RECORD OF DECISION
221-U FACILITY
(CANYON DISPOSITION INITIATIVE)
HANFORD SITE, WASHINGTON

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Part 1: DECLARATION OF THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

USDOE Hanford 200 Area
221-U Facility
Hanford Site
Benton County, Washington

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected final remedial action for the 221-U Facility as a portion of the U.S. Department of Energy (DOE) Hanford 200 Area, Hanford Site, Benton County, Washington, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan). This decision is based on the information contained in the Administrative Record for the 221-U Facility.

The State of Washington concurs with the selected remedy.

1.3 ASSESSMENT OF SITE

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

1.4 DESCRIPTION OF SELECTED REMEDY

The 221-U Facility, located within the U Plant Area (Figures 1 and 2), is one of three nearly identical Hanford Site chemical separations plants constructed from 1944 through 1945 to support World War II plutonium production. Two more plants were constructed after World War II to support Cold War efforts. These facilities are referred to as "canyon buildings" because of the expansive main room stretching the entire 800-plus-foot length of each building. The term "Canyon Disposition Initiative" refers to the DOE-sponsored program to help determine the end state for the canyon buildings and to explore their potential as assets to cleanup of the Hanford Site.

The 221-U Facility was built to extract plutonium from fuel rods irradiated in the Hanford Site production reactors. However, the 221-U Facility was never used for this purpose because canyon buildings constructed earlier met the Hanford Site's production goals. Instead, the 221-U Facility was used to train B and T Plant operators until 1952. At that time, it was converted to include a uranium recovery process for waste from other canyon facilities. Process equipment was transferred from other canyon facilities and included remote-handled materials and materials contaminated with transuranic (TRU) isotopes. A cross section of the facility is shown in Figure 3.

The selected remedy in this final ROD includes the following components:

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

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

- Partial removal of contaminated equipment and piping from the gallery side of the facility, as needed to facilitate demolition activities, and disposal of this waste at the Environmental Restoration Disposal Facility (ERDF) located on Hanford's Central Plateau between the 200 West and 200 East Areas or other disposal facilities approved in advance by the U.S. Environmental Protection Agency (EPA);

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

- Consolidation of contaminated equipment on the deck into the below-grade cells for disposal;

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

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

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

- Construction of an engineered barrier over the remnants of the canyon building (with the possible inclusion of inert rubble from the demolition of ancillary facilities as fill material);

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

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

- Post-closure care, including barrier inspection and maintenance; and

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

The reasonably anticipated future land use for the 200 Area is industrial, and the 221-U Facility remedy will result in protection of human health and the environment based on the exposure assumptions contained in the 200 Area industrial use scenario.

The procedures used to implement the multi-year work effort required by this ROD will be outlined and documented in more detail in the RD/RA workplan, a primary document under the Tri-Party Agreement (TPA), subject to EPA and Washington Department of Ecology (Ecology) approval. The draft RD/RA workplan shall be submitted to EPA and Ecology by December 31, 2006. The RD/RA workplan shall contain a detailed plan and schedule, including associated milestones, for implementing this ROD. Once initiated, substantial continuous physical on-site remedial action shall be maintained until all of the cleanup work is completed. The cleanup work shall be coordinated with other cleanup projects in the U Plant area as well as the 200 Area as a whole. The detailed cleanup schedule shall be consistent with the current TPA milestone to complete all 200 Area remedial actions by September 30, 2024 (TPA Milestone M-16-00).

The DOE is responsible for implementing, maintaining, reporting on and enforcing the land use controls required under this ROD. The current implementation, maintenance, and periodic inspection requirements for the institutional controls at Hanford are described in approved workplans and in the Site-wide Institutional Controls Plan for Hanford CERCLA Response Actions that was prepared by DOE and approved by EPA and Ecology in 2002, and includes the commitment to notify EPA and Ecology immediately upon discovery of any activity that is inconsistent with the land use designation of a site.

No later than 180 days after the ROD is signed, DOE shall update the Site-wide Institutional Controls Plan to include the institutional controls required by this ROD and specify the implementation and maintenance actions that will be taken, including periodic inspections. The revised Hanford Site-wide Institutional Controls Plan shall be submitted to EPA and Ecology for review and approval as a TPA primary document. DOE shall comply with the Site-wide Institutional Controls Plan as updated and approved by EPA and Ecology.

1.5 STATUTORY DETERMINATIONS

The selected remedy specified for this final action is protective of human health and the environment; complies with or waives Federal and state requirements that are legally applicable, or are relevant and appropriate to this final action; is cost-effective; and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use and unrestricted exposure, a statutory review shall be conducted within five years after initiation of remedial action to ensure that the remedy is, and will be, protective of human health and the environment.

The preamble to the NCP states that when noncontiguous facilities are reasonably close to one another and wastes at these sites are compatible for a selected treatment or disposal approach, CERCLA Section 104(d)(4) allows the lead agency to treat these related facilities as one site for response purposes and, therefore, allows the lead agency to manage waste transferred between such noncontiguous facilities without having to obtain a permit. The facility addressed by this final action ROD and ERDF are reasonably close to one another, and the wastes are compatible for the selected disposal approach. Therefore, the sites are considered to be a single site for response purposes.

1.6 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary of this ROD. Additional information can be found in the Administrative Record file for this facility (221-U Facility [U Plant] Canyon Disposition Initiative).

- Contaminants of concern (COCs) and their respective concentrations (see Section 2.5.7).
- Baseline risk represented by the COCs (see Section 2.7.2).
- Cleanup levels established for COCs and the basis for the levels (see Section 2.8.1).
- How source materials constituting principal threats are addressed (see Section 2.11).
- Current and reasonably anticipated future land use and current and potential future beneficial uses of groundwater (see Sections 2.6.1 and 2.6.3).
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (see Sections 2.6.2 and 2.6.4).
- Estimated capital, annual operation and maintenance (O&M), and total present value costs; discount rate; and the number of years over which the remedy cost estimates are projected (see Section 2.10.7).
- Key factor(s) that led to selecting the remedy (i.e., describing how the selected remedy provides the best balance of trade-offs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (see Section 2.12.1).

1.7 AUTHORIZING SIGNATURES

Signature sheet for the Record of Decision for the USDOE Hanford 200 Area 221-U Facility Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Keith A. Klein
Manager
Richland Operations Office

9/30/05
Date

Signature sheet for the Record of Decision for the USDOE Hanford 200 Area 221-U Facility Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

for Dan Opalski
Director of Office of Environmental Cleanup, Region 10
United States Environmental Protection Agency

9/30/05
Date

Signature sheet for the Record of Decision for the USDOE Hanford 200 Area 221-U Facility Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Oct 3, 2005

Michael Wilson
Program Manager, Nuclear Waste Program
Washington State Department of Ecology

Date

Part 2: DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

The U.S. Department of Energy's (DOE's) Hanford Site is a 1517-km^2 (586-$mile^2$) Federal Facility located in southeastern Washington along the Columbia River (Figure 1). It is situated north and west of the cities of Richland, Kennewick, and Pasco, an area commonly known as the Tri-Cities. The region includes the incorporated cities of Richland, Pasco, and Kennewick, as well as surrounding communities in Benton, Franklin, and Grant counties. The Hanford Site was established during World War II, as part of the Manhattan Project, to produce plutonium for nuclear weapons. From 1943 to 1990, the primary mission of the Hanford Site was the production of nuclear materials for national defense.

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

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

The 221-U Facility is a large, concrete structure approximately 800 feet long, 70 feet wide and 80 feet high (approximately 30 feet of this height is below grade). The reinforced concrete walls and floor range from approximately 3 to 9 feet thick. One large room extends the entire length with galleries on the other side of a dividing wall from this room. Covered processing cells reside below the deck in the large room. Because the facility has this long, expansive room, it is often referred to as a "canyon building." See Figure 3 for a cross section of the facility.

Figure 1. Hanford Site Location Map.

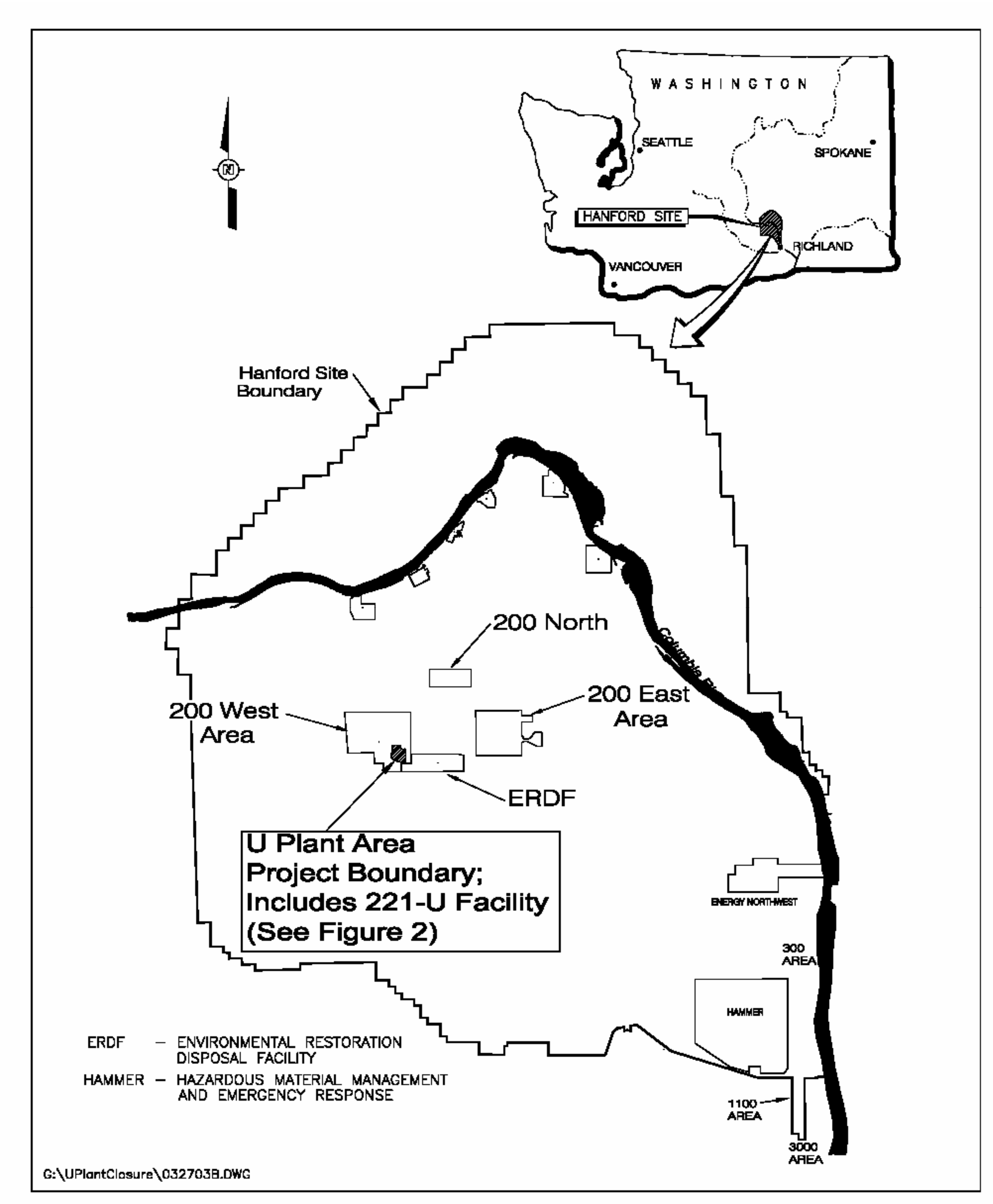


Figure 2. 221-U Facility with Adjacent Waste Sites and Ancillary Facilities.

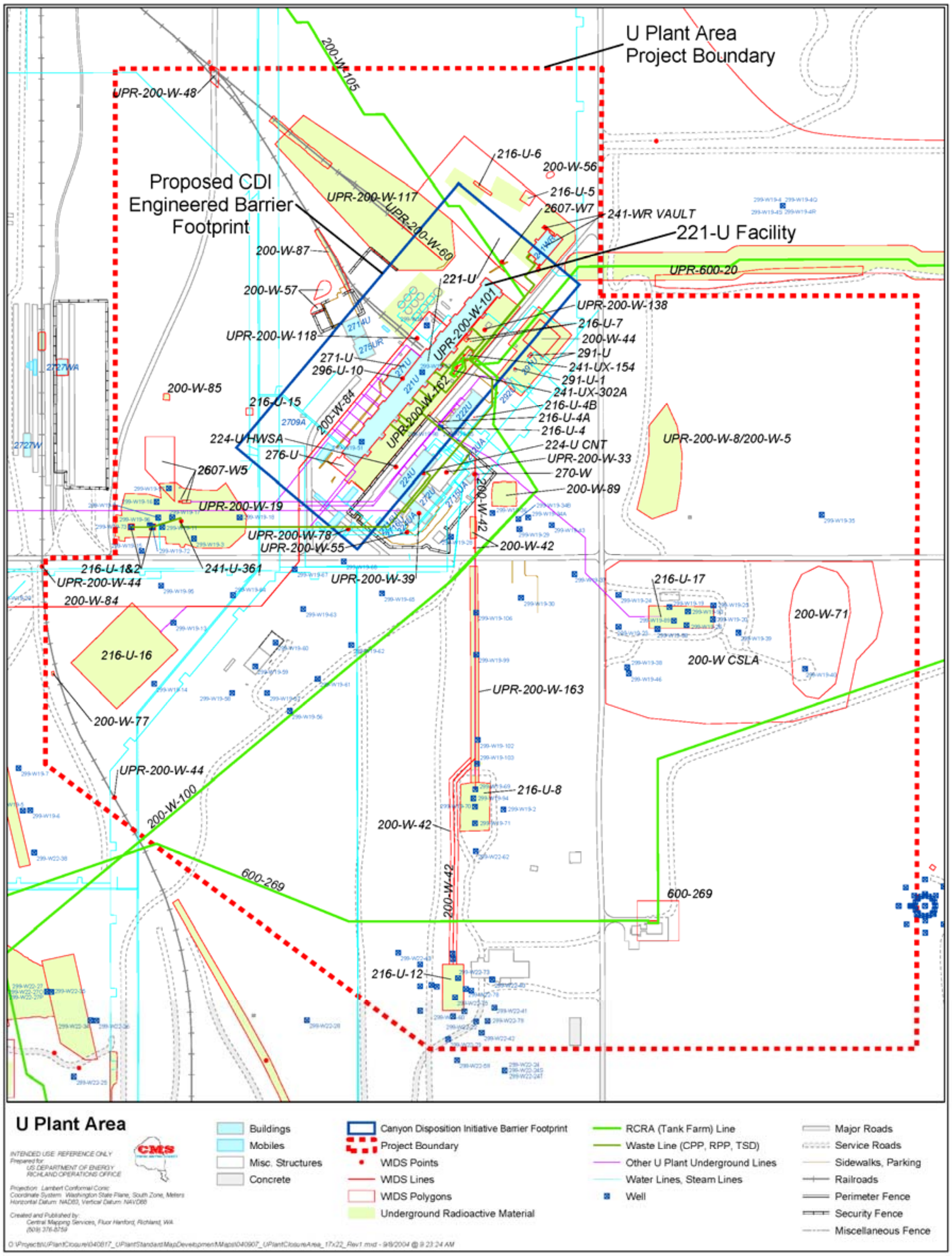
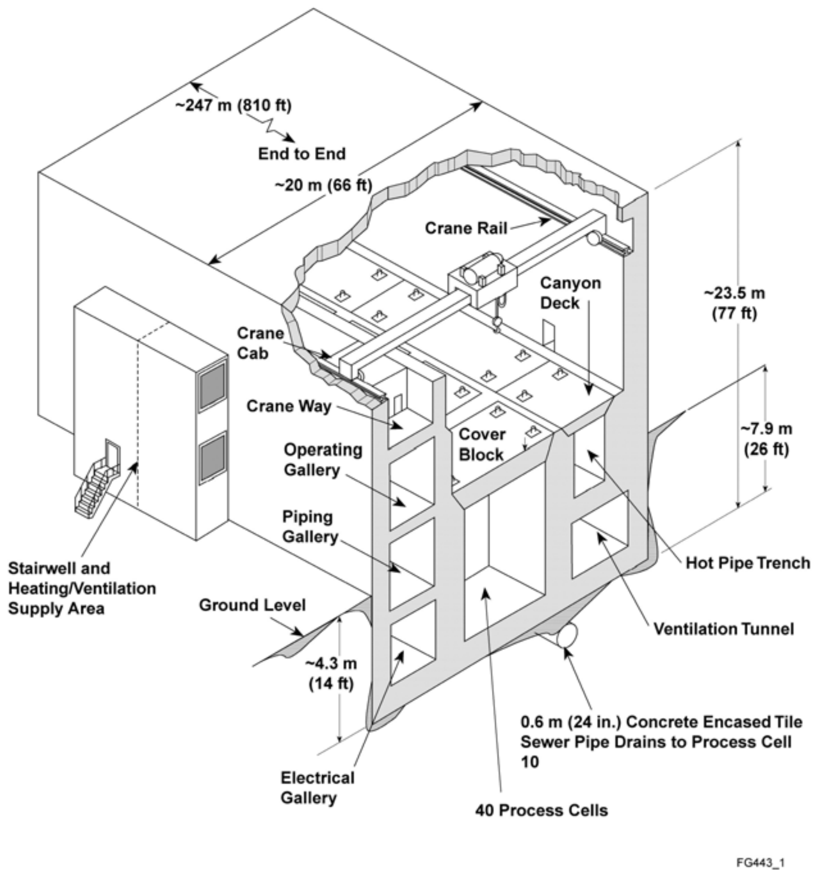


Figure 3. Cross Section of the 221-U Facility.



2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

In July 1989, the 100, 200, 300 and 1100 Areas[1] of the Hanford Site were placed on the National Priorities List (NPL) pursuant to CERCLA. In anticipation of the NPL listing, the DOE, EPA, and Ecology entered into the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement or TPA) in May 1989. This agreement established a procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions at Hanford. The agreement also addresses Resource Conservation and Recovery Act (RCRA) compliance and permitting.

The 200 Area was divided into source operable units that have either a geographic or chemical separation or waste process basis and include various types of soil waste sites, structures, and pipelines. Many facilities are not associated with the soil operable units, but are part of the 200 Area NPL site. The 221-U Facility is a key facility and underwent formal decommissioning activities according to Section 8 of the TPA Action Plan. A key facility is one that warrants special attention to the decommissioning process due to high contamination or substantial complexity.

The 1996 Agreement in Principle (DOE-RL 1996) among the Tri-Parties of DOE, EPA, and Ecology established that the CERCLA Remedial Investigation/Feasibility Study process will be followed, on a case-by-case basis, to evaluate potential cleanup remedies and identify preferred alternatives for the final end state for the five major canyon buildings in the 200 Area of the Hanford Site. The Canyon Disposition Initiative (CDI) is a Tri-Party agency program that resulted from this agreement and is designed to help identify end states for the canyon buildings and evaluate the potential for using the facilities for safe disposal of waste from other Hanford cleanup actions. The 221-U Facility is serving as the pilot for remediation of the four other canyon buildings at Hanford. Other buildings are to be addressed under CERCLA remedial action or under CERCLA non-time critical removal action in accordance with the joint DOE-EPA Policy on Decommissioning Department of Energy Facilities Under CERCLA (DOE and EPA 1995); or under RCRA for Treatment Storage and Disposal (TSD) units or under RCRA past-practice authority; or through the National Environmental Policy Act review process.

The EPA issued a Notice of Violation to DOE (letter from Doug Sherwood of EPA to Keith Klein of DOE dated March 1, 2000) for failing to follow the Sampling and Analysis Plan and for disposing of hazardous waste before sampling it. The incident occurred during the Remedial Investigation of the 221-U Facility. Stipulated penalties totaling $55,000 were assessed for not having a waste control plan in place before the generation of investigation-derived waste and for improperly disposing of 2.5 gallons of tributyl phosphate waste at the Environmental Restoration Disposal Facility (contents based on process knowledge developed after the fact). The waste was the result of the cleanup of liquid that spilled from a pipe on the end of the 221-U building after it was cut to gain access to the ventilation tunnel during characterization activities.

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[1] The 400 and 600 Areas are other Hanford Site areas that were not identified as separate NPL sites. Any waste sites within these areas are addressed under one of the other NPL sites. The 1100 Area was removed from the NPL in 1996.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Tri-Parties developed a Community Relations Plan (CRP) in April 1990 as part of the overall Hanford Site cleanup process. The CRP was designed to promote public awareness of the investigations and public involvement in the decision-making process. The CRP summarizes known concerns based on community interviews. The CRP was updated in 1993 and in 1996 to enhance public involvement.

In a 1996 *Agreement In Principle* (DOE–RL 1996), the Tri-Parties of DOE, Ecology, and EPA established that the CERCLA process will be followed, on a case-by-case basis, to evaluate potential cleanup remedies and identify a preferred alternative for the final end state for the five major canyon buildings in the 200 Area of the Hanford Site. The 221-U Facility was selected as a pilot project for the CDI. Public involvement on the CDI project has consisted of the following:

- In 1997, the Hanford Advisory Board issued a letter from Board chair Merilyn Reeves to the Tri-Party agencies to frame issues for the CDI. After providing initial responses to the letter in 1997, the Tri-Party agencies produced a matrix in 2001 entitled, "Responses to Hanford Advisory Board Canyon Disposition Initiative Issues." The Hanford Advisory Board letter was most recently discussed at the Hanford Advisory Board River and Plateau Committee in December 2004 to provide background on the project prior to the start of public comment on the proposed plan. The matrix is available in the Administrative Record file.

- In 1998, DOE issued the *Phase 1 Focused Feasibility Study for the Canyon Disposition Initiative* for review and comment by the public and stakeholders. A 30-day period was provided for the receipt of comments. The objective of the phase I feasibility study (DOE-RL 1998b) was to provide decision-makers sufficient information on the remedial alternatives specific to the disposition of the 221-U Facility to determine which alternatives were viable for further detailed analysis in a final feasibility study report.

- Following extensive interactions with stakeholders, cooperating agencies (U.S. Department of the Interior; Benton, Franklin, and Grant Counties of Washington State; and the City of Richland, Washington), and consulting Tribal governments (Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, and initially including the Yakama Nation), DOE issued the Hanford Comprehensive Land Use Plan Environmental Impact Statement (DOE/EIS-0222-F) and associated Record of Decision in 1999.

- From 1996 through 2005, the Tri-Parties provided regular formal presentations and updates to the Hanford Advisory Board and associated subcommittees on the progress of the CDI project.

- Funding constraints and prioritization of Hanford cleanup towards a focus on waste sites along the Columbia River placed the project on hold at several points over the 8 years of development, and this affected the frequency of formal updates.

- In 2004, the Tri-Parties issued the *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)* (EPA 2004) for review and comment by the public and stakeholders. The proposed plan summarized the alternatives evaluated for disposition of the 221-U Facility and identified the preferred disposition alternative.

- In 2001 and 2005, the Hanford Communities of Richland, Kennewick, Pasco, West Richland, Benton County, and the Port of Benton broadcast informational videos covering the CDI and the overall vision for closure of the U Plant Area of the Hanford Site. As a part of these videos, the Tri-Parties participated in question and answer sessions with the public.

The proposed plan, along with the *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE-RL-2001-11), which will henceforth be referred to as the "Final Feasibility Study," and other supporting documents are available to the public in both the Administrative Record and the Information Repositories maintained at the locations listed below. An example of a supporting document is the *Phase I Interim Characterization Report for the 221-U Canyon Disposition Initiative* (BHI-01292), which contains a portion of the information from the remedial investigation. The information from the final characterization phase of the remedial investigation is provided in the Final Feasibility Study.

ADMINISTRATIVE RECORD (Contains documents that form the basis for selection of the remedial action)

U.S. Department of Energy
Richland Operations Office
Administrative Record Center
2440 Stevens Center
Richland, Washington 99354

INFORMATION REPOSITORIES (Contain limited documentation)

University of Washington
Suzzallo Library
Government Publications Room
Seattle, Washington 98195

Gonzaga University
Foley Center
E. 502 Boone
Spokane, Washington 99258

Portland State University
Branford Price Millar Library
Science and Engineering Floor
SW Harrison and Park
Portland, Oregon 97207

DOE Richland Public Reading Room
Washington State University, Tri-Cities
Consolidated Information Center, Room 101L
2770 University Drive
Richland, WA 99354

The notice of the availability of the proposed plan and associated documents was published in the *Tri-City Herald* on December 13, 2004. A 50-day public comment period was held from December 13, 2004 to January 31, 2005. All submitted written comments can be found in the Administrative Record. Responses to the public comments received during the public comment period are included in the Responsiveness Summary (Appendix). The comments were considered during the development of this ROD. The Tri-Parties received no requests for a public meeting for the *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)* (EPA 2004).

2.4 SCOPE AND ROLE OF ACTION

Scope and Role of 221-U Facility Within Overall Strategy for Cleaning Up the Hanford Site

As a major processing facility within the 200 Area of Hanford, the disposition of the 221-U Facility plays an important role in the cleanup of Hanford. The most significant contaminant sources at Hanford are associated with the processing activities carried out in the 200 Area, which is situated on a broad plateau in the center of the Hanford Site. The five chemical separation processing facilities (B Plant, PUREX, REDOX, T Plant and U Plant – also known as the 221-U Facility) generated vast quantities of liquid effluent. Waste streams with high levels of contaminants were diverted to large underground tanks in the tank farms in the 200 Area. Waste streams with lower levels of contaminants were diverted to ditches, cribs and trenches as well as ponds located in the 200 Area, some of them outside of the 200 West and East Area fence lines. Over many years of production, there were leaks and unplanned releases to the soil and underlying vadose zone.

Cleanup of the 221-U Facility shall be coordinated with efforts to address surrounding soil waste sites, ancillary structures (such as nearby mobile office trailers, warehouses, and smaller processing facilities), pipelines, and groundwater contamination. For example, the 200-UW-1 (U Plant Waste Sites) operable unit proposed plan, which was issued for public comment in May 2005, identified the potential that the 221-U Facility remedy could be selected as the remedy for several adjacent waste sites if the 221-U Facility remedy resulted in capping those waste sites. The 200-UW-1 ROD will be issued after this ROD. Ancillary structures will be evaluated in multiple decision documents: some will be cleaned up as a part of the 221-U Facility action (the railroad tunnel connected to the facility, above-ground portions of the 291-U-1 Stack, the 291-U Fan Control Building, and the 292-U Stack Monitoring Building), while others will be evaluated under separate CERCLA actions or through the National Environmental Policy Act review process. Pipelines will also be remediated under other

CERCLA actions. U Plant Area waste sites, ancillary structures, and pipelines that could interfere with the 221-U Facility remedy shall be addressed prior to completion of the 221-U Facility remedy under separate actions. Groundwater contamination underlying the U Plant Area will be addressed under the remedial action for the 200-UP-1 groundwater operable unit, and the post-remediation groundwater monitoring needs for U Plant area cleanup actions will be coordinated with the 200-UP-1 groundwater monitoring program. The coordinated approach being taken in the U Plant Area will serve as a pilot for cleanup and closure of the other geographic zones in the 200 Area.

Decommissioning of the 221-U Facility as a key facility was initiated in accordance with Section 8 of the TPA Action Plan. The facility was placed in surveillance and maintenance mode, and the 1996 Agreement in Principle between the Tri-Party agencies set the stage for the CERCLA remedial investigation and feasibility study process. The 1996 Agreement in Principle established the CDI to explore the potential benefits of using the canyon buildings for disposal of cleanup waste from other Hanford waste sites. The 221-U Facility was selected as the pilot as it is the least contaminated facility and allowed for the safest demonstration of characterization and cleanup methods. Besides serving as the pilot for the other Hanford canyon buildings, the 221-U Facility can provide lessons learned for canyons at the Idaho National Engineering Laboratory and Savannah River sites.

The 221-U Facility consists of the 221-U Building (both above- and below-grade portions), the attached 271-U Office Building (including its attached stack, 296-U-10), and the 276-U Feed Tank infrastructure. The railroad tunnel and the above-ground portions of the 291-U-1 Stack, the 291-U Fan Control Building, and the 292-U Stack Monitoring Building will also be addressed by this remedy.

2.5 SITE CHARACTERISTICS

The following sections provide background information for the Hanford Site, the 200 West Area, and the 221-U Facility regarding the following:

- Local geology
- Local hydrogeology
- Meteorology
- Ecology
- Cultural resources
- Nature and extent of contamination at the 221-U Facility.

2.5.1 Local Geology

The Hanford Site lies in a sediment-filled basin on the Columbia Plateau in southeastern Washington. The 200 Area Plateau, which contains the 221-U Facility, is a relatively flat, prominent terrace near the center of the Hanford Site.

Basalt of the Columbia River Basalt Group and a sequence of suprabasalt sediments underlie the area. The suprabasalt sediments are approximately 169 m (555 ft) thick and consist primarily of the Ringold Formation and Hanford formation. Surface elevations around the 221-U Facility range from approximately 215 m (705 ft) above mean sea level on the south end of the facility to 220 m (722 ft) on the north end.

Regional soil in the Hanford Site area is highly permeable. The soil in the 200 West Area is characterized as silty sand and gravelly sand.

2.5.2 Local Hydrogeology

The vadose zone thickness 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 vadose zone is approximately 79 m (260 ft) thick near the 221-U Facility.

Recharge to the unconfined aquifer within the 200 Area occurs from natural and artificial sources. Natural recharge originates from precipitation. Estimates of recharge from precipitation range from 0 to 10 cm/yr (0 to 4 in/yr) and are largely dependent on soil texture and the type and density of vegetation. Artificial recharge occurs when effluent such as cooling water is disposed to the ground. Most sources of artificial recharge have been halted. The artificial recharge that does continue is largely limited to liquid discharges from sanitary sewers; two state-approved land disposal structures; and 140 small-volume, uncontaminated, miscellaneous waste streams. Refurbishing of water lines in the 200 Area to minimize the potential for water leaks that could contribute to artificial recharge is an ongoing activity. In the absence of significant artificial recharge, the potential for recharge from precipitation becomes the primary driving force for any contaminant movement in the vadose zone.

Groundwater beneath the Hanford Site is found in both an upper unconfined aquifer system and in deeper basalt-confined aquifers. The Columbia River is the primary discharge area for both the unconfined and confined aquifers.

Groundwater in the 200 West Area occurs primarily in the Ringold Formation. Near the 221-U Facility, the depth to water measures approximately 79 m (260 ft) and groundwater flow is to the south-southeast. The surface of the water table beneath the 200 West Area is currently declining at a rate of less than 0.5 m/yr (1.6 ft/yr) because the large influx of artificial recharge that created the elevated water table was eliminated when Hanford production ceased.

The natural groundwater quality at the Hanford Site is generally very good. However, groundwater throughout the 200 Area has become contaminated from past fuel reprocessing activities. In the 200 West Area, notable groundwater contaminants include carbon tetrachloride, nitrate, uranium, technetium-99, iodine-129, and tritium. Two pump-and-treat systems currently operate in the 200 West Area to address carbon tetrachloride, uranium, and technetium plumes.

2.5.3 Surface Water

Surface water at the Hanford Site includes the Columbia River (northern and eastern sections), Columbia Riverbank springs, springs on Rattlesnake Mountain, ponds on the Hanford

Site, and water systems directly east and across the Columbia River from the Hanford Site. In addition, the Yakima River flows along a short section of the southern boundary of the Hanford Site. The 200 West Area is about 8 km (5 mi) from the Columbia River.

2.5.4 Meteorology

The Hanford Site is located in a semiarid region characterized by a low annual rainfall of approximately 16 cm/yr (6.3 in/yr). The summer months are typically hot and dry, and winters are moderately cold. Prevailing wind directions near the surface on the Hanford Site's Central Plateau are from the northwest in all months of the year. Winds from the southwest also have a high frequency of occurrence on the Central Plateau. Windblown dust accompanies strong winds on the Hanford Site.

2.5.5 Ecology

Public access to the Hanford Site has been restricted for more than 50 years, and the portion of the site occupied by DOE's nuclear activities is only a small fraction of the total land area. As a result, much of the Hanford Site is relatively undisturbed and ecological resources are abundant. However, the 221-U Facility and surrounding areas have been disturbed by industrial activities and have little vegetative cover.

Vegetation. The Hanford Site has been classified primarily as a shrub-steppe grassland. Washington State considers the pristine shrub-steppe habitat priority habitat because of its relative scarcity in the state and because of its requirement as a nesting/breeding habitat by several state and federal species of concern.

The 200 Area ecology is characterized by sagebrush/cheatgrass or Sandberg's bluegrass communities. The dominant plants on the 200 Area Plateau are big sagebrush, rabbitbrush, cheatgrass, and Sandberg's bluegrass. Although no Hanford Site plant species have been identified from the federal list of threatened and endangered species, eight species of Hanford Site plants are included in the Washington State listing as threatened or endangered. Several sensitive species have been documented on or near the 200 Area, as follows:

- Few-flowered collinsia
- Gray cryptantha
- Piper's daisy
- Palouse milkvetch
- Coyote tobacco.

Animals. Approximately 17 species of amphibians and reptiles, 246 species of birds, and 42 species of mammals have been found at the Hanford Site. No mammals on the federal list of threatened and endangered species are known to occur at the Hanford Site. However, the bald eagle and two species of fish (steelhead and spring-run Chinook salmon) are both on the list and are found on the Hanford Site on a regular basis, though not in the 200 Area.

The Hanford Site is a permanent home for a number of avian species. It is also located on the Pacific Flyway and serves as a resting place for many migratory birds. The shrub and grassland habitat at the Hanford Site provides nesting and foraging for many passerine bird species, including horned larks, western meadowlarks, long-billed curlews, and vesper sparrows. Species that are dependent on undisturbed shrub habitat include the sage sparrow, sage thrasher, and loggerhead shrike. The burrowing owl also nests in the grass-covered uplands. Game birds (hunted off the Hanford Site) include chukar, partridge, California quail, and Chinese ring-necked pheasant. Among the common raptor species that use the Hanford Site's shrub and grassland habitat are the ferruginous hawk, Swainson's hawk, and red-tailed hawk.

The largest mammals at the Hanford Site are the Rocky Mountain elk and mule deer. The elk are found predominantly on the Fitzner-Eberhardt Arid Land Ecology Reserve, but are occasionally observed on the 200 Area Plateau. The mule deer are found throughout the Hanford Site, but are more common along the Columbia River and on the Fitzner-Eberhardt Arid Land Ecology Reserve. Other mammal species include coyotes, badgers, blacktail jackrabbits, ground squirrels, and several species of mice. The Great Basin pocket mouse is the most abundant small mammal. Mammals associated more closely with buildings and facilities include cottontails, house mice, Norway rats, and some bat species.

Wildlife species of concern occurring near the 221-U Facility include burrowing owls, prairie falcons, sage sparrows, and loggerhead shrikes.

2.5.6 Cultural Resources

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

Manhattan Project and Cold War era buildings in the 200 East and 200 West Areas have been evaluated for National Register of Historic Places eligibility under the provisions of the Historic Buildings Programmatic Agreement. Fifty-eight properties have been determined eligible for the National Register as contributing properties within the Hanford Site Manhattan Project and Cold War Era Historic District and recommended for individual documentation. The 221-U Facility (221-U Canyon Building) was determined to be a contributing property within the Historic District, but was not selected for mitigation. Historic artifacts identified within the structure have been documented in photographs and selectively tagged for preservation. The 222-U Laboratory/Office Building and the 241-WR Vault were the only properties selected for mitigation within the 221-U Complex. No items were tagged for removal from these structures; however, photographs were taken, and a narrative description was documented per the Historic District Treatment Plan.

2.5.7 Nature and Extent of Contamination at the 221-U Facility

The 221-U Facility consists of two major sections: (1) the process area (or canyon), which contained the "hot" process equipment and the controlled work zones; and (2) the service area, which housed personnel and equipment necessary for remote operation of the process area. The process area contains widespread contamination at often significant levels, while the service area has substantially lower contamination levels. The predominant contaminants of concern are radionuclides. Radionuclides currently within the 221-U Facility that are considered to be of concern are americium-241; cesium-137; cobalt-60; neptunium-237; plutonium-239/240; strontium-90; and isotopes of europium, thorium, and uranium. Chemical contaminants of concern currently within the facility are antimony, arsenic, barium, cadmium, chromium, lead, mercury, phthalates, polychlorinated biphenyls, selenium, silver, and uranium.

Information regarding the nature and extent of contamination at the 221-U Facility has been derived from several activities. General information concerning residual radioactive contamination was obtained during facility decontamination and reclamation, which occurred from 1958 to 1964. The *Phase I Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE-RL 1998) identified the need for further characterization, so beginning in 1998 the canyon deck surface and equipment were systematically surveyed for radioactive contamination. In addition, smear samples were collected and screened for radionuclides. The results were reported in *Phase I Interim Characterization Report for the 221-U Canyon Disposition Initiative* (Bechtel Hanford Incorporated [BHI] 1999). In 1999, each of the canyon cells was opened and surveyed and the information was used to determine the optimum locations for collecting concrete core samples. These samples were analyzed for both radioactive and nonradioactive constituents. In addition, sludge samples were collected from the process sewer, selected process tanks, and electrical gallery. The analytical results for the concrete and sludge samples were reported in *Final Data Report for the 221-U Facility Characterization* (BHI-01565). Key results from these characterization activities were as follows:

- Radiation surveys of the canyon deck surface and equipment indicated high levels of beta contamination (up to 45,000 mRad/hr), low levels of alpha contamination (<10,000 dpm), and low levels of gamma radiation (<100 mrem/hr) (BHI 1997a). Concrete samples from the canyon deck and railroad tunnel showed the principal radionuclides to be fission products that include strontium-89/90 and cesium-137. The next-most-abundant radionuclides are plutonium-239/240 and americium-241. No significant levels of chemical contaminants were detected on the canyon deck and in the railroad tunnel.

- Liquid in the process tank on the canyon deck above cell 24 was determined to contain high concentrations of kerosene, phenol, potassium, and nitrate. The principal radionuclides detected were strontium-89/90 and cesium-137. The next-most-abundant radionuclides include plutonium-239 and plutonium-240. The estimated transuranic concentration in the liquid in this tank is less than 100 nCi/g.

- Liquid in the process tank in cell 30 contains relatively high concentrations of nitrate and radionuclides (millicurie levels). The principal radionuclides present are strontium-89/90 and cesium-137. The estimated concentrations of plutonium-239/240 and americium-241 in the liquid sample exceed 100 nCi/g.

- The drain line under the 221-U Facility has dose rates ranging from approximately 1 mrem/hr to 2,400 mrem/hr in one location, with overall dose rates about 100 mrem/hr. A sample collected in the south section of the pipeline contained transuranic radionuclide activity that is slightly greater than 100 nCi/g. This sample also contained elevated levels of chromium, lead, and polychlorinated biphenyls (PCBs). A sample collected from the north section contained elevated levels of mercury and phthalates.

- Concrete samples were collected from process cells 5, 6, 26, and 36, and the principal radionuclides detected were strontium-89/90 and cesium-137. The next-most-abundant radionuclides include plutonium-239/240 and americium-241. Heavy metals were detected in several of the samples. The estimated total concentration of transuranic isotopes in the samples was less than 100 nCi/g.

- A composite sludge sample and a duplicate sample were collected to characterize the electrical gallery sumps. No significant levels of radionuclides or toxic characteristic leachate procedure (TCLP) metals were detected in the samples. PCBs were detected, ranging from 7.7 to 9.1 ppm (mg/kg).

- Samples collected from the liquid contained in tank 5-6, located in process cell 10, indicate that the liquid contains dissolved inorganic materials, including sodium, potassium, nitrate, and sulfate. The liquid also contains strontium-89/90 and cesium-137 and relatively high concentrations of uranium isotopes. Sludge collected from tank 5-6 contains high concentrations of metals and radionuclides. The sludge also contains relatively high concentrations of cobalt-60, strontium-89/90, cesium-137, and uranium isotopes. The estimated total concentrations of plutonium-239/240 and americium-241 in the liquid and associated sludge are less than 100 nCi/g.

Table 1 lists the contaminants of concern and concentrations used in the baseline risk assessment, which represent the 95% upper confidence limit. These concentrations typically reflect the concentrations detected in the liquid and sludge heels contained in tanks in the 221-U Facility.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

To identify appropriate cleanup objectives, the future land use of a site must be considered. Current and future land uses of the 200 Area are discussed in the following sections.

Table 1. Characterization of 221-U Facility Contaminants.

Contaminant	95% UCL of Contaminant Concentrations[a]
Nonradionuclides	
Antimony	2.96 +/– 0.14 mg/kg
Arsenic	50.3 +/– 23.3 mg/kg
Barium	387 +/– 196 mg/kg
Cadmium	5.54 +/– 0.33 mg/kg
Chromium	2,100 +/– 349 mg/kg
Lead	1,140 +/– 125 mg/kg
Mercury	1,190 +/– 117 mg/kg
Selenium	0.225 +/– 0.053 mg/kg
Silver	24.7 +/– 1.9 mg/kg
Uranium	8,260 +/– 1,400 mg/kg
Radionuclides	
Americium–241	$6.4 \times 10^{+6}$ +/– $3.1 \times 10^{+6}$ pCi/g
Cesium–137	$2.4 \times 10^{+8}$ +/– $0.4 \times 10^{+8}$ pCi/g
Cobalt–60	$9.4 \times 10^{+3}$ +/– $1.4 \times 10^{+3}$ pCi/g
Europium–154	$3.3 \times 10^{+5}$ +/– $0.9 \times 10^{+5}$ pCi/g
Neptunium–237	$7.1 \times 10^{+4}$ +/– $4.6 \times 10^{+4}$ pCi/g
Plutonium–238	$5.4 \times 10^{+2}$ +/– $0.8 \times 10^{+2}$ pCi/g
Plutonium–239	$1.4 \times 10^{+7}$ +/– $0.3 \times 10^{+7}$ pCi/g
Plutonium–240	$3.3 \times 10^{+6}$ +/– $0.6 \times 10^{+6}$ pCi/g
Strontium–90	$2.3 \times 10^{+8}$ +/– $0.6 \times 10^{+8}$ pCi/g
Thorium–230	$1.1 \times 10^{+1}$ +/– $0.2 \times 10^{+1}$ pCi/g
Uranium–234	$6.1 \times 10^{+3}$ +/– $2.2 \times 10^{+3}$ pCi/g
Uranium–235	$6.0 \times 10^{+2}$ +/– $3.6 \times 10^{+2}$ pCi/g
Uranium–238	$4.0 \times 10^{+3}$ +/– $1.1 \times 10^{+3}$ pCi/g

[a] 95% upper confidence limit (UCL) values for individual contaminants are calculated as described in *Statistical Guidance for Ecology Site Managers,* Ecology Pub. #92–54, Washington Department of Ecology, Olympia, Washington. They were used to calculate risks as described in Appendix A of the feasibility study.

UCL = upper confidence limit

2.6.1 Current Land Use

All current land use activities associated with the 200 Area are under federal control and are industrial in nature. The facilities located in the Central Plateau were built to process irradiated fuel from the plutonium production reactors in the 100 Area. Most of the facilities directly associated with fuel reprocessing are now inactive and awaiting final disposition. The Plutonium Finishing Plant has encapsulated and is currently storing plutonium. Several waste management facilities operate in the 200 Area, including permanent waste disposal facilities such as the ERDF, low-level radioactive waste burial grounds, and a RCRA-permitted mixed waste trench. Construction of tank waste treatment facilities in the 200 Area has begun and vitrified low-activity tank wastes will be disposed in the 200 Area. Past-practice disposal sites in the 200 Area are being evaluated for remediation and are likely to include institutional controls (e.g., administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land and resource use) as part of the selected remedy. Other federal agencies, such as the Department of the Navy also use the Hanford Site's 200 Area nuclear waste treatment, storage, or disposal facilities. A commercial low-level radioactive waste disposal facility run by US Ecology, Inc., currently operates on a portion of a tract in the 200 Area leased to the State of Washington.

2.6.2 Reasonably Anticipated Future Land Use

The reasonably anticipated future land use for the 200 Area is continued industrial-exclusive activities for at least 50 years and industrial (non-DOE-worker) after that.

The DOE worked for several years with cooperating agencies and stakeholders to define land use goals for the Hanford Site and develop future land use plans. The cooperating agencies and stakeholders included the National Park Service, Tribes, states of Washington and Oregon, local county and city governments, economic and business development interests, environmental groups, and agricultural interests. A 1992 report entitled, *"The Future For Hanford: Uses and Cleanup – The Final Report of the Hanford Future Site Uses Working Group"* was an early product of efforts to develop land use assumptions. The report acknowledged a recognition that the 200 Area would be used to some degree for waste management activities for the foreseeable future. These efforts culminated in the Hanford Comprehensive Land Use Plan Environmental Impact Statement (HCP EIS) and associated ROD, which were issued by DOE in 1999. The HCP EIS analyzes the potential environmental impacts of alternative land use plans for the Hanford Site and considers the land use implication of ongoing and proposed activities. Under the preferred land use alternative selected in the ROD, the Central Plateau was designated for industrial-exclusive use, defined as areas suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes, and related activities. In contrast, the HCP-EIS defines industrial use as areas suitable and desirable for activities such as reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations, and related activities.

In response to the HCP EIS, the Hanford Advisory Board (HAB) issued HAB Advice #132. The Board acknowledged that some waste within acceptable levels will remain in the industrial-exclusive use core zone of the Central Plateau when cleanup is complete. The goal identified within the HAB advice is that the core zone be as small as possible and not include contaminated areas outside the Central Plateau fenced areas. The advice further stated that waste within the core zone should be stored and managed to make it inaccessible to inadvertent intruding humans and biota and that DOE should maximize the potential for any beneficial use of the accessible areas of the core zone. The HAB advised that risk scenarios for the waste management areas of the core zone should include a reasonable maximum exposure to a worker/day user and to an intruder.

In response to the HAB advice, and for the purposes of the 221-U Facility remedial action, the Tri-Parties have agreed to assume the following reasonably expected future land use for the 200 Area. It will continue to be designated industrial-exclusive for at least 50 years and will be used for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Following that, the 200 Area is anticipated to be industrial (non-DOE-worker). Starting at least 100 years after active waste management (roughly 150 years from present) the potential for inadvertent intrusion into subsurface waste increases as knowledge of hazards may not be as widely held.

2.6.3 Current Ground/Surface Water Uses

Groundwater in the 200 Area is currently contaminated and is not withdrawn for beneficial uses.

The Columbia River is the second-largest river in the contiguous United States in terms of total flow and is the dominant surface-water body on the Hanford Site. The Columbia River is the principal source of drinking water for the Tri-Cities and the Hanford Site. Regionally, it is also used extensively for irrigation and for recreation, which includes fishing, hunting, boating, water skiing, diving, and swimming.

2.6.4 Potential Future Ground/Surface Water Uses

Washington State cleanup regulations define groundwater that is a “potential future source of drinking water” based on yield, natural quality, and pumpability (*Washington Administrative Code* [WAC] 173-340-720[2]). Based on these technical standards, groundwater underlying the 200 Area may be considered a potential future drinking water source. In addition, groundwater underlying the 200 Area is hydraulically connected to groundwater systems that are currently used for drinking water and irrigation and ultimately discharges to the Columbia River. In accordance with the National Contingency Plan, the goal is to restore the groundwater at Hanford to maximum beneficial uses, if practicable. This Record of Decision requires that any contaminant migration from the 221-U Facility result in no further degradation of groundwater or surface water. Given the local hydrogeology at the 221-U Facility (discussed in Section 2.5.2 of this Record of Decision), protection of the groundwater from the contaminants in the facility will, by design, also result in protection of the Columbia River.

It is anticipated that current uses of the Columbia River will continue in the future.

2.7 SUMMARY OF SITE RISKS

This section describes potential pathways for exposure to contaminants in the 221-U Facility and summarizes the risks the site poses if no action were taken. In the Superfund process, potential risks to human health and the environment are evaluated to determine whether significant risks exist due to site contaminants. A conceptual site model was developed for the 221-U Facility, and potential risks to human health and ecological receptors were evaluated using the data collected during facility sampling.

2.7.1 Conceptual Site Model

Contamination at the 221-U Facility poses the potential for increased risk to future site users and ecological receptors as the facility ages and deteriorates. The level of potential human health risk posed by the facility depends on the anticipated land use. Two exposure scenarios were evaluated for the 221-U Facility: an industrial scenario and an inadvertent intruder scenario.

The conceptual industrial exposure model for potential human exposure to 221-U Facility contamination assumes a continued industrial land use for the facility. For conservatism, the model further assumes that none of the current health and safety controls (e.g., access limitations, shielding, and exposure monitoring) are enforced, no demolition or decontamination activities are completed, and the entire 221-U Facility is used by industrial workers who have no knowledge of the facility history or risks. Under these completely uncontrolled conditions, the workers (members of the general public that are not trained radiological workers) would have access to all areas within the facility, and exposure to radioactive and chemical contamination could occur through external exposure, dermal contact, inhalation, and ingestion. This baseline conceptual exposure model assumes minimal potential for environmental exposure (extensive paved/covered areas and operational disturbances would limit biota use).

The conceptual inadvertent intruder exposure model assumes the loss of institutional controls and resulting exposure to “inadvertent intruders” (people and biota) who may freely access the area. The model assumes that intruders could obtain access to the area, bring contaminated material to the surface by trenching or drilling, and be exposed to the material in a residential scenario. Because of the exposure pathways and exposure times of the trenching, drilling, and residential scenarios, the reasonable maximum exposure (RME) for an inadvertent intruder occurs in the residential scenario. The inadvertent intruders are assumed to live on or adjacent to the 221-U Facility and to raise and consume their own crops and livestock. The inadvertent intruders also drink groundwater from a well located adjacent to the 221-U Facility and use this water to irrigate their crops and water their livestock.

The primary exposure routes for ecological receptors at the 221-U Facility include direct exposure to radiation and ingestion or inhalation of particulate released from the facility if present containment structures fail; plant uptake of contaminants released from the facility through physical/biological processes; and consumption of contaminated plants and animals by various animal species. Plant exposure is a function of the species, root depth, physical nature of the contamination, and concentration/distribution of contaminants in the soil.

2.7.2 Human Health Risk

Two types of potential human health effects due to contact with site contaminants are evaluated at Superfund sites: an increase in cancer risk, and non-carcinogenic health risks. The potential increase in cancer risk is expressed exponentially in numbers such as 1×10^{-4}, 1×10^{-5}, 1×10^{-6} (one in ten thousand, one in one hundred thousand, one in a million, respectively). The chance of an individual developing cancer during his or her lifetime from all other (non-site-related) causes is approximately 3,500 people in a population of 10,000. One additional extra cancer in a population of 10,000 may be expected to occur as a result of exposure to site contaminants at a 1×10^{-4} increased cancer risk. For the second type of potential human health effect, non-carcinogenic health impacts, a hazard index is calculated. A hazard index less than 1.0 does not pose a potential adverse health risk.

Estimates of the potential increased cancer risk to human receptors from radionuclides were calculated using the RESidual RADioactivity (RESRAD) dose assessment model. Human non-carcinogenic health risks due to chemical contaminants were evaluated using the equations presented in the *Hanford Site Risk Assessment Methodology* (HSRAM). The input parameters for the RESRAD model and the HSRAM equations are presented in the 221-U Facility Final Feasibility Study. The maximum baseline risk for the 221-U Facility is associated with the industrial scenario. The industrial scenario makes the following key assumptions:

- Adult workers are the potential receptor.
- There will be industrial-exclusive use for the next 50 years (through 2055) and industrial land use (non-DOE worker) for at least 100 years after that.
- Direct exposure of onsite workers to residual contamination to a depth of 4.6 m (15 ft) is presumed to occur.
- The period of analysis for evaluation of site risks and groundwater protection is 1000 years.
- The exposure pathways for calculating risks from radionuclides are: 1) direct exposure to radiation; 2) ingestion of soil containing residual contamination; and 3) inhalation of particles in the air from residual contamination.

The assessment of risk was based on EPA's standard exposure assumptions. The cancer slope factors and reference doses were taken from Health Effects Assessment Summary Tables (HEAST – EPA/540/R-97/036, EPA Office of Emergency and Remedial Response, 1997).

The baseline (with no cleanup) risk assessment results show that the contaminants at the 221-U Facility that have the highest contribution to potential increased human health risks include various radionuclides (americium-241, cesium-137, cobalt-60, europium-154, neptunium-237, plutonium-239/240, strontium-90, and uranium isotopes) and heavy metals (lead, mercury, and uranium). The total incremental cancer risk (ICR) of the radionuclides at concentrations measured at the 221-U Facility is greater than 10^{-2}. Concentrations and baseline risk ranges are presented in Table 2. The baseline risk assessment demonstrates that the risk associated with the industrial scenario justifies proceeding with a remedial action.

2.7.3 Ecological Risk

The area immediately surrounding the 221-U Facility is highly disturbed by past industrial and waste management operations. As a result, the area lacks habitat suitable for establishment of ecological communities and food webs with a hierarchy of terrestrial receptors. In addition, there is little likelihood of ecological exposure to 221-U Facility contaminants via intrusion or releases at the present time. However, if remedial action is not implemented, the possibility of exposure will increase over time because the likelihood of breaching of the present containment increases as the facility ages and deteriorates.

The revised *Model Toxics Control Act* (MTCA) (Ecology, amended February 12, 2001) provides cleanup standards for the protection of terrestrial plants and animals. Simplified terrestrial ecological evaluation procedures are provided in WAC 173-340-7492 to identify sites that do not have a substantial potential for posing a threat of significant adverse effects to terrestrial ecological receptors. Priority chemicals of ecological concern and their soil cleanup levels for industrial sites are listed in Table 749-2, WAC 173-340-900. These soil cleanup levels were used in the Final Feasibility Study to develop preliminary remediation goals for ecological protection.

2.7.4 Uncertainties in Risk Assessment

Uncertainties with the exact nature of future industrial and inadvertent intruder exposures may lead to under- or overestimation of human health risk. Another significant source of uncertainty is the limited sampling data. Because the investigation and sampling focused on the most highly radioactive wastes in the facility and the risk assessment assumed that these wastes were present throughout the facility, the risk assessment is more likely to overestimate the potential human health risk.

2.7.5 Basis for Action

The baseline risks of most of the 221-U Facility constituents presented in Table 2 are greater than acceptable cancer risk levels (greater than the excess cancer risk range of 1×10^{-6} to 1×10^{-4}) and, for systemic toxicants, above acceptable exposure levels which the human population, including sensitive subgroups, may be exposed without adverse effect; therefore, remedial action is necessary. Materials contaminated by these constituents include concrete, metallic waste,

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

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

[a] 95% upper confidence limit (UCL) values for individual contaminants are calculated as described in *Statistical Guidance for Ecology Site Managers*, Ecology Pub. #92–54, Washington Department of Ecology, Olympia, Washington. They were used to calculate risks as described in Appendix A of the feasibility study.

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

[c] Calculation of risk indices is not applicable to lead because lead is a neurotoxin with soil cleanup levels defined by the EPA's *Integrated Exposure Uptake Biokinetic Model for Lead in Children* available on the internet at http://www.epa.gov/superfund/programs/lead/products/htm

> = greater than
HI = hazard index
HQ = hazard quotient = sum of hazard indices
ICR = incremental cancer risk
UCL = upper confidence limit

containerized materials, and miscellaneous debris currently contained within the structure of the 221-U Facility. As the structure degrades with time, the risk of chemical or radiological release from the 221-U Facility increases. Decreased structural stability would increase the potential for contaminant release due to man-made and natural disasters (e.g., earthquake). Additionally, infiltration of precipitation into the facility would eventually release contamination to the environment and potentially expose humans and biota to contaminants at the surface through direct exposure and through uptake of contaminated groundwater. Past releases from associated pipelines and waste sites are addressed under other U Plant Area response actions.

The response action selected in this final Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) for the 221-U Facility were developed based on protection of human health given the reasonably anticipated future land use and the conceptual site model, protection of the environment, protection of groundwater as a potential future drinking water source, protection of the Columbia River, applicable or relevant and appropriate requirements (ARARs), and worker safety. The RAOs developed for the 221-U Facility are designed to be consistent with those developed for other components of the U Plant Area cleanup. They are as follows:

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

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

RAO 3: Prevent the migration of contaminants to surface water and through the soil column to groundwater such that no further degradation of groundwater occurs due to leaching from the 221-U Facility.[2]

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

2.8.1 Cleanup Levels for the 221-U Facility

Based on historical 200 Area operations and characterization information, a comprehensive list of potential contaminants was identified for the 221-U Facility. An initial set of contaminant-specific cleanup levels was developed to define the specific cleanup goals that

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

will result in achievement of the remedial action objectives. The initial cleanup levels, known as preliminary remediation goals, were developed independently for each contaminant of concern for each of the three human health pathways of concern (direct contact/direct exposure under an industrial exposure scenario, protection of groundwater, and protection of the Columbia River) and for ecological protection. For mobile contaminants, the most restrictive cleanup level from among the four was selected. For contaminants that are not mobile, and hence do not pose a threat to groundwater or the Columbia River, the most restrictive cleanup level between direct contact/direct exposure (human health) and ecological protection was selected. The preliminary remediation goals are presented in Table 3. These preliminary remediation goals would not apply as remediation goals to remedies that would contain the contaminants rather than remove and/or treat them.

A complete discussion of the technical approach used to develop these cleanup levels can be found in Appendix B of the 221-U Facility Final Feasibility Study.

2.8.2 Justification for Use of Industrial Cleanup Standards

A number of key factors support the Tri-Parties determination that it is appropriate to use industrial cleanup standards for the 221-U Facility. These include:

- The reasonably anticipated future land use is industrial pursuant to EPA policy and guidance (see discussion in Section 2.6)

- The area meets the criteria of "traditional industrial use," as provided in WAC 173-340-745, because it has the following characteristics:

  a) Humans do not live on the site, and the reasonable maximum exposure scenario is based on an adult employee located on an industrial property;

  b) Access to the property by the general public is generally not allowed. When permitted, it is highly limited and controlled.

  c) Food is not grown or raised on the property.

  d) Industrial operations generally involve the storage of chemicals, as well as noise, odors, and truck traffic.

  e) Industrial properties are generally covered by buildings and structures, paved parking lots, paved access roads and material storage areas, and other surface barriers to contaminated soil and debris.

  f) Industrial properties generally contain support facilities that are intended to serve the industrial facility employees and not the general public.

Table 3. Summary of Preliminary Remediation Goals for All Pathways.

Nonradionuclides					
Constituent	**Overall Most Restrictive PRG [a, b] (mg/kg)**	**Driver for Most Restrictive PRG**	**Constituent**	**Overall Most Restrictive PRG [a, b] (mg/kg)**	**Driver for Most Restrictive PRG**
Antimony	5.4	Groundwater Protection	Nitrate	40	Groundwater Protection
Arsenic	20	Terrestrial Wildlife Protection	Nitrite	4	Groundwater Protection
Beryllium	31.6	River Protection	Petroleum hydrocarbons	2,000	Groundwater Protection
Cadmium	0.81	Background	Phthalates	8.01	River Protection
Chromium (III)	135	Terrestrial Wildlife Protection	Polycyclic aromatic hydrocarbons	0.040	River Protection
Chromium (VI)	3.85	River Protection	Polychlorinated biphenyls	0.0021	River Protection
Fluoride	16	Groundwater Protection	Sulfate	1,000	Groundwater Protection
Lead	220	Terrestrial Wildlife Protection	Uranium	3.21	Background
Mercury	0.33	Background	--	--	--
Radionuclides [c]					
Constituent	**Overall Most Restrictive PRG [a] (pCi/g)**	**Driver for Most Restrictive PRG**	**Constituent**	**Overall Most Restrictive PRG [a] (pCi/g)**	**Driver for Most Restrictive PRG**
Americium–241	335	Direct Exposure	Plutonium–239/240	425	Direct Exposure
Carbon–14	14.9	Groundwater Protection	Strontium–90	2410	Direct Exposure
Cesium–137	23.4	Direct Exposure	Technetium–99	6.16	Groundwater Protection
Cobalt–60	4.90	Direct Exposure	Thorium–228	7.73	Direct Exposure
Europium–152	11.4	Direct Exposure	Thorium–232	4.80	Direct Exposure
Europium–154	10.3	Direct Exposure	Tritium (H–3)	150	Groundwater Protection
Europium–155	426	Direct Exposure	Uranium (total)	2.27	Direct Exposure
Neptunium–237	59.2	Direct Exposure	--	--	--

[a]Listed values represent the most restrictive soil PRG derived from evaluation of direct contact, groundwater protection, Columbia River protection, and terrestrial wildlife protection per the feasibility study.

[b]For contaminants where groundwater or river protection is the driver for the most restrictive PRG, and excluding petroleum hydrocarbons, this value was derived using the Model Toxics Control Act (MTCA) fixed parameter three-phase partitioning model. MTCA (WAC 173-340) allows a variety of methods to be used to establish soil concentrations that will be protective of the groundwater, including using site-specific data in the three-phase model and alternative fate and transport models. Any of these methods may be used if this cleanup level is a critical factor in remedy decisions.

[c]Background for cadmium is based on Ecology, 1994, “Natural Background Soil Metals Concentrations in Washington State,” Publication #94-115, Washington State Department of Ecology, Olympia, WA. Background for mercury is based on DOE-RL, 1995, “Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes,” DOE/RL-92-24, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, WA. Background for uranium is based on DOE-RL, 1996, “Hanford Site Background: Part 2, Soil Background for Radioactive Analytes,” DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, WA.

pCi/g = picocuries per gram.

- Institutional controls are required as part of the selected remedy to protect the remedy and ensure that the potential for human exposure to contaminants is minimized by limiting land and resource use to industrial uses. Institutional controls are specified in Section 2.12.2.3 of this ROD. The land use restrictions required as part of this ROD must be enforceable and must continue, independent of who the property owner is (e.g., proprietary controls such as property easements and covenants).

- Hazardous substances remaining at the site after the remedial action will not pose an unacceptable risk to human health or the environment at the site or in adjacent areas. A remedial action closeout report and continued environmental monitoring (also required as part of the selected remedy) will gather the data necessary to evaluate and verify that the remedy remains effective.

The effectiveness of the remedy in protecting human health and the environment shall be reviewed no less often than every 5 years and documented in Five-Year Review reports.

2.9 DESCRIPTION OF ALTERNATIVES

Remedial alternatives/technologies were identified and evaluated in the CDI phase I feasibility study based on their effectiveness in reducing potential risks to human health and the environment from the 221-U Facility. Collective experience gained from previous studies and evaluation of cleanup methods at the Hanford Site was used to identify technologies that would be carried forward as remedial alternatives to address the 221-U Facility RAOs. Seven remedial alternatives were considered in the preliminary analysis. The seven alternatives were as follows:

- No Action (Alternative 0)
- Full Removal and Disposal (Alternative 1)
- Decontaminate and Leave in Place (Alternative 2)
- Entombment with Internal Waste Disposal (Alternative 3)
- Entombment with Internal/External Waste Disposal (Alternative 4)
- Close in Place - Standing Structure (Alternative 5)
- Close in Place - Partially Demolish Structure (Alternative 6)

Under Alternative 2, contaminated equipment already present in the structure would be left in place. Although Alternative 2 reduces the contamination and waste inventories at the facility site by decontamination, it is not a permanent remedy; long-term surveillance and maintenance plus eventual facility demolition and disposal would still be necessary. Hazardous substances left in place still pose a potential threat to human health and the environment over the long term. Therefore, this alternative was not recommended for further study. Alternative 5 is generally the same as Alternative 3, except that uncontaminated fill materials (e.g., clean soil and/or grout) would be used to fill internal void spaces. Its similarity to Alternative 3 makes it almost redundant, except that Alternative 5 essentially would provide containment for mostly uncontaminated fill, which does not make effective use of limited resources. Therefore, Alternative 5 was also not recommended for further study.

The remaining five alternatives were carried forward into the detailed and comparative analyses. Alternative 0 provides a baseline for these evaluations. Alternatives 1, 3, 4, and 6 represent a range of potentially viable alternatives for meeting the RAOs. These four alternatives share “common elements” including institutional control; and for Alternatives 3, 4 and 6, an engineered barrier (to cover the building structure to reduce water infiltration and the risk of human and biotic intrusion), and post-closure barrier performance monitoring. In addition, Alternatives 3, 4, and 6 include post-remediation monitoring of groundwater. The common elements for the 221-U Facility remedial action alternatives are summarized in Table 4.

The footprint of the engineered barrier could be adjusted slightly for Alternatives 3, 4, or 6 to accommodate requirements for the remediation of nearby facilities, waste sites, and pipelines, as necessary. For example, coverage by the 221-U Facility engineered barrier also could be the preferred remedy for some facilities, waste sites or pipelines as part of other ongoing CERCLA actions in the U Plant Area. (For more detail, see the 200-UW-1 Feasibility Study and Proposed Plan – DOE-RL-2003-23 and DOE-RL-2003-24, respectively.) The main components of an engineered barrier are illustrated in Figure 4. The specific engineered barrier design and layout would be developed during remedial design. For example, the portion of the engineered barrier designed to limit water infiltration (shown in Figure 4 as the narrow section at the top of the barrier with diagonal shading and plants on top) may consist of one layer, or alternatively, of multiple layers incorporating a capillary break feature.

For Alternatives 1, 3, 4, and 6, wastes that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) would be removed and dispositioned prior to stabilization in accordance with an approved RD/RA workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste would be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, in accordance with an approved workplan and schedule no later than September 30, 2024. Additional TRU wastes discovered during remedial activities would be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site no later than September 30, 2024.

Figure 4. 221-U Facility Engineered Barrier Components.

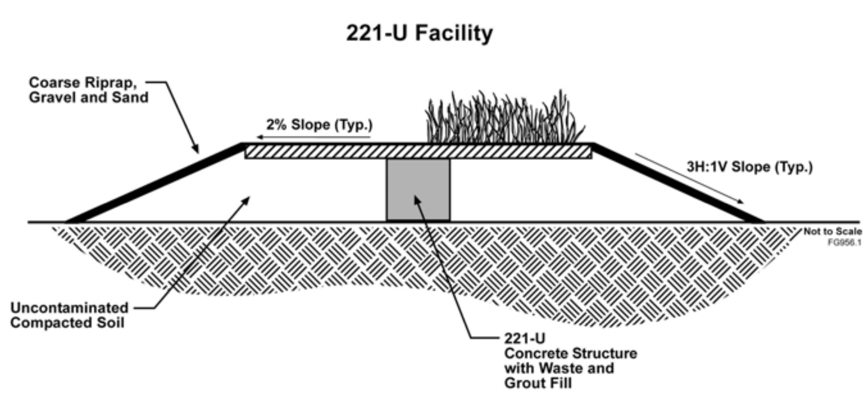


Table 4. Common Elements of the Active Remedial Alternatives for the 221-U Facility.

Element	Description
Remedial Activity	All alternatives would require common steps to: • stabilize and disposition identified transuranic material; • upgrade and maintain the existing roof cover; as necessary, • grout the concrete-encased cell drain header and ventilation tunnel (Alternatives 3, 4, and 6 only); • size reduce and dismantle equipment currently on the canyon deck; • stabilize or remove contamination on the canyon walls, floor, roof, cells, hot pipe trench, and equipment (Alternative 1 may not require stabilization of contamination prior to disposal); • decontaminate the outer 22.9 m (75 ft) of the railroad tunnel and wing walls; • demolish the 276-U Solvent Recovery Facility, the 271-U Office Building, and front and rear stairs of the 221-U Building • install an engineered barrier for the containment response actions (Alternatives 3, 4, and 6).
Institutional Controls	Institutional controls are an integral part of the active response actions. These controls would be required during implementation of any active alternative. The controls would also be required after implementation of any active alternative (unless Alternative 1 results in complete source removal to unrestricted levels) to ensure that future land use remains consistent with the industrial scenario. For containment alternatives (Alternatives 3, 4, and 6), more robust institutional controls would be required to ensure, among other things, that engineered barriers are protected from breach or degradation due to incompatible use of the site. Unintentional trespassing would be precluded, and access to the site would be limited and controlled. Legal restrictions on the use of land and groundwater would be imposed (e.g., prohibit irrigation and well drilling).
Monitoring	This remedial action component is a common element for Alternatives 3, 4, and 6. Alternative 1 relies upon the 200-UP-1 groundwater operable unit and the U Plant Area project for post-remediation groundwater monitoring. For Alternatives 3, 4, and 6, performance monitoring of the barrier would be conducted, thereby allowing various appropriate mitigative measures/best management practices to be implemented, if necessary, to mitigate or prevent percolating water from reaching the underlying waste (e.g. thickening of barrier, runon/runoff water flow controls). The final design of the engineered barrier would provide the specific details on engineered features to accomplish any performance monitoring. Post-remediation groundwater monitoring for Alternatives 3, 4, and 6 includes upgradient and downgradient groundwater wells. Key elements of groundwater monitoring activities include maintenance of all groundwater monitoring wells, periodic replacement of monitoring wells, periodic groundwater monitoring, and annual reporting. The specific monitoring system design would be established as part of the RD/RA workplan, and its performance would be verified in accordance with an operations and maintenance plan. The design, operation, and maintenance of the monitoring system would be coordinated with the 200-UP-1 groundwater operable unit and the U Plant Area project.

2.9.1 Alternative 0: No Action Alternative

The National Contingency Plan requires that a No Action alternative be evaluated as a baseline for comparison with other remedial alternatives. Alternative 0 represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the site. No Action implies allowing the wastes to remain in their current configuration, affected only by natural processes and without benefit of surveillance or maintenance activities. Selecting Alternative 0 as the preferred alternative would require agreement that the 221-U Facility poses no unacceptable threat to human health or the environment when, in fact, existing contamination poses the potential for increased human health risk to future site users because of the likelihood of breaching the present containment as the facility ages and deteriorates, allowing release of contaminants to the environment.

2.9.2 Alternative 1: Full Removal and Disposal

In this alternative, the 221-U Facility structure and contents would be removed and demolished, including the foundation below existing grade level. Structural material, facility contents, and associated soil above risk-based standards would be disposed at the ERDF. The ERDF meets RCRA minimum technological standards for hazardous waste landfills. An estimated 78,000 m^3 (102,000 yd^3) of debris and soil would be disposed to the ERDF. Under Alternative 1, the ERDF would need to be expanded by about 12% of one cell to accommodate 221-U Facility waste. Most wastes would be expected to meet the waste acceptance criteria established for ERDF. If the ERDF waste acceptance criteria cannot be achieved, waste treatment to meet the ERDF waste acceptance criteria or disposal at another disposal facility would be required. Material to be disposed of would be segregated, evaluated for safe and economical reuse or recycle, and packaged and shipped to the disposal facility if it cannot be recycled or reused. The demolition excavation would then be backfilled to surrounding grade, and the disturbed area would be reseeded or otherwise resurfaced consistent with future land–use decisions. Alternative 1 would require approximately 89,000 m^3 (116,500 yd^3) of backfill materials. Institutional controls to maintain industrial land use would be required, even though the structure would be removed fully, because the remaining soil would be cleaned up to industrial (not unrestricted) levels.

2.9.3 Alternative 3: Entombment with Internal Waste Disposal

This alternative would involve preparation of the 221-U Facility for internal placement of wastes from other CERCLA cleanup actions at Hanford. Approximately 3,400 m^3 (4,400 yd^3) of existing contaminated equipment from the canyon deck would be reduced in size and volume (e.g., cut up into smaller pieces) and then disposed to process cells of the facility. Approximately 10,100 m^3 (13,200 yd^3) of waste from other CERCLA actions would also be disposed in available remaining spaces within the 221-U Facility, resulting in a total waste disposal volume of up to 13,500 m^3 (17,600 yd^3). These wastes would be grouted to minimize the potential for void spaces and to reduce the mobility, solubility, and/or toxicity of the grouted waste. Grout amendments, such as fly ash or zeolite clays, and the cost-benefit of using a soil-cement grout mixture would be considered during final design for grouting activities to reduce the potential for leaching of radioactive isotopes, while maintaining desirable properties of Portland cement (e.g., a flowable, structural grout with good compressive strength).

An estimated 10,000 m^3 (13,000 yd^3) of waste generated during building preparation for waste receiving operations (e.g., legacy equipment in the canyon operating gallery) and debris from demolition of impacted ancillary facilities would be disposed at the ERDF. These wastes would be sent to ERDF rather than disposed in the canyon for optimum handling, scheduling, and because other wastes would be better suited for more protective disposal in the grouted facility.

Concurrent with waste-filling operations, the entire 221-U Facility would be surrounded with compacted clean fill. The use of inert rubble from other nearby CERCLA demolition activities, such as the ancillary facilities, suitable for fill material in the engineered barrier, would be considered during remedial design to decrease the amount of borrow materials needed. At completion of fill placement activities, the 221-U Facility would then be covered with an engineered barrier that would provide protection against water infiltration and human and biotic intrusion into the underlying waste.

Selection of the most appropriate engineered barrier design would be made during final design. For cost estimating purposes in the feasibility study, an evapotranspiration barrier has been used. The actual barrier configuration selected during final design would be designed to minimize the potential for earthquake-induced deformations that could compromise its integrity. The engineered barrier would be designed to meet RAOs and ARARs and to provide long-term containment and protection of the waste from water infiltration for a performance period of at least 500 years. Feasibility cost estimates for the barrier were based on an assumption that barrier reconstruction at year 500 would be required to extend the period of full containment to 1,000 years. Observation of natural analog sites for barrier materials show promise for long-term stability without the need for reconstruction. The remedial design would evaluate barrier options that would minimize maintenance and reconstruction needs.

Water spraying would generally be used to control dust from materials associated with engineered barrier construction. Operation and maintenance activities would include regular inspections, cover vegetation management, regular environmental monitoring (e.g., groundwater and performance monitoring of the barrier), and maintenance as needed. Institutional controls, such as drilling restrictions, would be required. When complete, the top of the engineered barrier would be reseeded along with disturbed areas in the vicinity of the 221-U Facility (e.g., equipment staging areas and former sites of impacted ancillary structures). The side slopes of the barrier may include 0.6 m (2 ft) of coarse riprap; however, the remedial design would establish the specific erosion control design features.

The feasibility study assumes that most engineered barrier materials would be excavated with standard soil excavation equipment and transported to the 221-U Facility from borrow areas on the Hanford Site or within close proximity. Approximately 1.5 million m^3 (1.9 million yd^3) of borrow materials would be required to construct the engineered barrier. The facility, after construction of the engineered barrier, would be approximately 461 m (1,512 ft) in length by 234 m (768 ft) in width by 24 m (80 ft) high.

2.9.4 Alternative 4: Entombment with Internal/External Waste Disposal

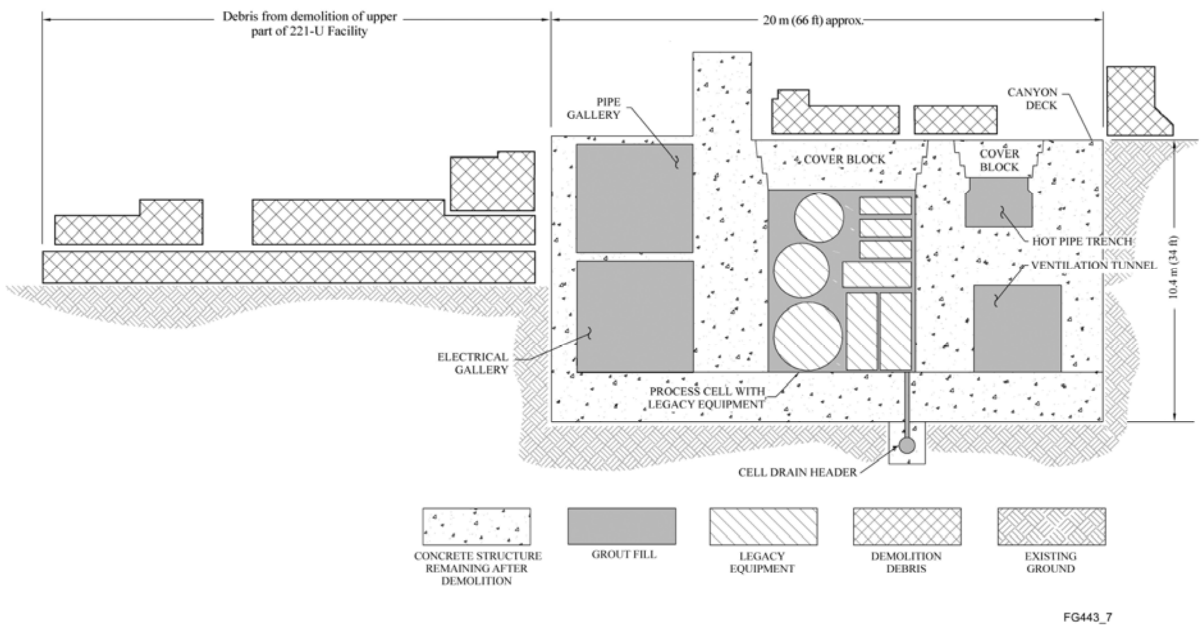
This alternative is identical to Alternative 3, except that the total waste disposal volume would be increased by 50,100 m^3 (65,463 yd^3) by modifying the external area around the perimeter of the 221-U Facility for disposal of contaminated soil from other CERCLA actions at Hanford. The barrier would provide containment to both interior and exterior waste fill. The disposal unit's exterior waste fill area would include as part of its design a RCRA double liner and leachate collection system to account for the potential to receive hazardous waste from CERCLA or RCRA past-practice cleanups at Hanford in this portion of the facility. An estimated 10,000 m^3 (13,000 yd^3) of waste generated during building preparation for waste receiving operations (e.g., legacy equipment in the canyon operating gallery) and debris from demolition of impacted ancillary facilities would be disposed at the ERDF. These wastes would be sent to ERDF rather than disposed in the canyon for optimum handling, scheduling, and because other wastes would be better suited for more protective disposal in the grouted facility.

The use of inert rubble from other nearby CERCLA demolition activities, such as the ancillary facilities, suitable for fill material in the engineered barrier, would be considered during remedial design. With the addition of the external disposal area, approximately 63,600 m^3 (82,700 yd^3) of waste could be disposed at the 221-U Facility under Alternative 4. Approximately 1.4 million m^3 (1.8 million yd^3) of borrow materials would be required to construct the engineered barrier, slightly less than Alternative 3 due to the exterior waste fill. The facility, after construction of the engineered barrier, would be approximately 461 m (1,512 ft) in length by 234 m (768 ft) in width by 24 m (80 ft) high at existing grade.

2.9.5 Alternative 6: Close in Place – Partially Demolished Structure

This alternative would require that approximately 3,400 m^3 (4,400 yd^3) of existing contaminated equipment from the canyon deck be size-reduced, disposed to the process cells, and grouted (Figure 5). Cementitious grout would be pumped into the process cells and tanks containing residual materials, the cell drain header, and the galleries to minimize the potential for void spaces and to reduce the mobility, solubility, and/or toxicity of the grouted waste. The upper part of the 221-U Facility would then be demolished to approximately the level of the canyon deck, and the remnants of the facility would be covered by an engineered barrier. Unlike Alternatives 3 and 4, Alternative 6 would not include disposal of imported Hanford Site remediation wastes inside or around the outside of the 221-U Facility. An estimated 9,600 m^3 (12,500 yd^3) of debris from demolition of impacted ancillary facilities would be disposed at the ERDF. These wastes would be sent to ERDF rather than disposed in the canyon due to considerations for optimum handling and scheduling. The use of inert rubble from other nearby CERCLA demolition activities, such as the ancillary facilities, suitable for fill material in the engineered barrier, would be considered during remedial design.

Figure 5. Alternative 6 – Cross Section of the 221-U Facility Interior and Exterior.



2.10 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The following evaluation of remedial alternatives summarizes each alternative in relation to each of the nine CERCLA criteria. The first two criteria, overall protection and compliance with ARARs, are defined under CERCLA as "threshold criteria." Threshold criteria must be met by an alternative to be eligible for selection. The next five criteria are defined as "primary balancing criteria." These criteria are used to weigh major trade-offs among alternatives. The last two criteria, State and community acceptance, are defined as "modifying criteria." In the final comparison of alternatives to select a remedy, modifying criteria are of equal importance to the balancing criteria.

2.10.1 Overall Protection of Human Health and the Environment

Alternative 0 (the No Action alternative) would fail to meet this threshold criterion because contaminated wastes would remain in place above acceptable levels without any measures to prevent releases, contain or monitor contaminants, or control exposure pathways. Therefore, the No Action alternative is not discussed further in this evaluation. All remaining alternatives would meet this threshold criterion.

For Alternatives 1, 3, 4, and 6, wastes that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) would be removed and dispositioned prior to stabilization in accordance with an approved RD/RA workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste would be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, in accordance with an approved workplan and schedule no later than September 30, 2024. Additional TRU wastes discovered during remedial activities would be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site in accordance with an approved workplan and schedule no later than September 30, 2024.

Alternative 1 would protect human health and the environment by fully removing the facility and reducing residual contaminant levels to those acceptable for industrial use of the site. The majority of waste would be disposed of at ERDF. Alternatives 3, 4, and 6 would protect human health and the environment by eliminating or reducing exposure pathways through encapsulation of contaminants in a grouted concrete structure and use of an engineered surface barrier. This configuration provides protection by shielding against direct radiation exposure, preventing intrusion by biota and humans, and by significantly reducing or preventing infiltration of precipitation to limit the potential for release of contained contaminants. Alternatives 3 and 4 involve use of the 221-U Facility as a waste disposal site that would receive waste from other Hanford cleanup activities. However, it has not yet been determined what waste would be disposed of in the 221-U Facility under Alternatives 3 or 4. Additional risk evaluation and waste acceptance criteria would be developed to ensure overall protectiveness for Alternatives 3 or 4, if selected.

2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 1 would attain all potential ARARs. Alternatives 3, 4, and 6 would attain all ARARs except for RCRA landfill minimum technological requirements for leak detection at WAC 173-303-665(2). In addition, Alternatives 3, 4, and 6 require compliance with substantive requirements for a RCRA land disposal restriction treatability variance and a TSCA risk-based determination for the management of polychlorinated biphenyls (PCBs).

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

The in-place disposal of waste currently in the 221-U Facility under Alternatives 3, 4, and 6 would not include liners and a leachate collection and removal system and would satisfy these RCRA landfill minimum technological requirements by satisfying and waiving in part the substantive requirements for an alternative design at WAC 173-303-665(2)(j). Waste would be grout-encapsulated within the canyon, and an engineered barrier would be constructed to provide contaminant containment. Modeling predicts that no contaminants would migrate out of the grout and concrete monolith and to groundwater within 1000 years. Computer-aided modeling has been performed to demonstrate that, once encapsulated in grout and contained within the reinforced canyon structure, contaminants currently identified in the 221-U Facility would not migrate into the accessible environment including the soils around or under the facility for the duration considered for normal liner performance. This approach will prevent the migration of any dangerous constituents into the groundwater or surface water at least as effectively as the liners and leachate collection and removal system. Details of this demonstration are provided in the Final Feasibility Study.

The in-place disposal of waste currently in the 221-U Facility under Alternatives 3, 4, and 6, however, would not satisfy WAC 173-303-665(2)(j)(ii) alternative landfill minimum requirements for leak detection. This requirement would be waived in accordance with 40 CFR 300.430(f)(1)(ii)(C)(3) because, from an engineering standpoint, it is technically impracticable to construct a leak detection system beneath the canyon building (bottom of structure is approximately 9.1 meters or 30 feet below grade). Again, modeling predicts that no contaminants would migrate out of the grout and concrete monolith and to groundwater within 1000 years. Performance monitoring of the engineered barrier would allow for application of mitigative or preventative action (e.g., increasing barrier thickness) to impede water from reaching the underlying waste. Groundwater monitoring would also be performed to monitor the effectiveness of the remedial action.

Land disposal restricted waste currently in the 221-U Facility includes liquid and sludge that exhibit characteristics (primarily toxicity, such as for mercury or lead) that cause the waste to designate as dangerous waste. Under all the containment alternatives, in lieu of treatment pursuant to land disposal restriction provisions (e.g., to remove toxic characteristics or thermally treat mercury), alternative treatment will be provided to mitigate risk associated with disposal of this waste within the canyon. For disposal of waste currently located within the 221-U Facility, Alternatives 3, 4, and 6 would satisfy RCRA land disposal restrictions by meeting substantive criteria for a treatability variance in accordance with 40 CFR 268.44(h)(2)(i) because it would be technically inappropriate to treat mercury contained in sludge with the specified treatment method (incineration, retorting, or roasting) considering the limited incremental benefit when weighed against the significant increase in worker risk from radiological exposure. Under Alternatives 3, 4, and 6, alternative treatment (macroencapsulation in grout and ultimate containment within the 221-U Facility reinforced canyon structure) would be provided.

To meet the Toxic Substances Control Act (TSCA) ARARs under Alternatives 3, 4, and 6, DOE would use the risk-based disposal option, and EPA would make a risk-based determination for the purpose of demonstrating there is no unreasonable risk of injury to human health or the environment associated with the management and disposal of PCB remediation waste in the 221-U Facility, in accordance with the substantive requirements of 40 CFR 761.61(c). The determination would be based on the small amount of PCBs identified in the 221-U Facility, the low volatility of the PCBs, and the protectiveness that will be provided via macroencapsulation of the PCBs in grout and in the reinforced concrete monolith of the canyon structure.

2.10.3 Long-Term Effectiveness and Permanence

For Alternatives 1, 3, 4, and 6, wastes that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) would be removed and dispositioned prior to stabilization in accordance with an approved RD/RA workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste would be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, in accordance with an approved workplan and schedule, no later than September 30, 2024. Additional TRU wastes discovered during remedial activities would be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site in accordance with an approved workplan and schedule no later than September 30, 2024.

Alternatives 1, 3, 4, and 6 all would provide a substantial degree of long-term protection. Alternative 1 would transfer contaminants from the 221-U Facility to the ERDF, where an engineered surface barrier would isolate contaminants for a minimum of 1,000 years and minimize contaminant migration associated with water intrusion. The engineered barrier that would be constructed over the 221-U Facility in Alternatives 3, 4, and 6 would similarly isolate and contain contaminants. Long-term use restrictions, monitoring, and engineered barrier maintenance would be similar for both ERDF under Alternative 1 and the engineered barriers for Alternatives 3, 4, and 6.

In the unlikely event of barrier failure, Alternatives 3, 4, and 6 would be somewhat more effective than Alternative 1 because a majority of contaminants would be grouted (except that external disposal envisioned in Alternative 4 would be similar to that of ERDF and would not likely be grouted). The thick-walled concrete structure of the canyon facility would also contribute to the long-term effectiveness of Alternatives 3, 4, and 6 by providing an additional isolation barrier to contaminant transport for a substantial period of time. Concrete sampling to support structural analysis during the characterization phase showed that the facility concrete was in excellent condition with no discernable degradation more than 50 years after construction. The engineered barrier for Alternatives 3 and 4 would be significantly higher than that for Alternatives 1 and 6 and would be more susceptible to side slope failure from seismic loading conditions, as well as wind and water erosion. Therefore, the barriers in Alternatives 1 (provided at ERDF) and 6 may be more stable than Alternatives 3 and 4 in the long term.

Under Alternative 1, essentially all contaminants would be removed from the 221-U Facility (some residual contamination may remain in the subsoils). For Alternatives 3, 4 and 6, all exposure pathways would be severed post-remediation as long as the cap is maintained and not breached. Therefore, for all alternatives except the No Action alternative, the design would ensure that there was no excess long-term post-remediation carcinogenic or noncarcinogenic risk at the site of the 221-U Facility. Remedial Alternatives 3 and 4 consider use of the 221-U Facility as a waste disposal site. However, to date, no viable waste streams have been identified for disposal to the 221-U Facility. Evaluation of post-remediation exposure pathways and exposure risks was not performed for Alternatives 3 and 4 because waste forms to be disposed to the

221-U Facility under these alternatives have not yet been identified. However, the expectation is that the barrier and other design elements, combined with decisions on what to allow into the facility, would result in a protective remedy.

2.10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Under Alternative 1, treatment would be a relatively minor component of the remedy. Treatment would be limited to those wastes that require treatment to meet land disposal restrictions or ERDF waste acceptance criteria. Therefore, this alternative would not substantially reduce toxicity, mobility, or volume through treatment.

Alternatives 3, 4, and 6 would all include treatment via grouting as a major component of the remedy. The filling of void space with grout would effectively treat by encapsulation both contaminants remaining in the 221-U Facility and wastes received into the facility (Alternatives 3 and 4 only). Grout amendments, such as fly ash or zeolite clays, and the cost-benefit of using a soil-cement grout mixture, would be considered during final design for grouting activities to reduce the potential for leaching of radioactive isotopes and reduce overall grouting costs, respectively. Upon filling the facility, there would be a cementitious matrix formed that would aid in preventing the mobilization of contaminants from the facility.

Although the encapsulation of contaminants may not be entirely verifiable in portions of the facility, in general this action would immobilize a large portion of radiological and inorganic wastes. Although treatment is provided to a degree in all active alternatives, the reduction in mobility afforded by grout encapsulation of waste in the three containment alternatives would perform more effectively for this criterion than Alternative 1. Within the containment alternatives, Alternative 6 would perform more effectively than Alternatives 3 and 4 because of the smaller amount of disposed waste in the canyon for Alternative 6. Alternative 3 would perform more effectively than Alternative 4 because exterior waste in Alternative 4 would not be grout encapsulated.

2.10.5 Short-Term Effectiveness

All of the alternatives would be expected to be effective in protecting human health and the environment in the short term. Alternatives 3, 4, and 6 would be more effective in the short term than Alternative 1, due predominantly to a significantly lower risk to workers from radiological exposure and industrial accidents. Alternative 1 is predicted to cause nearly six times more worker dose as a result of exposure to radionuclides than Alternatives 3 and 4, and nearly eight times more than Alternative 6, which would have the lowest worker dose expected of the alternatives. This is because Alternative 1 would require the breaching of a larger number of radioactively contaminated systems and structures that may present hazards to workers through direct exposure as well as inhalation.

Industrial accidents would be more likely for a large-scale decontamination and decommissioning action such as would occur mainly under Alternative 1 and, to a lesser extent, Alternative 6. Waste receipt activities under Alternatives 3 and 4 would occur under controlled circumstances and would not be expected to pose significant worker safety issues. Because Alternative 4 would include placement of waste both inside and outside of the structure, it would perform less effectively in the short term than would Alternative 3 because of worker risk associated with the added waste handling activities.

Short-term impacts to vegetation, wildlife, and cultural resources are not considered significant indicators of short-term effectiveness for any alternative at the 221-U Facility because the site and adjacent land area have been previously disturbed. However, Alternatives 1, 3, 4, and 6 could impact natural and cultural resources at borrow sites. The quantity of geologic materials required would be significantly less for Alternative 1; thus, the impacts to these resources would be less. Approximately 86,900 m^3 (113,600 yd^3) of material would be required to backfill and re-contour the site for Alternative 1. The total volume of geologic materials would be 1,500,000 m^3 (1,900,000 yd^3) for Alternative 3, 1,400,000 m^3 (1,800,000 yd^3) for Alternative 4, and 460,000 m^3 (602,000 yd^3) for Alternative 6.

Analyses presented in the feasibility study for the 221-U Facility indicate that all alternatives, although their specific activities as described earlier differ to some degree, would take approximately the same amount of time (9 to 10 years) to achieve RAOs.

2.10.6 Implementability

All of the alternatives are considered to be implementable. Alternative 1 and, to a lesser extent, Alternative 6 would involve technical difficulties and safety requirements associated with large-scale radiological decontamination and decommissioning actions. However, these alternatives use standard, proven technologies and are considered implementable. Size reduction, transportation, and disposal of large volumes of radioactively contaminated structures, piping systems, equipment, wastes, and soils would add complexity to Alternative 1 relative to the other alternatives.

Internal waste placement under Alternatives 3 and 4 would be implementable. Technologies for waste receipt and placement using shielded containers and container lift equipment are proven and reliable. External waste placement under Alternative 4 would require that a bottom liner system be placed on a steep slope and attached to a vertical exterior wall. This would complicate the implementation of this alternative. Alternative 6 involves less waste movement (e.g., contaminated legacy equipment on the deck lowered into the cells) and, from a material handling perspective, is slightly more implementable than Alternatives 3 and 4, with exterior waste placement under Alternative 4 being the most difficult to implement.

Construction of an engineered barrier for the containment alternatives would require innovative engineering design applications. Alternatives 3 and 4 have the greatest inherent engineered barrier design uncertainty due to height. Inherent uncertainties include instability during certain seismic conditions, as well as possible sideslope instability and susceptibility to erosion. The engineered barrier for Alternative 6 faces similar performance issues. However, because the barrier for Alternative 6 would not be as high as the barriers for Alternatives 3 and 4, these performance issues would be less pronounced. Alternative 4 would be the most complex engineered barrier to construct because of technical issues in the construction of the external liner installation, the exterior wall of the 221-U Facility, and the steeply lined area for external waste fill. In addition, the steep slope for the external fill area in Alternatives 3 and 4 would need to be built in stages to accommodate the need for equal loading of outside and inside walls of the 221-U Facility during waste placement. Geotechnical specialists would be required for design of the engineered barrier.

Because of the technical difficulties that may result in the design and construction of the engineered barrier, Alternatives 3 and 4 are considered slightly less implementable than Alternatives 1 and 6, with Alternative 4 being the most difficult to implement.

2.10.7 Cost

Table 5 summarizes the capital, operation and maintenance, and total present-worth costs for each alternative. The present-worth costs for Alternatives 6 and 1 are $67 million and $84 million, respectively, making these the least costly alternatives. The present-worth costs for Alternatives 3 and 4 are $111 million and $113 million, respectively.

At the time the cost analysis was prepared for the 221-U Facility remedial alternatives, the remedy for the waste sites and ancillary structures immediately adjacent to the 221-U Facility was unknown. For planning purposes, several assumptions are made to address these unknowns. For Alternative 1, it is assumed that waste sites in the immediate vicinity of the 221-U Facility would be excavated as a part of the implementation of the remedy. Waste site remediation is not assumed to be part of the implementation of the containment alternatives (3, 4, and 6). Additionally, it is assumed that the adjacent ancillary structures would have to be removed before implementation of any of the active remedial alternatives. The cost evaluation in the feasibility study assumes that costs associated with the demolition and disposal of these facilities will be incurred by the 221-U Facility remediation project. It is also assumed that preparation of the ancillary structures for demolition, including activities such as decontamination and removal of hazardous contaminants if required, is completed under another project before implementation of the preferred alternative; therefore, these structural demolition preparation costs are not included in cost estimates for any of the alternatives.

Annual cost projections are provided in Table K-1 of Appendix K of the final feasibility study. Following the period of active remediation work, annual costs for operations and maintenance activities are estimated to be $3.5K for Alternative 1 for most years and $401K for the containment alternatives for most years.

Table 5. 221-U Facility Remediation Total Project Cost Summary.

Project Phase	Dollar Amounts			
	Alternative 1	Alternative 3	Alternative 4	Alternative 6
Capital Cost Summary				
Prepare the existing complex				
Assessment activities	700,000	700,000	700,000	700,000
Design activities	7,900,000	8,800,000	9,000,000	4,500,000
Removal of sludge and liquids from equipment	1,300,000	1,300,000	1,300,000	1,300,000
Establish infrastructure	1,600,000	2,000,000	2,200,000	1,600,000
Modify 221-U Facility	15,400,000	16,900,000	16,900,000	16,500,000
Modify external area				
Disposition of external legacy structures	5,300,000	21,800,000	21,800,000	20,900,000
Disposition of waste sites within footprint	2,000,000	0	0	0
Operate existing complex				
Building demolition, removal, and disposal	59,000,000	1,300,000	1,300,000	10,700,000
Fill galleries with waste and grout	0	8,400,000	8,400,000	1,400,000
Fill operating deck area with waste and grout	0	16,400,000	16,400,000	0
Construct engineered clean fill	0	30,200,000	28,800,000	7,400,000
Construct external leachate collection system	0	0	1,600,000	0
Place external contaminated soil fill	0	0	1,900,000	0
Close complex				
Backfill 221-U excavation void	1,300,000	0	0	0
Construct engineered barrier	0	4,700,000	4,700,000	4,100,000
Construct erosion protection on sideslopes	0	7,800,000	7,800,000	3,100,000
Revegetate	30,000	50,000	50,000	50,000
Closeout activities	200,000	200,000	200,000	200,000
Demobilization	50,000	60,000	60,000	50,000
Establish groundwater or vadose zone monitoring	0	300,000	300,000	300,000
Total capital costs (Undiscounted)	**94,800,000**	**120,900,000**	**123,400,000**	**72,800,000**
O&M Cost Summary				
Monitoring and inspections (Total)	500,000	49,300,000	49,300,000	49,000,000
Engineered barrier replacement (year 500 only)	500,000	4,700,000	4,700,000	4,100,000
Total O&M Cost (Undiscounted)	**1,000,000**	**54,000,000**	**54,000,000**	**53,100,000**
Overall Cost Summary				
Project Total Costs (Undiscounted)	**95,800,000**	**174,900,000**	**177,400,000**	**125,900,000**
Net Present Worth Totals	**84,400,000**	**111,200,000**	**113,100,000**	**67,400,000**

NOTE: All cost estimates have an accuracy of –30% to +50%. Present–worth costs are based on a 3.2% real discount rate (OMB Circular No. A–94, Appendix C) and a 1,000–year period of performance. Total undiscounted costs are 2001 dollars for a 1,000–year period of analysis. All costs have been rounded. Under "Engineered barrier replacement" for Alternative 1, $500K is included for the 221-U share of the ERDF barrier construction and replacement at year 500.

O&M = Operations and Maintenance

2.10.8 State/Support Agency Acceptance

The State of Washington supports the selected remedy, Alternative 6. The Washington Department of Ecology is a joint-lead regulatory agency for the 221-U Facility remedial action.

2.10.9 Community Acceptance

In general, comments received on the proposed plan were supportive of Alternative 6. Some concerns were voiced regarding implementation of this final remedial action that will leave waste in place, construction of large barriers on the Hanford Site Central Plateau, and future land use on the Central Plateau. However, after considering public comments, there were no significant changes made to the remedy as it was originally described in the proposed plan. Detailed responses to comments are contained in the Appendix.

2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the "principal threats" posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). "Principal threat" wastes are those source materials that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds. A "source material" is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure.

Although no "threshold level" of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for unrestricted use and unlimited exposure. Remedies that involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element, although this will not necessarily be true in all cases.

Principal threat waste in the 221-U Facility includes radionuclides and mercury mixed in sludge heels in the bottom of stainless steel containers located within the cells and on the canyon deck. The primary radionuclides that will remain in the structure after construction of the remedy include transuranic isotopes (at concentrations of 100 nCi/g or below), uranium, and the fission products cesium-137 and strontium-90. Mercury exists within the matrix of radioactively contaminated sludge heels.

Wastes that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) would be removed and dispositioned prior to stabilization in accordance with an approved RD/RA workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste would be shipped to the Waste Isolation Pilot Plant near

Carlsbad, New Mexico, in accordance with an approved workplan and schedule, no later than September 30, 2024. Additional TRU wastes discovered during remedial activities would be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site no later than September 30, 2024.

2.12 SELECTED REMEDY

This ROD presents the selected final remedial action for the 221-U Facility in the Hanford 200 Area, Hanford Site, Benton County, Washington, which was chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. This decision is based on the information contained in the Administrative Record for this site.

2.12.1 Summary of the Rationale for the Selected Remedy

The Tri-Parties have selected a close-in-place cleanup approach (Alternative 6) as the remedy for the 221-U Facility. This was also the Preferred Alternative identified in the proposed plan. It is the most appropriate remedial alternative because:

- Alternative 6 satisfies the CERCLA threshold criteria.

- Alternative 6 represents the best balance of tradeoffs with respect to the CERCLA balancing and modifying criteria. In particular, Alternative 6 is more protective of remedial action workers and provides somewhat greater long-term effectiveness and permanence when compared to Alternative 1. It also provides somewhat greater long-term effectiveness and permanence than Alternatives 3 and 4 at a lower cost. (See discussion in Section 2.10.)

- Alternative 6 satisfies the statutory requirements as outlined by Section 121 of CERCLA. (See discussion in Section 2.13.)

Other benefits that the selected remedy provides include:

- Alternative 6 is consistent with the anticipated future use of the 200 Area at Hanford (i.e., industrial).

- Alternative 6 is consistent with the overall cleanup approach for the 200 Area at Hanford, as embodied in the TPA and past waste management decisions in the 200 Area (i.e., permanent disposal of remediation waste in the Hanford Site Central Plateau core zone).

2.12.2 Detailed Description of the Selected Remedy

The selected remedy is Alternative 6, Close in Place – Partially Demolished Structure. Alternative 6 will result in the treatment and encapsulation of wastes within the grouted, reinforced-concrete structure of the canyon. The structure will then be covered by a protective engineered barrier. WAC 173-340-740(6)(f) assumes for containment remedies (such as Alternative 6) that soil cleanup levels will not be met at the point of compliance and provides a process for determining that cleanup standards are met without establishing a point of compliance. The point of compliance for groundwater protection shall be determined during remedial design and be included in the RD/RA workplan to be reviewed and approved by EPA and Ecology. The groundwater monitoring network will be optimized to coordinate to the extent practical with the groundwater monitoring requirements for the 200-UW-1 waste sites operable unit and the 200-UP-1 groundwater operable unit. Protection of surface water (the Columbia River) will be achieved through protection of the groundwater.

The schedule and procedures that will be used to implement the multi-year work effort required by this ROD will be described and documented in more detail in the RD/RA workplan, a primary document under the TPA subject to EPA and Ecology approval. The draft RD/RA workplan shall be submitted to EPA and Ecology by December 31, 2006 and shall include a detailed schedule and associated activities.

The selected remedy for the 221-U Facility includes four primary components: demolition and barrier construction, post-closure care and environmental monitoring, institutional controls, and five-year review.

2.12.2.1 Construction Component of the Selected Remedy

The demolition and barrier construction component will consist of the following activities:

- Residual materials that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) will be removed and dispositioned prior to stabilization in accordance with an approved remedial design/remedial action (RD/RA) workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste will be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, in accordance with an approved workplan and schedule no later than September 30, 2024. Additional TRU wastes discovered during remedial activities will be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site in accordance with an approved workplan and schedule no later than September 30, 2024.

- Facility modifications will be made as necessary to support equipment removal and remediation activities. Such activities may include partial removal of contaminated equipment and piping from the gallery side of the 221-U Facility, cutting access openings into the canyon, refurbishment of the 221-U Facility roof covering (versus the underlying roof structure), and upgrades to the ventilation system to support work that will be performed within the facility as a part of the remedial action.

- Demolition of attached structures (railroad tunnel, 276-U, 271-U, and the 296-U-10 stack) and cleanup of impacted ancillary structures (291-U, 292-U, and the 291-U-1 stack), will be completed. The locations will be stabilized to support construction of the engineered barrier after removal of these structures. Dust and fugitive emissions associated with these actions will be controlled, such as by application of fixatives or spraying with water. Activities associated with this remedial action will not result in radioactive emissions that cause the total offsite dose resulting from Hanford Site emissions to exceed 10 mrem/yr. Details regarding emissions controls and monitoring will be documented in a RD/RA workplan submitted to EPA and Ecology for approval.

- Existing contaminated equipment from the canyon deck will be size-reduced within the 221-U Facility and lowered into the process cells. Size and volume reduction would be necessary so that all of the contaminated equipment would fit into the process cells. However, size reduction activities will be minimized to the extent possible to limit worker exposure to contaminants.

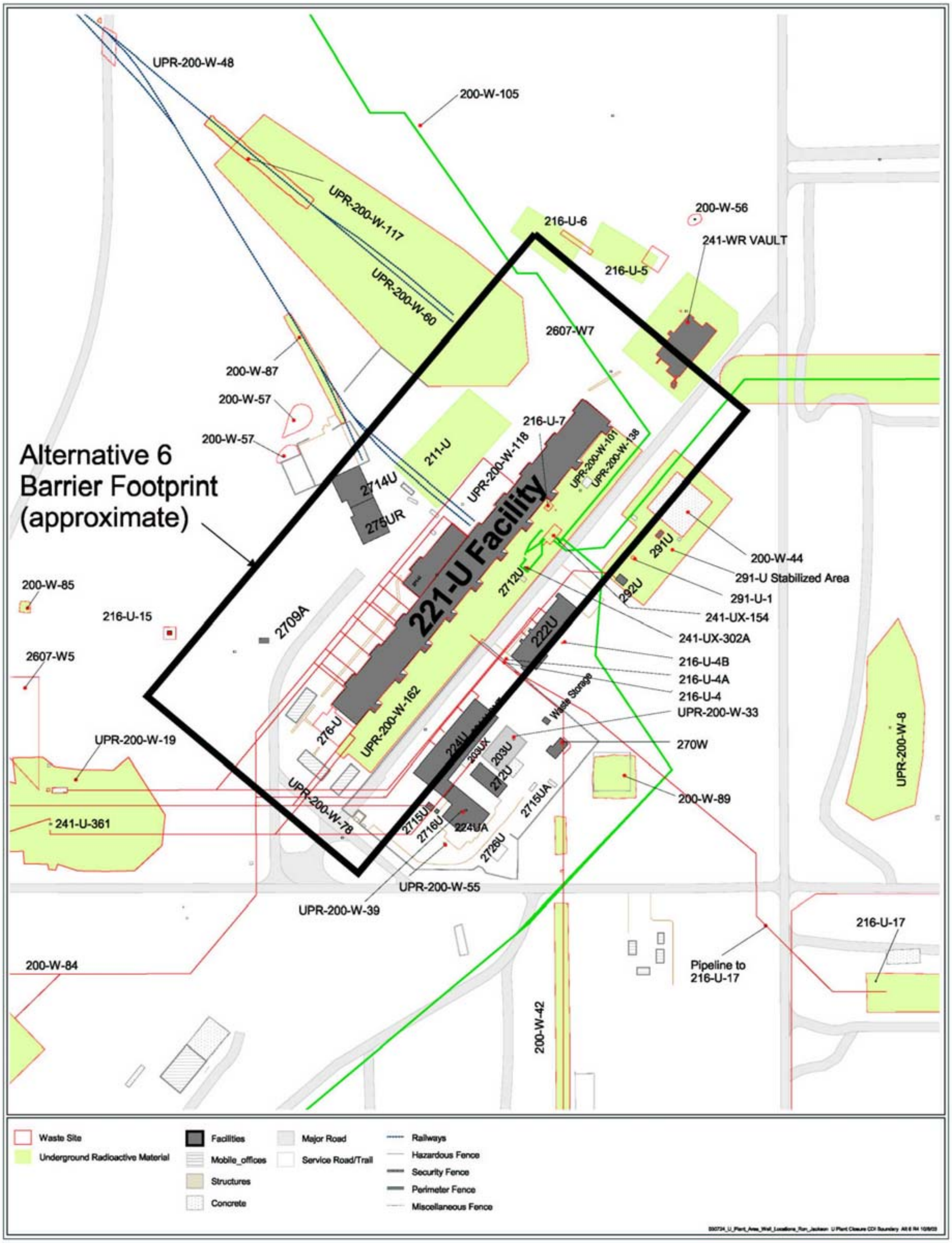
- Cementitious grout will be pumped into the galleries, cell drain header, process cells, and tanks containing residual materials to the maximum extent practical, to minimize the potential for void spaces and to reduce the mobility, solubility, and/or toxicity of the grouted waste. Grout amendments,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

- Waste generated during building preparation for demolition and from demolition of attached and impacted ancillary structures will be disposed at the ERDF or other disposal locations approved in advance by the EPA. Inert rubble from other nearby CERCLA demolition activities, such as the ancillary structures, will be considered during remedial design for use as fill material in the engineered barrier.

- Surface contamination on the canyon walls, deck, and ceiling will be addressed (e.g., sprayed with fixatives) after equipment removal and grouting activities have been completed. The upper part of the 221-U Facility will be demolished to approximately the level of the canyon deck. The concrete debris from building demolition will be placed on the canyon deck underneath the engineered barrier. Rubble or wall and ceiling sections that are minimally contaminated and don't contain dangerous waste may be used as fill along side the canyon substructure under the barrier to limit impacts on soil borrow areas.

- The partially demolished building and concrete debris will be covered with an engineered barrier. See Figure 6 for an illustration of the extent of the engineered barrier. The remedial design shall minimize maintenance and reconstruction needs. The barrier design configuration will be selected during final design, and the barrier will be designed to minimize the potential for earthquake-induced deformations and to provide long-term containment and protection of the waste from water infiltration for a performance period of at least 500 years.

Figure 6. Footprint of the Engineered Surface Barrier for the Selected Remedy.



- The engineered barrier shall be designed to prevent percolation rates greater than 3.2 mm/year (long-term average) from reaching contaminants to ensure the remedy is protective of groundwater and the Columbia River. This performance criterion is based on contaminant transport modeling within the grouted monolith of the remaining structure and on modeling of vadose zone transport to groundwater below the facility. Recent studies indicate that the percolation rate is conservative because it is ten times lower than the rate resulting from flux through the low-permeability layer of a typical RCRA Subtitle C barrier under climatic conditions where the precipitation rate is not a limiting factor on infiltration. In arid and semiarid climates, large matric potential gradients can be orders of magnitude greater than the gravitational potential or force driving moisture down through a soil profile. Evapotranspirative surface barriers function by taking advantage of dry climates (Hanford's average precipitation rate is approximately 17 cm/year) and large soil matric potentials.

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

When complete, the top of the engineered barrier will be reseeded along with disturbed areas in the vicinity of the 221-U Facility. Reseeding of the barrier will be conducted to stabilize barrier materials and improve evapotranspiration rates, which will reduce barrier percolation rates. Reseeding of adjacent disturbed areas will be for surface restoration purposes consistent with the expected future industrial land use.

2.12.2.2 Post-Closure Care and Environmental Monitoring Component of the Selected Remedy

Because contaminants will be left in place at levels that do not allow for unrestricted use, post-closure care is necessary. The post-closure care component will consist of the following activities.

- DOE shall prepare an operations and maintenance (O&M) plan to be approved by EPA and Ecology detailing post-closure care requirements and schedules. The plan shall be submitted in accordance with the schedule contained in the approved RD/RA workplan.

- The engineered barrier will be visually inspected periodically for signs of erosion, settlement, displacement, and cracking.

- DOE shall demonstrate that the surface barrier performance criterion (percolation rates will not exceed 3.2 mm/year long-term average) is being met . The details regarding the method of demonstration shall be documented in the approved RD/RA workplan. The O&M plan shall provide for assessment of barrier performance and for the application of appropriate maintenance or mitigative actions (e.g., thickening of the barrier, runon/runoff water flow controls) where necessary to mitigate or prevent percolating water from reaching the underlying waste.

- The engineered barrier will be maintained as necessary, including replacement as appropriate to meet the requirement for a performance period of at least 1,000 years.

- Cover vegetation will be maintained to stabilize barrier materials and provide an evapotranspirative function for the engineered barrier to limit percolation to contaminants.

- Environmental monitoring will be conducted to ensure air emissions ARARs are being met during remedy implementation and to assess the performance of the engineered barrier and continued protection of the groundwater following remedy implementation. Environmental monitoring data will be evaluated regularly and used in support of CERCLA five-year reviews to detect releases and to ensure that the selected remedy is functioning in a manner that is protective of both human health and the environment. The point of compliance for groundwater protection shall be determined during remedial design and be included in the RD/RA workplan to be reviewed and approved by EPA and Ecology. The groundwater monitoring network will be optimized to coordinate to the extent practical with the groundwater monitoring requirements for the 200-UW-1 waste sites operable unit and the 200-UP-1 groundwater operable unit.

2.12.2.3 Institutional Control Component of the Selected Remedy

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

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

No later than 180 days after the ROD is signed, DOE shall update the Site-wide Institutional Controls Plan to include the institutional controls required by this ROD and specify the implementation and maintenance actions that will be taken, including periodic inspections. The revised Hanford Site-wide Institutional Controls Plan shall be submitted to EPA and Ecology for review and approval as a TPA primary document. DOE shall comply with the Hanford Site-wide Institutional Controls Plan as updated and approved by EPA and Ecology.

The following institutional controls performance objectives are required to be met as part of this remedial action.

Institutional controls required through the time of completion of remedy construction:

1) DOE shall control access to prevent unacceptable exposure of humans to contaminants at the 221-U Facility site addressed in the scope of this ROD until remedy construction is complete. Visitors entering any site areas are required to be badged and escorted at all times. See Figure 7 for a site map showing the extent of the 221-U Facility site and the boundaries of the land use controls. A more detailed map will be developed and included in the RD/RA workplan to be approved by EPA and Ecology.

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

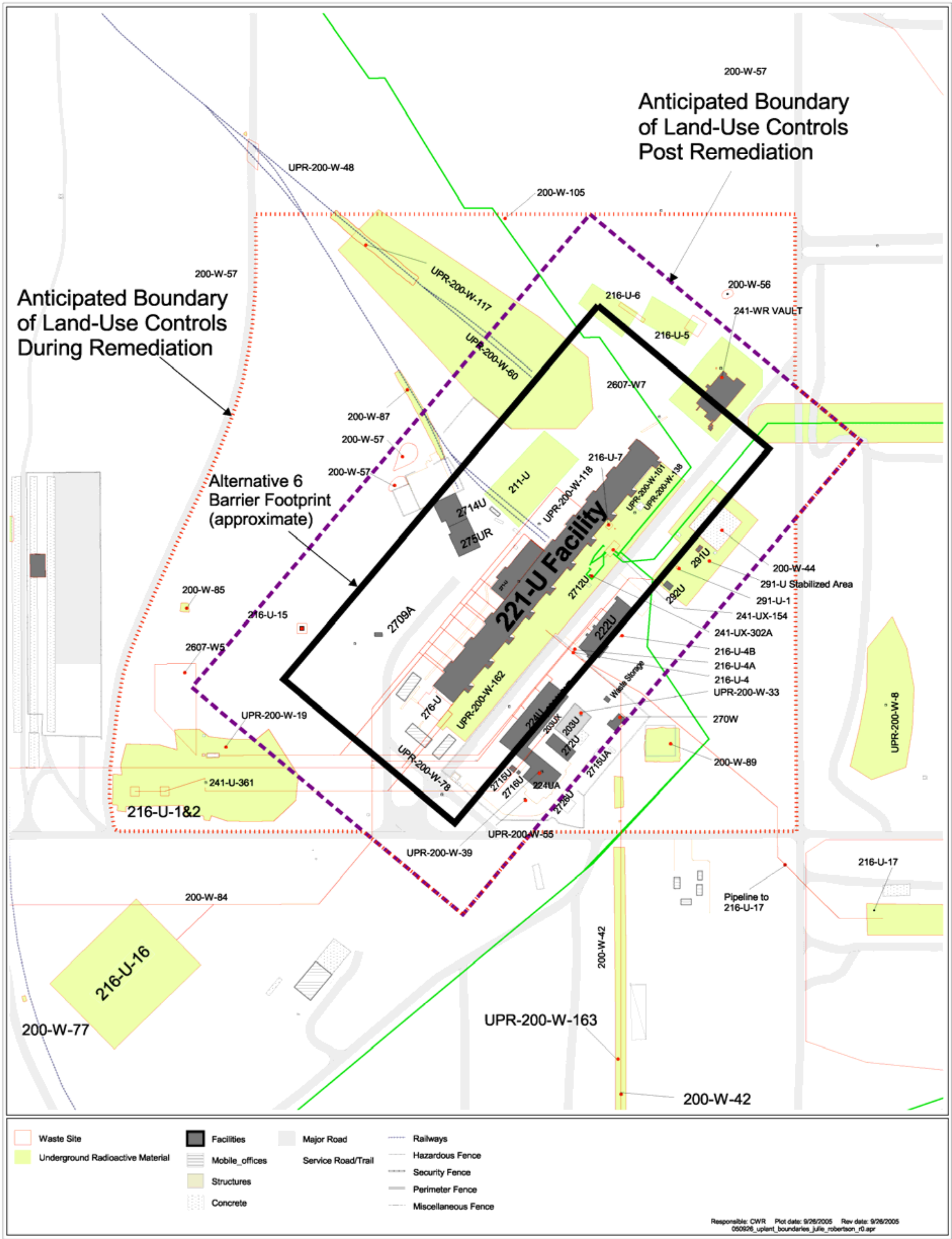
3) DOE shall prohibit well drilling at the 221-U Facility site except for monitoring, characterization, or remediation wells authorized in EPA and Ecology approved documents.

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

5) DOE shall post and maintain warning signs along access roads which caution site visitors and workers of potential hazards from the 221-U Facility site.

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

Figure 7. Area of Land Use Controls for the Selected Remedy.



Institutional controls required after construction of the remedial action:

Except for item numbers 3, 4, and 7 below, the Land Use Controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure.

1) DOE shall ensure that use of the 221-U Facility site as well as any activities at the site are restricted to industrial use only, consistent with the exposure assumptions used in establishing risk-based cleanup levels for radionuclides and the use of MTCA Method C to calculate industrial cleanup levels for chemicals. A surveillance program shall be maintained to document that risk- and ARAR-based cleanup levels (and the exposure durations upon which they are based) are not exceeded. Furthermore, DOE shall prohibit the development and use of the 221-U Facility site for residential housing, elementary and secondary schools, child care facilities, and playgrounds.

2) Activities that would disrupt or lessen the performance of the engineered surface barrier are to be prohibited. The engineered surface barrier is anticipated to cover the area delineated in Figure 6.

3) DOE shall maintain an effective vegetative soil layer to promote the succession of native plants as a feature of the evapotranspiration surface barrier and prohibit activities that would lessen the effectiveness of the vegetation, barrier, and run on/run off controls. These infiltration control measures shall be maintained unless (or until) DOE can demonstrate that the proposed activity or change in maintenance will result in no negative impact on groundwater or river water quality from any potential release of contamination from the site and EPA and Ecology approve the change.

4) No irrigation will be permitted for agriculture or landscaping on the 221-U Facility site. This infiltration restriction shall be maintained unless (or until) DOE can demonstrate that the proposed irrigation will have no negative impact on groundwater or river water quality from any potential release of contamination from the site and EPA and Ecology approve the change.

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

6) DOE shall prohibit well drilling at the 221-U Facility site except for monitoring, characterization, or remediation wells authorized in EPA and Ecology approved documents.

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

8) DOE shall prohibit activities that would damage the monitoring system and its components (e.g., monitoring wells).

9) DOE shall establish and maintain a records system or database that tracks locations and estimated quantities of residual contamination left in place.

10) DOE shall report the location of residual contamination in deed notices and other informational devices. In addition, a copy of any material documenting the location and quantity of residual contamination shall be given to any prospective purchaser/transferee before any transfer or lease. Measures that are necessary to ensure the continuation of land use restrictions or other institutional controls (e.g., proprietary controls such as property easements or covenants) shall be taken before any transfer or lease of the property. DOE shall notify EPA and Ecology at least 6 months before any transfer, sale or lease of any property subject to institutional controls required by a CERCLA decision document so that EPA and Ecology can be involved in discussions to ensure that appropriate provisions are included in the conveyance documents to maintain effective institutional controls. If it is not possible for DOE to notify EPA and Ecology at least 6 months before any transfer, sale, or lease, then DOE will notify EPA and Ecology as soon as possible, but no later than 60 days before the transfer, sale, or lease of any property subject to institutional controls.

11) DOE shall report on the effectiveness of institutional controls for this remedy in an annual report, or on an alternative reporting frequency specified by EPA and Ecology. Such reporting may be for this site alone or may be part of a Hanford site-wide report.

2.12.2.4 Five-Year Review Component of the Selected Remedy

Because hazardous substances, pollutants, or contaminants will continue to be present at the 221-U Facility above levels that allow for unrestricted use and unlimited exposure, a CERCLA five-year reviews will be required. The five-year reviews shall include, but shall not be limited to, reviewing environmental monitoring data, barrier performance data, institutional control effectiveness, and any changes to the land use that are inconsistent with the land use assumptions used to determine whether the remedy selected in this ROD continues to be protective.

2.12.3 Cost Estimate for the Selected Remedy

Table 5 summarizes the cost estimates, including those costs for the selected remedy (Alternative 6).

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the selected remedial action. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial action. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Difference, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within -30 to +50 percent of the actual project cost.

Present value analysis is the standard methodology for evaluating costs of cleanup actions which occur over different time frames. In calculating present value costs, a discount factor of 3.2% (based on the Office of Management and Budget Circular No. A-94, Appendix C) is used to account for the time value of money.

2.12.4 Expected Outcomes of the Selected Remedy

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

2.12.4.1 Residual Risks Post-Achievement of RAOs

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

2.12.4.2 Remediation Time Frame

It is anticipated that remedial action will be implemented using a multi-year phased approach, beginning with preparation of an RD/RA workplan. The RD/RA workplan shall include a detailed schedule (including associated milestones) and cleanup plan for implementing this ROD and will be a primary document under the TPA subject to EPA and Ecology approval. The draft RD/RA workplan shall be submitted to EPA and Ecology for review by December 31, 2006. Once initiated, substantial continuous physical on-site remedial action shall be maintained until all of the cleanup work is completed. The cleanup work shall be coordinated with other cleanup projects in the U Plant Area as well as the 200 Area as a whole. The detailed cleanup schedule shall be consistent with the current TPA milestone to complete all 200 Area remedial actions by September 30, 2024 (TPA Milestone M-16-00).

2.13 STATUTORY DETERMINATIONS

Under CERCLA Section 121, selected remedies must be protective of human health and the environment, comply with ARARs, be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. CERCLA also includes a preference for remedies that employ treatment that significantly and permanently reduces the volume, toxicity, or mobility of hazardous wastes as their principal element and a bias against the off site disposal of untreated wastes. This section discusses how the selected remedy meets these statutory requirements.

2.13.1 Protection of Human Health and the Environment

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

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

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

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy shall attain all ARARs except for RCRA landfill minimum technological requirements for leak detection. In addition, RCRA land disposal restrictions and polychlorinated biphenyl (PCB) requirements shall be satisfied by satisfying the substantive requirements for a treatability variance and a TSCA risk-based determination for the management of PCBs as described below.

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

The in-place disposal of waste currently in the 221-U Facility under the selected remedy would not include liners and a leachate collection and removal system and would satisfy these RCRA landfill minimum technological requirements by satisfying and waiving in part the substantive requirements for an alternative design at WAC 173-303-665(2)(j). Waste would be grout-encapsulated within the canyon, and an engineered barrier would be constructed to provide contaminant containment. Modeling predicts that no contaminants would migrate out of the grout and concrete monolith and to groundwater within 1000 years. Computer-aided modeling has been performed to demonstrate that, once encapsulated in grout and contained within the reinforced canyon structure, contaminants currently identified in the 221-U Facility would not migrate into the accessible environment including the soils around or under the facility for the duration considered for normal liner performance. This approach will prevent the migration of any dangerous constituents into the groundwater or surface water at least as effectively as the liners and leachate collection and removal system. Details of this demonstration are provided in the Final Feasibility Study.

The in-place disposal of waste currently in the 221-U Facility under the selected remedy, however, would not satisfy WAC 173-303-665(2)(j)(ii) alternative landfill minimum requirements for leak detection. This requirement is being waived in accordance with 40 CFR 300.430(f)(1)(ii)(C)(3) because, from an engineering standpoint, it is technically impracticable to construct a leak detection system beneath the canyon building (bottom of structure is approximately 9.1 meters or 30 feet below grade). Again, modeling predicts that no contaminants would migrate out of the grout and concrete monolith and to groundwater within 1000 years. Performance monitoring of the engineered barrier would allow for application of mitigative or preventative action (e.g., increasing barrier thickness) to impede water from reaching the underlying waste. Groundwater monitoring would also be performed to monitor the effectiveness of the remedial action.

Land disposal restricted waste currently in the 221-U Facility includes liquid and sludge that exhibit characteristics (primarily toxicity, such as for mercury or lead) that cause the waste to designate as dangerous waste. Under the selected remedy, in lieu of treatment pursuant to land disposal restriction provisions (e.g., to remove toxic characteristics or thermally treat mercury), alternative treatment will be provided to mitigate risk associated with disposal of this waste within the canyon. For disposal of waste currently located within the 221-U Facility, the selected remedy would satisfy RCRA land disposal restrictions by meeting substantive criteria for a treatability variance in accordance with 40 CFR 268.44(h)(2)(i) because it would be technically inappropriate to treat mercury contained in sludge with the specified treatment method (incineration, retorting, or roasting) considering the limited incremental benefit when

Table 6. Description of ARARs for Selected Remedy

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Hazardous Waste Cleanup/Model Toxics Control Act of 1989, Ch. 70.105.D RCW	Model Toxics Control Act of 1989, WAC 173-340 (as amended January 1996), Specific subsections: WAC 173-340-720 WAC 173-340-730 WAC 173-340-740 WAC 173-340-745 WAC 173-340-747 WAC 173-340-7490 WAC 173-340-7491 WAC 173-340-7492	Relevant and appropriate	Establishes the process and methods used to evaluate risk and develop cleanup standards for soil and other environmental media.	The specified subsections are relevant and appropriate to developing cleanup standards for the selected remedy for the 221-U Facility.
Safe Drinking Water Act of 1974, 42 USC 300 et seq.	National Primary Drinking Water Standards, 40 CFR 141 Subpart G	Relevant and appropriate	Establishes maximum contaminant levels for drinking water.	The selected remedy needs to ensure that migration of contaminants from the 221-U Facility to groundwater does not cause further degradation of the groundwater.
Water Pollution Control/Water Resource Act of 1971, Ch. 90.48 and Ch. 90.54 RCW	Surface Water Quality Standards for Waters of the State of Washington, WAC 173-201A	Relevant and appropriate	Sets water quality standards at levels protective of aquatic life.	Because groundwater below the 221-U Facility discharges to the Columbia River, surface water quality criteria are relevant and appropriate when developing cleanup standards for the selected remedy.
	State Waste Discharge Program, WAC 173-216	Relevant and appropriate	Identifies specific discharges prohibited under the program.	Relevant and appropriate to any stormwater discharged to an engineered structure as part of the selected remedy.
Clean Air Act of 1977, 42 USC 7401 et seq.	National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities, 40 CFR 61, Subpart H Specific subsections: 40 CFR 61.92 40 CFR 61.93	Applicable	Requires that emissions of radionuclides to the ambient air shall not exceed amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. Emissions from point sources shall be measured.	Applicable to the selected remedy because the 221-U Facility is a point source of radioactive emissions.
	National Emission Standards for Asbestos, Standard for Demolition and Renovation, 40 CFR 61, Subpart M Specific subsections: 40 CFR 61.145(a)(1) 40 CFR 61.145(a)(5) 40 CFR 61.145(c) 40 CFR 61.150(a-c)	Applicable	Requires facilities to be inspected for the presence of asbestos prior to demolition, defines regulated asbestos-containing materials, and establishes removal, handling, and disposal requirements.	The selected remedy requires demolition of structural elements of the 221-U Facility that contain regulated asbestos-containing materials.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
	National Emission Standards for Asbestos, Standards for Active Waste Disposal Sites, 40 CFR 61, Subpart M Specific subsection: 40 CFR 61.154	Applicable	Establishes operating requirements for landfills that handle asbestos-containing wastes.	Applicable because of disposal of asbestos waste.
Washington Clean Air Act of 1967, Ch. 70.94 RCW and Ch. 43.21A RCW	Radiation Protection - Air Emissions, WAC 246-247 Specific subsections: WAC 246-247-040(3) WAC 246-247-040(4) WAC 246-247-075	Applicable	Requires emissions to be controlled to assure emission standards are not exceeded. Requires emissions from non-point and fugitive sources of airborne radioactive material to be measured.	Applicable because fugitive, diffuse, and/or point source emissions of radionuclides to the ambient air will result from implementation of the selected remedy.
	General Regulation for Air Pollution Sources, WAC 173-400 WAC Specific subsections: WAC 173-400-040	Applicable	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.	Applicable to remedial actions at the site due to the generation of fugitive dust that will occur during demolition and other types of construction activities (e.g., construction of a barrier).
	Specific subsection: WAC 173-400-113	Applicable	Requires controls to minimize the release of air contaminants resulting from new or modified sources of regulated emissions. Emissions are to be minimized through application of best available control technology.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility acceptance requirements) that emits regulated air emissions. If such treatment is required, this requirement would be applicable.
	Controls for New Sources of Toxic Air Pollutants, WAC 173-460 Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070	Applicable	Requires specific controls for new regulated air emissions.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility standards) that emits toxic air emissions. If such treatment is required, this requirement would be applicable.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Atomic Energy Act of 1954, as amended, 42 USC 2011 et seq.	Licensing Requirements for the Land Disposal of Radioactive Waste, 10 CFR 61, Subparts C and D	Relevant and appropriate	Requires that radioactive waste disposal systems be designed to limit the annual dose equivalent beyond the facility boundary to specified values.	Relevant and appropriate to low-level waste left permanently onsite under the selected remedy.
Hazardous Waste Management Act of 1985, Ch. 70.105 RCW	Dangerous Waste Regulations, WAC 173-303 Specific subsections: WAC 173-303-016 WAC 173-303-017 WAC 173-303-070(3) WAC 173-303-073 WAC 173-303-077 WAC 173-303-170(3)	Applicable	Specifies how to identify dangerous waste. Establishes the management standards for solid wastes that designate as dangerous or mixed wastes.	Applicable to identifying solid and dangerous wastes generated during 221-U Facility remedial actions. The management standards are applicable to the management and disposal of those wastes identified as dangerous/mixed waste.
	Dangerous Waste Regulations, WAC 173-303 Specific subsection: WAC 173-303-140	Applicable or relevant and appropriate	Identifies dangerous wastes that are restricted from land disposal, describes requirements for state-only restricted wastes, and prohibits land disposal of restricted wastes unless treatment standards have been met. Incorporates federal land disposal restrictions including provisions for treatability variances by reference.	Applicable to the disposal of dangerous and/or radioactive mixed waste that will be generated during implementation of the 221-U Facility selected remedy. They are ARARs to the *in situ* disposal of restricted waste pre-existing within the 221-U Facility. In accordance with the provisions of 40 CFR 268.44(h)(2)(i), a treatability variance is granted for mercury associated with legacy waste in the facility.[a]
	Dangerous Waste Regulations, WAC 173-303 Specific subsection: WAC 173-303-665	Applicable or relevant and appropriate	Specifies environmental performance standards, monitoring and testing, and postclosure care requirements for the disposal of waste in landfills.	The selected remedy will meet the alternative design standards of WAC 173-303-665(2)(j)(i) in lieu of the double liner and leachate collection and removal system provisions of WAC 173-303-665(2)(h) for waste disposed within the 221-U Facility. A CERCLA ARAR waiver from the leachate detection provision of WAC 173-303-665(2)(j)(ii) is granted pursuant to 40 CFR 300.430(f)(1)(ii)(C)(3) because construction of a leachate detection system beneath the canyon is technically impracticable.[b]

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Solid Waste Management, Recovery, and Recycling Act of 1969, Ch. 70.95 RCW	Nondangerous Nonradioactive Solid Waste Management, WAC 173-304 Specific subsections: WAC 173-304-190 WAC 173-304-200 WAC 173-304-460)	Applicable	Establishes requirements for the management of solid waste.	Applicable to the onsite management and disposal of solid waste that will be generated during implementation of the selected remedy.
Toxic Substances Control Act of 1976, 15 USC 2601 et seq.	Regulation of PCBs, 40 CFR 761 Specific subsections: 40 CFR 761.50[b][7] 40 CFR 761.61[c]	Applicable	Identifies requirements applicable to the handling and disposal of PCB remediation waste, including PCB remediation waste that is also radioactive.	The risk-based disposal option of 40 CFR 761.61(c) has been selected, and EPA has determined that the selected remedy will not pose an unreasonable risk of injury to health or the environment.
Water Well Construction, Ch. 18.104 RCW	Minimum Standards for Construction and Maintenance of Water Wells, WAC 173-160 Rules and Regulations Governing the Licensing of Well Contractors and Operators, WAC 173-162	Applicable	Establishes minimum standards for design, construction, capping, sealing, and decommissioning of wells. Establishes qualifications for well contractors and operators.	Applicable to the installation of wells that will be required for groundwater monitoring.
Archeological and Historic Preservation Act of 1974, 16 USC 469a		Applicable	Requires that actions conducted at the site not cause the loss of any archeological and historic data. Mandates preservation of the data and does not require protection of the actual facility.	Archeological and historic sites have been identified within the 200 Area, and therefore, substantive requirements of this standard are applicable to actions that might disturb these sites.
National Historic Preservation Act of 1966,16 USC 470	*National Register of Historic Places*, 36 CFR Part 60 Specific subsection: 36 CFR 60.4	Applicable	Requires that historically significant properties be protected and that agencies undertaking projects evaluate impacts to properties listed on or eligible for inclusion on the National Register of Historic Places. Establishes the criteria for evaluating properties for the National Register.	The 221-U Facility has been determined to be a contributing property to the Manhattan Historic District. Mitigation activities have already been completed, and no further action is required.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
Endangered Species Act of 1973, 16 USC 1531 et seq., subsection 16 USC 15 36[c]		Applicable	Prohibits actions by federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect this resource.	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where remedial actions will occur.
Migratory Bird Treaty Act of 1918, 16 USC 703 et seq.	Migratory Bird Treaty Act, 50 CFR 10-24	Applicable	Makes it illegal to pursue, hunt, take, capture, kill, possess, trade, or transport any migratory bird, part, nest, or egg included in the terms of the conventions between the U.S. and Great Britain, the U.S. and Mexico, and the U.S. and Japan.	Three species of birds protected under the Migratory Bird Treaty Act, may nest on or near the 221-U Facility. If these bird species are impacted by the selected remedy, this act will be applicable. It is also applicable to endangered or threatened species that may be identified near borrow sites.
Fish and Wildlife Code of the State of Washington, Ch. 77 RCW	Department of Game Procedures, Ch. 232-012 WAC	Relevant and appropriate	This regulation defines the requirements that the Department of Game must take to protect endangered or threatened wildlife.	May be relevant and appropriate if endangered or threatened wildlife is identified near the 221-U Facility or borrow sites during wildlife surveys.

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

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

weighed against the significant increase in worker risk from radiological exposure. Under the selected remedy, alternative treatment (macroencapsulation in grout and ultimate containment within the 221-U Facility reinforced canyon structure) would be provided.

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

Additional background information on these ARARs can be found in Appendix J of the Final Feasibility Study.

2.13.3 Cost Effectiveness

The selected remedy provides overall effectiveness proportional to its cost. Overall effectiveness was determined through an evaluation of long-term effectiveness and permanence, reduction in toxicity, mobility, and volume through treatment, and short-term effectiveness. Containment of contaminants in place is more cost-effective in the long-term than removing contaminants for subsequent disposal at the ERDF. In addition, under the containment alternative, radiological exposure to remedial action workers will be substantially less than under a removal scenario, such as Alternative 1.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

Grout encapsulation of the waste should effectively solidify liquids in the facility and chemically stabilize the dangerous characteristics of the waste. As noted in EPA Office of Solid Waste and Emergency Response (OSWER) Policy Directive 9487.00-2A, a Portland cement-based treatment process is especially effective in the chemical stabilization of wastes with high levels of toxic metals because at the pH of the cement mixture, most multivalent cations are precipitated as hydroxide or carbonate minerals of very low solubility. The Portland cement-based process is also effective in removing liquids because the reaction of the anhydrous cement powder and water (liquids) incorporates the water into the solid mineral species. Chemical stabilization using fine-grained siliceous (pozzolanic) material (e.g., fly ash) can also provide effective treatment of liquids prior to landfilling.

The primary objectives of the grouting of the canyon void spaces are to provide structural stability, prevent subsidence, and provide effective chemical and physical stabilization; therefore a flowable structural grout with good compressive strength will be used. This will also help ensure the following results:

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

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

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

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

2.13.5 Preference for Treatment as a Principal Element

The NCP establishes an expectation that EPA will use treatment to address the "principal threats" posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). "Principal threat" wastes are those source materials that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds. A "source material" is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure.

Treatment technologies will be employed to address principal threat waste as part of the selected remedy. Principal threat waste in the 221-U Facility falls into two general categories: 1) waste containing greater than 100 nCi/g of transuranic isotopes in specific process vessels within the facility and 2) liquid and non-liquid sludge contaminated with radionuclides and mercury that form heels in the bottom of stainless steel vessels located within the cells and on the canyon deck.

Under the selected remedy, residual materials that would have transuranic isotope concentrations greater than 100 nCi/g after stabilization (such as liquid and sludge identified in a tank in process cell 30) would be removed and dispositioned prior to stabilization in accordance with an approved RD/RA workplan. Most likely, the material would be pumped into small geometrically favorable (for criticality) containers with absorbents or grouted to stabilize the liquid. The material would then be overpacked, as needed, into shielded containers and sent to the Hanford Central Waste Complex for interim storage. This waste would be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, in accordance with an approved workplan and schedule, no later than September 30, 2024. Additional TRU wastes discovered during remedial activities would be removed and stored at the Hanford Central Waste Complex and disposed off the Hanford Site in accordance with an approved workplan and schedule no later than September 30, 2024.

Other contaminants shall be encapsulated in grout and disposed in place. Grout encapsulation of the waste will effectively solidify liquids in the facility and chemically stabilize the dangerous waste characteristics of the waste. Vessels on the deck will be size-reduced to fit into the cells alongside equipment already in the cells. Sludge shall be grouted in place with a mixture of Portland cement and possibly amendments such as zeolites or fly ash to help limit contaminant mobility. The benefit of using amendments will be examined in the remedial design. The void spaces of vessels and the space around vessels within the cells shall be grouted. The grout will serve to treat the radionuclides and mercury by macroencapsulation. The grout will also provide a stabilization function for the structural integrity of the remedy. Waste disposed of within the grouted structure of the 221-U Facility will meet the substantive requirements of the RCRA land disposal restrictions.

Radiologically contaminated debris sent to ERDF for disposal is not anticipated to be treated, except when necessary to meet ERDF waste acceptance criteria or RCRA land disposal restrictions because cost-effective methods to reduce the toxicity, mobility, or volume of radiological constituents at these concentrations have not been identified.

The selected remedy is utilizing treatment to the maximum extent practicable and results in the treatment of principal threat waste, and thus satisfies the statutory preference for treatment as a principal element of the remedy.

2.13.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, and/or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment every 5 years after the commencement of the remedial action.

2.13.7 Onsite Determination

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

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The Tri-Parties reviewed all written comments submitted during the public comment period. Upon review of these comments, a number of clarifications were made in the description of the analysis of alternatives in this Record of Decision, but it was determined that no significant changes would be made to the selected remedy, as it was originally described in the proposed plan. Responses to comments received on the proposed plan can be found in the responsiveness summary in the Appendix.

Appendix: RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY

Introduction

This responsiveness summary was prepared in accordance with the requirements of Section 117 of CERCLA, as amended. The purpose of this responsiveness summary is to summarize and respond to public comments on the *Proposed Plan for the Remediation of the 221-U Facility (Canyon Disposition Initiative)*.

Community Involvement

A public notice was placed in the *Tri-City Herald* on December 13, 2004, announcing the availability of the proposed plan and Administrative Record, and the start of the public comment period. On December 9, 2004 approximately 900 copies of a fact sheet describing the proposed plan were sent out by mail. An electronic fact sheet was sent out on December 13, 2005 to 600 individuals. A public comment period was held from December 13, 2004 through January 31, 2005. The fact sheet stated that a public meeting would be held if requested. No requests for a public meeting were received, therefore, no public meeting was held. The proposed plan was discussed with the Hanford Advisory Board (HAB) River and Plateau committee at three meetings and with the full HAB at the January 2005 meeting.

Comments and Responses

Twelve commenters provided public comments. The comments, along with responses from DOE, EPA and Ecology, are presented below.

COMMENTER: #1

Comment 1: Oregon appreciates the opportunity to review the plans for the 221-U Canyon. We previously submitted preliminary comments to Kevin Leary on November 1, 2004. We have incorporated many of those previous comments into this comment document. We refer you to that correspondence for specific comments on each of the waste sites in the U area and for additional comments.

We fully anticipate that many actions taken at U Plant will set precedent for disposition of the remaining canyon facilities. There are considerable differences between the canyons in terms of the condition of the facilities and the hazards they contain. We appreciate the U.S. Department of Energy (DOE) acknowledging that these differences must be considered and addressed for each individual canyon and their surrounding waste sites.

One action we would like to see from the process so far is the elimination of alternatives 3 and 4 from consideration for the remaining canyon facilities. Since the analysis indicates that alternatives 3 and 4 are inappropriate for 221-U – the least contaminated of the canyons – it seems prudent to save time and expense by not considering these options any further for more contaminated canyon facilities.

Response to Comment 1: The Tri-Party Agencies appreciate your continued interest in the disposition of Hanford's canyon facilities.

The Tri-Party Agencies have reviewed your November 1, 2004 letter. Regarding your comments on waste sites in the U Plant area, the Tri-Party Agencies are analyzing those waste sites in a separate CERCLA evaluation process (i.e., Proposed Plan for the 200-UW-1 Operable Unit). Your waste sites comments will be forwarded to the Ecology representative who is receiving comments on that document. The November 1, 2004 letter also expressed a concern about possible radon emissions. The RESidual RADioactivity (RESRAD) computer code (used to evaluate radionuclide dose and excess cancer risk) evaluated radon and all other daughter products of radioactive decay of waste site contaminants. For the 221-U Facility, the RESRAD evaluation showed that radon does not contribute to risk or dose over the time period of the evaluation (1,000 years). Radon occurs in the presence of natural uranium or in facilities that may concentrate radon for some purpose. The 221-U Facility did not produce nor accumulate radon.

Regarding Alternatives 3 & 4, the Tri-Party Agencies are issuing a Record of Decision on the disposition of the 221-U Facility. As your comment states the disposition of Hanford's other canyon facilities will be evaluated on a case-by-case basis. The inclusion or elimination of any alternatives also will be determined on a case-by-case basis as the disposition of each canyon facility is considered.

Comment 2: We support the preferred alternative 6 for U Canyon. It may not be appropriate for the more contaminated canyons.

Response to Comment 2: The Tri-Party Agencies appreciate your support for the preferred alternative, Alternative 6 (Close in Place – Partially Demolished Structure). As previously stated, the disposition of Hanford's other canyon facilities will be evaluated on a case-by-case basis.

Comment 3: Irreversible and Irretrievable Commitment of Resources
We support including NEPA values in CERCLA documents to the degree it is appropriate. Under CERCLA, it is appropriate to weigh and consider the irretrievable and irreversible consumptive use of resources for an action. It is not however, in our view, acceptable to incorporate claims for harms that have already occurred. We believe it would be appropriate to include a claim for irreversibly and irretrievably committing land to use as a disposal facility under an Environmental Impact Statement, outside of a CERCLA action. We believe it is neither appropriate nor allowable to make such a claim as a part of a CERCLA action, as doing so forecloses on the Natural Resource Injury provisions of CERCLA.

Response to Comment 3: The agencies are not using the CERCLA process to irreversibly and irretrievably designate past natural resource damage claims. The basis for past-practice Natural Resource Damage Assessments (NRDA) exclusions would be ERDA (Energy Research Development Administration) – 1538 "Final Environmental Statements – Hanford Waste Management Operations" 1975. CERCLA is being used for cleanup actions. The alternative evaluation within the 221-U Facility final feasibility study was conducted through CERCLA. Use of the CERCLA process in conducting decommissioning activities effectively integrates EPA oversight responsibility; DOE lead agency responsibility, with state and stakeholder participation. In accordance with DOE Secretarial Policy, the DOE incorporates NEPA values, such as analysis of cumulative, off-site, ecological, and socioeconomic impacts, to the extent practicable, in DOE documents prepared under CERCLA.

Comment 4: Preference for Removal-Treatment-and-Disposal
We previously reviewed and commented on several U area waste site remedial plans and refer you to our November 1, 2004 letter and other comments for specific waste site recommendations. In general, those previous analyses of alternatives showed that in most cases the "remove, treat and dispose" (RTD) alternative met remedial action objectives and was the least expensive alternative. We generally recommended that capped areas be kept as small as possible to minimize costs, borrow and fill materials consumed, and area permanently committed to non-use.

We recently received Fluor Hanford's proposal for capping of waste sites on the central plateau. We are struck by the immense areas that are proposed for capping, and by the immense need for fill materials to produce the caps. These actions will lead to large-scale changes to the Hanford landscape both at the waste sites and at borrow sites. Oregon is mindful that these borrow sites will also be damaged and require restoration. We believe that this injury, and necessary mitigation actions, must be assessed in this decision making process to reach the best overall decision.

Response to Comment 4: As previously stated, the Parties did review your November 1, 2004 letter.

Additional analysis of Alternative 1 (Full Removal and Disposal) and variations of that alternative show it would be significantly more difficult to implement, have greater short-term risk, and cost more with no additional long-term benefit to human health and the environment when compared to Alternative 6. In fact, Alternative 6 provides better protectiveness for human health and the environment due to the grout encapsulation of waste and the robust structural concrete that is left intact. Alternative 6 is the selected alternative for the 221-U Facility.

The Tri-Party Agencies agree with the concept of keeping the capped areas as small as possible. The agencies will work to that goal during final design of the proposed 221-U Facility barrier. The preliminary work done on optimizing 221-U Facility barrier heights/coverage indicates significant savings on area coverage and fill volume may be achieved by minimizing the height of the engineered barrier (based on recent data showing less thickness is needed for effective evapotranspiration caps) and building the side slopes as steeply as technically feasible.

The referenced Fluor Hanford document (*Plan for Central Plateau Closure*) is a contract deliverable to the U.S. Department of Energy. It is a planning tool that provides a comprehensive, systematic look at what scope and activities are needed to remediate the Central Plateau. It identifies planning assumptions and lays out one approach for cleanup. Cleanup actions, however, will be made through the appropriate regulatory decision processes.

An Environmental Assessment (EA) was conducted in 2001that evaluated the potential environmental impacts associated with the use of borrow sources (DOE/EA-1403, *Use of Existing Borrow Areas, Hanford Site, Richland, Washington*), and a Finding of No Significant Impact was issued. The EA calculated a 10-year volume projection need based on new facility construction, maintenance of existing facilities, and transportation corridors and fill/capping material for remedial actions. It estimated approximately 7,600,000 cubic meters (10,000,000 cubic yards) would be needed over 10 years, including 6,100,000 cubic meters (8,000,000 cubic yards) for remedial actions and other waste disposal projects. The EA identified no significant environmental impacts from the excavation and transportation of borrow materials. While the EA did not specifically include the borrow material that would be required for the 221-U Facility (an estimated 460,100 cubic meters or 601,700 cubic yards), the quantity required for the 221-U Facility cap is a small fraction of the quantity analyzed in the EA.

As a planning tool, the *Plan for Central Plateau Closure* assumes that many barriers would/could be built on the Central Plateau over the years to come. If more borrow material is needed to complete the remediation of the Central Plateau than was evaluated in DOE/EA-1403, an additional environmental review and NEPA analysis would be conducted.

Comment 5: Industrial Cleanup Standards
The industrial cleanup standard under CERCLA is predicated on the idea that the area that is being cleaned up will be used for industrial purposes. This continued use of the land serves in part as an institutional control with continued human presence and activity. Re-industrialization of the central plateau has been proposed at Hanford to assure just such a presence.

However, in reviewing the 221-U proposal, we are struck that the cap design(s) being considered preclude precisely this use. The caps are too thin to allow industry to build on them. We wonder what industry DOE expects would use this land, and how it could be used by industry without damaging the caps. If industry cannot or will not use this land, how then is an industrial cleanup standard appropriate?

Response to Comment 5: Site risks analyses for the 221-U Facility were based on the reasonably anticipated future land use for the Central Plateau Core Zone, which encompasses a much larger area than the area affected by the 221-U Facility barrier. While placement of a barrier over the footprint of the 221-U Facility would require some land use limits be established to ensure the integrity of the barrier, such limits would not necessarily preclude all industrial use of the area. For example, the area might be able to accommodate light industrial uses such as warehousing.

Comment 6: Groundwater
The documents refer to groundwater use being restricted for 150 years. We do not agree this is reasonable. Groundwater restrictions are only reasonable during active onsite presence, or for 50 years as was written in the Record of Decision for the Solid Waste Environmental Impact Statement. Thereafter, no institutional

control should be presumed to be effective, and groundwater use should be unrestricted. The lost use of the groundwater, along with the other environmental injuries, should be assessed early to provide decision makers a reasonable estimate of the damages that each alternative represents to better allow for selection of the best alternative.

Response to Comment 6: The 221-U Facility Proposed Plan references an assumed 150-year timeframe of restricted groundwater use, consistent with the Tri-Party Agencies' response to Hanford Advisory Board Advice #132. However, the 221-U Facility post-remediation risk evaluation does include (for information only) a risk scenario of an intruder drilling a well adjacent to the grouted canyon and using the groundwater for drinking and irrigation. The evaluation in the final feasibility study concludes that under Alternative 6, none of the contaminants known to be in the 221-U Facility would reach groundwater within the 1,000-year modeled period. Additional modeling performed to support this responsiveness summary has confirmed these conclusions. Implementation of Alternative 6 will not result in further degradation of the groundwater in the vicinity of the 221-U Facility. Existing groundwater contamination in the area will be addressed through separate cleanup actions. If there are any natural resource damages, the Natural Resource Trustees will address them through the appropriate processes.

Comment 7: Cap Design
Implementation of the CDI will leave long-lived radionuclides entombed in the shallow subsurface. We recommend that additional analysis for cap or cover failure phenomena be conducted and included in the Remedial Design document(s). We are concerned about wind erosion removing cap material from the leading edge of the cap and depositing it on the lee side of the cap. Material removal from the leading edge may accelerate leaching of contaminants into the environment and render the cap ineffective. Deposition of cap or other material on the lee edge of the cover may create a moisture trap that provides storage for moisture that will compromise cap performance, or provide an environment conducive to deeply rooted vegetation that could remobilize contaminants. Monitoring for these conditions should be incorporated into the design and operations plans to be developed.

Response to Comment 7: Detailed slope stability analyses for the engineered barrier were performed using computer model simulations. The results of the analyses are presented in Appendix D of the 221-U Facility Final Feasibility Study. The analyses form the basis for the barrier layout under Alternative 6. During final design, additional modeling will be done to determine the optimum barrier layout and construction and to calculate slope stability. At that time, wind erosion issues will also be addressed.

Cost estimates for Alternative 6 include provisions for quarterly visual inspections. These inspections will look for barrier erosion, settlement, subsidence, displacement, cracking, and vegetative cover status. There will also be annual civil surveys to measure barrier settlement, and an annual application of fertilizers/ herbicides to maintain the vegetative cover. Should wind erosion be detected, measures such as enhancing vegetative cover or application of soil stabilizers (e.g., Soil-Sement®) could be implemented to enhance erosion control.

Under Alternative 6, monitoring will be conducted to assess the performance of the barrier and the need for implementation of various measures/best management practices to mitigate or prevent percolating water from reaching the underlying waste (e.g. thickening of barrier, run-on/runoff water flow controls). The final barrier monitoring design will be detailed in approved remedial design documents.

Comment 8: We are also concerned about lateral movement of water and moisture beneath the cap. Work at the Vadose Zone Observatory, as well as studies and reports from numerous historical documents make it clear that water and waste move laterally in the Hanford soils until there is either sufficient addition of water to overcome the soil features causing lateral movement, or until vertical features like clastic dikes are reached. This phenomenon is clearly associated with how Hanford soils were deposited.

We encourage DOE to incorporate vertical cutoff barriers keyed to the cap(s) in the subsurface to prevent lateral intrusion. The costs of these lateral barriers is small in comparison to the project costs and in comparison to the potential impacts of failing to include them.

The cap/barrier design needs to carefully assess runoff/discharge control from the cap/barrier during both expected conditions and extreme storm conditions – especially for caps that would be adjacent to other caps.

Additionally, the cap/barrier design should be such that it allows for redevelopment of native shrub steppe habitat, including sagebrush. If this is not possible, feasible, or cost effective, offsetting habitat restoration and development actions will be required to replace the lost habitat areas.

Response to Comment 8: The use of vertical cutoff barriers is an important design feature that will be evaluated during remedial design. The remedial design analysis of the barrier system will be based on the best available data for the specific U Plant Area geologic conditions, including information about soil layers that could contribute to lateral transport. Runoff/discharge controls for all expected meteorological patterns, including storms and snowfalls, will also be addressed during remedial design.

Over the long term, all the cap designs currently under consideration would allow for native shrub steppe habitat development.

Comment 9: Modeling
We recommend additional efforts be made to determine how uncertainty may be propagating through the various conceptual and numerical models employed in the decision making process. We are concerned that small changes in design features could dramatically change cap performance over the thousands of years of protectiveness required. We remain concerned that there is a fundamental gap in the technical understanding of the subsurface fate and transport of both water and contaminants. Therefore, we request analysis be conducted that verifies minimum performance standards that must be met to meet risk profiles based on the multiple contaminants that will be entombed within the final structure for thousands of years.

Response to Comment 9: The 221-U Facility surface barrier design will be required to meet performance criteria that will ensure adequate long-term performance. Periodic surveillance and maintenance will indicate any deviations from required performance and allow for corrective maintenance and updated analysis of expected performance. The remedial design analysis will include consideration of lessons learned and technical progress from the ongoing site-wide composite analysis work. (See Section 3.7 of the 221-U Facility final feasibility study.)

The infrastructure to support sophisticated modeling of subsurface transport of contaminants and barrier performance is being continuously improved and compared to data from field demonstrations and actual installed barriers (Dwyer, S.F., *Water Balance Measurement and Computer Simulations of Landfill Covers*, Dissertation – University of New Mexico, May 2003). The remedial design efforts will take advantage of updates in the modeling tools and data sources as they become available.

Comment 10: Monitoring
The proposed caps and barriers – though similar to other barriers used elsewhere – are new and unproven. Monitoring will be necessary to validate the cap and barrier performance.

We recommend that monitoring of subsurface moisture conditions, such as humidity, may provide early information about contaminant mobilization and transport. Accordingly, we recommend inclusion of development and use of performance monitoring and triggering actions in the remedial design document. These triggers should specify the actions that will be required if the trigger levels are exceeded.

Additionally, the history of caps and barriers is quite short. Historically, barriers have been observed to fail in the near term. The proposed barriers should not be presumed to be effective for much more than 50 years without extensive performance monitoring, and without contingency plans in place for what to do if and when the barriers are seen to fail.

Response to Comment 10: While barrier design technology does not yet have a long history, important progress in understanding barrier performance in semi-arid and arid climates has occurred in the past decade (e.g., Desert Research Institute, *Alternative Cover Assessment Project Phase I Report*, October

2002, Publication No. 41183, prepared for the U.S. EPA; ITRC, *Technology Overview Using Case Studies of Alternative Landfill Technologies and Associated Regulatory Topics*, March 2003). There appears to be great promise for evapotranspiration barriers patterned after natural analog sites (i.e., sites where the naturally deposited soil types and layers are used as a basis for the barrier design). The evapotranspiration type barriers appear to provide a high level of protection against excessive water infiltration into a covered waste site over a long time period.

As previously discussed, under Alternative 6 monitoring will be conducted to assess the performance of the barrier so that early action could be taken to mitigate or prevent water from reaching underlying wastes. Specific performance monitoring trigger points and response actions (i.e., contingency plans) will be developed and documented.

For cost estimating purposes, the Alternative 6 barrier has an assumed design life of 500 years. As noted earlier, cost estimates for Alternative 6 include a number of barrier surveillance and maintenance activities (e.g., quarterly visual inspections for barrier erosion, settlement, subsidence, displacement, cracking). In addition, the cost estimates include replacement of the engineered barrier at 500 years (if needed).

Comment 11: Technical Issues
Table 1 in the proposed plan details the representative risks from facility contaminants. It appears that a number of contaminants that should have been included are missing, including: carbon-14, tritium, nitrite, nitrate, sulfate, total petroleum hydrocarbons, hexavalent chromium (separate from total chromium), polcyclic aromatic hydrocarbons, phthalates, polychlorinated biphenyls and possibly others.

Response to Comment 11: The purpose of Table 1 is to show baseline risks that, in some cases, exceed acceptable criteria and so justify a CERCLA response action at the 221-U Facility. The contaminants listed in Table 1 are known to be in the 221-U Facility.

The additional contaminants you list would most likely have to be considered in post-remediation risk evaluations for the alternatives that would import waste into the canyon. These contaminants do not apply to the baseline risk scenario because they are not present in the facility now. The final feasibility study (where a more detailed analysis of all the alternatives is provided) identifies preliminary remediation goals that include these contaminants to allow a comparison of all the alternatives against the criteria.

Comment 12: Table 2 in the proposed plan (as compared to Table 3.3 in the Feasibility Study) appears to be missing preliminary remediation goals for thorium 228, 230 and 232, plutonium 238, 239/240, strontium 90, technetium 99 and uranium isotopes.

Response to Comment 12: The same radionuclides are listed in Table 2 in the proposed plan and Table 3-3 of the final feasibility study; however, the tables are formatted differently. The preliminary remediation goals for the eight contaminants you list are provided in the fifth column of Table 2.

Comment 13: The Feasibility Study relies heavily on the RESRAD model to establish the preliminary remediation goals. The RESRAD model in turn relies on gross assumptions about the behavior of water and waste in the subsurface, and upon model parameters to assess the relative mobility of various contaminants.

The modeling concerns raise substantial uncertainty in the protectiveness assigned to the alternatives that leave waste in place. Additional work and analysis in the field is needed to resolve the vadose zone transport and other issues before deciding on any alternative that leaves waste in place.

Response to Comment 13: The Parties do not believe it is necessary to use models more sophisticated than RESRAD to evaluate contaminant transport through soils to determine preliminary remediation goals (PRGs). For development of PRGs, EPA recommends a tiered evaluation wherein more rigorous evaluations are done only if less rigorous evaluations fail. RESRAD provides a worst-case evaluation of contaminant transport through soils to groundwater. Fate and transport models that are more sophisticated than RESRAD have always indicated that RESRAD is less likely than more sophisticated models to indicate that residual concentrations of contaminants in soils or solid materials are protective of groundwater and the river.

Comment 14: The alternative(s) selected should ensure the complete removal, treatment and proper disposal of the canyon exhaust filters and the sizeable inventory of radioactive cesium and strontium they contain.

Response to Comment 14: Remediation of the canyon exhaust filters and the contamination contained within the filters is outside the scope of this remedial action and will be addressed in future CERCLA actions

COMMENTER: #2

Comment 1: The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Science and Engineering (DOSE) is in receipt of the Department of Energy's Focused Feasibility Study (FFS) for the Canyon Disposition Initiative (CDI) (221-U Facility). The CTUIR DOSE submits the following comments, which are similar to comments previously filed on the FFTF Decommissioning EIS Scoping NOI. A paper copy will follow.

Our analysis of the alternatives indicates that Alternative 1 (remove, treat, dispose) is by far the most logical has the lowest lifecycle costs, uses the least clean fill, is most permanent, and protects Tribal and public health the most.

Response to Comment 1: The Tri-Party Agencies appreciate your interest in and analysis of the disposition of the 221-U Facility and the Canyon Disposition Initiative.

The Proposed Plan provides the results of the evaluations done on the five alternatives against the nine CERCLA criteria for evaluation of remedies. Both Alternative 1 (Full Removal and Disposal) and Alternative 6 (Close in Place – Partially Demolished Structure) satisfy the two essential evaluation criteria for protection of human health and the environment and being in compliance with ARARs (or qualify for ARAR waiver). However, based on our analyses, the Parties believe that partial dismantlement down to the canyon floor level, with in situ placement and grouting of building wastes into available space below the floor level, and capping over the canyon floor with a protective barrier (Alternative 6) is more protective. In this alternative, the grouting is considered an effective treatment while removal and disposal of the facility at the ERDF (only about 1.5 miles away) without grouting is less protective. The removal process under Alternative 1 would also tend to produce smaller waste pieces exposing more contaminates to potential migration or intruders in contrast to the Alternative 6 disposed condition of a grouted monolith inside a thick concrete structure. Alternative 6 also performed the best overall against the five balancing criteria in the CERCLA National Contingency Plan 40 CFR 300.430(e)(9)(iii).

Comment 2: The summary document (DOE/RL-2001-29, Rev 0) does not mention Tribes or Treaty rights. It refers to HAB advice, but completely ignores Tribes. HAB advice is not the same as government-to-government consultation, which is required in the DOE American Indian (AI) Policy. The AI policies of all the other federal agencies including USEPA have this type of language.

Response to Comment 2: The U.S. Department of Energy (USDOE) Richland Operations Office consults with tribal governments pursuant to its *2001 American Indian & Alaska Native Tribal Government Policy* and its *2000 Working with Indian Tribal Nations Guide* for DOE employees. USDOE recognizes its federal trust relationship and has committed to a government-to-government relationship. It recognizes the need to fulfill Treaty and Trustee obligations.

The agencies asked for advice and feedback from the CTUIR on the *Proposed Plan for the Remediation of the 221-U Facility (Canyon Disposition Initiative)* and are committed to providing ongoing opportunities for your input.

Comment 3: We look forward to ongoing discussions about the vision for the remedial actions in the central plateau. We would like to coordinate with you on this topic prior to us setting up a government to government meeting with the CTUIR committee on Science and Engineering. If you have any questions please do not hesitate to call Dr. Barbara Harper or Althea Huesties Wolf of my staff at 541-966-2400.

Response to Comment 3: EPA met and discussed the basis for the preferred alternative with the members of your Committee on Science and Engineering April 27, 2005. The Parties look forward to ongoing discussions with you and your staff on the Canyon Disposition Initiative.

Comment 4: This 221U FFS is intended to serve as the prototype closure for the other canyon facilities in the central plateau. Therefore, we also have to evaluate DOE's preferred alternative in the context of an integrated or cumulative picture for the entire Central Plateau.

Our core values and principles are:

1. Comply with the Treaty of 1855, which reserves rights of access and use across all of Hanford, including the Central Plateau. The NEPA process cannot be used to break Treaties or reduce Treaty rights.

2. Protect human health and the environment as tribal members use their resources and exercise their rights. This means using the CTUIR exposure scenario for risk assessment and for establishing remedial goals and cleanup levels. This also means that a Land Use EIS cannot be used to undermine CERLCA land use requirements. We have not accepted industrial cleanup levels as the PRG for the Central Plateau.

3. If baseline conditions cannot be regained or restored, they will be the subject of Natural Resource injury assessment.

4. Institutional controls cannot be relied on to protect human health and the environment for longer than 50 years. Engineered barriers cannot be relied on longer than one demonstrable design life. Both kinds of control are de facto proof of natural resource injury and lost use during their use.

5. The CERLCA criteria of permanence and retrievability must be carefully defined. To us, "permanence" means permanently safe, not permanently entombed. Entombment is irretrievable, and results in permanent loss of access and use of natural resources, which is one of the definitions of natural resource injury.

6. All caps and barriers must meet near-surface disposal criteria, including external dose rates, liners and leachate collection, erosion prevention, and infiltration (including the umbrella effect). All near-surface waste must meet land disposal and hazardous waste identification rules. All containment must be demonstrated to remain effective for as long as the waste remains intrinsically hazardous and as long as the time period required for radioactive materials to decay to levels that do not present a significant to tribal health and the environment.

7. All long-term legacy or stewardship plans (such as long-term groundwater monitoring, barrier maintenance, and so on) must be funded in full before delisting can occur. Long-term remedial measures demonstrate natural resource injury. However, establishing a permanent (i.e., front-end funded) legacy program with the Natural Resource Trustees would be a mitigative measure.

8. Life cycle risks and costs need to be well-studied. Life-cycle risk profiles [1] for each type of risk (tribal, public, worker, ecological, economic, cultural/social) should be developed. Worker dose is not an acceptable excuse to avoid cleanup. Worker dose limits will not be exceeded by law, whereas tribal or public/intruder risk has different attributes of knowledge, protection, willingness, equity, and occupational dosimetry.

9. Worker doses are not an excuse to avoid remediation. Worker doses will not exceed occupational limits by law - this is why dosimetry is performed for workers. The worker acceptable risk ceiling is 5 Rads per year, by DOE's own Directives. This is equivalent to a public acceptable risk ceiling of 10-6 (Tribes), 10-5 (MTCA) or 10-4 (EPA). Therefore, as long as ALARA is an operational principle along with the occupational dose limit, worker risk is not a decision criterion. The proper way to compare worker and public risk is to define the acceptable risk ceiling for each, and then to design the project so that neither limit is exceeded. Anything under either limit is therefore acceptable by definition and ceases to be a decision driver. The cost associated with preventing excessive worker doses is simply part of the cost of the project, the same as designing a remedy to prevent excessive tribal/public/intruder dose.

10. Ecological and cultural impacts of contamination versus remediation must be formally evaluated in a report. If it is determined that physical disturbance of excavation would be unacceptable, other alternatives must be considered, including non-intrusive decontamination or lateral drilling. Natural resource injury is not alleviated merely because physical disturbance is too great to be selected as a remedy.

11. The impacts of obtaining clean fill or borrow material cannot be designated an I&I commitment of natural resources and therefore written off as acceptable or 'free.' This includes borrow pits, institutional controls, visual resources, land transfer, land use designation, and any other natural or cultural resource impact.

12. Implementation of a remedy selected by regulators in a Record of Decision and delisting of a site or partial site from the NPL does not relieve DOE of its Natural Resource Trusteeship or injury and damage assessment requirements.

Response to Comment 4: U Plant was selected as the pilot because of the five canyons; it was the least contaminated. We believe it will provide several opportunities to test equipment and procedures. Because there are significant differences between the canyon structures at Hanford, each of the canyon facilities will be characterized and evaluated on a case-by-case basis.

We appreciate you providing the Parties with a copy of your core values and principles.

Comment 5: Land Use. The CTUIR does not "acknowledge that some waste within acceptable levels will remain in the industrial-exclusive core zone." This section needs to be rewritten to acknowledge that Treaty rights exist for all of Hanford, including the central plateau.

Response to Comment 5: Both the1999 *Hanford Comprehensive Land–Use Plan (CLUP) Environmental Impact Statement)* (DOE/EIS-0222-F) and *the Record of Decision (ROD): Hanford Comprehensive Land Use Plan Environmental Impact Statement* (64 FR 61615) address land use and Treaty rights.

The tribes were formally invited to be consulting Tribal governments, and the CTUIR were consulted extensively during the development of the *CLUP*. The draft document was revised to include Alternative 4, which represented the CTUIR's vision emphasizing natural and cultural resources. The *CLUP* policies addressed numerous issues, including honoring treaties with American Indian Tribes as they relate to land and resource uses. The 221-U Facility Final Feasibility Study and the Proposed Plan's discussions of land use are consistent with those documents.

Comment 6: Human Health Risk. No mention of Tribal use, and no evaluation of tribal risks using the CTUIR exposure scenario. This is the only program at Hanford that is not using our scenario to evaluate risks. Industrial cleanup levels result in a de facto institutional control, which is a natural resource injury. If the industrial risks are 10-2 then the tribal risks are unity.

Response to Comment 6: In the past the agencies agreed to consider Tribal risk assessment scenarios when conducting required risk assessments that evaluate whether Hanford cleanup alternatives are protective of human health and the environment. The CTUIR's continued involvement in risk assessment processes being conducted for the Central Plateau and other portions of the Hanford Site are appreciated by the agencies.

Risk is calculated using assumptions of exposure to contaminants, which varies according to land use. An intruder scenario assumes that someone could get exposed to contaminants by being somewhere or doing something they are not expected to be/do. Intruder scenarios are used as "worst case" to determine parameters of a risk assessment.

The risk evaluation summarized in Table 1 shows the baseline risks associated with the 221-U Facility if no cleanup work is done. The data show that cleanup of the 221-U Facility is necessary to protect human health and the environment. This finding is valid for any land use scenario including an industrial or Native American scenario.

The footnotes to Table 1 clarify that the maximum risk value that is reported is 10^{-2} per the EPA's *Risk Assessment Guidance for Superfund*, because the linear equation for risk estimation is only valid for contaminant intakes resulting in calculated risks below 10^{-2}. A calculated risk that is at or above 10^{-2} indicates that the baseline risk level at the 221-U Facility is not protective, and that cleanup action is required. The purpose of the table is simply to illustrate that the baseline risks are not protective and that there is a need to take clean up action. The Parties address post-remediation risks in Response to Comment 10.

Comment 7: Pb. It is not true that lead cannot be evaluated as part of a risk assessment even though the IEUBK is used separately. Our board-certified toxicologist can do this. In any event, a soil lead level of >1000 ppm is tremendously high and must be remediated to WAC levels (which are not health protective, but better than 1000 ppm).

Response to Comment 7: Soil lead levels would be addressed during remediation, even though lead blood levels were not calculated in the evaluation of risk. Calculation of the risk indices (cancer risk and toxicity hazard quotient) provided for other contaminants is not possible for lead. Because the risk associated with contaminants other than lead already shows that this site should be remediated, it is not necessary to calculate the risk associated with lead. Normally, preliminary remediation goals (PRGs) are calculated for contaminants in soil. The situation at the 221-U Facility is unique in that the contaminants are inside the facility instead of mixed with soil. As a part of Alternative 6, the contaminants will be sealed in grout and then covered with a barrier up to 15-feet thick, which effectively breaks the pathway for direct contact with the contaminants. The concern for direct contact exposure, and the applicability of PRGs in soil, is more applicable to the 200-UW-1 waste sites than to remediation of the 221-U Facility under Alternative 6. The 200-UW-1 waste sites are being addressed in a separate CERCLA analysis.

Comment 8: Ecorisk. The fact that the U zone is highly disturbed does not mean that there is no ecological risk. This concept is flawed.

Response to Comment 8: The ecological risk discussion referenced in your comment is contained in the Summary of Site Risk section of the proposed plan (page 9). There was no intent in that discussion to imply that, because the area around the 221-U Facility is highly disturbed, there is no ecological risk. In accordance with U.S. Environmental Protection Agency guidelines for preparing a proposed plan (EPA 540-R-98-031, July 1999) this discussion summarizes the baseline risk to the environment presented by the 221-U Facility, assuming no remedial action is taken. The purpose of the discussion is to establish that site risks provide a basis for action at the 221-U Facility.

Comment 9: RAOs. The RAOs are much too vague - they basically say DOE must protect human health and the environment. This gives no guidance on how to balance competing risks, and no criteria for what is acceptable or not. There is no mention of integrated impacts within the central plateau, or between the central plateau and other areas at Hanford. There is no evaluation of the 9 CERCLA criteria.

Response to Comment 9: The level of detail provided in the remedial action objectives is consistent with CERCLA requirements and guidelines. The RAOs incorporate by reference applicable or relevant and appropriate requirements (ARARs) that contain specific cleanup criteria. The 221-U Facility Record of Decision will establish specific cleanup levels that are based on RAOs and ARARs. The ARARS are in *the Record of Decision 221-U Facility (Canyon Disposition Initiative), Hanford Site, Washington,* Section 2.13.2.

Analysis of risk and impact at the Hanford Site are conducted and reported on a site-wide scale via a Composite Analysis, as noted in Section 3.7 of the *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)*, DOE/RL-2001-11. This analysis is a site-wide assessment of the public exposure and risk from all past and possible future onsite discharges and disposals. It is being prepared using a computer model and database that considers cumulative impacts to groundwater attributable to a variety of sources across the Hanford Site. The impact to groundwater from individual facilities is evaluated in individual Remedial Investigation/Feasibility Study Reports (such as the 221-U Facility feasibility study), which are then integrated with the site-wide Composite Analysis effort. The Composite Analysis is the starting point for a tool that will maintain a comprehensive "Risk Baseline" for all of Hanford. This baseline will be updated periodically as detailed risk assessments are conducted for individual waste sites and projects.

Alternatives for cleaning up the 221-U Facility were evaluated against RAOs and ARARs using the 9 CERCLA evaluation criteria in the final feasibility study. That evaluation is summarized in the proposed plan.

Comment 10: PRGs. Again, the tribal scenario must be used to evaluate exposure, which was not done. Then, risk-based PRGs should be developed rather than single-contaminant, single-medium ARARs since there are multiple pathways of exposure and multiple contaminants. This is a perennial point of confusion that can be summarized by the fact that ARARs do not protect tribal health at all, and do not protect the health of the general population if there are multiple contaminants or pathways. The PRGs in Table 2 appear to be single-contaminant, single-pathway ARARs, not risk-based cumulative PRGs. There are no soil-based PRGs. The distinction between groundwater protection and river protection is not clear - why don't all the ARARs protect groundwater? Where is the groundwater point of compliance?

Response to Comment 10: The Parties agreed to use the WAC 173-340 formulas for calculation of risk and PRGs for nonradionuclides to provide evaluations consistent with other remediation sites across the State of Washington.

Typically, PRGs are identified for individual hazardous substances. If multiple contaminants are present at a site, the suitability of using individual PRGs as final cleanup values protective of human health and the environment is evaluated based on site–specific information and the potential for contaminant interaction. In hundreds of waste site cleanups across the Hanford Site since 1989, we are aware of only one site where cleanup levels had to be adjusted downward because cumulative risk goals were exceeded. Qualitative evaluation of the contaminants at the 221-U Facility does not indicate cumulative risk goals are likely to be exceeded.

The situation at the 221-U Facility is unique in that the contaminants are inside the facility instead of mixed with soil. As a part of Alternative 6, the contaminants will be sealed in grout and then covered with a barrier up to 15-feet thick, which effectively breaks the pathway for direct contact with the contaminants. The concern for direct contact exposure, and the applicability of PRGs in soil, is more applicable to the 200-UW-1 waste sites than to remediation of the 221-U Facility under Alternative 6.

Table 2 presents the lowest cleanup levels from evaluation of soil, groundwater, river, and terrestrial wildlife protection. Cleanup levels are based on federal and State of Washington remediation goals. Many contaminants do not have remediation goals for all media. The cleanup levels presented in Table 2 are based on currently available, up-to-date information and so are protective of groundwater, the river, soil, and terrestrial wildlife. For purposes of establishing PRGs for the project, the groundwater point of compliance was set at the boundary of the 221-U Facility waste site. The 221-U Facility cleanup action will protect human health and the environment by greatly reducing all the exposure pathways by which contamination might reach human or environmental receptors. The action will protect soil, groundwater, and surface water.

Comment 11: Specific Comments on Alternatives.

As with the HAB, our default alternative is to remove, treat, and dispose unless there is a compelling argument for selecting another alternative. In the FFS document, six alternatives (plus the no action alternative) are being considered. In reality, Alternative 6 has already been selected and is being used as the budgetary and planning basis.

Alternative 1: Full removal and disposal.
Alternative 2: Decontaminate and leave in place.
Alternative 3: Entombment with internal waste disposal
Alternative 4: Entombment with internal and external waste disposal
Alternative 5: Close in place, fill with soil or concrete.
Alternative 6: Close in place, collapse structure, internal waste disposal, cap.

Response to Comment 11: CERCLA requires a range of potential cleanup actions be developed and evaluated. For the 221-U Facility the potential actions range from taking no action to address the hazards presented by the facility, to complete removal of the facility with subsequent disposal of most of the resulting waste at the Hanford Site Environmental Remediation Disposal Facility. Each alternative was evaluated against 9 separate criteria to determine the preferred alternative. For the 221-U Facility, the Close in Place – Partially Demolish Structure alternative (i.e., grout existing contamination in place under a barrier) was selected for implementation in the record of decision because this alternative meets the 9 CERCLA decision criteria better than any other alternative evaluated. As described in the Addendum to this responsiveness summary, Alternative 6 is more protective, less expensive, has lower short-term impacts, and is easier to implement than the removal alternative (Alternative 1).

DOE has an iterative, multi-year budget process. For planning purposes, DOE selects a "placeholder" alternative around which to build out-year funding requests. This ensures that some level of funding will be set aside to plan and implement a response action at the facility. For out-year budget planning purposes, DOE assumed that Alternative 6 would be selected in the ROD for implementation. If a different alternative were to have been selected in the record of decision, the baseline would have been changed, and funding levels adjusted to support the final decision.

Comment 12: Alternative 1.
In the summary document, this alternative does not seem to be taken seriously and the site does not seem to be fully characterized. The document implies that we don't know whether this alternative could meet PRGs or not. Yet, at the January 27, 2005 meeting a cost analysis was done and this alternative would cost less in the long run, but DOE has not paid half their attention to this one, as they have on Alternative 6; which is presumably the "Preferred Alternative."

Response to Comment 12: All alternatives were evaluated to a similar level of detail in the 221-U Facility final feasibility study, and the results summarized in the proposed plan. As described in the addendum to this responsiveness summary, Alternative 6 is more protective, less expensive, has lower short-term impacts, and is easier to implement than Alternative 1. Facility characterization activities were done using the Data Quality Objectives process and CERCLA methodology. Sample types and locations were approved by the Tri-Party Agencies.

Page 13 of the 221-U Facility proposed plan states that unrestricted cleanup levels may not be achieved by Alternative 1. However, Alternative 1 would meet PRGs. The 221-U Facility PRGs were based on an industrial land use scenario, not an unrestricted land use scenario.

The cost analysis presented on January 27, 2005, was not prepared by the Tri-Party Agencies and was not based on EPA guidelines for cost estimating. EPA has a specific cost estimating methodology for remedial alternatives. Cost comparisons under CERCLA are made based on discounted (present value) costs. This is consistent with industry practice. The methodology accounts for the fact that, over time, the relative value of a dollar decreases. This methodology generates, for each cleanup alternative, a single cost value that factors in the time-value of money, and allows for a fair comparison of the life cycle costs of alternatives that will be implemented over varying time frames. Based on this methodology, the present value cost of Alternative 1 is greater than the present value cost of Alternative 6.

Comment 13: Alternative 2.There is no discussion of this alternative. We concur with dropping this alternative.

Response to Comment 13: Decontaminate and Leave in Place (Alternative 2) was evaluated in detail in the 221-U Facility/CDI Phase I feasibility study and was eliminated from further consideration, because it was not considered protective. It was discussed in Section 2 of the 221-U Facility final feasibility study.

Comment 14: Alternative 3.
This alternative would require 1,500,000 m3 of borrow material, but does not way whether PRGs could be met. The barrier would be reconstructed once, at 500 years (requiring another 1,500,000 m3 of borrow material and disposal of the material from the first barrier), for a total time of 1,000 years, at which time the material would still be highly radioactive. Therefore, this alternative appears to fail the requirement to be safe for unrestricted use, including intruder and tribal risk, at 1,000 years.

Response to Comment 14: This proposed plan assumes industrial, not unrestricted land use. Alternative 3 was not selected for implementation because no viable waste stream was identified for disposal in the 221-U Facility in the timeframe required to support issuance of the record of decision. Should a waste stream be identified in the future for disposal to the facility, detailed waste acceptance criteria would be developed, and risks associated with the waste disposal action would be evaluated to verify that the action would meet PRGs. At that time, additional public review would be required, and the Record of Decision would then be amended.

Comment 15: Alternative 4.
Similar to alternative, but larger.

Response to Comment 15: Alternative 4 was not selected for implementation because no viable waste stream was identified for disposal in the 221-U Facility in the timeframe required to support issuance of the record of decision. Should a waste stream be identified in the future for disposal to the facility, a process similar to the one described in Response to Comment 14 would be undertaken.

Comment 16: Alternative 5.
There is no discussion of this alternative. We concur with dropping this alternative.

Response to Comment 16: Close in Place – Standing Structure (Alternative 5) was evaluated in detail in the 221-U Facility/CDI Phase I feasibility study and was eliminated from further consideration. It was not considered to be a viable alternative because its similarity to Alternative 3 makes it almost redundant. The major difference is that Alternative 5 would provide containment for mostly uncontaminated fill, which does not make effective use of limited resources.

Comment 17: Alternative 6.
This alternative would be smaller than alternative 3, since no additional waste would be disposed and the walls would be collapsed in place. However, this is also a perpetual-care solution, with barrier reconstruction at 500 years. This alternative also appears to fail the criterion of being safe for unrestricted use, including tribal and intruder risk, at 1,000 years.

Response to Comment 17: The barrier reconstruction/replacement at 500 years discussed in the analysis is a conservative assumption and may not be required. The replacement was included as part of the cost estimate to provide for a one-time, significant preventive maintenance action if needed. Natural analogs and recent barrier design work suggest that such reconstruction is not likely to be required.

The remedial alternatives evaluated for the 221-U Facility would greatly reduce all the exposure pathways (including those identified in the Native American scenario) by which contamination might reach human or environmental receptors. Therefore, for all alternatives, risk would be expected to be reduced to less than the guideline risk range of 10^{-4} to 10^{-6} in any scenario. This proposed plan assumes industrial, not unrestricted land use.

Comment 18: DOE's analysis says that all alternatives except the No Action alternative would be protective of human health. However, this assumes that institutional controls will be effective, that the barrier will never fail, all associated remedies for waste sites will function as hoped, and that all materials will be decayed to safe levels in 1,000 years. We do not think that this assertion is supportable. Especially when DOE mentions in majority of the alternatives that, "The use of inert, uncontaminated rubble from other nearby CERCLA demolition activities...will be considered during remedial design," yet in an "Alternative Surface-Barrier Workshop" (11/13/04) it was noted that allowing stones greater than about two inches generated construction flaws and allows woody plants to break down barrier further.

Response to Comment 18: The barrier design is intended to be robust and forgiving of minor construction flaws. The evapotranspiration design mimics natural analogs and is meant to be self healing if subsidence occurs. In contrast, complex multilayer barriers with clay or asphalt layers could tend to develop cracking from subsidence, seismic movement, or wetting/drying cycles.

Performance expectations are that the barrier modeled on natural analogs will in the long run work with nature and behave as the analog does. Because the evapotranspiration barrier designs are likely to be very similar to natural soil structures, minimal maintenance should be required. The use of rubble or demolition debris will be carefully analyzed during remedial design, and controlled during construction of the barrier, to assure it does not introduce performance degradation into the barrier construction. Barrier monitoring will be instituted to assess whether any adverse performance trends can be detected, and if needed, maintenance or other response actions will be taken.

The agencies recognize that constituents may remain in the facility beyond 1,000 years. However, additional modeling done after issuance of the 221-U Facility proposed plan showed that grouting contaminants in place in the robust canyon structure (such as in Alternative 6) is very effective at limiting contaminant movement. Contaminants known to be in the 221-U Facility would not reach groundwater in a 1,000 year time frame from a grouted facility, even if a barrier is not constructed. Should barrier performance vary over time, grouting of the waste provides an extra margin of performance that ensures groundwater will not be impacted. This extra margin will provide contingency for uncertainties in characterization, and also could contribute to protection in time frames past the 1,000-year period evaluated in the risk assessments. The modeling did indicate that if present, extremely mobile, long lived constituents would reach the water table in the 1,000-year time frame if no environmental barrier were present, but would not if the barrier were installed.

Comment 19: Compliance with ARARs.
Since ARARs are not protective of tribal health, and are not protective of anyone's health due to multiple pathways and contaminants, the assertion that the alternatives comply with ARARs (and by inference projection of human health) is unsupportable. There is a statement on page 19 of the summary document that says "EPA and Ecology propose to use a risk-based determination for the purpose of demonstrating no unreasonable risk of injury to human health or the environment..." This statement seems to apply only to PCBs as TSCA waste, and not to other contaminants. The regulators should apply a risk-based (not standards based) criterion to the cumulative contaminants, not just to PCBs.

Response to Comment 19: Applicable or relevant and appropriate requirements (ARARs) are standards, criteria, or limitations under federal and/or more stringent state environmental laws, including RCRA, that apply or are relevant and appropriate to CERCLA remedial actions, unless site-specific waivers are obtained. ARARs are also the applicable or relevant and appropriate laws and bounding conditions that are implemented under CERCLA.

Preliminary remediation goals for the 221-U Facility are based on ARARs. The post-remediation risk evaluation detailed in the 221-U Facility final feasibility study indicates that both Alternatives 1 and 6 will meet remediation goals that are protective of human health and the environment. Risk would be expected to be reduced to less than the guideline risk range of 10^{-4} to 10^{-6} in any scenario.

The Tri-Party agencies have agreed to use the WAC 173-340 formulas for calculation of risk and PRGs for nonradionuclides to provide evaluations consistent with other remediation sites across the State of Washington. Typically, preliminary remediation goals (PRGs) are identified for individual hazardous substances. If multiple contaminants are present at a site, the use of individual PRGs as final cleanup values protective of human health and the environment is evaluated based on site–specific information and the potential for contaminant interaction. Since 1989, hundreds of Hanford waste sites have been cleaned up, and cleanup levels had to be adjusted downward at only one of those because cumulative risk goals were exceeded. Qualitative evaluation of the contaminants at the 221-U Facility does not indicate cumulative risk goals are likely to be exceeded. The 221-U Facility cleanup action will protect human health and the environment by greatly reducing all the exposure pathways by which contamination might reach human or environmental receptors. The action will protect soil, groundwater, and surface water.

With regard to the particular statement on page 19 of the proposed plan, the comment is correct that the statement pertains only to PCBs. The statement is part of a discussion of ARARs governing PCB disposal. Additional information regarding the risk-based determination for PCBs can be found in Appendix J of the 221-U Facility final feasibility study.

Comment 20: Costs.

According to Table 4, Alternatives 1 and 6 are approximately the same cost ($84M and $67M, well within the usual Hanford uncertainty of cost overruns). Several very important cost savings are not accounted for in this analysis. Alternative 1 truly reduces risk while Alternative 6 relies on perpetual care and barriers. Alternative 1 is a permanent final remedy, while Alternative 6 requires continual O&M and barrier reconstruction. Alternative 1 uses much less backfill or barrier material than Alternative 6. Alternative 1 restores natural resource injury, while Alternative 6 perpetuates injury and will result in costly natural resource damages. Environmental justice impacts have not been evaluated correctly; impacts to tribal uses and resources will be significantly more impacted by Alternative 6 than Alternative 1, and tribes are disproportionately affected by any residual waste and institutional controls. Cumulative effects would be much larger with Alternative 6 than with Alternative 1 because Alternative 1 would remove most of its impacts while Alternative 6 would leave a significant amount of waste in place. In the January 20, 2005 HAB meeting, lower costs leaned towards Alternative 1 as well.

Response to Comment 20: Alternative 1 costs 25% more than Alternative 6. If either alternative were implemented and experienced an equivalent percentage of unforeseen overruns, the overall cost would still be lower for Alternative 6.

Under Alternative 6, waste encapsulation in grout and the substantial concrete structure of the canyon building protects human health (including that of any intruder) better than Alternative 1. While Alternative 6 leaves waste in place, Alternative 1 achieves risk reduction at the building site by transferring that risk to ERDF. The additive loss of natural resources and the need for maintenance activities (such as barrier monitoring and repair) are also transferred to ERDF.

The Parties assume that the cost analysis referenced in this comment is the same as the cost analysis presented at the January 27, 2005, HAB meeting. This cost analysis was not prepared by the Tri-Party Agencies and did not follow EPA guidelines for cost estimating. EPA has a specific cost estimating methodology for comparing the costs of remedial alternatives. Cost comparisons under the CERCLA are based on discounted (present value) costs. This is consistent with industry practice. The methodology accounts for the fact that, over time, the relative value of a dollar decreases. This methodology generates, for each cleanup alternative, a single cost value that factors in the time-value of money, and allows for a fair comparison of the life cycle costs of alternatives that will be implemented over varying time frames. The present value cost of Alternative 1 is greater than the present value cost of Alternative 6.

Comment 21: A final note on the Alternatives; it appears that using DOE's and regulators' analysis, Alternative 1 meets RAOs and PRGs better than Alternative 6, and is also much cheaper over its life cycle.

Response to Comment 21: For the 221-U Facility, Alternative 6 was selected as the preferred alternative because this alternative meets the 9 CERCLA decision criteria better than any other alternative evaluated.

As a part of Alternative 6, the contaminants will be sealed in grout and then covered with a barrier up to 15-feet thick, which effectively breaks the pathway for direct contact with the contaminants. The 221-U Facility cleanup action will protect human health and the environment by severing all the exposure pathways by which contamination might reach human or environmental receptors. The action will protect soil, groundwater, and surface water.

Cost issues are addressed in response to comment 20.

COMMENTER: #3

Comment 1: The Nez Perce Tribe's Environmental Restoration and Waste Management Program (ERWM) has reviewed the above-mentioned document.

Since 1855, reserved treaty rights of the Nez Perce Tribe in the Mid-Columbia have been recognized and affirmed through a series of Federal and State actions. These actions protect Nez Perce rights to utilize their usual and accustomed resource areas in the Hanford Reach of the Columbia River and elsewhere. Accordingly, the ERWM responds to actions that impact the Hanford ecosystem.

Response to Comment 1: The Tri-Party Agencies appreciate your time and effort to provide comments on the 221-U Facility Proposed Plan.

Comment 2: ERWM Philosophy of Hanford Cleanup In order to understand our specific comments on disposition of the 221-U Facility we feel it necessary to provide a brief background of the tribe's philosophy concerning cleanup of the Hanford Site. Whenever the tribe is asked to comment on a Hanford cleanup action, the question that always arises is, How Clean is Clean? What level of cleanup should occur at Hanford?

In general, ERWM believes that the ultimate goal of the Hanford cleanup including the canyons should be to restore the land to a safe, unrestricted use condition. ERWM has long held that our ultimate goal for the Hanford site is unrestricted use with no risk to human life and the ecosystems associated with the site. ERWM believes that this level of cleanup is necessary for the Nez Perce Tribe to be able to utilize the site for their usual and accustomed activities. Our view is that the majority of cleanup actions at Hanford are interim measures only. ERWM recognizes the difficulties in accomplishing this goal and are aware of many of the obstacles that must be overcome. To accomplish this long term cleanup goal, ERWM recognizes the following:

1. This goal may require several generations before it is finally attained.
2. The Nez Perce Tribe will continue to work with DOE via its cooperative agreement on cleanup issues to ensure that treaty rights, cultural and natural resources are being protected and that cleanup decisions are protective of human health and the environment.
3. Technology to cleanup or dispose of some contaminants may not yet exist, but as the Department of Energy continues to develop these technologies and they become available, the Nez Perce Tribe will work with the federal government to further reduce the levels of any residual contamination.

Response to Comment 2: The Parties appreciate you sharing Nez Perce ERWM's philosophy on Hanford Cleanup.

Comment 3: The ERWM has reviewed the 221-U Canyon Initiative and feels that of all the alternatives, alternatives one and six are the most reasonable measures to consider.

ERWM believes the best way to avoid future risk to people and the environment is to remove all contaminants. This would mean complete demolition and removal of the building and all the ancillary equipment, and it would require removal and disposal of the radioactive and hazardous materials. ERWM recognizes that such removal (Alternative 1) constitutes a high short-term worker risk and that it is currently impossible to eliminate many of these contaminants. These radionuclides and chemicals will remain a long-term risk, as an ERDF-type disposal will not protect in perpetuity.

However, with some modification Alternative 6 may be the most appropriate resolution. Short-term risk is reduced. Long-term risk is reduced and eventually eliminated when adding the commitment to Alternative 6 to continue research and development of technologies with the goal to render radioactive and chemical hazards harmless. From this perspective, we see Alternative 6 as a reasonable interim remediation action, but not as final clean up for this canyon facility.

Response to Comment 3: The Parties agreed to pursue a CERCLA decision for the final disposition of the 221-U Facility as a prototype for the Canyon Disposition Initiative. All of the active cleanup alternatives evaluated in the 221-U Facility final feasibility study will result in a final cleanup action. The post-remediation risk evaluation detailed in the 221-U Facility final feasibility study indicates that Alternative 6 will meet remediation goals that are protective of human health and the environment. The Parties do not believe that the waste needs to be retrievable because the selected remedy is protective.

Comment 4: ERWM also wants to go on record as stating that we do not believe the process of closure for the 221-U Canyon, which is the least contaminated facility, should be necessarily used as a template for closure of the other four canyon facilities at Hanford. Each canyon will need to be treated separately and appropriate remedial actions determined.

Response to Comment 4: The Parties agree. While 221-U Facility may serve as a prototype, there are significant differences between the canyon structures at Hanford, requiring each of the canyon facilities to be characterized and evaluated on a case-by-case basis.

Comment 5: The ERWM staff appreciates the attention you give to our comments and will continue to monitor and participate in the Canyon Disposition Initiative.

Response to Comment 5: The parties appreciate your comments on this document and look forward to continued discussions with you on the Canyon Disposition Initiative.

COMMENTER: #4

Comment 1: The Hanford Advisory Board (Board) previously advised the Department of Energy (DOE) to make 221-U Facility remediation a priority. Lessons learned from this activity could be germane to other "canyon" facility cleanup. In addition, the analysis of alternatives process resulting in the "Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative) DOE/RL-2001-29" will likely be used as a model for additional canyon clean up plans and remedial actions.

Board Concerns

The Proposed Plan for 221-U remediation raises several concerns, particularly in the lack of breadth and depth of alternative analyses presented in the plan.

- In a review of the Proposed Plan performed by Board members, other reasonable alternatives were identified (see attachment.) As a result, the Board is not confident the Proposed Plan contains a sufficiently wide range of alternatives in sufficient detail to present a compelling case for the selection of alternative #6 as the preferred alternative. This gives the impression that a bias towards capping as a solution may have influenced the analysis and selection process.
- The level of analysis presented in this Proposed Plan is not sufficient for use as a "template" for future canyon cleanup plans.

Response to Comment 1: The Tri-Party Agencies agreed to use the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to clean up the 221-U Facility. CERCLA requires that a range of potential cleanup actions be developed and evaluated. Seven cleanup actions (alternatives) were evaluated in the Phase I feasibility study, which was issued for public review in 1997. The seven alternatives ranged from taking no action to address the hazards presented by the facility, to removing the facility completely and disposing of most of the resulting waste at the Hanford Site Environmental Remediation Disposal Facility.

In July 1997 the Hanford Advisory Board provided comprehensive comments on the Phase I feasibility study. Those comments did not ask the Tri-Party Agencies to evaluate additional alternatives or variations on the seven alternatives. As a result of the screening evaluation performed in the Phase I feasibility study, and input from the public, five cleanup alternatives were carried forward for further evaluation in the final feasibility study.

Each of the five alternatives evaluated in the 221-U Facility final feasibility study was evaluated against nine separate CERCLA criteria to determine the preferred alternative. For the 221-U Facility, the Close in Place – Partially Demolished alternative (i.e., grout existing contamination in place under a barrier) was determined to be the preferred alternative.

During the public comment period for the 221-U Facility proposed plan, the HAB requested that the Tri-Party Agencies evaluate two additional variations on Alternative 1, Full Removal and Disposal of the facility. Additional analyses were done on the two alternatives included in your attachment and are provided in the attached Addendum. Based on this information, the Parties still believe that Alternative 6, Close in Place – Partially Demolished, is the most protective of human health and the environment and best meets the balancing CERCLA criteria. Alternative 6 remains the preferred alternative for the 221-U Facility.

In the CERCLA process, the detailed evaluation of alternatives is presented in the feasibility study and supporting documents, which is available in the Administrative Record. The proposed plan provides a brief summary description of the remedial alternatives, proposes a preferred remedial action alternative, and summarizes the information relied upon to select the preferred alternative. The proposed plan is not intended to provide all the information used by the decision makers. Because the proposed plan is intended to satisfy the information needs of a broader public, it is a constant challenge to present the appropriate level of detail in documents that are used by different and varying audiences. The Tri-Party Agencies will work to improve articulation of the decision logic used in future feasibility studies when preparing future proposed plans.

The cleanup activities at the 221-U Facility, the least contaminated of the five Hanford canyons, may serve as a pilot for the other canyons. There are many lessons from dispositioning this facility that will be able to be applied to the others. The Parties, however, do recognize that there are significant differences between the five canyon facilities and will evaluate each on a case-by-case basis.

Comment 2: A wider range of scenarios should be explored for all alternatives before selecting the preferred alternative and should be clearly communicated for this and all subsequent canyons.

Response to Comment 2: A broader range of scenarios was evaluated in the 221-U Facility Phase I Feasibility Study (1997), as noted in Section 2 of the 221-U Facility Final Feasibility Study. Based on the screening evaluation performed in the Phase I feasibility study and input from the public, only five of the seven cleanup alternatives were carried forward for further evaluation in the final feasibility study. Based on your advice, the Tri-Party Agencies evaluated two variations on Alternative 1. Those evaluations are provided in the attached addendum.

Comment 3: If the preferred alternative changes as a result of the additional analyses, the Proposed Plan should be revised and reissued for public comment prior to finalization and implementation.

Response to Comment 3: In the proposed plan Alternative 6, Close in Place – Partially Demolished was the preferred alternative. After considering all comments received, this alternative was found to best meet the 9 CERCLA evaluation criteria and was selected as the final remedy. The proposed plan will not be reissued.

Comment 4: The Tri-Party Agencies should more clearly identify and communicate how decisions are made in future planning and decision documents.

Response to Comment 4: The Parties plan to continue their on-going Canyon Disposition Initiative dialogue with the Hanford Advisory Board and its committee and will make every effort to better communicate the process and information on which decisions are based.

COMMENTER: #5.

Comment 1: This document is essentially the same as Preliminary (Draft E) of the subject report, which I reviewed in February of 2004. Only one significant bit of information has been added, a partial paragraph stating that the cumulative occupational exposure for Alternative 1 was about 6 times higher that Alternatives 3 and 4, and was about 8 times higher than Alternative 6. However, no actual values of exposure are given for each alternative, which leaves the reader wondering about the actual magnitudes of these exposures, and are they important.

Response to Comment 1: The Tri-Parties agree that it might have been helpful to include the actual values of exposure in the 221-U Facility proposed plan. The values for estimated cumulative occupational exposures are provided in Section 4 of the 221-U Facility Final Feasibility Study, which was available at the Administrative Record and Public Information Repository in Richland, WA or can be accessed at http://www2.hanford.gov/arpir/.

Comment 2: The principal problem with this document is that it does not contain all of the information needed, nor is it assembled in a format useful to a decision-maker. There is no executive summary wherein the alternatives are defined and the preferred alternative is identified. In fact, the reader is not made aware of what alternatives are considered in the plan until Page 7 of the report, and the preferred alternative is not identified until Page 21. The critical information needed by the decision-maker should be presented in the executive summary. The values of the various parameters arising from each alternative should be presented for a side-by-side comparison in the executive summary. The values of those parameters for each alternative that are given in the document don't start appearing until Page 12 of the report, and are dispersed throughout the next 7 pages of discussion on the performance of the alternatives under the nine CERCLA criteria. In my previous comments, I provided a suggested table of information important for the decision-maker to see in order to understand the full scope of impacts of each alternative, for inclusion in the executive summary. This table is presented again, below, with that information available from the current report inserted. Obviously, there is quite a bit of useful information that has not been presented in the subject report, and it leads to the question: were any of these parameters evaluated in the study?

Table ES-1 Information Pertinent to the Comparison of the Considered Alternatives

Parameter	Alternative 1	Alternative 3	Alternative 4	Alternative 6
Net ERDF Volume Used (m^3)	78,000	(3,500)	(63,600)	6,200
Borrow Volume Used (m^3)	86,900	1,500,000	1,400,000	460,000
Area of Containment Cap (m^2)	0	107,874	107,874	58,830
Cum. Occup. Radiation Dose (man-rem)	342	58	58	42
Cum. Post-Closure Dose (man-rem)				
Industrial Scenario	?	?	?	?
Intruder Scenario	?	?	?	?
Active Remediation Period (years)	?	?	?	?
Post-Remediation Period (years)	?	?	?	?
Undiscounted Total Life-cycle Cost (millions of 2001 $)	$95.8	$174.9	$177.4	$125.9

Response to Comment 2: The Parties followed the guidance provided by CERCLA (*A Guide to Preparing Superfund* P*roposed Plans, Records of Decision, and Other Remedy Selection Decision Documents,* EPA 540-R-98-031) to layout the proposed plan. The proposed plan is a summary document written for the general public. It is not intended to provide all the information used by the decision makers. The final focused feasibility study is the technical document and does include the evaluation of parameters you have identified. The availability of it and supporting documents at the Administrative Record and Public Information Repository were noted in both the fact sheet and proposed plan.

The Parties appreciate your suggestions. In the development of future documents, the Parties will consider adding an Executive Summary and/or providing key information earlier in the document to assist the reader.

Comment 3: A subjective comparison of the performance of the alternatives under the nine CERCLA should also be provided in the executive summary, to help support the selection of the preferred alternative. One way to do this is illustrated in the table below. In this subjective comparison, the first two and the last two CERCLA criteria were postulated to be satisfied by all alternatives, leaving the relative performance of each alternative under the five balancing criteria to be evaluated. In the analysis given in the table, each criterion was assigned an equal weight (1), and the performance of each alternative under each of the balancing criteria was assigned a value of (1) if inferior, (2) if about equal, and (3) if superior. Obviously, the values given in the table are mine, and someone else may arrive at different performance values from reading the text in the document. The important thing is that such a comparison should appear in the executive summary. Of course, the decision-maker can also examine the text information and arrive at his own conclusions about what values are appropriate, and which alternative should be preferred.

Subjective Comparison of CDI Alternatives

	CERCLA Balancing Criteria					
Alternative	Long-Term	Reduction	Short-Term	Implement	Cost	Score
Remove (1)	3	2	1	3	3	12
Intact w/o (3)	2	2	2	2	1	9
Intact w/ (4)	2	2	2	2	1	9
Partial dism. (6)	2	2	2	3	2	11

Response to Comment 3: As stated in your comment, use of a numeric rating system requires an individual (evaluator) to assign a value or weight to the various criteria. And as you also stated, it is a subjective process; different people have very different values regarding which criterion is more or less important than another criterion. For that reason, the U.S. Environmental Protection Agency encourages the use of a narrative evaluation that discusses the pros and cons of the alternatives against the criteria, allowing reviewers to evaluate the information against their own values.

Comment 4: The cost information given in the report suggests that the present-value costs should be used to compare the estimated costs for the alternatives. Given the annual authorization nature of DOE funding, wherein no funds can be received and invested to provide for future expenditures, present-value costs are not an appropriate way to look at total life-cycle costs for a DOE project. Rather, the future expenditures should probably be escalated from current-year dollars to the year of expenditure, instead of discounted, when calculating life-cycle costs.

Response to Comment 4: EPA has a specific cost estimating methodology for remedial alternatives (EPA 540-R-00-002, July 2000). Cost comparisons under CERCLA are made based on discounted (present value) costs. This is consistent with industry practice. The methodology accounts for the fact that, over time, the relative value of a dollar decreases. This methodology generates, for each cleanup alternative, a single cost value that factors in the time-value of money, and allows for a fair comparison of the life cycle costs of alternatives that will be implemented over varying time frames.

Comment 5: Another parameter that might be of interest to examine, when considering the disposition alternatives, would be the total amounts of cap area required (in ERDF for disposition in Alternative 1, and the cap area required to cover the residual structure in Alternatives 3, 4, and 6). This comparison would provide a feel for the amount of 200 Area surface that would be permanently removed from future use by each alternative.

Response to Comment 5: The Tri-Parties agree that it might have been helpful to include the requested information in the 221-U Facility proposed plan. The Proposed Plan is a summary document of the feasibility study that has the more detailed technical information. Barrier dimension information for the various alternatives is provided in Sections 4 and 5 and in Appendices F, G, and H of the 221-U final feasibility study.

Comment 6: The large occupational radiation dose estimated for the removal alternative (1) made me wonder whether other reasonable scenarios for removal that would result in lower occupational dose had been considered. As a result, I developed two additional scenarios for removal and evaluated them using the data provided in the FFS for this project. The results of that analysis is provided in a file separate from these comments, for your examination (Considerations on the Proposed Plan for Remediation of the 221-U Facility).

Response to Comment 6: The Tri Party Agencies examined the two additional removal scenarios, Alternatives 1(a) and 1(b), you provided. The explanation of our analyses is contained in the attached Addendum (page 34).

After carefully evaluating your proposed alternatives, the Parties believe both these alternatives when compared to Alternative 6 would result in greater worker risk, be more difficult to implement, and more costly with little or no improvement in long-term effectiveness and permanence. Therefore, the Tri-Party Agencies did not feel that these alternatives warranted further consideration or development.

Comment 7: The strong, safe environment within the lower portion of the canyon suggests that an alternative scenario for Alternative 6 might be to seal up the canyon cells, place an impervious concrete cover over the canyon floor level, and leave the lower structure standing, without an earthen cap. The upper portions of the canyon walls and the roof would be sent to ERDF for disposition. This approach would, however, necessitate cleanup of the waste sites presently planned to be covered by the wall and roof debris and the 221-U cap. An evaluation of this scenario might lead to an better preferred alternative.

Response to Comment 7: There are numerous advantages associated with an environmental cap and filling canyon void space with grout: Some of these advantages include:

- Limiting water infiltration to minimize contaminant migration towards groundwater
- Treating legacy waste to inhibit contaminant transport – thus adding greater (defense-in-depth) protection of human health and the environment
- Meeting the landfill requirements for an environmental cap
- Providing a remedy for nearby waste sites
- Not depending solely on the concrete structure to isolate the waste and prevent contaminant transport.

The alternative you suggest appears to eliminate filling the process cells with grout. In response to comments received, additional modeling was done. The modeling looked at the question of grout treatment and encapsulation as they relate to protection of human health and the environment. The modeling showed contaminant movement is constrained when waste is encapsulated in grout within the thick concrete structure of the canyon. Over a 1,000 year time frame known canyon contaminants are shown not to migrate to groundwater.

Your suggested alternative would include a concrete cap but would eliminate the construction of an environmental barrier. Landfill closure requirements, including construction of a surface barrier over the waste, are identified as Applicable or Relevant and Appropriate Requirements (ARARs) to Alternatives 3, 4, and 6. Natural analogs and modeling performed to support the feasibility study show the potential for successful long-term performance of properly designed evapotranspiration barriers. Additional modeling was performed to assess the potential migration of mobile, long-lived contaminants. While these types of contaminants were not identified in the remedial investigation, there is some potential that they could be present. The modeling showed that mobile, long lived contaminants would not reach the water table in the 1,000-year time frame if an environmental barrier was present, but would reach the water table if a barrier was not installed. This suggests that a barrier would greatly limit the transport of any potentially overlooked mobile contaminants and provide defense in depth against characterization uncertainties. Under your proposal the waste sites currently proposed to be covered by the cap would require additional evaluation, since they take credit for the cap's presence

Comment 8: ERRATA: There is a small discrepancy between the quantity of backfill material needed for Alternative 1 given on Page 13 and the quantity given on Page 20.

Response to Comment 8: Thank you for identifying this discrepancy. There is a typographical error in the value provided on Page 20. The correct value of 89,000 m^3 is presented on Page 13.

COMMENTER: #6

Comment 1: The original focus for the Canyon Disposition Initiative was on using the canyon buildings as final receptacles for radioactive waste from throughout the Hanford complex, creating a number of large, above-surface repositories. Initial consideration was given to (a) in situ filling and grouting the intact structures and capping with protective barriers over the structures (Alternative 3); and (b) the same in situ grouted structures surrounded with other site wastes and capping over the buildings and the surrounding wastes with protective barriers (Alternative 4). Also considered were (c) partial dismantlement down to the canyon floor level, with in situ placement and grouting of building wastes into available space below the floor level, and capping over the canyon floor with protective barriers (Alternative 6); and (d) total dismantlement and removal of the structures, with disposal at ERDF (Alternative 1). Of these four alternatives, only Alternative 1 (the total dismantlement and removal option) truly satisfies the HAB's guiding principle of Remove, Treat, and Dispose, with regard to hazardous and/or radioactive wastes.
All of these proposed alternatives can satisfy the two essential evaluation criteria set forth by CERCLA for protection of human health and the environment, and for compliance with ARARs. Achieving state and community acceptance for any of the four alternatives should be possible. Thus, one is left with examining the five balancing criteria: long-term effectiveness and performance; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The four alternatives are subjectively compared and ranked, based on the discussions given below for performance under the five CERCLA balancing criteria. Each criterion is assigned an equal weight (1), and the relative evaluation of performance under each criterion is assessed as superior (3), neutral (2), and inferior (1).

Subjective Comparison of CDI Alternatives

Option	Long-Term	Reduction	Short-Term	Implement	Cost	Score
Remove (1)	3	2	1	3	3	12
Intact w/o (3)	2	2	2	2	1	9
Intact w/ (4)	2	2	2	2	1	9
Partial dism. (6)	2	2	2	3	2	11

Thus, under this crude scoring system, the removal option is preferred, with the partial dismantlement option the second choice, and the intact in situ options clearly not preferred.

Response to Comment 1: The agencies appreciate the considerable time spent to review the documents and provide such detailed comments.

The initial intent of the Canyon Disposition Initiative was to evaluate remedies that considered the canyons as an asset, a disposal site for Hanford cleanup waste. While a specific Hanford waste stream was not identified during the preparation of the 221-U Facility proposed plan, the option to amend the Record of Decision should such a waste stream be identified does exist well after Alternative 6 actions are implemented.

The discussion below summarizes the detailed evaluation of alternatives contained in the 221-U Facility final feasibility study and examines your suggested preferred alternative with different findings

The HAB guiding principle, remove, treat, and dispose, was seriously considered by the Parties as part of stakeholder input into the CERCLA process. The Parties, however, believe that partial dismantlement down to the canyon floor level, with in situ placement and grouting of building wastes into available space below the floor level, and capping over the canyon floor with protective barriers (Alternative 6) is more protective. In this alternative, the grouting is considered an effective treatment while breaking up the thick concrete structure, removing and disposing of it at the ERDF facility (only about 1.5 miles away) without grouting is considered to be less protective.

Alternatives 1, 3, 4 and 6

All four alternatives result in waste being disposed on the Central Plateau under environmental caps. Alternatives 3, 4, and 6 propose to install an environmental cap over the 221-U Facility after the waste is encapsulated in grout. Alternative 1 proposes disposal at the ERDF, which will have an environmental cap placed over it when it is closed. All four alternatives meet the CERCLA threshold criteria for protection of human health and the environment. Alternatives 3, 4, and 6 would attain all ARARs except for RCRA landfill minimum technological requirements for leachate detection. CERCLA allows for the waiver of ARARs for preferred alternatives under certain circumstances, which are met. The leachate detection requirement is being waived in accordance with 40 CFR 300.430(f)(1)(ii)(C)(3) because it is technically impracticable to construct a leachate detection system beneath the canyon building. The selection of a preferred alternative is based on evaluating the four alternatives against the five balancing criteria.

- Long-Term Effectiveness and Permanence: Alternatives 3, 4, and 6 propose to grout the waste inside the concrete structure. Over the long term disposing of waste inside a thick concrete structure is more protective than disposing of waste at ERDF (Alternative 1). In Alternatives 3, 4 (interior waste only) and 6 the intact concrete structure and grout encapsulation provide greater protection to an intruder accidentally coming into contact with the waste than compared to ERDF where the waste would not be grouted and there would be no concrete structure (Alternative 1).

In evaluating long-term performance, the potential for earthquake deformation of the barrier for Alternatives 3 and 4 is greater than for Alternative 6, because of the increased height of the barrier for Alternatives 3 and 4. Based on these evaluations, Alternative 6 performs the best in terms of long-term effectiveness and permanence.

- Reduction of Toxicity, Mobility or Volume through Treatment: Under Alternatives 3, 4 and 6, grouting the waste effectively treats the waste and reduces contaminant (e.g., metals) toxicity and mobility. Under Alternative 1, contaminated structures and equipment are demolished and placed in ERDF. This alternative results in more surfaces and contaminants being potentially exposed during transport to ERDF. Also, more surfaces are exposed increasing the possibility of leaching after placement at ERDF. Alternative 3, 4, or 6 performs better than Alternative 1 (Full Removal and Disposal) better under this criterion.

- Short-Term Effectiveness: Compared to Alternative 1, Alternatives 3, 4 and 6 expose workers to less risk, both radiological (dose) and industrial. Alternative 1 requires workers to handle or reduce in size more process equipment and contaminated concrete structure. In addition, Alternative 1 requires workers to do more hands-on preparation of the waste for movement to ERDF. Alternative 6 provides the smallest dose to workers; however, because of the large-scale demolition activities associated with this alternative, there are more industrial risks than are associated with Alternatives 3 and 4. Alternative 3 has the smallest worker dose and fewest industrial risks, followed by Alternative 4. Alternative 1 provides a 30-year liner and leachate collection system under the waste, whereas in Alternatives 3, 4, and 6 the thick, concrete structures provide equivalent protection to prevent contaminant migration. Alternatives 3, 4, or 6 perform better under this criterion.

- Implementability: Although there are available technologies, Alternative 1 and, to a lesser extent, Alternative 6 would present technical difficulties associated with large-scale demolition of radiologically contaminated, concrete structures. Alternatives 3 and 4 require significantly higher caps than Alternatives 1 and 6. These higher caps would be more difficult to design and construct. Alternative 4 includes external waste disposal and an associated liner system that could be difficult to implement. Overall, Alternatives 3 and 4 are judged to be more difficult to implement, followed by Alternative 1, with Alternative 6 being the easiest to implement.

- Costs: The present-worth cost for Alternative 6 is $67 million, $84 million for Alternative 1, $111 million for Alternative 3, and $113 million for Alternative 4. Alternative 6 is the least costly alternative.

Close in Place – Partially Demolished Structure (Alternative 6) performs the best when evaluated against the balancing criteria. It provides the best long-term protection of human health and the environment by encapsulating the legacy wastes in grout within the concrete structure. When compared to Alternative 1, Alternative 6 is shown to inhibit more effectively the movement of contaminants to the groundwater and makes human and biota intrusion into the waste more difficult. Alternatives 3 and 4 propose to grout waste within the structure; however, since specific Hanford cleanup waste streams were not identified, the risks associated with Alternatives 3 and 4 cannot be fully analyzed. Also, Alternatives 3 and 4 would require much higher barriers. This increased visual impact needs to be taken into consideration, along with the other NEPA values. Based on these analyses and considerations, Alternative 6 was selected for implementation.

Comment 2: Performance under CERCLA Balancing Criteria

Long-term effectiveness and performance is similar for all alternatives. The ability to provide long-term protection of human health and the environment is essentially the same for all options, whether the wastes are removed, packaged, and transported to ERDF or are grouted in-place within the canyon building structure. All options utilize a final protective barrier over the residual wastes, whether in ERDF or in situ in the buildings. The principal differences arise in the number and size of barrier caps required. The in situ options require a large cap over each facility, i.e., five large caps to cover U, B, T, Redox, and Purex, while the removal option requires one large cap over the ERDF disposal location. The fraction of ERDF cap area attributable to canyon building disposals would be significantly smaller than the combined areas of the five individual canyon caps, thus releasing more surface area in the central plateau for future beneficial use. Centralizing the wastes within ERDF in the removal option has the advantage of reducing the number of barrier caps that would require surveillance and maintenance in perpetuity.

Response to Comment 2: Our analysis shows that long-term protection of human health and the environment is not the same for all options. Alternative 6 has better long-term effectiveness and permanence than the other alternatives. It is true that each alternative would result in placement of the waste under a barrier; therefore, the effect of a barrier in providing long term protection was considered equivalent for all the alternatives. Long-term surveillance and maintenance would be required on any barrier. However, between Alternatives 1 & 6, if a barrier were to fail, Alternative 6 (which calls for encapsulating waste in grout) would be more protective of human health and the environment than Alternative 1 (under which the waste would not be grouted). Grouting would immobilize contaminants, and a thick concrete structure would remain to slow or eliminate contaminant transport and impede intruder access to the waste.

Additionally, under Alternative 1, the concrete structure would be demolished for disposal at ERDF, potentially exposing waste and converting the thick concrete walls into rubble or slabs with much greater exposed surface areas. The added protectiveness of grouting in place that is associated with Alternative 6 was an important factor in the decision to select Alternative 6.

The Parties will evaluate the disposition of other Hanford canyon facilities on a case-by-case basis. The 221-U Facility is considered to be a pilot that will provide important lessons learned to consider in the future. The ROD for the 221-U Facility will not provide a disposition decision for B Plant, T Plant, REDOX, or PUREX.

Comment 3: Reduction of toxicity, mobility, or volume through treatment may be better for the in situ grouted options, compared with the removal option. However, grouting of the packages of waste arising from the removal option prior to transport and disposal would make that option roughly equivalent.

Response to Comment 3: Usually, waste sent to ERDF is not grouted unless it requires special treatment. Grouted waste at ERDF requires special inner waste grout containers, which would add to the cost of disposal. In addition to increased cost, there would be increased worker dose and risk associated with grouting every waste container. The grouting of thousands of waste containers at ERDF increases the amount of exposed contaminated surface area that could result in the spread of contamination to the air and/or surrounding area. Grouting waste in process cells under 6-foot-thick concrete cover blocks minimizes the spread of any potential contamination. Encapsulating equipment in place is more effective in reducing contaminant toxicity and mobility.

Comment 4: Short-term effectiveness involves consideration of cumulative worker radiation dose, potential for industrial accidents, and perturbation of the natural environment. The estimated worker doses range from about 342 person-rem for the removal option, to about 58 person-rem for the intact in situ options, and about 42 person-rem for the partial dismantlement in situ option. Obviously, the lowest-dose option would generally be preferred. However, there are always ways to reduce the worker dose for a given activity, albeit usually at a greater cost of performance (more remote operations, etc.), so it often becomes a cost-dose tradeoff. The difference in doses between removal and partial dismantlement is about 300 person-rem. The difference in costs between removal and partial dismantlement is about $30 million. Thus, one could spend up to $100,000 per person-rem to reduce the worker dose for the removal option and not exceed the cost of the partial dismantlement option. The removal and partial dismantlement options both entail removing large, heavy roof and wall segments for disposition and would have similar potential risks from industrial accidents. Perturbation of the environment involves the amounts of soil that would have to be removed from some on-site location to fill the excavated cavity after plant removal in the removal option, or to build the barrier cap over the canyon floor and cells for the partial dismantlement option. A volume of 86,900 m^3 is estimated for the removal option, as compared with a volume of 460,000 m^3 estimated for the partial dismantlement option. The other two options require even larger volumes (about 1.4 to 1.5 million m^3). Clearly, the removal option would be preferred to minimize perturbation of the environment.

Response to Comment 4: As low as reasonably achievable (ALARA) principles would be followed in the remedial design and remedial action work plan for any selected alternative to achieve the lowest reasonable worker exposures.

Greater dose is expected in any alternative requiring significant hands-on worker involvement. While robotics and other mechanisms can be used to minimize worker exposure, the costs of using such equipment can escalate rapidly with no guarantee that a lower specific person-rem per fixed cost unit can be achieved. In the area of cleanup, one of the lessons learned is that at the onset of a project, reducing worker risk may be inexpensive and fairly easily achieved, but further into a project more complex issues arise that drive up costs without maintaining or reducing worker risk.

You state that up to $100,000 per person-rem could be spent to reduce worker dose for Alternative 1 and not exceed the cost of Alternative 6. Your cost estimate is based on undiscounted costs while our costs are based on present value (non-inflated or discounted).

Under Alternative 6, workers would avoid most activities associated with process equipment and wastes in the process cells, process cell drain header, and pipe trench (the most radioactive areas). The avoidance of worker exposure in these areas results in a significantly lower dose to the workers when compared with Alternative 1. Alternative 1 requires the waste and equipment be removed, size reduced or otherwise prepared, packaged, and shipped to ERDF for disposal.

While both the removal (Alternative 1) and partial dismantlement (Alternative 6) options have worker risk associated with cutting, lifting, and exposure to large, contaminated, concrete slabs, these risks are not the same. The removal option requires many more cuts to be made and slabs to be lifted and moved. Also, the thickness of the concrete to be cut and the weight/size of the slabs to be lifted are greater. In addition, the removal option requires workers to handle materials in the bottom areas of the canyon (e.g., process cells, pipe trench, ventilation tunnel, and drain header) where most of the contamination resides. These activities would increase the likelihood for worker exposure.

The information cited on borrow-material quantities required for each alternative is consistent with information presented in the Proposed Plan. This information was factored into our analysis. While the amounts of geologic materials required favors Alternative 1, preliminary engineering evaluations were performed after the 221-U Facility final feasibility study was completed to evaluate optimizing the engineering barrier thickness and coverage. These preliminary evaluations indicate that the amount of borrow materials required for Alternative 6 could be significantly reduced by eliminating the central rib of the canyon left standing in the final feasibility study evaluation, and by more effectively selecting the coverage needed at the edge of the barrier. Based on these recent evaluations, the difference in the amount of borrow material between Alternatives 6 and 1 could potentially be reduced to a factor of about two versus five currently described in the final feasibility study.

Comment 5: Implementablity is focused on the difficulty of actually performing the activities necessary to accomplish the disposition option, and all options are considered to be implementable. The removal option presents the fewest potential difficulties for performance, because all of the operations are reasonably well-known. The intact in situ options present somewhat more difficulties in emplacing, grouting, and capping. The partial dismantlement option presents lesser difficulties in emplacing, grouting and capping than the two intact in situ options, but somewhat more difficulty than the removal option.

Response to Comment 5: Although the full removal option (Alternative 1) is considered implementable using standard and proven technologies, its implementation is not a typical or routine operation. Associated with large-scale radiological removal actions are significant technical difficulties and safety requirements. The large volumes of radioactively contaminated, demolition debris (such as structural steel, massive concrete, a wide variety of size and configuration process equipment, wastes, and soils) would add considerable complexity to size-reduction, transportation, and disposal activities of this alternative compared to the containment alternatives.

The partial dismantlement option (Alternative 6) also includes some of these large-scale removal activities; however, Alternative 1 requires the highest degree of facility and process systems dismantling. These activities significantly increase worker contact with contaminated equipment and wastes. In addition, more intricate radiological and safety work procedures would need to be developed because of the inherent unknowns associated with total dismantling of the facility and its radiological systems. Implementing Alternative 6 requires grouting, which has been successfully used in similar waste treatments, construction of a large engineered barrier, which has many precedents (e.g., earth fill dams), and uses standard radiological and safety work standards.

Comment 6: Cost is always a driver when considering alternatives. The short-term costs for the partial dismantlement option are estimated to be about $73 million, not including about $53 million in long-term monitoring and repair/replacement costs for the cap. The removal option costs are estimated to be about $95 million, not including about $1 million in costs for monitoring and cap repair/replacement of an appropriate portion of ERDF. The estimated costs for the intact in situ options are much higher. Because DOE is most concerned about near-term costs, their preferred option is partial dismantlement. However, for an honest assessment of costs for a project, it is essential to include any future expenditures to develop the total life-cycle cost. When those future costs are included (in current year dollars), the removal option is about $96 million, the intact in situ options are about $175 to $178 million, and the partial dismantlement option is about $126 million. Clearly, from a life-cycle cost viewpoint, removal is the preferred option.

Response to Comment 6: The present value cost of Alternative 6 is less than the present value cost of Alternative 1. EPA cost estimating methodology for remedial alternatives prescribes that cost comparisons under CERCLA be based on present value (non-inflated, or "discounted") costs. Present value costs are calculated in accordance with Office of Management and Budget Circular A-94 (revised), *Guidelines and Discount Rates for Benefit-Cost Analysis for Federal Programs.* Present value costs are developed for remedial alternatives that are implemented over different time frames. This methodology allows for equitable cost comparisons for alternatives on the basis of a single cost figure that factors in the time value of money. The present value cost of the alternatives does include life-cycle costs, including long-term monitoring and repair/replacement of the cap.

Cost is only one of the nine CERCLA criteria against which alternatives are evaluated. As detailed in the 221-U Facility final feasibility study, Alternative 6 was also the alternative that best satisfied other CERCLA criteria. In other words, Alternative 6 was determined to be the most effective for the least cost and was, therefore, recommended.

Comment 7: The approach postulated for the removal option (Alternative 1), was to remove all of the contaminated material/equipment from the canyon deck, from within the hot pipe tunnel, and from within all of the 40 individual process cells, size-reduce that material as appropriate for packaging in maritime shipping containers, and transport the containers to ERDF for disposal. Because of the anticipated high radiation dose rates associated with the equipment to be removed and size-reduced in many of the process cells, the occupational radiation dose estimated to be accumulated by the workers in performing these actions was rather large, about 248 person-rem, or about 72% of the total worker dose accumulation for Alternative 1. There are several possible variations to the current Alternative 1 scenario, described below, which could greatly reduce the worker dose accumulation, and are worthy of evaluation before a preferred approach is selected.

Response to Comment 7: The Parties have carefully examined the two variations on Alternative 1 (Full Removal and Disposal). A detailed discussion of our evaluation is the attached Addendum. Below is a summary of that evaluation.

Both Alternatives 1(a) and 1(b) would reduce worker dose when compared to Alternative 1. All three of the removal alternatives would place most of the remediation waste in ERDF, which provides a double-lined, RCRA-compliant landfill liner beneath the waste and has centralized institutional controls, surveillance and maintenance, and monitoring. However, none of the removal alternatives would reduce worker dose below those associated with Alternative 6. In addition, encapsulating waste in grout within the canyon’s concrete structure (under Alternative 6) provides additional protection of human health and the environment. Finally, post-remediation controls under Alternative 6 will be integrated across the whole U Plant Area, which will result in efficiencies/cost savings for each individual remedial action in the U Plant Area that are not reflected in the cost analysis presented in the 221-U Facility final feasibility study.

The Parties believe the feasibility of Alternative 1(a) when compared to Alternative 6 would result in greater worker risk, be significantly (and perhaps prohibitively) more complex to implement, and be more costly with no significant improvement in long-term effectiveness and permanence.

Alternative 1(b) would reduce worker dose compared to Alternative 1, but it has about the same dose as Alternative 6, which would remediate the 221 U Facility sooner. Alternative 1(b) would raise considerable implementation issues. Also, there would be additional costs associated with facility preparation, placement and subsequent future replacement of the cover, and long-term surveillance. The increased work and costs associated with this alternative do not result in a significant improvement in long-term effectiveness and permanence.

Comment 8: Alternative 1(a): Removal of the Grouted Process Cells in Large Intact Units The size-reduced canyon floor debris and the segmented piping from the hot pipe tunnel are placed into the process cells and the cells are filled with grout. The canyon structure is already divided into 20 segments by expansion joints in the poured concrete; thus these joints would be the obvious places to separate the process cell units. To reduce the size and weight of these segments, the exterior walls would be removed down to the base mat on both sides, and the lower floors and base mat segments outside of the process cell walls would be sawed free and removed in large segments, similar to the above-grade wall segments. The remaining process cell segments, each segment containing 2 process cells, would be removed intact and transported to ERDF for disposal. These segments are large (about 40 ft x 34 ft x 34 ft) and heavy (about 3400 tons each when filled with grout), but are certainly within the capability of large transporter systems available today. The cell segments would weigh about 1/3 as much as the intact production reactor blocks which were postulated to be removed in one piece and transported to the 200 Areas for disposal as the preferred alternative in the Retired Production Reactors EIS, DOE/RL-0119D.

Response to Comment 8: The Tri-Party Agency response is provided in the attached addendum.

Comment 9: Alternative 1(b): Deferred Removal of the Process Cells The canyon floor debris is size-reduced and placed into process cells. The canyon floor is decontaminated, and the canyon roof is removed in 40-ft segments and placed on the ground. The exterior and canyon walls are removed to the canyon floor level by segmentation into large pieces for disposal. The canyon roof segments are replaced over the canyon floor and grouted into place. A long-lived cover is placed over the existing canyon roof, and the unit remains in passive safe storage for about 75 years (comparable with the retired production reactor safe storage period). Because most of the dose-producing radionuclides are relatively short-lived, the dose rates associated with the hot pipe tunnel and the process cell interiors would have been reduced by about 70% to 80% by decay. Thus, the final removal could be accomplished by removing the grouted canyon roof structure from on top of the canyon floor and segmenting it for disposal. Then, disposal of the lower portion of the canyon building could be accomplished either by (a) removal and size-reduction of material and equipment from the hot pipe tunnel and the process cells, and segmentation of the decontaminated process cells and base mat into appropriately sized pieces for disposal, or by (b) placing the pipe tunnel material into the cells and grouting the cells and removing the process cells in the large segments as described in Alternative 1(a), above.

Response to Comment 9: The Tri-Party Agency response is provided in the attached addendum.

Comment 10: Either Alternative 1(a) or 1(b) would greatly reduce the accumulated worker radiation dose required to accomplish the disposition of the canyon facility, probably reduce the direct costs, improve the overall effectiveness of Removal as compared with Alternative 6, and could result in Alternative 1(a) or (1b) becoming the preferred alternative for canyon disposition. The proposed Alternative 1b may not be politically correct these days, but the reduction in worker dose achieved by a 70 to 80 year delay in the size-reduction and packaging activities (probably on the order of a 70 to 80% reduction) would bring the estimated worker dose down to the same range as Alternative 6, without the complication of using the very large transporters needed for the intact cell block removals of Alternative 1a. Bottom line estimates for Alternatives 1, 6, 1a, and 1b are summarized in the following table.

COMPARISON OF ALTERNATIVES 1, 6, 1a, and 1b

Alternative	1 (demolish)	6 (partial)	1a (intact cells)	1b (demolish)	1b (intact cells)
Timing	immediate	immediate	immediate	75 yr. decay	75 yr. decay
Cost (a)	95.79	125.87	72.64	121.2	102
Dose (b)	341.37	41.44	79.51	42.3	42

(a) Millions of current year dollars.
(b) Accumulated occupational exposure in person-rem.

The values presented in the preceding table are developed in the two following spreadsheets. These calculations were performed to develop estimated costs and worker doses likely to arise under proposed

Alternatives 1a and 1b, by analogy with the values developed for Alternatives 1 and 6 in the Final Feasibility Study for the Canyon Disposition Initiative.

Response to Comment 10: While Alternatives 1(a) and (b) when compared to Alternative 1 would result in reduced worker dose, the Tri-Party Agencies' analysis (see attached Addendum) indicates that worker dose under any removal alternative would not be less than the dose associated with Alternative 6. The Tri-Party Agencies' analysis also indicates that Alternatives 1(a) and 1(b) would present additional, significant implementation issues and costs. But the most important consideration is that the in-place grouting and disposal of waste, followed by capping with a barrier, as envisioned under Alternative 6, is more protective of human health and the environment than any of the scenarios envisioned under Alternative 1, particularly with respect to an intruder scenario.

In addition, the relative costs of CERCLA remedial alternatives must be compared using present value (discounted) costs developed according to CERCLA and OMB guidance. The costs shown in this comment are not present value costs. The Tri-Party Agencies' analysis (see attached Addendum) indicates that both Alternatives 1(a) and 1(b) would be significantly more expensive to implement than Alternative 6 in present value costs.

Comment 11:

EXAMINATION OF COST DIFFERENCES BETWEEN ALTERNATIVES 1 AND 6, FOR THE PURPOSE OF DEVELOPING COST ESTIMATES FOR THE PROPOSED ALTERNATIVES 1a, b

These data obtained from Table K-5 of the Final Feasibility Study DOE/RL-2001-11 Revision 1
The values examined herein are only those items which had different values in Alternative 1 and in Alternative 6.
Those values which were common to both alternatives comprised about $6.2 million of the total estimated cost in both alternatives.

Alternative	1 (millions)	6 (millions)	1a (millions)		1b (millions)
Preparatory Activities	13.98	15.61	13.98		13.98
Canyon Floor and Cells	4.80	1.96	1.96		1.96
Galleries	0.57	0	0		0
Hot Pipe Tunnel	0.54	0.14	0.54		0.54
Ventilation Tunnel Grouting	0	0.5	0		0
Fix contamination and decon	1.03	0.32	0.32		0.32
Waste Site Remediation	1.97	0	1.97		1.97
External Facilities Removal	5.39	20.85	5.39		5.39
Building Demolition	59.03	10.73	40.00	(a)	59.03
Fill Galleries	0	1.44	0		0
Construct Engineered Fill	0	7.42	0		0
Backfill Excavation Cavity	1.26	0	1.26		1.26
Construct Engineered Barrier	0	4.11	0		0
Construct Erosion Protection	0	3.15	0		0
Revegetate	0.03	0.05	0.03		0.03
Establish Monitoring Stations	0	0.3	0		0.3
Long-Term Monitoring (out-year)	0.51	48.98	0.51		28.97
Replace Engineered Barrier(500yr)	0.48	4.11	0.48		0.48
Replace monitoring wells (2 ea.)					0.8
Subtotals	89.59	119.67	66.44		115.03

Deltas for Common Costs	6.20	6.20	6.20	(b)	6.20
Alternative Total Cost (millions)	95.79	125.87	72.64		121.23

(a) This value is comprised of $10.73M demolition, plus $12.0M for excavation, plus $15.0M for transporter system, plus $2.0M for road construction, derived from DOE/RL-0119D, Decommissioning of Eight Surplus Production Reactors, March 1989, with escalation of 25% since 1989.
(b) The value of $6.20M is based on $6.20M from Alternative1 and $6.20M from Alternative 6.
(c) This value for total demolition following 75 years of decay. Alternative 1b with intact removal of cell blocks might reduce this cost by about $19M, to about $102M.

Performing Alternative 1a would reduce the cost by about 24% compared to Alternative 1, and by about 42% compared to Alternative 6.

Response to Comment 11: As previously stated, EPA cost estimating methodology for remedial alternatives (EPA 540-R-00-002, July 2000) uses discounted (present value) costs for comparison of remediation alternatives. This is consistent with industry practice.

The 221-U Facility final feasibility study developed present value costs for each alternative using a 3.2% real discount rate and a 1,000-year period of performance. Your analysis, though thorough and detailed, did not apply the 3.2% discount factor over a 1,000-year period of performance; therefore, the cost data are not comparable.

A basic evaluation of the present value costs associated with Alternative 1(a) indicates that both Alternatives 1(a) and 1(b) would be significantly more expensive to implement than Alternative 6. A detailed cost estimate, based on extensive assumptions about how the proposed Alternatives 1(a) and 1(b) would be completed, would be required to quantify values.

Comment 12:
EXAMINATION OF DOSE DIFFERENCES BETWEEN ALTERNATIVES 1 AND 6, FOR THE PURPOSE OF DEVELOPING A DOSE ESTIMATE FOR THE PROPOSED ALTERNATIVES 1a, b

These data were obtained from Canyon Disposition Initiative: Preliminary ALARA Evaluation for Final Feasibility Study Alternatives 1, 3, 4, and 6, dated May 31, 2001, and from the Updated Preliminary ALARA Evaluation for Final Feasibility Study, Revision 1, Alternative 6, 7/24/2002.

Occupational Dose from Alternatives (person-rem)	1	6	1a		1b	
BEFORE DECAY						
Remove cell equipment	184.52	22.08	0		0	
Remove deck equipment	10.95	10.95	10.95		10.95	
Clean out Galleries	0.92	0	0.92		0.92	
Fix contamination and decontaminate	7.91	1.26	1.26		1.26	
Building Demolition: Above canyon floor	4.48	4.48	4.48		4.48	
Package and Transport equipment w/o decay)	5.3	2.58	2.58		0.52	(a)
AFTER DECAY						
Package and Transport equipment w/decay					0.41	(a)
Clean out Hot Pipe Trench	38.05	0.09	29.57		5.91	
Building Demolition: Below floor to mat	48.51	0	16.17	(b)	9.70	(d)
Building Demolition: Base Mat	40.73	0	13.58	(c)	8.15	(d)

Total Person-rem	341.37	41.44	79.51	42.30

(a) The 2.58 person rem is postulated to be split into 0.52 person rem before decay and to 2.06 x 0.2 after.
(b) Assumes demolition of gallery and tunnel walls and floors between the canyon floor and the base mat represents about one-third as much activity as demolition of the galleries, cells and tunnels in Alternative 1.
(c) Assumes demolition of the mat outside of the cell walls represents about one-third as much activity as demolition of the entire base mat in Alternative 1.
(d) Assumes Alternative 1 dose decayed by 80%

Performing Alternative 1a would reduce the dose by more than a factor of 4, compared to Alternative 1, but would increase the dose by nearly a factor of 2 compared to Alternative 6. Alternative 1b would be nearly equal to Alternative 6, and reduce the dose by about a factor of 8, compared to Alternative 1. Intact cell blocks removal after decay would very slightly reduce the Alternative 1b dose.

Response to Comment 12: In looking at your analysis we did not find some important activities that would result in increased worker exposure and were addressed in Table 4-2 of the 221-U Facility final feasibility study. For example, the dose summary given for Alternative 1(a) does not include dose to fix or remove building contamination as a preparatory work activity (estimated at 7.9 person-rem) or the dose associated with removal of the cell drain header beneath the building (5.7 person-rem). Also, the total person-rem for Alternative 1(a) credits several activities with a decayed dose rate, even though decay is not a condition of Alternative 1(a). These omissions in the calculations result in a lower total dose level for Alternative 1(a). The Parties, however, do agree that a rigorous analysis of Alternative 1(a), would show the overall dose associated with Alternative 1(a) would be less than Alternative 1 but at least double (or possibly triple) the level for Alternative 6.

The analysis for Alternative 1(b) also omits the same work activities noted above. While overall worker dose for Alternative 1(b) would be lower than Alternative 1(a), a more rigorous analysis is required to validate the assumptions made regarding total worker dose after decay. The in-place grouting and disposal of waste, followed by capping with a barrier, as envisioned under Alternative 6, is more protective of human health and the environment than any of the scenarios envisioned under Alternative 1.

COMMENTER: #7

Comment 1: We owned a small orchard in West Richland. Our nephew worked in the orchard as our handyman. We fired him for failing to dispose of trash off the orchard site. The 221-U Facility preferred alternative to Close in Place-Partially Demolished Structure is the same as failing to dispose of trash off the orchard site. Perhaps the parties proposing it merit the same treatment as received by our nephew.

It seems to us that the clean-up plans and work to date on the Hanford site is just about the equivalent of "sweeping the dust under the carpet". A real cleanup would involve turning the site back to the condition it was in 1942.

Response to Comment 1: The agencies are proceeding under CERCLA to clean up the 221-U Facility. CERCLA requires a range of potential cleanup actions be developed and evaluated. For the 221-U Facility, five cleanup actions (alternatives) were identified. They range from taking no action to address the hazards presented by the facility, to complete removal of the facility with subsequent disposal of most of the resulting waste at the Hanford Site Environmental Remediation Disposal Facility. Each alternative was evaluated against nine separate criteria to determine the preferred alternative. For the 221-U Facility, the Close in Place – Partially Demolish Structure alternative (i.e., grout existing contamination in place under a barrier) was selected for implementation.

CERCLA bases cleanup standards on future anticipated land use. The 1999 *Hanford Comprehensive Land–Use Plan Environmental Impact Statement* (DOE/EIS-0222-F) and associated ROD, "Record of Decision: Hanford Comprehensive Land Use Plan Environmental Impact Statement" *(64 FR 61615)*, and *The Future for Hanford: Uses and Cleanup, the Final Report of the Hanford Future Site Uses Working Group* (issued in 1992), identified the area encompassed by the 221–U Facility as an industrial land use area. In the land–use EIS, this area is designated "industrial–exclusive" and is defined as "land areas suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, non-radioactive wastes, and related activities." A portion of the 200 Area (i.e., Central Plateau) for the foreseeable future will be a waste-management area.

COMMENTER: #8

Comment 1: It was my understanding from the 200 Area End State Workshop held August 10 and 11, 2004, that the stakeholders were willing to consider ensuring long term roof integrity, then sealing the canyons and allowing them to stand (uncovered) as monuments. This alternative should be included.

Response to Comment 1: The alternative you identified was considered in the Phase 1 feasibility study, which evaluated a broader range of potential cleanup actions. That feasibility study determined the cleanup alternative you identified did not achieve the goal of long-term protection of human health and the environment, because it postpones final action until some future date. It would require continued surveillance and maintenance of the facility, and over time, it would become increasingly more difficult to maintain the integrity of the structure. Based on that finding, the alternative was dropped from further consideration.

COMMENTER: #9

Comment 1: I have seen the presentation given by the DOE during the Hanford Advisory Board, River and Plateau Committee meeting and have the following comments:

I am not categorically opposed to the selected alternative for disposition of this canyon facility. However, I believe it is over optimistic to believe it will serve as an adequate "pilot" for the disposition of the other canyons. Too many differences exist between each of them for this to be considered useful for that purpose.

Response to Comment 1: U Plant was selected as the pilot because of the five canyons, it was the least contaminated. We believe it will provide several opportunities to test equipment and procedures. Because there are significant differences between the canyon structures at Hanford, the Parties agree each of the canyon facilities will need to be characterized and evaluated on a case-by-case basis.

Comment 2: There is vast difference in grout performance and how it may be utilized for stabilizing waste. Full performance reviews should be done on each of the grouting activity, and anything known about the performance of each. I know this seems better than taking the facility down completely, and hauling it and its contents to the ERDF, but consideration should be given to each type of waste and its potential for needing to be retrieved, before giving the green light to its permanent entombment in the facility itself. As for the concrete, rebar, etc, it really matters little, where its final resting place may be as far as the environment is concerned.

Response to Comment 2: Grout performance will be carefully considered during the remedial design phase of the CERCLA action. Performance objectives will include flowability, compressive strength, setting times, effectiveness in encapsulating and immobilizing contaminants, and heat of hydration. Different grout formulations may be needed in different parts of the facility for optimum treatment of waste, placement characteristics, and structural properties.

The Feasibility Study identified only one category of waste that will need to be removed. That is the small amount of transuranic waste identified during characterization. After that waste is removed, the preferred alternative, Close in Place – Partially Demolished Structure, will meet criteria for long-term protection of human health and the environment.

Comment 3: Great care must be taken that any action provides the very best of final results. I believe the HAB has remarked any decision about waste should not take it to a point where future technology may not be able to deal with it better than current methods. It may take some effort to make a sensible decision with the foregoing in mind, but that effort should most certainly be made.

Response to Comment 3: Under CERCLA there is a preference for permanent remedies, which is one of the reasons why the waste will be grouted in place. This will help ensure the protectiveness of the remedy by minimizing the mobility of contaminants. CERCLA remedies must be protective of human health and the environment. The Parties believe this remedy is protective of human health and the environment.

COMMENTER: #10

Comment 1: For the 221-U Facility, I am in favor of the "Close in Place – Partially Demolished Structure. Thanks for the chance to comment.

Response to Comment 1: Thank you for your feedback in support of the preferred alternative, Alternative 6 (Close in Place – Partially Demolished Structure).

COMMENTER: #11

Comment 1: It's a new year and an OLD plan – DO <u>NOT</u> bury the 221-U Facility or any other radioactive waste in grout! It will <u>not</u> sit quietly for thousands of years – someone out in the future will need to get all that grout off the waste and deal with it properly – store it in some way to make it easy on them.

Response to Comment 1: As stated in the Responsive Summary introduction, the Parties pursued a CERCLA decision process for the final disposition of the 221-U Facility. Under CERCLA there is a preference for permanent remedies, which is one of the reasons why the waste will be grouted in place. This will help ensure the protectiveness of the remedy by minimizing the mobility of contaminants. CERCLA remedies must be protective of human health and the environment. The Parties believe this remedy is protective of human health and the environment and no other actions are necessary.

COMMENTER: #12

Comment 1: I support the choice of the recommended Alternative Six (Close in Place – Partially Demolished Structures) in ***Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)***, DOE/RL-2001-29, Rev. 0, November 2004.

Response to Comment 1: Thank you for your comment in support of the preferred alternative, Close in Place – Partially Demolished Structure.

Comment 2: I did not see anything indicating when this work would be initiated, although the document states that it would take 9 to10 years to achieve RAOs. I would like to see work started as soon as funding becomes available to:

- Decontaminate the outside railroad tunnel and wing walls
- Stabilize and disposition identified Transuranic material
- Stabilize (or remove) contamination on interior surfaces, in the hot pipe trench, and inside the cells and three galleries
- Size reduce and dismantle contaminated legacy equipment currently on the canyon deck and place it into the cells
- Fill the cells with grout, including filling tanks and pipes with grout

- Maintain the canyon structure sufficiently to keep radioactive and hazardous materials inside the canyon.

Response to Comment 2: The current Hanford Site baseline shows 221-U Facility remedial design work funded in the near term, while initiation of actual field work is deferred to the fall of 2010. Although the Tri-Party Agencies would like to see the initiation of fieldwork (such as the actions you cite in your comment) before 2010, the 221-U Facility budget needs must be balanced against the needs of projects that address urgent risks. DOE and the regulatory agencies continually re-evaluate funding priorities, and the expectation of the regulatory agencies is that preparatory field work could begin sooner.

Comment 3: When the canyon is demolished, consider taking the walls down as close to ground level as is reasonable, with demolition debris kept either inside the canyon footprint, although it would be acceptable to place such waste inside the cells before the cells are grouted. This should help to minimize the size, thickness and consequently the cost of the final engineered barrier.

Response to Comment 3: The Parties are exploring ways to minimize barrier height. The footprint (area covered by the barrier) is a major design issue that will be addressed during final design. Concepts such as the ones you identify will be considered during remedial design.

Alternative 6 does cut the walls at deck level, which is near ground level on the northwest side of the building. This approach is the most reasonable from the perspectives of structural design and implementability. The thick concrete deck and cover blocks remain in place as a protective feature.

Comment 4: Consider using the Pipe and Electrical Galleries for disposal of containers filled with acceptable waste forms, such as was proposed in Alternative 3, provide it is cost effective when compared with disposal at ERDF.

Response to Comment 4: Placement of waste containers into the canyon galleries was considered in the 221-U final feasibility study under Alternatives 3 and 4. Neither of these alternatives was selected as the recommended remedial action. At this time, the Parties do not anticipate bringing other Hanford cleanup waste to the 221-U Facility for disposal. However, if a viable Hanford waste stream is identified for disposal at the facility, it would require an amendment to the ROD, including a public process on that proposed amendment.

ADDENDUM

Discussion of Alternative 1(a): In the Smith and Davis whitepaper proposal Alternative 1(a) is presented as a variation on Alternative 1. The authors believe this alternative would improve short-term effectiveness by reducing the accumulated worker radiation dose required to accomplish the disposition of the canyon facility, result in lower removal and disposal costs, and improve the overall effectiveness of Alternative 1 when compared to Alternative 6 (Close in Place – Partially Demolished Structures). While worker exposure under Alternative 1(a) could be expected to be lower than Alternative 1, the Parties do not believe it would result in an improvement over Alternative 6. In Alternatives 1(a) and 6, equipment located on the canyon floor would be handled in a similar manner and workers would be expected to receive the same dose. However, workers would receive an additional dose under Alternative 1(a) during removal of gallery equipment and piping, the pipe trench, and cell drain header. These activities are not performed in Alternative 6. Based on worker exposure data from the final feasibility study, these additional activities are likely to more than double the radiation dose workers would receive compared to the amount received under the Close in Place – Partially Demolished Structures Alternative.

Alternative 1(a) has greater complexity associated with the removal, transportation and disposal of very large and heavy pieces of the canyon building at the ERDF. Based on our calculations when compared to Alternative 6, Alternative 1(a) is going to result in greater demolition, transportation, and disposal costs and not improve overall effectiveness. Below are some examples of implementability and cost issues the Parties identified with Alternative 1(a).

<u>Implementability/Cost Concerns for Demolition of 221-U</u>:

- To reduce size and weight of the remaining process-cell segments, Alternative 1(a) would remove the below-grade gallery, pipe trench, and building ventilation walls. We calculate to allow equipment access to lower portions of both sides of the building would require a 20 foot wider excavation along both sides of the canyon as compared to the excavation identified in Alternative 1.

  The sawing technologies, such as the use of diamond wire saws, described in Alternative 1(a), would also require the excavation at the bottom of the building to be at least 7 feet deeper than described in Alternative 1. This is needed to allow for deployment of a horizontal boring machine at each expansion joint to bore a 48-inch hole under the foundation to the other side. Then the wire saw would need to be threaded through that hole to make the cuts needed to separate building sections. Horizontal boring in 200W soils would be a difficult job due to the rocky nature of the deposits.

- The increased excavation requirements needed to support building demolition and horizontal boring for Alternative 1(a) would result in an estimated 50% increase in the amount of soil that would need to be excavated compared to Alternative 1. This additional excavated material would be screened in the field for contaminants and the excavated material piled for later use as fill. A portion of the soil around 221-U is contaminated (e.g., soil waste sites). That contaminated, excavated soil would likely require ERDF disposal, which will increase ERDF disposal costs. Because more soil is excavated, more backfill material would be required, which will impact both cost and borrow sites.

<u>Implementability/Cost Concerns for Transport/Disposal to ERDF</u>:

- In the EIS for *Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EISL-0119F*, the reactor block transport plan called for boring horizontal holes through the foundation and inserting steel I-beams. The area under the reactor blocks would be excavated to create space to position two large transporters and transfer the building load to the I-beams and transporters. Alternative 1(a) recommends adapting this EIS approach, including costs, for the loading and transporting of individual segments of the 221-U Facility for disposal to ERDF. Using 1990 cost data from the EIS escalated to 2005 dollars, the transport costs for each building segment, to go a shorter distance than the movement of the reactor blocks, would be about $1.9 million. The two required transporters would cost about $18.8 million. Total estimated transport costs from 221-U to ERDF for 20 building segments is approximately $57million in today's dollars.

- Deploying a large-capacity crane to lift the 221-U building segments on to a transporter (an option to the one described in the EIS methodology) poses its own unique set of challenges. The overall approach to lifting very large building segments, including design and construction of the lifting system and its attachment to the building, would require considerable engineering to develop a safe and effective lifting plan. If a mobile crane with sufficient lifting capacity could be identified and made available to support the project, the crane could lift the 221-U building segments, place them on a transporter to be ferried to ERDF for unloading and disposal, and then returned to the 221-U Facility for another load. However, if a suitable mobile crane could not be located, two stationary cranes would be needed, one at 221-U Facility and one at ERDF. One could anticipate considerable crane-standby costs due to the lengthy preparatory time between lifts at both the 221-U Facility and ERDF. The estimated four-month cost projection to remove segments of the 100 K East fuel storage basin using a crane with a 2,000-ton lifting capacity is about $1.3M (not including DOE or PHMC oversight). Also, only a few cranes exist in the world capable of lifting the anticipated 3,400-ton loads described in Alternative 1(a), and they would be expected to be more costly to procure or lease than the 2,000-ton crane.

- Construction of a dedicated haul road at least 1.5 miles in length would be required between the 221-U Facility and ERDF. The road would need to be designed and constructed to support very heavy and wide loads. It would need to incorporate very gentle ramp grades (not greater than about 5%) exiting the 221-U Facility excavation and entering ERDF. At a 5% slope, these ramps are estimated to be over 1,400 feet long. The present ERDF ramp is 8% grade and would not be suitable or wide enough for extremely large vehicles with a 3,400-ton load. Design and relocation of various overhead and underground utilities between 221-U Facility and ERDF would be required. Construction of such a road would have negative ecological impacts, e.g., destruction of habitats. Given these other factors discussed, the Parties believe the Smith and Davis estimate of $2M for the haul road is a significant under estimation.

- Moving very large building segment overland on transporters to ERDF raises concerns about their ability to make the trip intact. The original design of the 221-U Facility did not consider stresses involved with freestanding building segments or with the handling and transporting of these segments over long distances. If a building segment should crack or fail while being transported to ERDF, the result could be exposure of chemicals and radiologically contaminated materials to the environment. Structural engineering evaluations would be needed to assess the capability of each building segment to withstand stresses associated with transport to and unloading at ERDF. Design and construction work would likely be needed for each of the 20 building segments to reinforce and strengthen them to improve the likelihood of making the trip to ERDF, including loading and unloading, without structural failures.

<u>Implementability/Cost Concerns for Disposal at ERDF</u>:

- In evaluating Alternative 1(a) one needs to also consider the potential impacts to ERDF, e.g., those areas within an ERDF cell where transporters would travel. Special site preparations would be needed for approximately one-half of the bottom of an ERDF cell to minimize damage to the underlying lining and leachate collections systems when moving and depositing building segments. The loads on the liner system from the large transporters are likely to be much higher than any of the existing loading scenario evaluated for the ERDF landfill liner system.

  Loads from the crane, feet/tracks and transporter wheels at the ERDF would have to be evaluated to ensure no damage would occur to the underlying lining and leachate collections systems when lifting building segments. Site preparation activities at the ERDF would be needed at each crane setup location to minimize this risk.

- Placement (i.e., layout and spacing) of these 20 building segments within the ERDF would be a challenge. Placement, including sufficient working space between segments, would occupy at a minimum 20% of an ERDF cell. Additional space would be needed for demolition materials from the upper canyon, galleries, pipe trench, ventilation tunnel and drain header. As much as 30% of an ERDF cell could be occupied by the total amount of waste disposed. Alternative 1 would occupy an estimated 10% of an ERDF cell.

- ERDF disposal costs for Alternative 1(a) are anticipated to be more than for Alternative 1. These costs can be attributed to three factors inherent in Alternative 1(a): 1) requiring substantially more site preparations, 2) special handling requirements for the large building segments, and 3) occupying more space in an ERDF cell.

In summary, the Parties believe the feasibility of Alternative 1(a) when compared to Alternative 6 would result in greater worker risk, be significantly (and perhaps prohibitively) more complex to implement, and be more costly. Both Alternatives 1(a) and 6 would result in the disposal of grouted structural monolith(s) or blocks under an engineered surface barrier, and include long-term monitoring of the barrier and groundwater. To achieve this end state for Alternative 1(a) requires a more complicated set of activities – demolition, preparation and transport of large, grouted canyon segments - with eventual disposal under a similar surface barrier only about 1.5 miles away. These activities would be significantly more costly, with no significant improvement in long-term effectiveness and permanence. Therefore, the Tri-Party Agencies did not feel that Alternative 1(a) warranted further consideration or development.

Discussion of Alternative 1(b): In the 1996 Agreement in Principle that outlined the process for the clean up of the 221-U Facility, the Parties decided to pursue a final (as opposed to an interim) disposition of the 221-U Facility as a prototype for the Canyon Disposition Initiative. Alternative 1(b) would require the Parties and the public to defer completion of the 221-U Facility cleanup for up to 75 years. Deferring work could undermine the significant level of work completed, e.g., new characterization work would be needed.

Like Alternative 1(a), Alternative 1(b) is presented as a variation of Alternative 1 that would improve short-term effectiveness by reducing the accumulated worker radiation dose to disposition the 221-U Facility. Under Alternative 1(b), worker exposure (after 75 years) is estimated to be lower than Alternative 1 (342 person-rem). However, the dose rates for Alternatives 1(b) and 6 are essentially the same (42 person-rem), and the final disposition of the facility would be achieved sooner under Alternative 6 (Close in Place – Partially Demolished Structures).

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Also, Alternative 1(b) is discussed as being cheaper and improving the overall effectiveness of Alternative 1 compared to Alternative 6. However, Alternative 1(b) would have many of the same implementability and cost issues that were described for Alternative 1(a). In addition, there would be costs associated with facility preparation, placement and subsequent future replacement of the cover, and long-term surveillance. The Parties believe Alternative 1(b) would be more costly than Alternative 6 since it requires similar tasks as Alternative 1 or Alternative 1 (a), which have higher costs than Alternative 6, and would require additional costs for an interim 75-year surveillance and maintenance period and associated long-lived cover. These additional costs would be incurred with no significant improvement in long-term effectiveness and permanence, and no significant decrease in worker exposure over Alternative 6; therefore, the Parties did not feel Alternative 1(b) warranted further consideration or development.