The Plutonium Loadout Hood is composed of a metal frame supporting a series of LEXAN™ panels. This enclosure isolates the process vessels and piping inside the hood from the North Sample Gallery. The LEXAN part of the hood is approximately 2.55 m (8 ft 6 in.) high and is on a raised concrete curb (15.2 cm [6 in.] high). The topmost 0.6 m (2 ft) of the hood is enclosed by stainless steel panels. The hood

™ LEXAN is a trademark of SABIC Innovative Plastics, Houston, Texas.

is configured in an "L" shape, with the base leg 3.4 m (11 ft) long and 1.5 m (5 ft) wide and the other leg 5.2 m (17 ft) long and 1.5 m (5 ft) wide (BHI-01299, *Alternative Evaluation for the REDOX (202-S) Plutonium Loadout Hood*). The room is equipped with a stainless steel lined floor to support spill recovery.

The Plutonium Loadout Hood operated from 1951 to 1955. During operations, plutonium solution from separation activities within the 202S Building was piped to the hood for concentration and loadout of the liquid plutonium nitrate product. In 1955, operations in the hood ceased because improved capabilities were provided in the 233S Plutonium Concentration Facility. Upon cessation of operations in the Plutonium Loadout Hood, the system was deactivated. The Plutonium Loadout Hood was historically serviced by a dedicated ventilation system that is no longer active. Currently, ventilation to this area is supplied by the 291S Ventilation System and is maintained at negative differential pressure, drawing air from the North Sample Gallery and then exhausting through a replaceable filter to the atmosphere.

Records and process knowledge indicate that flushing of the piping and vessels in the Plutonium Loadout Hood was performed during the removal of loadout components from the 233S Building. Flushing was accomplished using nitric acid to decontaminate the internals of the hood and ancillary equipment followed by water (0200W-US-N0156-02, *Pu Loadout Hood Stabilization*).

The Plutonium Loadout Hood is radiologically contaminated and was stabilized in 1999 to prevent the spread of contamination during S&M activities (BHI-01255, *Interim Characterization Report for the REDOX Plutonium Loadout Hood*; 0200W-US-N0156-02). Planned stabilization activities consisted of stabilizing the Plutonium Loadout Hood, decontaminating areas within the North Sample Gallery, stabilizing former process and waste lines, and isolating the EF-8 exhaust system. The Plutonium Loadout Hood stabilization was accomplished by placing absorbent material in the sump, sealing the Plutonium Loadout Hood, and isolating the sampler hoods in the North Sample Gallery from the EF-8 exhaust system.

South Sample Gallery. The South Sample Gallery was used to collect samples from the process cells through highly shielded sample boxes on the walls shared between the galleries and the Canyon. Solutions and products were collected using vacuum jets from process streams. This equipment remains, and the internal configuration is unknown. In addition to sample boxes, numerous chemical lines run overhead, and miscellaneous equipment remains (e.g., carts, tanks, and lead bricks).

2.2.1.2.3 Pipe Galleries

Two pipe galleries, the North Pipe Gallery and the South Pipe Gallery, contain piping and junctions that were used to transfer nonradioactive chemicals during REDOX operations (Figure 2-7).

2.2.1.2.4 Operating Galleries

Two operating galleries, the North Operating Gallery and the South Operating Gallery, are located on the north and south sides of the Canyon and are the highest gallery level (Figure 2-8). The operating galleries include instrumentation panels, control valves, and tanks that were used during REDOX operations.

2.2.1.3 East End Rooms

During REDOX operations, tanks, piping, and other equipment were removed by remote handling to a maintenance area located at the east end of the Canyon. The Maintenance Shop area consists of a lobby used as a central staging area and the Hot Shop, Decontamination Room, and Regulated Shop.

2.2.1.3.1 Hot Shop

Also known as the Remote Shop, the Hot Shop is two stories and is located to the east of the Storage Gallery and the North and South Sample Galleries, directly east of the Railroad Tunnel. The Hot Shop includes a removable, 1.2 m (4 ft) thick ceiling panel (cover block) that provides access into the Canyon process area. Equipment, tools, and other supplies could be transferred between the Canyon Deck and Hot Shop via the overhead crane. The Hot Shop is equipped with a stainless steel floor and a hot drain where contaminated equipment was flushed and rinsed with decontaminants. The Hot Shop is a 12.3 m by 4.6 m (40.5 ft by 15 ft) room with an 8 m (26.25 ft) high ceiling. Due to the nature of the work conducted in this room, surface contamination of mixed fission products is present, and the floor of the Hot Shop is known to be contaminated.

2.2.1.3.2 Decontamination Room

Equipment and tools delivered to the Hot Shop from the Canyon process area were likely contaminated from processing activities. Equipment requiring repair or modification, as well as any tools used in contaminated areas, were moved to the Decontamination Room to undergo decontamination activities to reduce or remove contamination. The Decontamination Room contains two hooded sinks equipped with water, steam, and acid service for further decontamination of equipment. Decontamination activities were conducted under a ventilation hood. The Decontamination Room is a 12.3 m by 7.3 m (40.5 ft by 24 ft) room with a 6 m (19.67 ft) high ceiling.

2.2.1.3.3 Regulated Shop

Following decontamination, equipment would undergo contact maintenance in the Regulated Shop, a 20 m by 3.9 m (65.5 ft by 12.75 ft) room with a 6 m (19.75 ft) high ceiling. Maintenance was performed under controlled conditions in the Regulated Shop.

2.2.1.3.4 Special Work Permit Lobby

The special work permit (SWP) lobby is a central staging area that is accessed through an air lock on the South Pipe Gallery level. The SWP lobby provides access to the Health Instrument Storage Room, as well as a stairwell that leads to the Canyon Deck.

2.2.1.4 Other Rooms

Ventilation equipment rooms, compressor rooms, maintenance shops, offices, and other supporting facilities are located around the perimeter of the processing areas.

2.2.1.5 202S Silo

The Silo is an eight-story structure located at the west end of the 202S Building. The Silo is segregated into two parts: Silo Service Area and Silo Tower Shaft. The Silo is 40 m (132 ft) high, with 35.7 m (117 ft) abovegrade. Figure 2-10 presents a cross section of the 202S Silo, including the Silo Service Area and Silo Tower Shaft. The exterior walls of the Silo vary from 0.46 m to 1.1 m (1.5 ft to 3.5 ft) in thickness.

2.2.1.5.1 Silo Service Area

The Silo Service Area has eight levels, the first five of which are aqueous makeup unit (AMU) levels. The sixth level is occupied by the Silo Crane, and the Silo Operating Gallery and Sample Gallery are on the seventh level. The eighth level contains the blower room and feed tank area.

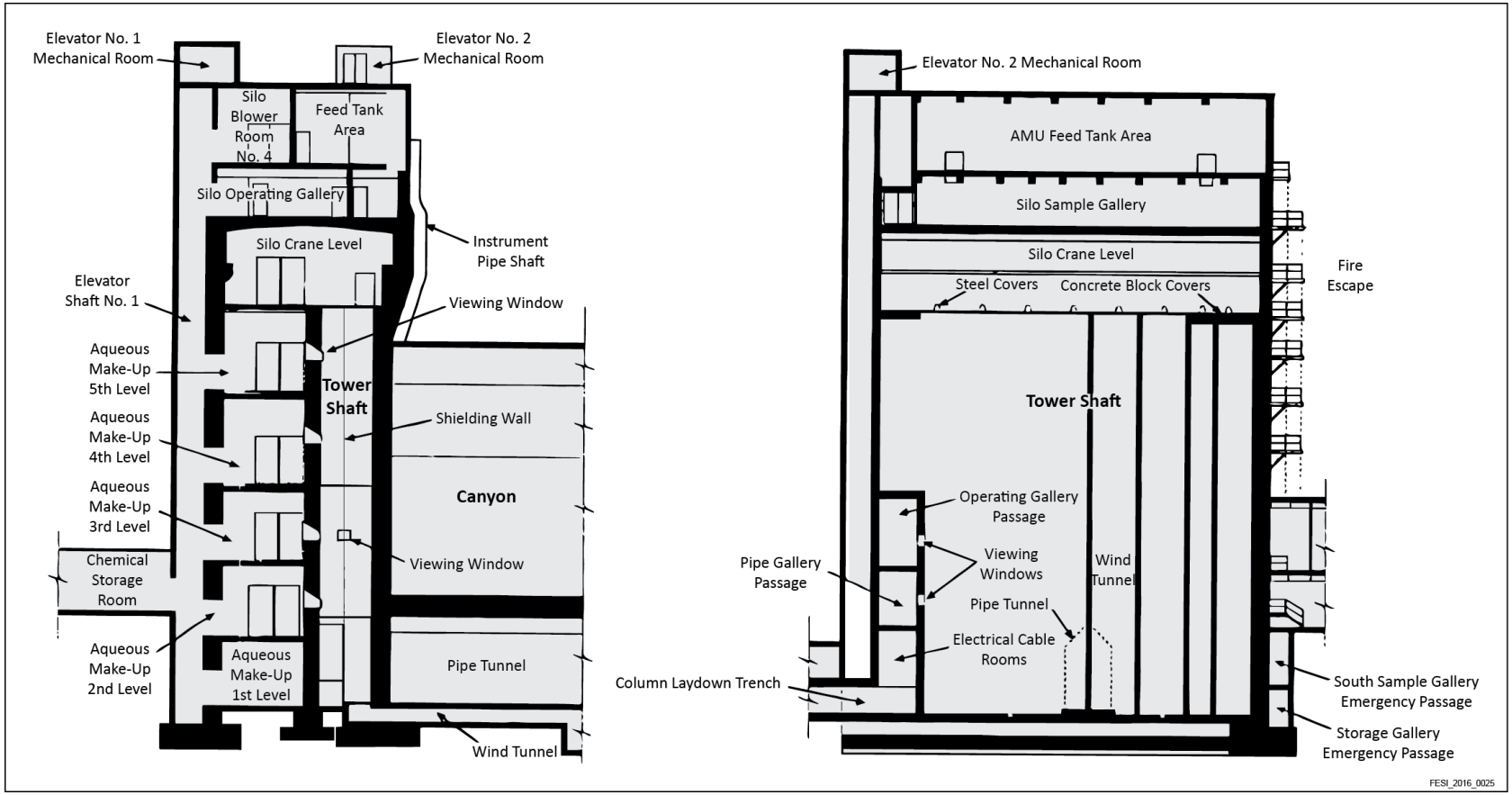

Figure 2-10. 202S Silo Cross Section Elevation View

2.2.1.5.2 Silo Tower Shaft

The Silo Tower Shaft area is separated from the Silo Service Area by concrete shielding. The tower shaft contains 13 solvent extraction columns and process jumpers. The columns were remotely operated from the overhead crane. Chemicals were gravity fed from the AMU feed tanks to the columns. The solvent extraction columns were brought into the facility through the Column Laydown Trench, located on the north side of the Silo. The tower shaft is 25.6 m (84 ft) high, 20.4 m (67 ft) long, and 3.3 m (11 ft) wide. The height of the solvent extraction columns varies between 9.7 m and 16.8 m (32 ft and 55 ft), depending on process function; column diameter varies between 7.62 cm and 25.4 cm (3 in. and 10 in.).

The tower shaft is highly contaminated due to the nature of the chemicals that were used and the radionuclides that were processed. Operations within the tower shaft were viewed through lead glass, mineral-oil-filled viewing windows located at each of the remote stations for operating the crane. Sixteen viewing windows are installed in the wall between the tower shaft and AMU levels. Another viewing window is located in the north wall of the tower shaft at the operating gallery level. These viewing windows are arranged in a pattern that provides a complete view of the equipment, connectors, and piping in the shaft. Process streams were sampled from the Silo Sampling Gallery, located above the Silo Crane Operating Area.

2.2.1.5.3 Column Laydown Trench

Columns were transferred in and out of the Silo Tower Shaft through an underground tunnel known as the Column Laydown Trench (Figure 2-5). The Column Laydown Trench, located beneath the Silo Tower Shaft and extending underground to the north of the 202S Building, was designed to facilitate the replacement of failed columns during processing. The Column Laydown Trench is radioactively contaminated.

2.2.1.6 202S Annex

The 202S Annex is separated from the main Canyon structure by massive concrete shielding. Three sub-annexes comprise the REDOX Annex (Figures 2-6 through 2-9). These nonradiologically contaminated areas contain offices, administrative support areas, and equipment rooms that are described in the following paragraphs.

2.2.1.6.1 North Annex

The north service area contains a 2.4 kV switchgear room, a wet cell battery room, the north 480 V switchgear room, Blower Room #2, Cable Room #1, Cable Room #2, the former electric shop, and an office. Blower Room #2 contains a deactivated supply fan for the north pipe and operating galleries. The electrical shop contains the motor control center (MCC) and the lighting panel for the operating equipment in the REDOX Complex.

2.2.1.6.2 Southwest Annex

The south and west service areas contain Blower Room #1, Blower Room #3, Blower Room #5, Cable Room #3, a compressor room, the south 480 V switchgear room, and the former chemical storage, equipment, shop, and offices. Blower Room #1 houses three deactivated supply fans for the REDOX Complex. The compressor room contains an air compressor and an instrument air dryer. The south 480 V switchgear room contains MCCs that have been deactivated.

2.2.1.6.3 East Annex

The east-end segment of the Annex contains the former hot shops for the facility and the Railroad Tunnel access to the Canyon processing area. This area is used for access to the 202S Canyon for ongoing S&M activities.

2.2.2 Ancillary Structures

In addition to the main process areas, the REDOX Complex includes multiple buildings that were formerly used to store chemicals, materials, and support systems (e.g., ventilation, exhaust stacks, and environmental monitoring systems). This section describes the ancillary facilities/structures that are included in the scope of the NTCRA for the REDOX Complex.

2.2.2.1 276S Hexone Storage Area Tanks (276-S-141 and 276-S-142)

Two hexone tanks (276-S-141 and 276-S-142) are buried north of the 276S Building. These single-shell, carbon steel storage tanks each have a capacity of 90,850 L (24,000 gal) and were formerly used to store makeup solvent for the REDOX Complex during operations. From 1990 through 1992, 132,000 L (35,000 gal) of the solvent remaining in the tanks were recovered, distilled, and incinerated at an offsite location. The process used to drain and flush the waste solvent is discussed in WHC-EP-0570, *The Distillation and Incineration of 132,000 Liters (35,000 Gallons) of Mixed-Waste Hexone Solvents from Hanford's REDOX Plant*. Residual sludge in the tanks from the distillation process was grouted as an interim closure in 2002 (BHI-01142, *REDOX Facility Safety Analysis Report*; 0200W-US-N0217-02, *REDOX, Stabilization of Hexone Tanks*). The remaining void space in the tanks was subsequently grouted and left in place. The tanks are left in place, pending final removal. As specified in DOE/RL-2009-112, the tanks will be clean closed. Waste generated from this clean closure activity will be disposed under this NTCRA.

2.2.2.2 293S Nitric Acid and Iodine Recovery Building

The 293S Nitric Acid and Iodine Recovery Building (293S Building) is located east of the 202S Building, directly south of the 291S Ventilation System.

The 293S Building housed the nitric acid and radioactive iodine recovery processes. The recovered nitric acid was stored in an underground, cylindrical, stainless steel nitric acid storage tank (3 m [10 ft] high by 3 m [10 ft] in diameter), located directly west of the 293S Building. The tank is currently empty. The acid fumes were captured in a nitric acid absorber, and radioactive iodine was removed using a caustic scrubber system.

Remaining hazards within the 293S Building include radioactive material inventory (mixed fission products, plutonium, and americium), estimated to be approximately 4 Ci beta and 1 Ci alpha, which is present in the scrubber/absorption column and piping. The upper level of the building contains fiber filter media and is designated as a radiological buffer area; the lower area contains the exchange columns and is designated as a contamination area.

2.3 Previous Investigations and Removal Actions

Various soil and groundwater investigations have been conducted in the Central Plateau in the 200 West Area. Previous investigations have been performed at the HSTF and the nearby 233S Plutonium Concentration Facility.

The 276S Hexone Tanks were permitted under RCRA and the 2008 Hanford Facility RCRA Permit (WA7890008967) modification for waste storage and treatment. In accordance with Section 6.0 of the TPA (Ecology et al., 1989a) and WAC 173-303, a closure plan was prepared for the REDOX Complex

retired hexone storage tanks (276-S-141 and 276-S-142) in 2010 (DOE/RL-2009-112). The closure plan presented the process to close the HSTF, a RCRA TSD unit. The closure plan includes a sampling and analysis plan (SAP) (DOE/RL-2009-116, *Sampling and Analysis Plan for the Hexone Storage and Treatment Facility Closure Plan*) that details the sampling and analysis for the Hexone Storage Tanks. Ecology will approve the closure plan after the public review and comment period has been completed, and the closure plan will then be included in the Hanford Facility RCRA Permit.

Past activities supporting closure of the 276S Hexone Tanks include removal and distillation of waste in 1992. A petition was submitted to Ecology to allow for a site-specific variance from land disposal restrictions because a small amount of tank residual mixed waste was present in the tank at the time of interim stabilization. Void space in the tank was grouted in 2002 to prevent accumulation of flammable vapors. Prior to grout stabilization, the waste was observed as a uniform, tar-like layer across the tank bottom, with a dried, cracked surface.

Portions of the 276S Hexone Tanks to be clean closed under the closure plan include the grouted tanks (276-S-141 and 276-S-142), associated centrifugal transfer pumps, approximately 13 m (42 ft) of underground piping, aboveground vent piping, and underlying soil. The closure plan identifies the clean closure performance standards and the physical closure activities necessary to achieve clean closure.

Clean closure of the 276S Hexone Tanks and associated piping will be achieved by removal and disposal and by removing any soil contaminated above numerical clean closure standards. Underground tank piping (200-W-230-PL) and aboveground piping associated with the pumps constitutes the tank system ancillary piping within the TSD unit boundary and the scope of closure (DOE/RL-2009-112). Soil beneath the tanks and piping will be clean closed through visual inspections and soil verification sampling. If releases to soil occurred, the contaminated soil will be removed and the removal area soil will be sampled in accordance with an approved SAP to verify achievement of clean closure standards. The 276S Hexone Tanks will be clean closed by demolition and removal, as proposed by the alternatives presented in this EE/CA. Waste generated from this closure activity will be managed as part of the removal action.

Although the 233S Plutonium Concentration Facility is not within the scope of this EE/CA, the previous investigation and removal action of this structure is provided here for informational purposes. The removal action of 233S was warranted per Memorandum 0047268, *Removal Action at the 233-S Plutonium Concentration Facility, United States Department of Energy (USDOE) Hanford Site, Benton County, Washington*. This included removing radioactive material, removing facility equipment and systems, decontaminating facility surfaces, dismantling facility structures, and disposing waste at ERDF and sending TRU waste to the Waste Isolation Pilot Plant (WIPP). Implementation guidance for the removal activities was provided in DOE/RL-97-08, *Removal Action Report for the 233-S Plutonium Concentration Facility*.

Multiple buildings/structures within the REDOX Complex that are not part of this removal action have been removed or are planned to be removed under DOE/RL-2010-33, *Removal Action Work Plan for Central Plateau General Decommissioning Activities.*

No additional investigations or removal actions have been previously performed for any other buildings or structures addressed by this NTCRA.

2.4 Source, Nature, and Extent of Contamination

The REDOX Complex buildings/structures are contaminated, to different degrees, with both radioactive and chemical substances that were used or generated during facility operations and waste management activities. Some hazardous substances were removed during the shutdown period; however, not all hazardous materials were removed at that time. During the shutdown period, actions were not taken to characterize or document the remaining hazards and inventory. Therefore, the list of hazardous materials present in the 202S Building and Ancillary Structures (Table 2-2) is an estimate and is only as complete as knowledge, S&M records, and hazard analyses allow. Some of the hazardous substance were removed from the buildings and structures as part of routine S&M activities. In addition to radiological and chemical hazards, structural hazards exist due to the degradation in the structural integrity of the buildings and structures. Structural degradation could result in partial or total loss of radiological material, confinement, and/or worker injury.

The types of waste likely to require disposal under this NTCRA include, but are not limited to, inorganic and organic chemicals, solid waste, low-level radioactive waste, asbestos, radioactively contaminated asbestos waste, beryllium, and polychlorinated biphenyl (PCB) waste. Transuranic (TRU) waste is also anticipated to be present.

Resources such as historical information, process knowledge, radiological survey reports, occurrence reports, assessment reports, personnel interviews, characterization reports, vulnerability assessments, inspections, walkdowns, and knowledge of construction and other materials will be used to characterize the remaining hazardous substances (e.g., within equipment and piping/drains) to facilitate removal action activities and associated waste disposal.

To support characterization of the building/structure waste, a SAP will be prepared in conjunction with the RAWP. As the lead regulatory agency for this action, EPA will approve the RAWP and SAP.

2.4.1 Chemical Hazards

The following chemical hazards may be present within the REDOX Complex. The buildings/structures contain some friable and/or nonfriable asbestos in the form of insulation, ductwork, gasket material, transite siding, and floor tiles, which will be confirmed through process knowledge and/or sampling and analysis. Additional chemical hazards present may include, but are not limited to, the following materials:

- Inorganic chemicals (e.g., arsenic, beryllium, cadmium, lead, mercury, silver, uranium, and zinc)
- Organic chemical residues (e.g., lubricants, oils, and PCBs)
- Radioactive sources contained in remaining smoke detectors
- Asbestos and asbestos-containing material (ACM)
- Refrigerants
- Corrosives (including both acids and caustics)

2.4.2 Radiological Hazards

The primary hazardous substances associated with the 202S Building and Ancillary Structures are radioactive materials. Primary radionuclide contaminants include, but are not limited to, uranium-234, uranium-235, uranium-238, plutonium-239/240, americium-241, and mixed fission products such as strontium-90, cesium-137, cobalt-60, europium-152, and europium-155. The majority of contaminants are found in the form of adherent films and residues within the structures. Table 2-2 presents the inventory estimates of the REDOX Complex (BHI-01142).

Table 2-2. Estimated REDOX Complex Radioactive Material Inventories

Location	Type	Inventory
202S Building Canyon (including process cells, equipment and piping, and Canyon Deck)	Plutonium-239	1,500 Ci alpha (24.5 kg plutonium-239)
	Strontium-90	9,000 Ci beta (64 g strontium-90)
202S Building North Sample Gallery and Plutonium Loadout Hood	Plutonium-239	140 Ci alpha (2,155 g plutonium-239)
	Strontium-90	840 Ci beta (6.0 g strontium-90)
202S Building North Sample Gallery (excluding Plutonium Loadout Hood); South Sample Gallery; North and South Operating, Pipe, and Storage Galleries	Mixed fission products, plutonium, and americium in hoods, ducting, and piping; also present as surface contamination	Residual amounts, included in inventory estimates for the Canyon
202S Building Remote Shop (east end of the Canyon at the cell floor level)	Mixed fission products, plutonium, and americium present as surface contamination	Minor residual amounts, included in inventory estimates for the Canyon
202S Building Silo	Mixed fission products, plutonium, and americium in hoods, ducting, and piping; also present as surface contamination	Included in inventory estimates for the Canyon
293S Building	Mixed fission products, plutonium, and americium present as surface contamination and contamination in equipment	4 Ci beta activity, 1 Ci alpha
276S Hexone Tanks	Mixed fission products, plutonium, and americium; contamination is present in fixed and hardened residue	Assumed to be 946 L (250 gal) of distillation sludge and 114 L (30 gal) of hexone-contaminated liquid

2.4.3 Current Hazard Conditions

Current S&M areas are identified in DOE/RL-98-19. These areas are surveyed annually to identify any changes in the conditions of the buildings. Table 2-3 lists the conditions noted from 2007 through 2015.

2.5 Risk Evaluation

The buildings/structures addressed by this NTCRA are contaminated with hazardous substances including radiological contaminants, metals, organic chemicals, PCBs, beryllium, and asbestos. While the precise inventory of the contaminants and contaminant quantities remaining in the 202S Building and Ancillary Structures is not known, the documented amount of radiological contamination and ACM present in the deteriorating facilities indicates a sufficient threat of release to the environment. Contaminants could be released directly to the environment through a fire; breach in a utility pipe, containment wall, or roof; or building collapse as the buildings age and deteriorate. Contaminants could also be released to the environment indirectly through animal and human intrusions.

Table 2-3. Current Hazard Conditions

Area	Surveyed Area	Documented Condition
Canyon Deck	No	The Canyon Deck has not been entered since 1997. Conditions on the deck are not known at this time. Based on current conditions in areas where surveillance inspections are performed, water accumulation, animal intrusion, structure deterioration, and contamination spread are expected.
Silo (Service Area)	Yes	Substantial structural deterioration has been observed in the Silo. Significant water stains, dirt deposits, animal intrusion, and chemical stains are noted on all levels of the Silo. White chemical crystals and powder are found on a number of tanks, flanges, valves, and pipes. Characteristics of all of the chemical residues are not know at this time. Deteriorated asbestos insulation has also been noted on most levels.
Plutonium Loadout Hood	No (since 2013)	The Plutonium Loadout Hood contains a large quantity of radiological inventory (140 Ci of plutonium and 840 Ci of strontium-90). Surveillance reports indicate that radiological contamination has been spreading in every entry from 2012 to 2015. In 2012, the surveillance inspection of the west end of the North Sample Gallery was halted because water was observed running down the loadout hood, and the contamination level in the gallery exceeded RWP limits. The HCA boundary was extended to the east. In 2013, high contamination levels were again found outside of the established HCA boundary. The boundary was further extended to the east. This area was not entered since 2013, but contamination continues to spread. In 2015, the RWP was voided again after nearing the Hump.
North Sample Gallery	Yes	Plutonium nitrate residue remains in the H-4 line prior to shut down. Where leaks were expected, plastic bags were taped to the line to collect the drip. Two of the bags were found to contain significant amounts of plutonium nitrate. Contamination spread to the gallery will occur if the bags fail. HCAs along the sample boxes are spreading, contaminated water intrusions are resulting from the leaking roof, and expansion joints are spalling. The survey route is limited to a walk path.
South Sample Gallery	Yes	Expansion joint filler is deteriorated and crumbled on the floor. Water intrusions were evident. Leaking mercury from manometers was noted. The survey route is limited to a walk path.
North Pipe Gallery	Yes	Multiple chemical leaks in both liquid and solid form, water intrusions, and degraded asbestos insulation were noted in the surveillance inspection report. Areas of sagging pipe and chemical leaks have been isolated.
South Pipe Gallery	Yes	Water stains and white chemical crystals throughout the gallery were reported. In 2015, radiologically contaminated water migrated in the west end of the gallery and resulted in an HCA. Since then, the area was covered with craft paper and downposted to a contamination area.
North Operating Gallery	Yes	Multiple chemical leaks, water intrusions, and degraded asbestos insulation were noted in the surveillance inspection report.
South Operating Gallery	Yes	Radiological contamination has spread, possibly due to roof leakage or rain seeping through expansion joints. HCAs were established in the gallery. Oily chemical leaks were noted in the surveillance report.
Storage Gallery	Yes	Stains due to water intrusion were observed throughout the gallery. In 2014, the surveillance inspection of the Storage Gallery was stopped due to high levels of contamination that exceeded RWP limits. The area was entered again in 2015.

HCA = high contamination area

RWP = radiological work permit

Built in the 1950s and unoccupied since the mid-1960s, the REDOX Complex buildings/structures within the scope of this EE/CA are structurally deteriorating. Contamination spread and increasing levels of contamination have been observed in some areas, as noted in Table 2-3. Contamination may intensify as the facilities continue to degrade and, if not timely addressed, the condition would present an imminent threat to HHE.

Radiological and chemical conditions of the REDOX Complex (as described in Section 2.3) indicate that the radiological level is increased over time at the Plutonium Loadout Hood, and contamination is spreading in the North Sample Gallery. The spread of contamination in this location indicates that contamination may be spreading in other areas that are not entered. Several rooms within the 202S Building are radiologically contaminated and need to be addressed before the occurrence of an unpredictable event that could be a threat to HHE. The possibility for contamination migration is very likely and is aided by water intrusion. The 202S Building has been unoccupied for a much longer period of time than the other Canyon buildings; therefore, conditions are expected to be much worse.

The nearby 222S Laboratory operating baseline has been extended 30 to 40 more years to support operations of the Waste Treatment Plant. Due to the nearby location of 222S, full-scale demolition of the 202S Building may be delayed, and the S&M period may be extended. Risk mitigation activities (as recommended in this EE/CA) will need to be implemented to ensure that catastrophic failure of components (e.g., filters, roof, and stairwells) does not occur.

The date for completion of TPA Milestone M-085-90, “Submit Remedial Investigation/Feasibility Study Work Plan for 200-CR-1 to EPA,” is September 30, 2021 (Ecology et al., 1989a). Therefore, remedial actions are not expected to be implemented for a number of years thereafter. Without any near-term hazard mitigation actions, the structural deterioration and contamination spread could result in an unacceptable release to HHE. Therefore, the removal action is needed in the near term to alleviate this potential risk.

In general, the risk of structure failure due to facility degradation would increase over time, and the risk of an accidental release would also increase the longer the structures await the eventual remedial action for the OU. Therefore, current conditions present a sufficient threat of release to the environment under a continued S&M scenario to justify an NTCRA.

3 Identification of Removal Action Objectives

This chapter discusses the removal objectives developed for the evaluated alternatives to reduce the risks associated with the REDOX Complex. The removal action objectives (RAOs) for this NTCRA are to perform removal actions in a manner that would, to the extent practicable, support the long-term and final cleanup goals for the 200 Area NPL (40 CFR 300, Appendix B) site. The RAOs were developed in conjunction with the reasonable anticipated land use, contaminants of concern, and potential applicable or relevant and appropriate requirements (ARARs). Threats to be addressed are the remaining radiological inventory and residual hazardous chemical contamination associated with past operations.

RAOs are general descriptions of what the removal action is expected to accomplish. They are defined as specifically as possible and usually address the following variables:

- Media of interest (e.g., structures, contaminated soil, and process and support equipment)
- Types of contaminants (e.g., radionuclides and inorganic and organic chemicals)
- Potential receptors (e.g., humans, animals, and plants)
- Possible exposure pathways (e.g., external radiation and ingestion)

As described in Section 2.2, potential contaminants that may be encountered during this removal action include asbestos, heavy metals, inorganic and organic chemicals, and radionuclides. The radionuclide and/or chemical contamination that may present a risk to HHE is described in Section 2.3. The RAOs identified to reduce potential hazards related to the REDOX Complex are defined in the following section.

3.1 Removal Action Objectives

The RAOs for this NTCRA are to perform removal actions to address identified risks in a manner that would, to the extent practicable, support the long-term and final cleanup goals for the 200 Area NPL (40 CFR 300, Appendix B) site. The following RAOs were developed to complete this scope:

- **RAO #1:** Reduce the inventory and any potential threat to HHE from an unacceptable exposure to hazardous and radioactive substances.
- **RAO #2:** Minimize the general disruption and adverse impacts to cultural resources and wildlife habitat.
- **RAO #3:** Safely treat, as appropriate, and dispose of waste generated by the removal action.
- **RAO #4:** Be consistent with anticipated remedial actions at the REDOX Complex.
- **RAO #5:** Minimize or eliminate the need for future S&M activities.

3.2 Applicable or Relevant and Appropriate Requirements

The NCP states, “Removal actions...shall, to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements (ARARs) under federal environmental or state environmental or facility siting laws” (40 CFR 300.415(j)).

The evaluation of potential ARARs for this proposed NTCRA are provided in Appendix A. This section provides an overview of the ARARs process and a summary of those ARARs that potentially affect the development of RAOs.

Identification of ARARs is a site-specific determination involving a two-part analysis: (1) determine whether a given requirement is applicable; and (2) if it is not applicable, determine whether it is relevant and appropriate. A requirement is deemed applicable if the specific terms of the law or regulation directly address the contaminants, remedial action, or place involved at the site. If the jurisdictional prerequisites of the law or regulation are not met, a legal requirement may nonetheless be relevant and appropriate if the circumstances of the site are sufficiently similar to circumstances in which the law otherwise applies, and it is well suited to the conditions of the site.

A requirement must be substantive in order to constitute an ARAR for activities conducted onsite. Procedural or administrative requirements such as permits and reporting are not ARARs.

In addition to ARARs, the NCP (40 CFR 300) provides that where ARARs do not exist, agency advisories, criteria, or guidance are to be considered (TBC) "…in helping to determine what is protective at a site or how to carry out certain actions or requirements" (55 FR 8745, "National Oil and Hazardous Substances Pollution Contingency Plan Overview"). The NCP preamble states, however, that provisions in the TBC category "…should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs."

As the lead federal agency, DOE has the primary responsibility to identify federal ARARs at the REDOX Complex. As the lead state agency, Ecology has the responsibility for identifying state ARARs (Appendix A). ARARs are presented in Chapter 5 for each of the alternatives considered. A detailed discussion of all ARARs considered for this EE/CA is provided in Appendix A.

4 Identification of Removal Action Alternatives

The removal action alternatives proposed in this EE/CA are consistent with and would support a final disposition similar to those described in EPA et al., 2005, *Record of Decision 221-U Facility (Canyon Disposition Initiative) Hanford Site, Washington*. The 221U Canyon Building remedial action is considered a pilot project for the remediation of other Hanford Site canyon buildings. The 221U Canyon remedial action involved removal of waste from abovegrade level galleries and the Canyon Deck, removal of a tank from the process cells, and grouting of internal spaces below the Canyon Deck level. All of these actions have been completed. The 221U Canyon Building ROD specified the final state of U Canyon as removal of roof and wall sections down to deck level and construction of an engineered barrier over the remnants of the Canyon. These remedial actions are still ongoing.

The removal action alternatives were developed in consideration of a future REDOX Canyon ROD, which would include evaluation of remedial actions similar to those described in the 221U Canyon Building ROD (EPA et al., 2005). Consistency with expected remedial decisions at the REDOX Complex is addressed in Chapter 5 of this EE/CA. All alternatives will be evaluated against these criteria.

Table 4-1 includes the four removal action alternatives identified for evaluation. Each successive alternative includes all of the actions involved in the previous alternative, with the addition of new actions, as outlined in each of the following alternative subsections.

Table 4-1. Proposed Alternatives for the REDOX Complex Removal Action

Alternative	Removal Action Description
1	No Action
2	• Surveillance and Maintenance of REDOX Complex Structures • Hazard Abatement of the 202S Galleries • Demo Prep of the 202S Silo Service Area • Demolition of the 293S Building and the 276S Hexone Storage Tanks • Grouting of the Belowgrade Areas of the 293S Building
3	Alternative 2 actions *plus*: • Demo Prep of the 202S Annex and Canyon Abovegrade
4	Alternative 3 actions *plus*: • Demolition of the 202S Annex

demo prep = demolition preparation
REDOX = Reduction-Oxidation

The removal action activities included in the proposed alternatives are S&M, hazard abatement, demolition preparation (demo prep), demolition, and grouting of the belowgrade areas of 293S. Descriptions of these activities are provided in this chapter. All activities will be performed in a manner that protects the safety of employees and the general public, minimizes spills and releases to the environment, and meets regulatory requirements. Worker health and safety will be addressed in site-specific work plans.

Waste generated during removal action activities would be characterized and segregated by waste type (e.g., TRU, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous). In compliance with WAC 173-303 and the *Atomic Energy Act of 1954*, waste would be dispositioned at

appropriate onsite or offsite waste disposal facilities. ERDF, Low-Level Burial Ground Trench 31/34, T Plant, and the Central Waste Complex (CWC) are considered onsite facilities for management and/or disposal of waste from activities addressed in this EE/CA.

ERDF is the preferred disposal location because it is an engineered facility that provides a high degree of protection to HHE. Historically, it has been shown that this disposal location is more cost effective than other waste disposal sites. Construction of ERDF was authorized using a separate CERCLA ROD (EPA et al., 1995, *Record of Decision U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*). ERDF is engineered to meet appropriate RCRA technological requirements for landfills, including standards for a double liner, a leachate collection system, leak detection, monitoring, and a final cover.

Hazardous, mixed, low-level, asbestos, and *Toxic Substances Control Act of 1976* waste can be accepted for disposal at ERDF (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*). It is expected that most of the waste generated during removal activities would be disposed onsite at ERDF. If a generated waste stream does not meet ERDF acceptance criteria or TRU waste is generated, it would be moved to an onsite facility for storage and managed according to applicable waste acceptance criteria prior to disposal at WIPP (HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*).

Treatment of waste may be necessary before disposal at ERDF or storage at an onsite facility. Residuals from treatment of waste originating from activities addressed in this EE/CA would be disposed at ERDF, provided that treatment residuals meet ERDF waste acceptance criteria. Waste treatment and/or disposal may take place at other facilities that are on the Hanford Site or at offsite facilities that have been authorized by EPA regional offices in accordance with the NCP (40 CFR 300.440, “Procedures for Planning and Implementing Off-Site Response Actions”) as suitable to receive waste from CERCLA sites.

4.1 Removal Action Activities

Each alternative, with the exception of Alternative 1, includes the following types of actions: S&M hazard abatement, demo prep, demolition, and grouting. Waste generated from these actions will be treated and/or disposed. The following subsections describe these action categories.

4.1.1 Surveillance and Maintenance

S&M activities will be performed in accordance with the most current S&M plan (e.g., DOE/RL-98-19) on a routine and nonroutine basis. Routine S&M activities ensure that structural and passive confinement integrity is maintained and may include access control, periodic monitoring for potential radiological contamination and other hazards, cold weather protection, maintenance, annual roof inspections, identification and minor repair of friable asbestos, and general visual inspections. Nonroutine activities include major responses to undesirable observations (e.g., a leak in one area spreading radiological contamination to another area). Major maintenance and other facility life extension operations (e.g., roof maintenance) would be performed to ensure that structures remain in a safe condition and that the ongoing deterioration process is minimized to control the potential for accidental release of radioactive materials and hazardous substances. The S&M plan will be included in the RAWP. Appropriate surveillance activities will be conducted based upon facility conditions during the removal action.

The objective of S&M is to ensure adequate containment of any contaminants left in place, provide physical safety and security controls, and maintain the facility in a manner that will minimize risk to HHE. In accordance with these objectives, some areas within the scope of this EE/CA are not accessed during the S&M phase according to the current S&M plan.

4.1.2 Hazard Abatement

Hazard abatement differs from S&M in that it allows for a proactive response to mitigate or reduce risk before a major response would be required. Hazard abatement activities may range from stabilization to complete removal of equipment and waste, as needed, to mitigate hazards. Identification of areas that will receive hazard abatement will be based on S&M activities and observations. This EE/CA assumes that modifications to the 291S Ventilation System will be needed to support removal activities at the REDOX Complex. An engineering evaluation of the ventilation system will be performed prior to initiating the removal activity, if needed.

4.1.3 Demolition Preparation

Demo prep may include activities such as general housekeeping and removal of equipment and waste. Decontamination, fixing/stabilization of contamination, and isolation of systems may be performed. Interior portions of the building may be removed, as practical and necessary, to support future access for final disposition activities. Overhead utilities and adjacent concrete and asphalt may be removed, as needed. Fluids will be drained from piping and equipment. Piping entering or exiting a structure may be plugged, blocked, or grouted to prevent potential release pathways to the environment, as appropriate. These activities will be managed in accordance with procedures that address removing, handling, and disposing these materials in a manner that protects the safety of employees and the public, minimizes spills and releases to the environment, and meets regulatory requirements.

4.1.4 Demolition

Demolition is preceded by hazard abatement and demo prep activities, including removing hazardous substances, as necessary, from within and around buildings and structures; decontaminating, fixing contamination, and isolating systems; removing equipment; and plugging of piping or drains entering or exiting belowgrade buildings and structures. Demolition of buildings and structures includes removing abovegrade structures. Belowgrade structural components, such as basements, will be left intact (with penetrations secured or blanked) and backfilled or grouted, as appropriate. If warranted, belowgrade structures and/or related equipment may be removed to facilitate other removal action activities surrounding the area, or as deemed necessary by the DOE-Richland Operations Office (DOE-RL), to support overall cleanup goals and priorities. If evidence of contamination to surrounding soil is encountered that is directly associated with the structure being removed or that resulted directly from the demolition activity, those soils would be excavated and disposed onsite at ERDF in accordance with ERDF waste acceptance criteria. The area will be stabilized (e.g., backfill, contour, and vegetate), as necessary and appropriate.

4.1.5 Grouting

Grouting of structures will be performed, as appropriate, to reduce the mobility, solubility, and/or toxicity of grouted waste and support final disposition. Structures and systems (including piping, utility systems, and structural steel) may be abandoned in place and grouted. Void spaces would be grouted, as necessary, and/or backfilled as appropriate and practicable. Fill material such as controlled density fill or grout may be installed to stabilize the material, provide shielding, and facilitate demolition and/or future removal or remedial actions.

4.2 Alternative 1 – No Action

CERCLA requires the No Action alternative as a baseline for comparison with other removal action alternatives. Under the No Action alternative, it is assumed that 202S, 276S, and 293S would be abandoned without any further action. No legal restrictions, institutional controls, or active measures are

applied to 202S, 276S, and 293S in this alternative. S&M activities would be discontinued, no additional facility stabilization would be performed, and degradation would continue indefinitely. Initial risks to HHE from the No Action alternative would be minimal and barring an unusual event, contaminants are assumed to remain confined within the structures. Risks over time are expected to increase as deterioration progresses and structural integrity is compromised. The possibility of a chemical and/or radiological contamination spread would increase due to lack of monitoring and controls. Physical hazards associated with partial structural collapse would also be anticipated.

Although Alternative 1 would not have an associated implementation cost under this analysis, it is understood that taking No Action would ultimately result in a substantial cost in the future. Alternative 1 is not consistent with DOE obligations under federal law to protect HHE; therefore, this alternative cannot be considered viable and is not considered further in this EE/CA. This alternative is used as a baseline for comparison purposes only.

4.3 Alternative 2 – Continued S&M/Hazard Abatement 202S/Demo Prep Silo Service Area/Demolition 276S/Demo and Grouting 293S

Alternative 2 would involve the following actions:

- Continued S&M of REDOX Complex Structures
- Hazard Abatement of the 202S Galleries
- Demo Prep of the 202S Silo Service Area
- Demolition of the 276S Hexone Storage Tanks and the 293S Building
- Grouting of Belowgrade Areas of the 293S Building

The removal activities for Alternative 2 are summarized in Figure 4-1 and Table 4-2.

Under Alternative 2, S&M activities would continue for the entire REDOX Complex. Hazard abatement would take place in high-priority areas in the 202S Canyon. The Silo Service Area would undergo demo prep, and the 276S Hexone Storage Tanks (276-S-141 and 276-S-142) and 293S Building would undergo demolition. The scope of each removal activity is described in the following subsections. Figure 4-1 provides a general overview of the removal activities that would be implemented under Alternative 2 throughout the REDOX Complex.

4.3.1 Surveillance and Maintenance

Under Alternative 2, S&M activities for the REDOX Complex would be performed for 25 years. S&M efforts are expected to increase over time in areas where no additional removal actions will take place due to continued degradation of structures and components. No facility lifecycle upgrades will be performed.

4.3.2 Hazard Abatement

Under Alternative 2, the 202S Galleries would undergo hazard abatement. At a minimum, high-risk areas that will receive hazard abatement are the North Sample Gallery, including the Plutonium Loadout Hood, South Operating Gallery, South Sample Gallery, South Pipe Gallery, and Storage Gallery. The Canyon Deck and areas below the cover blocks will not be included in hazard abatement activities.

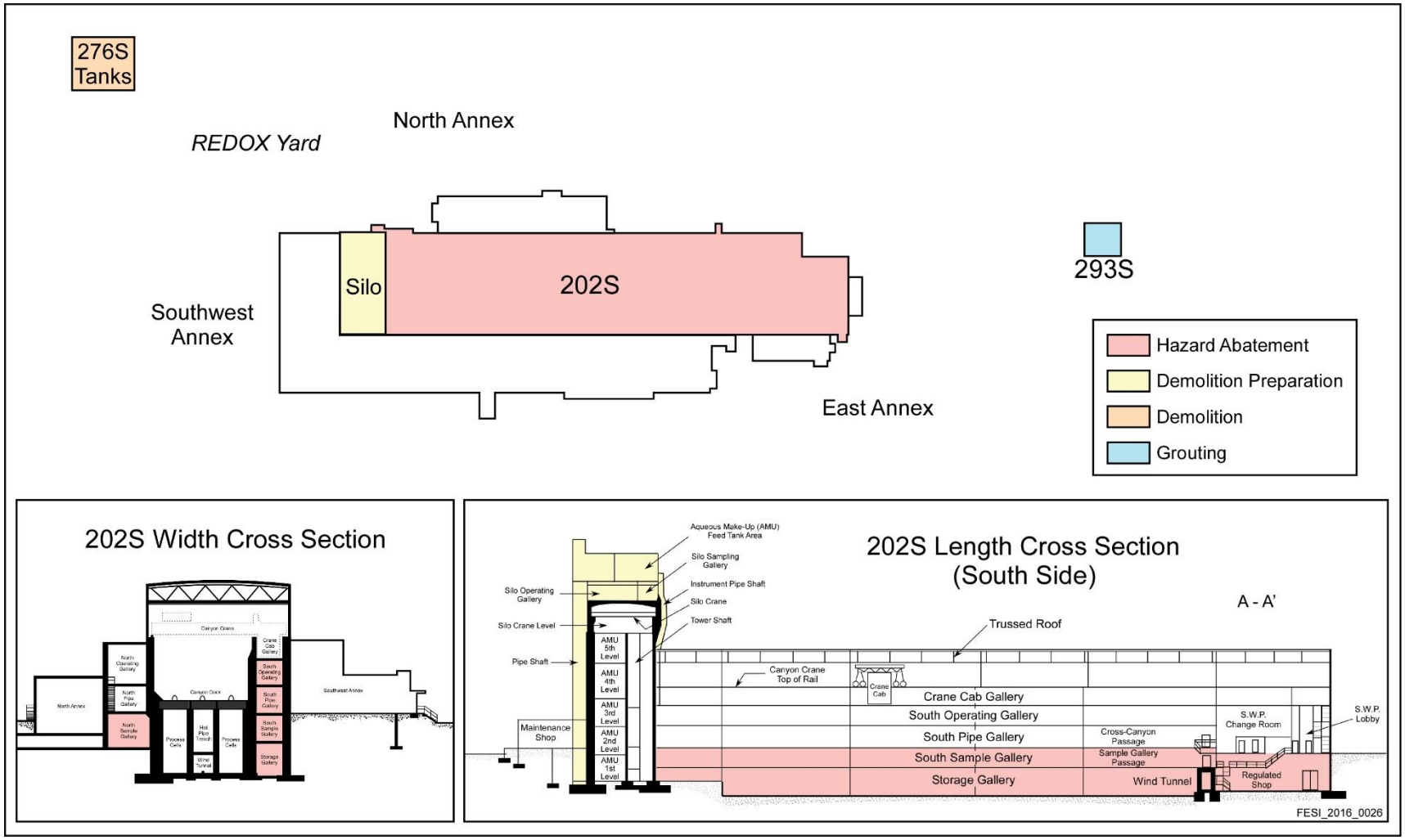

Figure 4-1. Alternative 2 – Proposed Actions

Table 4-2. Summary of Proposed Alternatives

	Structures						
	202S Building Abovegrade	**202S Building Belowgrade**	**Silo Service Area**	**Silo Tower Shaft and Tunnel**	**Annex**	**276S Hexone Storage Tanks**	**293S Building**
Alternative 2							
Surveillance and Maintenance	●	●	●	●	●	●	●
Hazard Abatement	●	●					
Demo Prep			●			●	●
Demolition						●	●
Grouting							●
Alternative 3							
Surveillance and Maintenance	○	○	○	○	○	○	○
Hazard Abatement	○	○					
Demo Prep	●		○		●	○	○
Demolition						○	○
Grouting							○
Alternative 4							
Surveillance and Maintenance	○	○	○	○	○	○	○
Hazard Abatement	○	○					
Demo Prep	○		○		○	○	○
Demolition					●	○	○
Grouting							○

● Action is new to this alternative.

○ Action was part of preceding alternative.

demo prep = demolition preparation

4.3.3 Demolition Preparation

Under Alternative 2, demo prep would occur in the Silo Service Area. This would include levels one through five, seven, and eight. Level six, which includes the crane and crane cover blocks, is not considered in the cost estimate for this activity. Demo prep will not occur in the Silo Tower Shaft and the Column Laydown Trench.

4.3.4 Demolition

Alternative 2 includes demolition of the 276S Hexone Storage Tanks and the 293S Building. Demo prep activities will be performed as necessary at these structures prior to starting demolition work.

The 276S Hexone Storage Tanks, associated pumps, piping, and soil beneath the pumps will be clean closed per the existing RCRA closure plan (DOE/RL-2009-112). The tanks will be clean closed by removal and disposal. If possible, the tanks will be removed intact and transferred to ERDF. If intact disposal is not feasible due to the weight of the tanks or field conditions, the tanks will be demolished onsite, and the debris will be placed in a double-lined roll-off container and transported to a cell at ERDF for disposal. The removal area soil will be sampled in accordance with an approved SAP to verify achievement of clean closure standards.

At the 293S Building, all abovegrade and belowgrade process equipment and tanks will be removed. The building would be demolished to slab-on-grade in order to minimize infiltration of precipitation to underlying soils. The slab and subsurface will become a waste site within the 200-CR-1 OU and will be considered during the data quality objectives process for the future remedial action.

4.3.5 Grouting

Following demolition and removal of the abovegrade structure and equipment, belowgrade areas of the 293S Building will be grouted.

4.4 Alternative 3 – Continued S&M/Hazard Abatement 202S/Demo Prep Silo Service Area/Demolition 276S/Demo and Grouting 293S/Demo Prep Annex and Abovegrade 202S

The primary elements of Alternative 3 (in italics) are as follows, which include all activities in Alternative 2:

- Continued S&M of REDOX Complex Structures (Alternative 2)
- Hazard Abatement of the 202S Canyon Galleries (Alternative 2)
- Demo Prep of the 202S Silo Service Area (Alternative 2)
- Demolition of the 276S Hexone Storage Tanks and the 293S Building (Alternative 2)
- Grouting of Belowgrade Areas of the 293S Building (Alternative 2)
- *Demo Prep of 202S Annex and Abovegrade Areas of the 202S Canyon*

The removal activities for Alternative 3 are summarized in Figure 4-2 and Table 4-2.

This alternative includes all activities included in Alternative 2, with the addition of demo prep in the Annex and abovegrade areas of the 202S Canyon. Prior to demo prep of the Annex, some hazard abatement activities may be performed, if necessary.

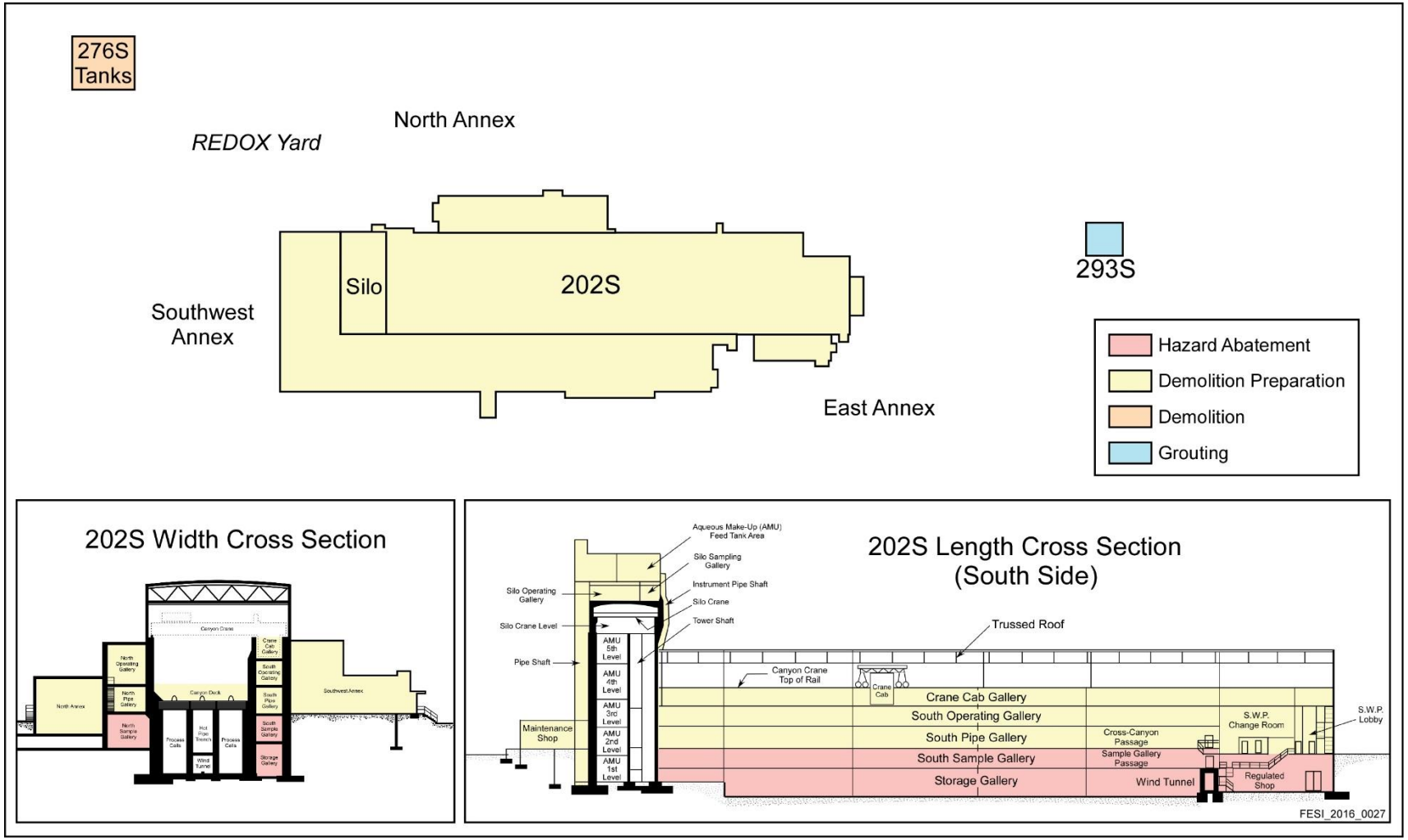

Figure 4-2. Alternative 3 – Proposed Actions

4.5 Alternative 4 – Continued S&M/Hazard Abatement 202S/Demo Prep Silo Service Area/Demolition 276S/Demo and Grouting 293S/Demo Prep Annex and Abovegrade/Demolition Annex

The primary elements of Alternative 4 (in italics) are as follows, which include all activities in Alternative 3:

- Continued S&M of the REDOX Complex (Alternative 2)
- Hazard Abatement of the 202S Canyon Galleries (Alternative 2)
- Demo Prep of the 202S Silo Service Area (Alternative 2)
- Demolition of the 276S Hexone Storage Tanks and the 293S Building (Alternative 2)
- Grouting of Belowgrade Areas of the 293S Building (Alternative 2)
- Demo Prep of 202S Annex and Abovegrade Areas of the 202S Canyon (Alternative 3)
- *Demolition of the 202S Annex*

The removal activities for Alternative 4 are summarized in Figure 4-3 and Table 4-2. This alternative includes all activities included in Alternative 3, with the addition of demolition of the 202S Annex. Currently, the North and East Annexes are service support areas. Demo prep will take place prior to all demolition activities. The Annex would be demolished down to ground level, and the basement level would be brought back to grade with fill material. Following demolition, any access points to the remaining Canyon portion will be isolated or sealed, as appropriate.

4.6 Summary of Alternatives

Figures 4-1 through 4-3 present schematics for the actions performed under Alternatives 2 through 4. Table 4-2 summarizes the five proposed alternatives, showing the actions included as they apply to the REDOX Complex buildings and structures.

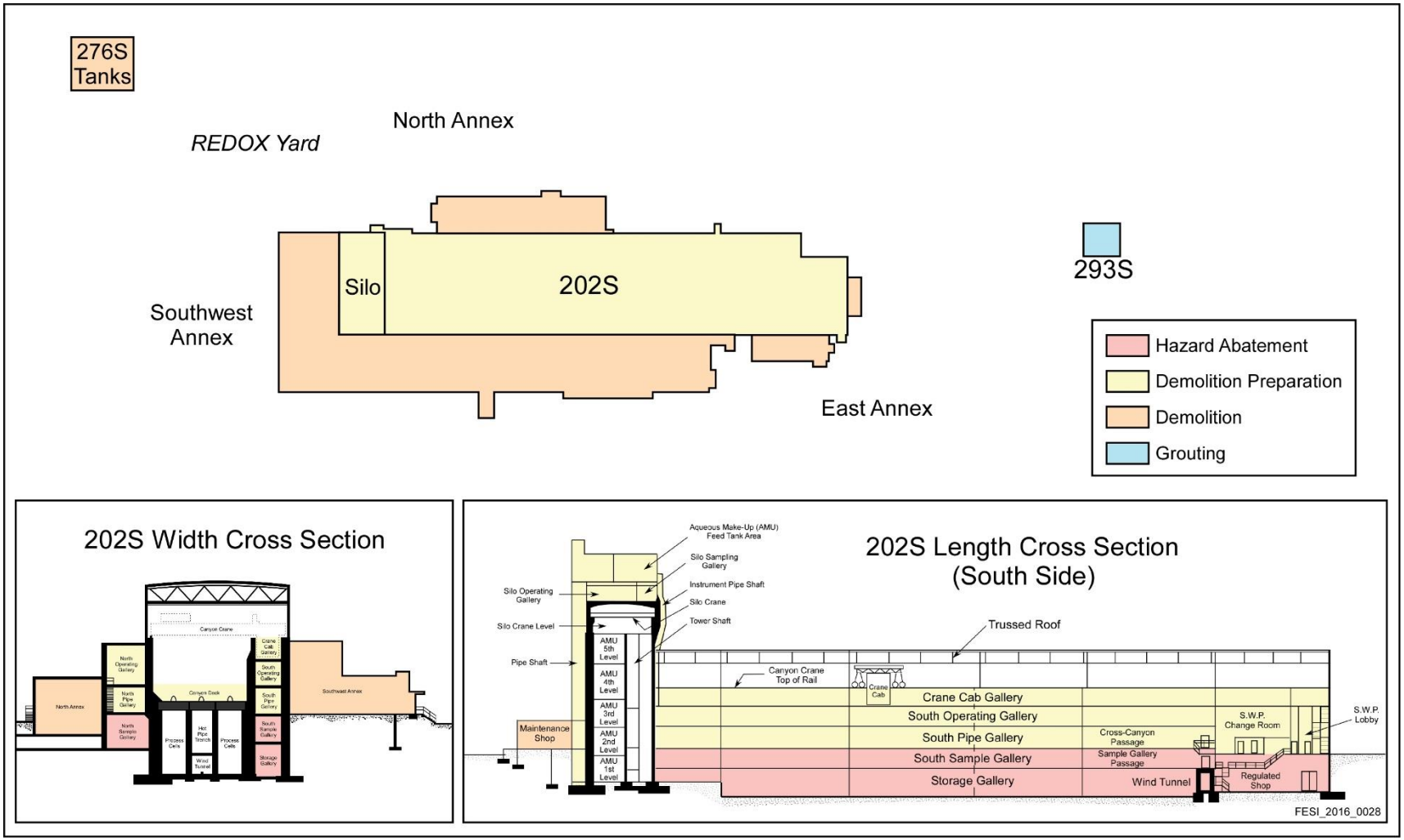

Figure 4-3. Alternative 4 – Proposed Actions

5 Analysis of Removal Action Alternatives

In accordance with EPA 540-R-93-057, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, this chapter evaluates the alternatives identified in Chapter 4 with respect to three criteria: effectiveness, implementability, and cost. Table 5-1 outlines the subcriteria used in this evaluation process. This analysis of alternatives considers that the removal actions performed under this EE/CA are short-term, interim measures to prevent potential harm to HHE and stabilize structures for future disposition. Long-term treatment or containment activities required for final remediation or disposition of the REDOX Complex will be executed under a future remedial action, as determined by a ROD.

Table 5-1. Alternative Analysis Criteria

Primary Criteria	Subcriteria for Evaluating Alternatives
Effectiveness	1. Protectiveness • Overall protection of human health and the environment • Compliance with applicable or relevant and appropriate requirements • Long-term effectiveness and permanence • Reduction of toxicity, mobility, or volume through treatment • Short-term effectiveness
	2. Ability to meet removal action objectives
Implementability	3. Technical and administrative feasibility
	4. Availability of equipment personnel, services, and disposal facilities
Cost	No subcriteria; estimated costs include the following: • Capital costs • Operational and maintenance costs

State and public acceptance will be evaluated after the public have an opportunity to review and comment on this EE/CA. Each criterion is explained briefly in the following subsections, as well as a detailed analysis of each alternative relative to each criterion. The actions associated with each alternative are reiterated in Table 5-2.

5.1 Effectiveness of Removal Action Alternatives

The two subcriteria for evaluating effectiveness of the NTCRA are protectiveness and the ability to achieve RAOs. The protectiveness analysis determines whether implementation of the removal action alternative and its ability to meet CERCLA thresholds are adequate for the protection of HHE. Overall protection of HHE involves the elimination, reduction, or control of risks posed by likely exposure pathways. Environmental protection also includes avoiding or minimizing impacts to natural, cultural, and historical resources. Compliance with ARARs overlaps with the protectiveness criterion by addressing chemical-, location-, and action-specific requirements for protection of HHE.

Table 5-2. Description of Removal Action Alternatives

Alternative	Removal Action Description
1	No Action
2	• Surveillance and Maintenance of REDOX Complex Structures • Hazard Abatement of the 202S Canyon Galleries • Demo Prep of the 202 Silo Service Area • Demolition of the 276S Hexone Storage Tanks and the 293S Building • Grouting Belowgrade Portions of the 293S Building
3	Alternative 2 actions *plus*: • Demo Prep of the 202S Annex and 202S Canyon Abovegrade
4	Alternative 3 actions *plus*: • Demolition of the 202S Annex

demo prep = demolition preparation
REDOX = Reduction-Oxidation

The analysis of long-term effectiveness and permanence considers the protectiveness of each alternative at the conclusion of the proposed removal action, after the RAOs have been met. The ability of each removal action alternative to reduce the toxicity, mobility, or volume (TMV) of contamination effectively is also evaluated. The short-term effectiveness criterion addresses protection of workers and HHE during implementation of the proposed action.

The ability of each alternative to meet RAOs is evaluated as part of the analysis of alternatives. The primary focus of this evaluation is the effectiveness of the removal actions and associated controls that may be required to manage risk to protect HHE.

5.1.1 Protectiveness

Protectiveness is the primary objective of a removal action and is a threshold criterion that must be met to recommend an alternative. Alternatives were evaluated relative to the protectiveness of workers, the community, and the environment both during implementation of the removal action (short term) and after the removal objectives have been met as the facility awaits final disposition (long term).

The removal actions proposed under each alternative demonstrate protectiveness to varying degrees based on their abilities to reduce or prevent releases of, and subsequent exposure to, hazardous substances.

5.1.1.1 Overall Protection of Human Health and the Environment

Overall protection of HHE considers the protectiveness of HHE during the removal action and the post-implementation conditions for each alternative.

The No Action alternative (Alternative 1) would fail to provide overall protection of HHE for the REDOX Complex because contaminated waste would remain in place without any measures to contain or monitor contaminants or control exposure pathways. Alternative 1 will not meet the requirement of RCRA clean closure decision for the 276S Hexone Storage Tanks (276-S-141 and 276-S-142), as documented in DOE/RL-2009-112. Because Alternative 1 fails to provide overall protection of HHE and does not comply with the clean closure decision for the 276S Hexone Storage Tanks, it is not effective

and, therefore, is no longer considered a viable alternative. This alternative will not be discussed further in the analysis of alternatives.

Alternatives 2, 3, and 4 meet requirements for the overall protection of HHE to varying degrees because waste would be removed, exposure pathways would be eliminated, and active monitoring would be performed to prevent or address deteriorating conditions.

5.1.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

The ARARs and TBCs identified for the removal actions are presented in Appendix A. The removal action activities proposed under all alternatives would be performed and managed in a manner compliant with ARARs, including emissions standards; waste management; and requirements for the protection of natural, cultural, and historical resources.

5.1.1.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion assesses the risk from waste and residuals remaining at the conclusion of site activities. This criterion also evaluates whether the alternative contributes to future remedial action objectives.

Key considerations for long-term effectiveness and permanence are the physical condition of the REDOX Complex over time and the amount of management needed to prevent a release of hazardous substances prior to final disposition. As the REDOX Complex structures continue to age and degrade without active intervention, the likelihood for a release of and subsequent exposure to hazardous substances increases.

Alternatives 2, 3, and 4 support future remedial objectives because they provide interim to long-term protectiveness until a final remedial action or inventory removal occurs at a future time.

5.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2, 3, and 4 provide reduction in the TMV of contaminants through the treatment or removal of contamination via hazard abatement, demo prep, and demolition. The removal of materials and waste from the REDOX Complex for disposal at ERDF under all alternatives would transfer long-term impacts of contamination from one area to another to a certain degree, but because ERDF was designed for disposal and has a double leachate liner collection system, disposal at ERDF is more environmentally protective.

5.1.1.5 Short-Term Effectiveness

The short-term effectiveness criterion refers to any potential adverse effects on HHE (including workers and the public) during the removal action implementation phases.

Short-term risks to workers would be present where hazard abatement, demo prep, and demolition are performed because these actions increase potential near-term exposure to hazardous substances during removal. Physical and industrial risks also exist near-term during active demolition. Personnel would enter the contaminated structures for a focused amount time and would handle contaminated materials. However, proper worker safety controls, the application of stringent health and safety procedures, as low as reasonably achievable principles, and engineering controls for each alternative would mitigate some short-term risk.

Similarly, performance of hazard abatement, demo prep, and demolition would temporarily increase environmental emissions and potential fugitive dust during facility stabilization, demolition, and waste removal. Breaching of containments during hazard abatement, demolition, and waste removal would also increase the likelihood of potential release and subsequent exposure to hazardous or radiological substances.

Strict adherence to environmental regulations and work controls would ensure short-term effectiveness in protecting HHE under Alternatives 2, 3, and 4.

5.1.2 Ability to Achieve Removal Action Objectives

This section evaluates the effectiveness of each alternative to meet the RAOs. Ability to achieve the RAOs effectively is considered at the end of the removal action. The following RAOs for this NTCRA are as follows:

- **RAO #1:** Reduce the inventory and any potential threat to HHE from an unacceptable exposure to hazardous and radioactive substances.
- **RAO #2:** Minimize the general disruption and the adverse impacts to cultural resources and wildlife habitat.
- **RAO #3:** Safely treat, as appropriate, and dispose of waste generated by the removal action.
- **RAO #4:** Be consistent with anticipated remedial actions at the REDOX Complex.
- **RAO #5:** Minimize or eliminate the need for future S&M activities.

Alternatives 2, 3, and 4 achieve all of the RAOs with varying degrees of effectiveness. All of the alternatives reduce potential threat to HHE from an unacceptable exposure to hazardous and radioactive substances (RAO #1). All removal action alternatives have little disruption or impact to cultural resources and wildlife (RAO #2). All waste generated in all removal actions will be managed and disposed in accordance with state and federal regulations (RAO #3). All of the alternatives are consistent with anticipated future remedial actions (RAO #4) and would minimize future S&M needs (RAO #5).

5.2 Implementability of the Removal Action Alternatives

The implementability of a removal action is dependent upon the technical and administrative feasibility of the action, including availability of materials and services needed to perform the selected action, as well as state and community acceptance of the action. This section discusses the technical and administrative implementability of the proposed removal action alternatives for the REDOX Complex.

5.2.1 Technical and Administrative Feasibility

Alternatives 2, 3, and 4 are technically and administratively feasible. All proposed removal actions could be performed using existing knowledge and procedures that have proven successful at the Hanford Site. The methods for performing S&M, hazard abatement, demo prep, and demolition are consistent with Hanford Site projects of similar scope (e.g., disposition of Plutonium Finishing Plant and U Plant). Disposal and recycling services are available, both on or off the Hanford Site, for the types of waste expected to be generated under all alternatives. ERDF and CWC are anticipated to be available to receive most or all of the waste to be generated by the removal action activities. Administratively, all included actions would adhere to applicable laws and permits and would have demonstrated success at the Hanford Site under projects of similar scope.

5.2.2 Availability of Equipment, Personnel, and Services

Equipment to support Alternatives 2, 3, and 4 is either available at the Hanford Site or is commercially available. Equipment, personnel, and services required for hazard abatement, demo prep, demolition, and grouting are consistent with resources and capabilities used elsewhere on the Hanford Site for similar actions. Front-end loaders and trackhoes with processor end effectors, as well as transport trucks, are

available onsite. Cranes capable of heavy lifts are also available onsite or are commercially available. Advanced methods are available for cutting contaminated equipment.

Disposal and recycling services are available on or off the Hanford Site for the types of waste expected to be generated by the actions performed under Alternatives 2, 3, and 4. ERDF and CWC are anticipated to be available for onsite disposal of most or all of the waste generated by the removal action activities. The need for specialized materials, services, treatment technology, or disposal facilities is expected to be minimal for Alternatives 2, 3, and 4.

If performed concurrently with other Hanford Site cleanup activities, trained personnel are available to perform the proposed removal actions under each alternative. If performance of the removal actions is delayed significantly relative to other Hanford Site cleanup, additional training and remobilization of a qualified work force may be required.

5.3 Cost of the Removal Action Alternatives

Cost estimates have been prepared for the removal action alternatives evaluated in this EE/CA. The estimates were prepared in accordance with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*, and DOE G 430.1-1, *Cost Estimating Guide*. ECE-200W15-00006, *Environmental Cost Estimate for the REDOX Complex*, provides an overview of removal action specific cost inputs, methodology, and results.

Table 5-3 shows the cost estimates for the four alternatives, starting from a present-day, nondiscounted cost (i.e., constant dollars). Nondiscounted costs assume that all work is performed today, and the costs are not affected by general price inflation (i.e., they represent units of stable purchasing power). Because nondiscounted costs do not reflect the changing value of money over time, presentation of this information under CERCLA is for informational purposes only and is not a factor in the selection of a response action alternative.

Table 5-3. Summary of Cost Estimates for the Alternatives

Alternative	Nondiscounted Cost	Net Present-Worth Cost
Alternative 1 – No Action	N/A*	N/A*
Alternative 2 – Continued Surveillance and Maintenance with Hazard Abatement of 202S, Demo Prep of the 202S Silo Service Area, Demolition of 293S and 276S, Grouting of the Belowgrade of 293S	$160.6 million	$148.1 million
Alternative 3 – Alternative 2 actions *plus*: Demo Prep of the 202S Annex and Canyon Abovegrade	$191.7 million	$176.5 million
Alternative 4 – Alternative 3 actions *plus*: Demolition of the 202S Annex	$196.5 million	$180.7 million

Note: Accuracy range of the cost estimate is expected to be -30% to +50%. No sensitivity analyses were performed, and the following factors could impact the costs: level of contamination, amount and type of equipment in the buildings, and differing structural design.

* Alternative 1 is not consistent with DOE obligations under federal law to protect human health and the environment; therefore, this alternative cannot be considered viable and is not considered further in this engineering evaluation/cost analysis, but it is included for comparative purposes only. Although Alternative 1 would not have an associated implementation cost under this analysis, it is understood that taking no action would ultimately result in cost to DOE.

DOE = U.S. Department of Energy

N/A = not applicable

5.3.1 Cost Estimate Rationale

Consistent with guidance from EPA and the U.S. Office of Management and Budget, present-worth analysis is used as the basis for comparing costs of cleanup alternatives under the CERCLA program (OMB Circular No. A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs"). A discount rate (OMB Circular No. A-94) is applied for cost estimates that span multiple years, making it possible to evaluate expenditures associated with the alternatives that occur during different periods (EPA 540-R-00-002). Because of the time-dependent value of money, future expenditures are not considered directly equivalent to current expenditures. The present-worth cost method shows the amount required at the initial point in time (e.g., in the current year) to fund activities occurring over the life of the alternative. Present-worth analysis assumes that the funding set aside at the initial point in time increases in value as time goes on (e.g., similar to how money placed in a savings account gains value because of the interest paid on the account). Although the federal government typically does not set aside funds in this manner, the present-worth analysis is specified under CERCLA as the approach for establishing a common baseline to evaluate and compare alternatives that have costs occurring at different times, although actual costs could vary. While the funds might not actually be set aside, the present-worth costs were considered directly comparable for evaluating the costs of each alternative.

The information in the cost estimate is based on the best available information regarding the anticipated scope of the removal action alternatives. Changes in the cost estimate are likely to occur due to new information collected during preparation and performance of the removal action. Consistent with EPA guidance, this is an order-of-magnitude engineering cost estimate that was developed to be within -30 percent to +50 percent of actual project cost.

5.3.2 Cost Estimate Information for Each Alternative

This section provides the major costs for each alternative. The expected duration before implementation of the remedial action for all of the alternatives is assumed to be 25 years. S&M is expected to continue throughout the duration of the NTCRA at the current yearly cost. Table 5-4 provides the cost estimates for the removal actions associated with each structure. The costs that are not specific to one building/structure, but apply to all, are provided as a sum in the "All Structures" category. The costs in the "All Structures" category include S&M, facility safety upgrades, site preparation, ventilation system modifications, and safety document modification.

Table 5-4. Total Present Value Cost Comparison

Structure	Alternative 1	Alternative 2	Alternative 3	Alternative 4
202S	$0	$42.2 million	$70.5 million	$74.7 million
276S	$0	$6.2 million	$6.2 million	$6.2 million
293S	$0	$3.5 million	$3.5 million	$3.5 million
All Structures	$0	$96.2 million	$96.2 million	$96.2 million

Note: Costs that support all structures within the complex such as site preparation, surveillance and maintenance, and engineering studies are provided for each alternative.

Alternative 1 is presented with no cost solely based on the context of no action being taken to mitigate existing hazardous conditions posed by structural deterioration and contamination spread. In reality, if no action was taken, costs would ultimately be incurred in terms of adverse impacts to HHE and could result in costlier actions in the future.

For Alternative 2, significant costs incurred are due to modification of the ventilation system, site preparation activities across the REDOX Complex, and hazard abatement activities within 202S. This EE/CA assumes that the existing 291S Ventilation System will be modified to support removal activities. The hazard abatement action will incur costs from waste disposal, demolition labor, characterization sampling, and air monitoring. This activity will remove contaminated equipment from several areas within 202S, including a complete cleanout of the Silo Service Areas and complete removal of the Plutonium Loadout Hood from the North Sample Gallery. Additional activities in Alternative 2 include demolition and removal of the 276S Hexone Storage Tanks and 293S Nitric Acid and Iodine Recovery Building. The belowgrade areas of the 293S Building will also be filled with grout.

Alternative 3 adds additional costs due to demo prep work inside the 202S Annex and abovegrade areas of the 202S Canyon. Demo prep activities will incur costs from waste treatment and disposal, demolition labor, characterization sampling, and air monitoring.

Alternative 4 cost increases are due to demolition of the 202S Annex. Costs associated with demolition activities include evaluation and planning, waste disposal, demolition labor, characterization sampling, and air monitoring.

5.4 Summary of Removal Action Alternative Evaluation

Table 5-5 summarizes the ability of the alternatives to achieve NTCRA CERCLA criteria for effectiveness, implementability, and cost for the removal actions described in Chapter 4.

Table 5-5. Criteria Analysis Summary

Alternative	Effectiveness		Implementability		Net Present-Worth Cost
	Protectiveness	Removal Action Objectives	Technical/ Administrative	Availability	
Alternative 1					
No Action	No	No	No	No	$0
Alternative 2					
Actions: • Surveillance and Maintenance of REDOX Complex Structures • Hazard Abatement of the 202S Canyon • Demo Prep of the 202S Silo Service Area • Demolition of the 276S Hexone Storage Tanks and 293S Building • Grouting of Belowgrade Areas of the 293S Building	Yes	Yes	Yes	Yes	$148.1 million
Alternative 3					
Alternative 2 actions *plus*: • Demo prep of 202S Annex and Canyon Abovegrade	Yes	Yes	Yes	Yes	$176.5 million
Alternative 4					
Alternative 3 actions *plus*: • Demolition of the 202S Annex	Yes	Yes	Yes	Yes	$180.7 million

Note: "Yes" indicates that actions performed under an alternative meet criteria. "No" indicates that actions performed under an alternative do not meet criteria.

demo prep = demolition preparation

REDOX = Reduction-Oxidation

6 Comparative Analysis of Removal Action Alternatives

The removal action alternatives were compared in terms of the criteria and subcriteria for overall protection of HHE, implementability, and cost. The removal actions proposed under each alternative meet overall protectiveness criteria, but their degree of effectiveness and ability to meet RAOs varies based on the magnitude of the actions undertaken. The comparative analysis of effectiveness, implementability, and cost is provided in the following subsections and summarized in Table 6-1.

6.1 Effectiveness of Removal Action Alternatives

The effectiveness of the alternatives considers that the removal actions performed under this EE/CA are short-term, interim measures to prevent imminent harm to HHE as the REDOX Complex awaits a final remedial action decision. Long-term treatment or containment activities required for permanent disposition of the 202S Building will be executed under a future remedial action, as determined by a final ROD. Alternatives are evaluated on the basis of protectiveness and their ability to achieve RAOs prior to issuance of the final ROD.

6.1.1 Protectiveness

As the 202S Building and Ancillary Structures degrade with age, increasingly aggressive removal actions will be needed to ensure protection of HHE. In this section, each alternative is compared against the others in terms of the level of protectiveness that would be achieved upon completion of the removal actions included in each alternative. This evaluation was made considering the protectiveness afforded by the removal actions as stated below within the context of each alternative.

Among the removal actions, continuing S&M would prolong monitoring for potential sources of exposure but would be the least effective to reduce the potential to release hazardous substances. Hazard abatement activities would preferentially remove or fix in-place hazardous substances, which would reduce or eliminate the release pathways to the environment to a higher degree, thus reducing the need for S&M. Demo prep provides an even higher degree of interim protectiveness by removing and disposing contamination, equipment, and structural material that may otherwise pose risk or hinder future remedial action. Demolition provides the most effective long-term remedy by permanently removing and disposing structures. Both demo prep and demolition would mitigate risks of structural failure and accidental release of contamination by stabilizing or demolishing the aging structures. Grouting of belowgrade portions of the 293S Building would encapsulate waste, thereby shielding and reducing the mobility of contamination, which is protective of HHE.

Of the active alternatives (2, 3, and 4), Alternative 2 offers the least protection for HHE because it provides the least long-term protectiveness through demo prep and demolition compared to Alternatives 3 and 4. Reliance on continued S&M and deferral of demo prep in Alternative 2 could result in increased hazards to workers and HHE from structural degradation.

Alternatives 3 and 4 provide a higher level of protectiveness than Alternative 2. Both alternatives provide nearly identical levels of protectiveness in terms of reducing the interim and long-term chemical, radiological, and physical hazards through direct removal (via hazard abatement and demo prep).

Alternative 4 includes demolition of the Annex, which would improve access to the 202S Canyon. Since the Annex structure is largely uncontaminated, demolition would easily be executed. With appropriate administrative controls and engineering barriers, demolition of the Annex could be performed in the correct manner to protect the health and safety of workers and nearby 222S Building occupants.

6.1.2 Ability to Achieve Removal Action Objectives

Alternatives 2, 3, and 4 are considered to achieve the RAOs to varying degrees. All of these alternatives reduce TMV of hazardous substances (RAO #1) to some extent.

Alternative 2 achieves all of the RAOs but is considered to be least effective among Alternatives 2, 3, and 4. In comparison to Alternatives 3 and 4, Alternative 2 maintains the highest degree of continued S&M, making it the least effective removal action considered in this EE/CA in terms of reducing future S&M activity (RAOs #4 and #5).

Alternative 3 contains all of the removal actions included in Alternative 2, with the addition of demo prep in the 202S Canyon and Annex. Implementation of demo prep in these areas will allow for greater reduction of TMV (RAO #1) compared to Alternative 2. It will also reduce future S&M activity and expedite future remedial actions (RAOs #4 and #5) more effectively than Alternative 2.

Alternative 4 contains all of the removal actions included in Alternative 3, with the addition of demolition of the Annex areas. Demolition of the 202S Annex eliminates more potential for release of and exposure to hazardous substances (RAO #1) than the previous Alternatives 2 and 3. Demolition of the Annex may cause temporary disruption to the 222S Laboratory in comparison to Alternatives 2 and 3 (RAO #2). Waste generated from Alternative 4 will be safely disposed (RAO #3). The actions are consistent with the anticipated remedial action (RAO #4) and result in minimal to no need for future S&M activities in this area (RAO #5).

6.2 Implementability

The comparative evaluation of implementability is based on technical and administrative feasibility and availability of equipment, personnel, services, and disposal facilities. Additional factors include state and community acceptance.

Alternative 2 would defer demo prep of the 202S Building to the final remedial action, which would result in increased hazards due to continued facility degradation. This would make the technical feasibility of future actions more challenging to implement.

Alternative 3 includes demo prep of the 202S Annex and abovegrade areas of the 202S Canyon, which would improve industrial access for waste stabilization and/or removal in these areas under the future remedial action. This would increase the technical and administrative feasibility of future actions.

Alternative 4 provides technical and logistical advantages compared to Alternatives 2 and 3 through demolition of the Annex. Demolition of the Annex structures, which surround the Canyon and Silo area, would improve industrial access for waste stabilization and/or removal in these areas under the future remedial action, increasing future technical and administrative feasibility. Demolition of the Annex would increase the amount of physical disturbance near the 222S Laboratory. However, engineering barriers and administrative controls would be in place to minimize disruption and protect the health and safety of 222S Laboratory personnel.

6.3 Cost of Alternatives

The cost increases in subsequent alternatives due to the addition of new actions. The estimated cost for each alternative is provided in Table 6-1.

6.4 Summary of Comparative Analysis of Alternatives

Table 6-1 compares the effectiveness, implementability, and cost criteria of the removal actions described in Chapter 4. Based on this analysis, an alternative is recommended in Chapter 7.

Table 6-1. Comparative Analysis Summary

Alternative	Effectiveness		Implementability			Net Present-Worth Cost
	Protectiveness	RAOs	Technical	Administrative	Availability	
Alternative 1						
No Action	Not protective	N/A*	N/A*	N/A*	N/A*	$0
Alternative 2						
Actions: • Surveillance and Maintenance of REDOX Complex Structures • Hazard Abatement of the 202S Canyon • Demo Prep of the 202S Silo Service Area • Demolition of the 276S Hexone Storage Tanks and 293S Building • Grouting of Belowgrade Areas of the 293S Building	●	◐	◐	◐	◐	$148.1 million
Alternative 3						
Alternative 2 actions *plus*: • Demo Prep of 202S Annex and Canyon Abovegrade	◐	◐	○	○	◐	$176.5 million
Alternative 4						
Alternative 3 actions *plus*: • Demolition of the 202S Annex	◐	○	○	◐	◐	$180.7 million

* Not applicable; the No Action alternative does not meet protectiveness criteria and is not a viable alternative.

● = performs less well against the criterion relative to the other alternatives with significant disadvantages or uncertainty

◐ = performs moderately well against the criterion relative to the other alternatives with some disadvantages or uncertainty

○ = performs very well against the criterion relative to the other alternatives with minor disadvantages or uncertainty

demo prep = demolition preparation

RAO = removal action objective

REDOX = Reduction-Oxidation

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7 Recommended Alternative

Based on the comparative analyses of the removal action alternatives provided in Chapter 6, the recommended removal action for the REDOX Complex is Alternative 4:

- Continued S&M of REDOX Complex Structures
- Hazard Abatement of the 202S Canyon
- Demo Prep of the 202S Silo Service Area, 202S Annex, and 202S Canyon Abovegrade Areas
- Demolition of 276S Hexone Storage Tanks and the 293S Building
- Grouting of 293S Belowgrade Areas
- Demolition of the 202S Annex

Alternative 4 is the best for achieving the RAOs presented in this EE/CA. This alternative is administratively feasible and allows for the greatest reduction of TMV of hazardous substances. Alternative 4 removal actions are technically feasible at present and support implementation of future remedial actions. Alternative 4 achieves the highest degree of interim and long-term protectiveness of HHE by reducing chemical, radiological, and physical hazards through direct removal (via hazard abatement, demo prep, and demolition).

The implementation of Alternative 4 is planned to commence upon issuance of the AM, which is anticipated in 2017. The removal action will be performed based on emergent facility conditions, funding availability, craft/engineering resource availability, and overall interactive site priorities. The removal action will continue until the issuance of a ROD. DOE-RL will attempt to provide funding of $2 million to $3 million dollars per year through efficiencies. Assuming that a ROD would be available in the 2032 time frame, the maximum expenditure would be in the range of $30 million to $45 million dollars over the 15-year time period.

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Appendix A

Applicable or Relevant and Appropriate Requirements

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Terms

ACM	asbestos-containing material
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
Cat I	Category I
Cat II	Category II
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
LLW	low-level waste
NESHAP	"National Emission Standards for Hazardous Air Pollutants" (40 CFR 61)
NTCRA	non-time-critical removal action
PCB	polychlorinated biphenyl
RACM	regulated asbestos-containing material
RACT	reasonably available control technology
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation
T-BACT	toxics best available control technology
TAP	toxic air pollutant
TBC	to be considered
TSCA	*Toxic Substances Control Act of 1976*
UIC	underground injection control

A1 Applicable or Relevant and Appropriate Requirements

For the removal action being considered in this engineering evaluation/cost analysis, implementation of any selected alternative would be designed to comply with the applicable or relevant and appropriate requirements (ARARs) cited in this appendix to the extent practicable. ARARs are defined to include only substantive requirements of environmental standards. ARARs do not include administrative requirements, including requirements to obtain any federal, state, or local permits (40 CFR 300.400(e), "National Oil and Hazardous Substances Pollution Contingency Plan," "General;" and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA], Section 121, "Cleanup Standards").

The ARARs listed in this appendix are the ARARs that the U.S. Department of Energy (DOE) proposes for implementation of the recommended alternative. Selection of these ARARs was based on knowledge regarding the hazardous substances present within the Reduction-Oxidation (REDOX) Complex buildings/structures.

Chemical-specific requirements are usually health-based or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a contaminant that may be found in, or discharged to, the ambient environment. Action-specific requirements are usually technology-based or activity-based requirements or limitations triggered by the remedial actions performed at the site.

Following public review and comment on the engineering evaluation/cost analysis, DOE will confer with the U.S. Environmental Protection Agency (EPA) in the issuance of an action memorandum that will identify the selected alternative for the removal actions. The final ARARs will be established within the action memorandum. The key ARARs identified for the alternatives considered include waste management standards, standards controlling releases to the environment, standards for protection of natural resources, and safety and health standards.[1] Potentially applicable federal and state ARARs for the proposed removal action are provided in Tables A-1 and A-2, respectively.

A1.1 Waste Management Standards

A variety of waste streams would be generated under the proposed removal action alternatives. It is anticipated that the majority of the waste would be determined to be low-level waste (LLW). However, dangerous or mixed waste, polychlorinated biphenyl (PCB) waste, and asbestos-containing material (ACM) could also be generated. The majority of the waste would be in a solid form; however, some liquid waste may be generated.

Radioactive waste is managed by DOE under the authority of the *Atomic Energy Act of 1954* and in accordance with DOE O 435.1 Chg 1, *Radioactive Waste Management*.

The identification, storage, treatment, and disposal of hazardous waste and hazardous components of mixed waste are governed by the *Resource Conservation and Recovery Act of 1976* (RCRA). The state of Washington, which implements RCRA requirements under WAC 173-303, "Dangerous Waste Regulations," has been authorized to implement most elements of the RCRA program. The dangerous waste standards for generation and storage would apply to the management of any dangerous or mixed waste generated by removal action activities. Treatment standards for dangerous or mixed waste subject

[1] Worker safety and health standards are not environmental standards per se and, therefore, are not potential ARARs. Instead, compliance with applicable safety and health regulations is required external to the CERCLA ARAR process. However, due to the nature and importance of these standards, a discussion of the safety and health requirements is included in this appendix.

to RCRA land disposal restrictions are specified in WAC 173-303-140, "Land Disposal Restrictions," which incorporates 40 CFR 268, "Land Disposal Restrictions," by reference.

The management and disposal of PCB waste are governed by the *Toxic Substances Control Act of 1976* (TSCA) and 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." TSCA regulations contain specific provisions for PCB waste, including PCB waste that contains a radioactive component. PCBs also are considered underlying hazardous constituents under RCRA and, thus, could be subject to the requirements of WAC 173-303 and 40 CFR 268.

Removal and disposal of asbestos and ACM will be performed in accordance with the substantive provisions of the *Clean Air Act of 1990* (40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" [hereafter called NESHAP], Subpart M, "National Emission Standard for Asbestos"), which require special precautions to control airborne emissions of asbestos fibers during asbestos removal activities. Asbestos abatement activities will be performed in full compliance with all substantive NESHAP standards that are ARARs for the work. Prior to beginning demolition, a thorough inspection of the affected facility will be performed and documented for the presence of asbestos, including Category I (Cat I) and Category II (Cat II) nonfriable ACM. All Cat II nonfriable ACM will generally be presumed to be potentially friable and will be removed prior to the start of actual demolition activities. If Cat II ACM is identified and allowed to remain in place, a demolition approach will be provided in advance to EPA. The demolition approach will describe how the Cat II ACM will not become crumbled, pulverized, reduced to powder, or otherwise friable during the demolition. Cat I nonfriable ACM will also be removed prior to the start of actual demolition activities, except in situations where demolition practices will be used that can be or have been demonstrated to the satisfaction of EPA not to render the Cat I ACM friable, consistent with NESHAP standards. Demonstration can be performed using existing EPA or Washington State guidance regarding asbestos abatement under NESHAP. Such Cat I nonfriable ACM must not be in poor condition, and planned demolition activities must not subject the ACM to sanding, grinding, cutting, or abrading. In all cases, ACM that is either friable or cannot be demonstrated to remain nonfriable during demolition will be removed prior to such demolition as required by NESHAP. Asbestos and ACM would be packaged, as appropriate, and disposed at the Environmental Restoration Disposal Facility (ERDF).

Beryllium may be encountered during performance of the non-time-critical removal action (NTCRA). If encountered, beryllium may be subject to the substantive requirements of NESHAP (40 CFR 61.32, "Emission Standard") or WAC 173-460, "Controls for New Sources of Toxic Air Pollutants."

Waste that is determined to be LLW that meet the ERDF[2] waste acceptance criteria (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*) would preferentially be disposed at ERDF because it is an engineered facility that provides a high degree of protection to human health and the environment. Previous engineering evaluations/cost analyses for other Hanford Site work have shown that disposal at ERDF is more cost effective than disposal at other disposal sites. Construction of ERDF was authorized using a CERCLA record of decision (EPA, 1995, *Record of Decision, U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*). ERDF is designed, constructed, and operated to meet the ARAR provisions of the minimum

[2] CERCLA Section 104(d)(4), "Response Authorities," states that where two or more noncontiguous facilities are reasonably related on the basis of geography, or on the basis of the threat or potential threat to the public health or welfare or the environment, the facilities can be treated as one for purposes of CERCLA response actions. Consistent with this, the Hanford Site buildings/structures and ERDF would be considered to be onsite for purposes of CERCLA Section 104, and waste may be transferred between the facilities without requiring a permit.

technological requirements for a hazardous waste landfill, including standards for double liner, a leachate collection system, leak detection, monitoring, and a final cover. Alternate potential disposal locations may be considered when the NTCRA occurs if a suitable and cost effective location is identified. Any potential alternate disposal location will be evaluated for appropriate performance standards to ensure that it is adequately protective of human health and the environment. If the alternate location is offsite, the location must comply with the requirements of 40 CFR 300.440, "Procedures for Planning and Implementing Off-Site Response Actions," which applies to offsite transfer of CERCLA waste and requires that such waste must be placed in a disposal facility operating in compliance with RCRA or other applicable federal or state requirements. Any potential alternate offsite disposal location will also require approval from the treatment, storage, and/or disposal facility's EPA region stating that the disposal facility is acceptable to receive waste from any CERCLA site and to ensure that the CERCLA waste will not be released to the environment at the new location and create a new CERCLA site.

Waste designated as dangerous or mixed waste would be treated, as appropriate, to meet land disposal restrictions and ERDF waste acceptance criteria and then be disposed at ERDF. Applicable packaging and pre-transportation requirements for dangerous or mixed waste generated by the NTCRA would be identified and implemented before movement of any waste outside the CERCLA onsite areas.

Some of the aqueous waste determined to be LLW or designated as dangerous or mixed waste would be transported to Effluent Treatment Facility (ETF) or other acceptable facility for treatment and disposal. The ETF is a RCRA-permitted unit authorized to treat aqueous waste streams generated on the Hanford Site and to dispose these streams at a designated state-approved land disposal facility in accordance with applicable requirements.

Waste designated as nonliquid PCB waste likely would be disposed at ERDF if it meets the facility's waste acceptance criteria. PCB waste that does not meet ERDF waste acceptance criteria would be retained at a PCB storage area meeting the requirements for TSCA storage and would then be transported for future disposal at an appropriate disposal facility.

Alternatives 2, 3, and 4 can be performed in compliance with the waste management ARARs. Waste streams will be evaluated, designated, and managed in compliance with the ARAR requirements. Before disposal, waste would be managed in a protective manner to prevent releases to the environment or unnecessary exposure to personnel.

A1.2 Standards Controlling Emissions to the Environment

The proposed removal action alternatives have the potential to generate both radioactive and nonradioactive airborne emissions.

A1.2.1 Radiological Air Emissions

The federal *Clean Air Act of 1990* and RCW 70.94, "Washington Clean Air Act," require regulation of radioactive air pollutants. Implementing regulations in 40 CFR 61.92, "Standard," set limits for radionuclide emissions from the DOE Hanford Site, which cannot exceed those amounts that would cause any member of the public to receive an effective does equivalent of 10 mrem/yr. This requirement would be applicable to any aspects of the NTCRA with the potential to emit radionuclides to unrestricted areas. Verification of compliance with this standard is required by the state implementing regulation at WAC 173-480-070, "Ambient Air Quality Standards and Emission Limits for Radionuclides," "Emission Monitoring and Compliance Procedures." Radioactive air emissions are to be controlled through the use of best available radionuclide control technology or as low as reasonably achievable control technology

where economically and technologically feasible (WAC 246-247-040(3) and (4), "Radiation Protection—Air Emissions," "General Standards," and associated definitions).

To address the substantive aspect of these potential requirements, best or reasonably achievable control technology could be accomplished by ensuring that applicable emission control technologies (those successfully operated in similar applications) would be used when economically and technologically feasible (i.e., based on cost/benefit). If it is determined that there are substantive aspects of the requirement for control of radioactive airborne emissions once ARARs are finalized, then controls will be administered as appropriate using the best methods from among those that are reasonable and effective. Administrative requirements (e.g., air licensing and permitting) will be discontinued after this CERCLA removal action has been approved, the removal action work plan has been issued, and the removal action is initiated. Existing air permits/licenses will be modified to reflect this removal action decision.

A1.2.2 Criteria/Toxic Air Emissions

WAC 173-400, "General Regulations for Air Pollution Sources"; and WAC 173-460 establish requirements for emissions criteria and toxic air pollutants (TAPs). The primary nonradioactive source of emissions resulting from this NTCRA is anticipated to be fugitive particulate matter. If waste characterization reveals the presence of potential air toxic precursors, they will be evaluated against the requirements of WAC 173-460 to determine what, if any, controls would be required. In accordance with WAC 173-400-040, "General Standards for Maximum Emissions," reasonable precautions must be taken to prevent the release of air contaminants associated with fugitive emissions resulting from demolition, materials handling, or other operations, and also prevent fugitive dust from becoming airborne from fugitive sources of emissions.

Treatment of some waste encountered during the NTCRA may be required to meet ERDF waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques (e.g., macroencapsulation or grouting), and WAC 173-460 would not be considered an ARAR because it would not result in the emission of TAPs. If more aggressive treatment is required that would result in the emission of regulated air pollutants above de minimis emission values in WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values," substantive requirements of WAC 173-400-113(2), "Requirements for New Sources in Attainment or Unclassifiable Areas," and WAC 173-460-060, "Control Technology Requirements," would be evaluated to determine applicability and satisfied if determined to be ARAR.

Emissions to the air will be minimized during implementation of the NTCRA through the use of standard industry practices as needed (e.g., application of water sprays and fixatives). These techniques are considered to be reasonable precautions to control fugitive emissions as required by regulatory standards.

A1.3 Standards for the Protection of Cultural and Ecological Resources

The *National Historic Preservation Act of 1966* (implemented in regulation via 36 CFR 800, "Protection of Historic Properties") requires federal agencies to consider the effect of an activity on any significant cultural resource, including properties listed on or eligible for inclusion on the National Register of Historic Places. The *Native American Graves Protection and Repatriation Act of 1990* establishes statutory provisions for the treatment of inadvertent discoveries of Native American remains and cultural objects. The *Archeological and Historical Preservation Act of 1974* requires action to recover and preserve archaeological or historical data in areas where activity may cause irreparable harm, loss, or destruction of significant data.

The *Endangered Species Act of 1973* (implemented via 50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended," and WAC 232-12-297, "Permanent Regulations," "Endangered, Threatened, and Sensitive Wildlife Species Classification") prohibits activities that threaten the continued existence of listed species or destroy critical habitat. The *Migratory Bird Treaty Act of 1918* makes it illegal to take, capture, or kill any migratory bird, or any part, nest, or egg of any such bird.

Hanford Site buildings/structures have been evaluated for their National Register of Historic Places eligibility as part of DOE/RL-97-56, *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan*. Some buildings/structures have been determined to be contributing properties to the Manhattan Project/Cold War Era Historic District with mitigation in the form of documentation required. DOE/RL-97-56 also requires that walkthroughs be completed of these buildings/structures to identify artifacts that are of educational and interpretive value. The 202S Building was determined not to be a contributing property and was not recommended for individual documentation.

The area around the REDOX Complex has already been extensively disturbed. The annual ecological review of the facility indicates that three species of birds protected under the *Migratory Bird Treaty Act of 1918* may nest on or near the building. Care will be required with any of the alternatives to ensure completion of pre-job surveys and the development of mitigative measures if cultural or natural resources are encountered at the facility and borrow areas.

Table A-1. Identification of Potential Federal ARARs for the Removal Action

Regulatory Citation	ARAR Category	Description of Regulatory Requirement	Rationale for Consideration
***Clean Air Act of 1990*, as amended (42 USC 7401 et seq.)**			
40 CFR 60, "Standards of Performance for New Stationary Sources" 40 CFR 60, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines" 40 CFR 60, Subpart JJJJ, "Standards of Performance for Stationary Spark Ignition Internal Combustion Engines" 40 CFR 63, "National Emission Standards for Hazardous Air Pollutants for Source Categories" 40 CFR 63, Subpart ZZZZ, "National Emission Standard for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines"	ARAR	The requirements for stationary engines changed May 3, 2013, to include timers, maintenance plans, and meeting monitoring requirements.	This applies to all stationary engines used during this NTCRA. This requirement is action-specific.
40 CFR 61.140, "Applicability" 40 CFR 61.145, "Standard for Demolition and Renovation" Specific subsections: 40 CFR 61.145(a)(1), (a)(2), and (a)(5) 40 CFR 61.145(c)	ARAR	These standards apply to demolition activities, including the removal of RACM. The standards of 40 CFR 61.145(a)(1), (a)(2), and (a)(5) are used to determine when the requirements of 40 CFR 61.145(c) apply to demolition activities.	Some buildings/structures addressed under the NTCRA could contain asbestos. The substantive provisions of 40 CFR 61.145(c) would be complied in accordance with 40 CFR 61.145(a)(1), (a)(2), and (a)(5) for the material that contains RACM under this REDOX Complex NTCRA. This requirement is chemical-specific.
40 CFR 61.150(a) through (c), "Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations"	ARAR	The standards of 40 CFR 61.150(a) through (c) are used to control asbestos emissions during collection, processing, packaging, and transport of any asbestos-containing waste material.	The substantive provisions of 40 CFR 61.150(a) through (c) would be met during activities that involve collection, processing, packaging, and transport of asbestos-containing waste material under the REDOX Complex NTCRA. This requirement is chemical-specific.

Table A-1. Identification of Potential Federal ARARs for the Removal Action

Regulatory Citation	ARAR Category	Description of Regulatory Requirement	Rationale for Consideration
***Archeological and Historic Preservation Act of 1974*, as amended (16 USC 469aa-469mm)**			
40 CFR 6.301(c), "Procedures for Implementing the National Environmental Policy Act and Assessing the Environmental Effects Abroad of EPA Actions," "Applicant Requirements"	ARAR	Requires that the removal action at the REDOX Complex does not cause the loss of any archaeological or historic data. This act mandates preservation of the data and does not require protection of the actual historical sites.	Archeological and historic sites have been identified within the 200 Areas; therefore, the substantive requirements of this act are applicable to removal actions that might disturb these sites. This requirement is action-specific.
***National Historic Preservation Act of 1966* (16 USC 470, Section 106)**			
36 CFR 800, "Protection of Historic Properties" 36 CFR 65, "National Historic Landmarks Program" 36 CFR 60, "National Register of Historic Places"	ARAR	Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation and mitigation processes.	Based on past identification of cultural and historic sites at the Hanford Site, these types of sites could be encountered during REDOX Complex NTCRA activities. The substantive requirements of this act are potentially applicable to and would be complied with for actions that might disturb these types of sites. This requirement is location-specific.
Native American Graves Protection and Repatriation Act of 1990			
43 CFR 10, "Native American Graves Protection and Repatriation Regulations"	ARAR	These provisions establish federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony.	Based on Hanford Site history, these types of sites could be encountered during the REDOX Complex NTCRA. Substantive requirements of this act are potentially applicable if remains and sacred objects are found during NTCRA activities. This requirement is location-specific.
***Endangered Species Act of 1973* (16 USC 1531 et seq., Subsection 16 USC 1536(c))**			
50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended"	ARAR	These regulations prohibit actions by federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification or critical habitat.	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where the removal action will occur. This requirement is location-specific.

Table A-1. Identification of Potential Federal ARARs for the Removal Action

Regulatory Citation	ARAR Category	Description of Regulatory Requirement	Rationale for Consideration
***Migratory Bird Treaty Act of 1918* (16 USC 703 et seq.)**			
50 CFR 10.13, "Wildlife and Fisheries," "List of Migratory Birds"	ARAR	These standards make 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 U.S. and Great Britain, U.S. and Mexico, and U.S. and Japan.	Three species of bird protected under the migratory bird treaty act may nest on or near the REDOX Complex. 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. This requirement is location-specific.
***Toxic Substances Control Act of 1976* (TSCA); 40 CFR 761, "Polychlorinated Biphenyls Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions"**			
40 CFR 761.50(b)1, 2, 3, 4, and 7, "Applicability," "PCB Waste" 40 CFR 761.50(c), "Storage for Disposal" 40 CFR 761.60(b), "PCB Articles" 40 CFR 761.60(c), "PCB Containers" 40 CFR 761.61, "PCB Remediation Waste" 40 CFR 761.62, "Disposal of PCB Bulk Product Waste" 40 CFR 761.79, "Decontamination Standards and Procedures"	ARAR	These regulations apply to the storage and disposal of PCB waste including liquid PCB waste, PCB items, PCB remediation waste, PCB bulk product waste, and PCB/radioactive waste at concentrations equal to or greater than 50 parts per million. These regulations also provide options for decontamination of materials contaminated with PCBs.	Some buildings/structures addressed under the NTCRA could include various forms of PCB waste, including, but not limited to, PCB items, PCB liquids, and PCB articles, and/or containers that would be managed in accordance with the substantive requirements of these standards if encountered and or generated during the NTCRA. This requirement is chemical-specific.
Radiological Dose and Cleanup (TBC)			
Luftig and Weinstock, 1997, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" Luftig and Page, 1999, "Distribution of OSWER Radiation Risk Assessment Q & A's Final Guidance"	TBC	This memorandum presents clarification for establishing protective cleanup levels in media for radioactive contamination at CERCLA sites. EPA has determined that the dose limits established by the U.S. Nuclear Regulatory Commission in 62 FR 39058, "Radiological Criteria for License Termination" (25 mrem/yr, which is equivalent to 5×10^{-4} increase lifetime risk), will not provide a protective basis for establishing preliminary remediation goals under CERCLA. A dose of 15 mrem/yr	Soil and debris in the REDOX Complex may contain radioactive contaminants that, if not removed, could pose unacceptable risk to human health.

Table A-1. Identification of Potential Federal ARARs for the Removal Action

Regulatory Citation	ARAR Category	Description of Regulatory Requirement	Rationale for Consideration
		effective dose (approximately equivalent to 3×10^{-4} increase in lifetime risk) is preferred as the maximum dose limit for humans. In the final guidance, EPA further clarifies that 15 mrem/yr is not a presumptive cleanup level under CERCLA. Rather, site decision makers should continue to use the CERCLA risk range when ARARs are not used to set cleanup levels. This is for several reasons, as using dose-based guidance would result in unnecessary inconsistency regarding how radiological and nonradiological (chemical) contaminants are addressed at CERCLA sites.	

ARAR = applicable or relevant and appropriate requirement
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
EPA = U.S. Environmental Protection Agency
NTCRA = non-time-critical removal action
PCB = polychlorinated biphenyl
RACM = regulated asbestos-containing material
REDOX = Reduction-Oxidation
TBC = to be considered

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-218, "Underground Injection Control Program"			
WAC 173-218-120(3)(b), "Decommissioning a UIC Well"	ARAR	This regulation provides the standards for decommissioning underground injection wells that are not in contact with the aquifer.	There is a potential to encounter UICs associated with buildings/structures during the NTCRA. While these UICs are not expected to be decontaminated, they do need to be decommissioned to the substantive requirements of this regulation. This requirement is action-specific.
RCW 70.95, "Solid Waste Management—Reduction and Recycling" (Regulations Pursuant to the *Solid Waste Management Recovery and Recycling Act of 1969*)			
WAC 173-303-016, "Identifying Solid Waste" WAC 173-303-017, "Recycling Processes Involving Solid Waste"	ARAR	This regulation applies for determining which materials are and are not solid waste. This determination is used to establish which waste are subject to the designation procedures of WAC 173-303-070(3).	Solid waste will be generated during the NTCRA. Substantive requirements of these regulations are potentially applicable because they define how to determine which materials are subject to the designation regulations. Specifically, materials that are generated for removal from the CERCLA site during the NTCRA would be evaluated using the procedures for identifying solid waste to ensure proper management. This requirement is action-specific.
WAC 173-303-070(3), "Designation of Dangerous Waste"	ARAR	This regulation applies for the evaluation of solid waste to determine if such waste is designated as dangerous or mixed waste. Solid waste that designates as dangerous or mixed waste are subject to management and disposal standards of WAC 173-303.	There is potential for generating solid waste during the NTCRA that would designate as dangerous or mixed waste. Substantive requirements of these regulations are potentially applicable to such solid waste if generated or encountered during the NTCRA. Specifically, solid waste generated for removal from the CERCLA site during this NTCRA would be evaluated using the dangerous waste designation procedures to ensure proper management. This requirement is action-specific.
WAC 173-303-071, "Excluded Categories of Waste"	ARAR	This regulation lists waste categories that are excluded from management in accordance with the requirements of WAC 173-303.	There is potential for generating waste during the NTCRA that would qualify for management under the substantive provisions of these regulations, which would be used as appropriate during the NTRCA. This requirement is action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-303-073, "Conditional Exclusion of Special Wastes"	ARAR	This regulation provides for management of waste that pose a relatively low hazard to human health and the environment. The standards provide for management of special waste with a level of protection that is intermediate between dangerous and nondangerous solid waste.	There is potential for generating waste during the NTCRA that would qualify for management under the substantive provisions of these regulations, which would be used as appropriate during the NTCRA. This requirement is action-specific.
RCW 70.95, "Solid Waste Management—Reduction and Recycling" (Regulations Pursuant to the *Solid Waste Management Recovery and Recycling Act of 1969*)			
WAC 173-303-077, "Requirements for Universal Waste"	ARAR	This regulation provides alternate reduced standards for certain solid waste (i.e., batteries, mercury containing equipment, and lamps) as described in WAC 173-303-573, "Standards for Universal Waste Management."	There is potential for generating waste during the NTCRA that would qualify for management under the substantive provisions of these regulations, which would be used as appropriate during the NTCRA. This requirement is action-specific.
WAC 173-303-120, "Recycled, Reclaimed, and Recovered Wastes"	ARAR	This regulation describes requirements for recycling materials that are solid waste and dangerous.	There is potential for generating solid waste during the NTCRA that will designate as dangerous that may be recycled.
WAC 173-303-140(4), "Land Disposal Restrictions"	ARAR	This regulation establishes state standards for land disposal of dangerous waste and incorporates by reference the federal land disposal restrictions of 40 CFR 268 that are applicable to solid waste designated as dangerous or mixed waste in accordance with WAC 173-303-070(3).	There is potential for generating solid waste during the NTCRA that would designate as dangerous or mixed waste and further require treatment prior to land disposal. The substantive requirements of this regulation are potentially applicable to dangerous and/or mixed waste that is generated or encountered during the NTCRA. Specifically, dangerous and/or mixed waste generated and removed from the CERCLA site during the NTCRA for land disposal (e.g., at the Environmental Restoration and Disposal Facility) or other approved disposal facility) would be evaluated for determination of applicable land disposal restrictions at the point of waste generation. This requirement is action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-303-170(3), "Requirements for Generators of Dangerous Waste"	ARAR	This regulation establishes standards for the temporary management of waste that designates as dangerous or mixed waste.	There may be waste generated during the NTCRA that needs to be temporarily accumulated or stored. Substantive requirements of these regulations would be used for management of materials generated and/or encountered during the NTCRA. WAC 173-303-170(3) includes by reference the substantive provisions of both the satellite accumulation standards of WAC 173-303-200, "Accumulating Dangerous Waste On-Site," and the standards for management in containers under WAC 173-303-630, "Use and Management of Containers," and tanks under WAC 173-303-640, "Tank Systems." This requirement is action-specific.
Regulations Pursuant to RCW 70.95, "Solid Waste Management—Reduction and Recycling"			
WAC 173-350-300(2), "Solid Waste Handling Standards," "On-Site Storage, Collection, and Transportation Standards"	ARAR	This regulation describes requirements for management of nondangerous, nonradioactive solid waste.	There is potential for generating nondangerous, nonradioactive solid waste during the NTCRA. This requirement is action-specific.
RCW 70.105D, "Hazardous Waste Cleanup—Model Toxics Control Act"			
WAC 173-340-745(5) and (6), "Soil Cleanup Standards for Industrial Properties"	ARAR	Rules set standards for degree of cleanup required by a remedial action where industrial land use represents the reasonable maximum exposure under both current and future site use conditions. Total excess cancer risk may not exceed 1×10^{-5} or a noncancer hazard index of 1 for chemical contaminants.	The selected NTCRA will comply through removal, treatment, and disposal of contaminants generated from the NTCRA that exceed the standards. This requirement is a chemical-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-340-747(3) through (8), "Deriving Soil Concentrations for Groundwater Protection"	ARAR	Establishes soil concentrations that will not cause contamination of groundwater at levels that exceed the groundwater cleanup levels established under WAC 173-340-720, "Groundwater Cleanup Standards." Provides an overview of the methods for deriving these soil concentrations to meet relevant criteria. Certain methods are tailored for particular types of hazardous substances or sites and certain methods are more complex than others and/or require the use of site-specific data.	Soil in the REDOX Complex may contain contaminants that require removal. The requirements corresponding to soil cleanup levels may be used to calculate cleanup levels to ensure protection of groundwater. Although groundwater is not currently used for drinking water, it is a potential drinking water source. This is a chemical-specific requirement.
RCW 70.105D, "Hazardous Waste Cleanup—Model Toxics Control Act"			
WAC 173-340-7490, "Terrestrial Ecological Evaluation Procedures" WAC 173-340-7493, "Site-Specific Terrestrial Ecological Evaluation Procedures" WAC 173-340-7494, "Priority Contaminants of Ecological Concern"	TBC	Defines goals and procedures for determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment. Characterizes existing or potential threats to terrestrial plants or animals exposed to hazardous substances in soil; establishes site-specific cleanup standards for the protection of terrestrial plants and animals. WAC 173-340-7494 provides for numeric concentrations of hazardous substances determined to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors.	Soil in the REDOX Complex may contain contaminants that require evaluation to determine if ecological exposures have the potential to cause significant adverse effects. This is a chemical-specific action.
Regulations Pursuant to *Washington Clean Air Act of 1967* (RCW 70.94, "Washington Clean Air Act") and RCW 43.21A, "Department of Ecology"			
WAC 173-400, "General Regulations for Air Pollution" Specific subsection: WAC 173-400-040(3) and (8), "General Standards for Maximum Emissions"	ARAR	These laws and regulations require all sources of air contaminants to meet standards for visible emissions, fallout, fugitive emissions, odors, emissions detrimental to persons or property, sulfur dioxide, concealment and masking, and fugitive dust. Requires use of RACT.	There is potential for fugitive emissions during the NTCRA activities. Substantive requirements of the general standards for control of fugitive emissions would be applied, as appropriate, to minimize the generation of fugitive dust during NTCRA activities. These requirements are action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-400-113, "Requirements for New Sources in Attainment or Unclassifiable Areas"	ARAR	This regulation applies to new and modified sources and requires controls to minimize the release of associated criteria and toxic air emissions. Emissions are to be minimized through application of best available control technology.	It is unlikely that the substantive provisions in this regulation would be triggered during the NTCRA. However, substantive requirements of this regulation would potentially be applicable to removal actions performed at the site if a treatment technology that emits regulated air emissions was necessary during the implementation of the NTCRA. This requirement is action-specific.
Regulations Pursuant to *Washington Clean Air Act of 1967* (RCW 70.94, "Washington Clean Air Act") and RCW 43.21A, "Department of Ecology"			
WAC 173-460, "Controls for New Sources of Toxic Air Pollutants" (adopts, by reference, 40 CFR 61.32, "Emission Standard") Specific subsections: WAC 173-460-060, "Control Technology Requirements" WAC 173-460-070, "Ambient Impact Requirement" WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values"	ARAR	These regulations apply for determination of de minimis emission values and for establishment of control technology as appropriate for new or modified TAP sources likely to increase TAP emission. Requires T-BACT for regulated emissions of TAPs and demonstration that emissions of TAP will not endanger human health or safety.	Beryllium is listed as a TAP and may be encountered during performance of the NTCRA. It is not expected that work performed under the NTCRA will trigger standards for T-BACT. However, substantive requirements of these regulations would potentially be applicable to removal actions performed at the site, if a treatment technology that emits toxic air emissions were necessary during the implementation of the NTCRA. These requirements are action-specific.
WAC 246-247-035 (1)(a)(i), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopts, by reference, 40 CFR 61.05, "Prohibited Activities")	ARAR	Identifies prohibition of any owner or operator of any stationary source subject to a national emission standard for hazardous air pollutants from constructing or operating the new or existing source in violation of any such standard.	Substantive requirements of this standard are applicable because the REDOX Complex NTCRA may be subject to NESHAP, and resultant requirements have the potential to be detected in, and potentially emitted from, structures, components, debris, soil, or groundwater involved in the NTCRA. This requirement is action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
Regulations Pursuant to *Washington Clean Air Act of 1967* (RCW 70.94, "Washington Clean Air Act") and RCW 43.21A, "Department of Ecology"			
WAC 246-247-035 (1)(a)(i), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopts by reference 40 CFR 61.12, "Compliance with Standards and Maintenance Requirements")	ARAR	Requires the owner or operator of each stationary source of hazardous air pollutants subject to a national emission standard for a hazardous air pollutant to determine compliance with numerical emission limits in accordance with emission tests established in NESHAP (40 CFR 61.13, "Emission Tests and Waiver of Emission Tests") or as otherwise specified in an individual subpart. Compliance with design, equipment, work practice, or operational standards shall be determined as specified in the individual subpart. Also, maintain and operate the source, including associated equipment for air pollution control, in a manner consistent with good air pollution control practice for minimizing emissions.	Hazardous contaminants that would be subject to NESHAP and resultant requirements have the potential to be detected in, and potentially emitted from, structures, components, debris, soil, or groundwater involved in the REDOX Complex NCTRA. Associated design, equipment, work practice, or equipment for air pollution control may also be maintained and operated. This requirement is action-specific.
WAC 246-247-035 (1)(a)(i), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopts, by reference, 40 CFR 61.14, "Monitoring Requirements")	ARAR	Requires the owner or operator to maintain and operate each monitoring system as specified in the applicable subpart, and in a manner consistent with good air pollution control practice for minimizing emissions. Approvals of alternatives to any monitoring requirements or procedures are obtained from the regulatory agency.	Hazardous contaminants that would be subject to NESHAP air pollutant standards and resultant requirements have the potential to be detected in, and emitted from, structures, components, debris, soil, or groundwater involved in the REDOX Complex NTCRA. The hazardous contaminants will be monitored as identified under each applicable NESHAP subpart. This requirement is action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
Regulations Pursuant to *Washington Clean Air Act of 1967* (RCW 70.94, "Washington Clean Air Act") and RCW 43.21A, "Department of Ecology"			
WAC 246-247-035 (1)(a)(ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopts, by reference, 40 CFR 61.92, "Standard")	ARAR	Establishes emission standards for radionuclides equivalent to NESHAP (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities"), by reference. Hanford Site radionuclide airborne emissions shall 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.	Hazardous radionuclide contaminants that would be subject to NESHAP; radionuclide air pollutant standards and resultant requirements have the potential to be detected in, and emitted from, structures, components, debris, soil or groundwater involved in the NTCRA. This requirement is chemical-specific action.
WAC 246-247-035 (1)(a)(ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopts, by reference, 40 CFR 61.93, "Emission Monitoring and Test Procedures")	ARAR	Specifies that radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated to determine compliance with the 10 mrem/yr effective dose equivalent standard. Radionuclide emissions shall be collected and measured using approved methods. A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114. Measurement by methods specified in the paragraph (b) shall be made at all release points that have the potential to discharge radionuclides to the air in quantities that cause an effective dose equivalent in excess of 1 percent of the 10 mrem/yr standard. For other release points that have a potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.	Hazardous radionuclide contaminants that would be subject to NESHAP; radionuclide air pollutant standards and resultant requirements have the potential to be detected in, and emitted from, structures, components, debris, soil, or groundwater involved in the REDOX Complex NTCRA. The hazardous contaminants will be monitored as identified under each applicable NESHAP subpart. This requirement is action-specific report.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
Regulations Pursuant to *Washington Clean Air Act of 1967* (RCW 70.94, "Washington Clean Air Act") and RCW 43.21A, "Department of Ecology"			
WAC 246-247-040(3) and (4), "General Standards"	ARAR	Requires that emissions be controlled to ensure that ALARA based and best available controls standards are not exceeded.	Hazardous contaminants that would be subject to radionuclide air emission standards and resultant requirements have the potential to be detected in, and emitted from, structures, components, debris, soil, or groundwater involved in the REDOX Complex NTCRA. This requirement is action-specific.
WAC 246-247-075, "Monitoring, Testing and Quality Assurance"	ARAR	Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions. Emissions from nonpoint and fugitive sources of airborne radioactive material will be measured. Measurement techniques may include but are not limited to sampling, calculation, smears, or other reasonable method for identifying emissions as determined by the lead agency.	Hazardous contaminants at either the REDOX Complex or generated from the NTCRA would be subject to radionuclide air emission standards and resultant requirements have the potential to be detected in, and emitted from, structures, components, debris, soil, or groundwater involved in the removal action. This requirement is action-specific.
WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"			
WAC 173-480-040, "Ambient Standard"	ARAR	Requires that emissions of radionuclides in the air shall not cause a maximum effective dose equivalent of more than 10 mrem/yr to the whole body to any member of the public.	The buildings/structures to be addressed under this NTCRA will contain radioactive constituents. Potential emissions from the NTCRA would be performed in accordance with this standard. This requirement is action-specific.
WAC 173-480-050(1), "General Standards for Maximum Permissible Emissions"	ARAR	This regulation establishes general standards for all radionuclide emission units and requires emission units to meet WAC 246-247 requiring every reasonable effort to maintain radioactive materials in effluents to unrestricted areas ALARA. The regulation indicates that control equipment of sites operating under ALARA shall be defined as RACT and ALARA control technology.	The potential for fugitive and diffuse emissions due to demolition and excavation and related activities potentially will require efforts to minimize those emissions by meeting WAC 246-247. This requirement is action-specific.

Table A-2. Identification of Potential State ARARs for the Removal Action

ARAR Citation	ARAR	Requirement	Rationale for Consideration
WAC 173-480-060, "Emission Standards for New and Modified Emission Units"	ARAR	Requires that construction, installation, or establishment of a new air emission unit shall use best available radionuclide control technology.	The potential for fugitive and diffuse emissions due to demolition and excavation and related activities potentially will require efforts to minimize those emissions by meeting WAC 246-247. This requirement is action-specific.
WAC 173-480-070(2), "Emission Monitoring and Compliance Procedures"	ARAR	Requires that procedures specified in WAC 246-247 or approved specifically by the regulatory agency shall be used to determine compliance with the 10 mrem/yr standard for dose to any member of the public. Compliance is determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public may be.	The potential for radionuclide emissions from some NTCRAs, such as fugitive and diffuse emissions during demolition and excavation, and related activities would be performed in compliance with the public dose standard. This requirement is action-specific.

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
NESHAP = "National Emission Standards for Hazardous Air Pollutants"
NTCRA = non-time-critical removal action
RACT = reasonably available control technology
REDOX = Reduction-Oxidation
TAP = toxic air pollutant
TBC = to be considered
T-BACT = toxics best available control technology
UIC = underground injection control

A2 References

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Appendix B

REDOX Implementation Area

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Terms

CHPRC	CH2M HILL Plateau Remediation Company
D&D	decontamination and decommissioning
EE/CA	engineering evaluation/cost analysis
REDOX	Reduction-Oxidation
RI/FS	remedial investigation/feasibility study
TPA	Tri-Party Agreement (*Hanford Federal Facility Agreement and Consent Order* [Ecology et al., 1989])
WRPS	Washington River Protection Solutions

B1 REDOX Implementation Area

The Hanford Site Central Plateau is divided into implementation areas, as defined in DOE/RL-2012-33, *Central Plateau Remediation Optimization Study*. These areas are configured around major components such as canyon buildings, landfills, and tank farms. Implementation areas were developed by the U.S. Department of Energy as an approach to track cleanup activities on the Hanford Site. Implementation areas each have a defined inventory of facilities and waste sites that lie relatively close to each other to enable effective management of future cleanup actions.

The boundary of the Reduction-Oxidation (REDOX) Implementation Area is shown in Figure B-1. Figure B-2 illustrates the close-up view of the building/structure around 202S. All buildings/structures within the REDOX Implementation Area will be considered during development of the associated operable unit remedial action(s). Prior to the remedial action, removal actions and *Resource Conservation and Recovery Act of 1976* closures will be undertaken within the REDOX Implementation Area. Table B-1 identifies the regulatory decision document for each building/structure within the area.

Figure B-1. REDOX Implementation Area

Figure B-2. Buildings/Structures Surrounding the 202S Building

Table B-1. REDOX Implementation Area Buildings/Structures and Regulatory Decision Documents

Structure Identification	Structure Name	Owner	Operating Status	EE/CA	Action Memorandum	Removal Action Work Plan	RI/FS and/or Closure Plan
202S	REDOX Canyon and Service Facility	CHPRC	Pending D&D	REDOX Complex[a]	—	—	200-CR-1
207SL	Water Retention Basin	WRPS	Operating	—	—	—	200-CR-1
211S	Cold Chemical Makeup Tank Farm	CHPRC	Pending D&D	General decommissioning[b]	General decommissioning[b]	General decommissioning[b]	200-CR-1
212S	Covered Gas Bottle Storage	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
219S	Rad Waste Staging and Transfer Facility	WRPS	Operating	—	—	—	200-CR-1
222S	Central Analytical Laboratory	WRPS	Operating	—	—	—	200-CR-1
222SB	South Filter Building	WRPS	Operating	—	—	—	200-CR-1
222S-BA	222S Boiler Annex	Johnson Controls	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
222SC	North Filter Building	WRPS	Operating	—	—	—	200-CR-1
222SD	Solid Waste Storage Pad	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
222SE	Lab Exhaust Filter Building	WRPS	Operating	—	—	—	200-CR-1
222SH	Office and Change Room North Side of 222S	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1

Table B-1. REDOX Implementation Area Buildings/Structures and Regulatory Decision Documents

Structure Identification	Structure Name	Owner	Operating Status	EE/CA	Action Memorandum	Removal Action Work Plan	RI/FS and/or Closure Plan
225WB	Treated Effluent Disposal Facility — Local Control Unit 55C-22	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
227S	Lab Conditioned Storage Building	WRPS	Operating	—	—	—	200-CR-1
2506W4	Telecommunications	WRPS	Operating	—	—	—	200-CR-1
2508W8	Siren North of 13th between Camden and Beloit	Mission Support Alliance	Operating	—	—	—	200-CR-1
2704S	Office Building	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
2705S	Lab Office Building	WRPS	Operating	—	—	—	200-CR-1
2708S	Storage Building North Side of 202S	CHPRC	Pending D&D	General decommissioning	General decommissioning	General decommissioning	200-CR-1
2710S	Inert Gas Generator Building	CHPRC	Pending D&D	General decommissioning	General decommissioning	General decommissioning	200-CR-1
2711S	Stack Gas Monitoring Station	CHPRC	Pending D&D	General decommissioning	General decommissioning	General decommissioning	200-CR-1
2712S	Electrical/Instrumentation Building	WRPS	Pending D&D	—	—	—	200-CR-1
2713S	Lab Office Building	WRPS	Operating	—	—	—	200-CR-1
2715S	Oil Storage Building	CHPRC	Pending D&D	General decommissioning	General decommissioning	General decommissioning	200-CR-1

Table B-1. REDOX Implementation Area Buildings/Structures and Regulatory Decision Documents

Structure Identification	Structure Name	Owner	Operating Status	EE/CA	Action Memorandum	Removal Action Work Plan	RI/FS and/or Closure Plan
2716S	Laboratory Storage	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
2718S	Equipment/Lead Shielding Storage Shed	CHPRC	Pending D&D	General decommissioning[b]	General decommissioning[b]	General decommissioning[b]	200-CR-1
2734S	Liquid Nitrogen Storage Facility	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
276S	Cold Solvent Storage and Makeup Building	CHPRC	Pending D&D	General decommissioning[b]	General decommissioning[b]	General decommissioning[b]	200-CR-1
276S141 276S142	276S Hexone Storage Tanks	CHPRC	Pending D&D	REDOX Complex[a]	—	—	Hexone Storage and Treatment Facility Closure Plan[c]
2904SA	Cooling Water Sampler Building	CHPRC	Pending D&D	General decommissioning	General decommissioning	General decommissioning	200-CR-1
291S	Exhaust Fan Control House, Sand Filter	CHPRC	Operating	—	—	—	200-CR-1
291S001	202S Main Stack	CHPRC	Operating	—	—	—	200-CR-1
292S	Jet Pit House	CHPRC	Pending D&D	—	—	—	200-CR-1
293S	Acid Recovery and Off Gas Treatment Building	CHPRC	Pending D&D	REDOX Complex[a]	—	—	200-CR-1
298TF	Pump and Treat Extraction Transfer Building	CHPRC	Operating	—	—	—	200-CR-1
MO037	Office Trailer at 222S	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
MO2171	Office Trailer Northwest of 2704S	WRPS	Operating	—	—	—	200-CR-1
MO291	Office Trailer Near 2704S	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1

Table B-1. REDOX Implementation Area Buildings/Structures and Regulatory Decision Documents

Structure Identification	Structure Name	Owner	Operating Status	EE/CA	Action Memorandum	Removal Action Work Plan	RI/FS and/or Closure Plan
MO409	Storage Trailer West of 202S	WRPS	Operating	General decommissioning	General decommissioning	General decommissioning	200-CR-1
MO648	222S Conference Trailer	WRPS	Operating	—	—	—	200-CR-1

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Notes: This table is current as of April 1, 2016.

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b. TPA-CN-635, *Tri-Party Agreement Change Notice Form: DOE/RL-2010-33, Rev 0 Removal Action Work Plan for Central Plateau General Decommissioning Activities*.

c. DOE/RL-2009-112, *Hexone Storage and Treatment Facility Closure Plan*.

CHPRC = CH2M HILL Plateau Remediation Company
D&D = decontamination and decommissioning
EE/CA = engineering evaluation/cost analysis
REDOX = Reduction-Oxidation
RI/FS = remedial investigation/feasibility study
TPA = Tri-Party Agreement (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*)
WRPS = Washington River Protection Solutions

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