APPENDIX F.4

FINAL REACTOR DISPOSITION (RC-DD-3, RIVER CORRIDOR) EVALUATION UNIT SUMMARY TEMPLATE

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PART I. EXECUTIVE SUMMARY

EU LOCATION

The 100 area of the Hanford Site along the Columbia River

RELATED EUS

Not applicable

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

The six (6) cocooned reactors are currently designated less than Hazard Category 3.

The report entitled *Surplus Reactor Auditable Safety Analysis*, BHI-01172 Rev.3, prepared by Bechtel Hanford and approved in August of 2004, provides information on estimated radionuclide inventories as of March 1, 1985 for B, C, DR, F, KE and KW reactors. It concluded that B, C, DR, F, KE and KW buildings "all have equivalent inventories of transuranics (e.g., Pu 239 and Americium 241), which are the primary dose contributors."

The specific radionuclides addressed in the Surveillance and Maintenance Reports (S&M Reports) for the 105-C, 105-D, 105-DR, 105-F and 105-H Reactors are:

Americium-241
Barium-133
Calcium-41
Cobalt-60
Cesium-137
Carbon-14
Chlorine-36
Europium-152 and -154
Nickel-59 and -63
Niobium-94
Plutonium-239
Strontium-90
Tritium (H-3)

The radionuclide inventory provided in the S&M Report for the 105-N Reactor contains additional radionuclides.

Non-radionuclide constituents, specifically, Asbestos and Lead, are expected to be present in significant amounts as well.

BRIEF NARRATIVE DESCRIPTION

This EU contains six of the nine water-cooled, graphite-moderated reactors constructed along the Columbia River by the US. Government within the Hanford Site's 100 Areas (Figure 1) to support the plutonium production effort initiated in 1942. They are designated C, D and DR, F, H, and N. Each of these reactors has been placed in final shutdown, declared surplus by the DOE, and placed in Interim Safe Storage (ISS). This consists of demolishing part of the reactor building and non-essential buildings

on the site and construction of a safe storage enclosure (SSE) over the reactor block ("cocooning" the reactor building). They are also under long-term monitoring programs pending final disposition.

Table F.4-1. Reactor Operation Dates and Current Status

Reactor	Began Operations	Terminated Operations	Status
D	December 1944	June 1967	Cocooned in 2004
F	February 1945	June 1965	Cocooned in 2003
H	October 1949	April 1965	Cocooned in 2005
DR	October 1950	June 1967	Cocooned in 2002
C	1952	1969	Cocooned in 1998
N	1963	1987	Cocooned in 2012

Source: Prepared from Hanford Reactor Summaries www.Hanford.gov/ (About Us/Projects & Facilities)

Not included in this EU is the 105-B Reactor Building, which was the first full-scale production nuclear reactor ever constructed and placed on the National Register of Historical Places on April 3, 1992, by the National Park Service *(NRS)* of the U.S. Department of the Interior (USDI). The 105-KE and 105-KW Reactor Buildings were third-generation design plutonium production reactors, and larger in size than the six older reactors with about twice the production capacity. They are currently undergoing the final stages of demolishing non-essential buildings in preparation for ISS.

Two remedial alternatives have been developed for these cocooned reactors. Safe storage of the reactors followed by deferred one-piece removal is the preferred method as noted in the 1993 ROD. The alternative of immediate dismantlement was evaluated in Supplemental EIS in 2010. The N Reactor was not included in the ROD and no decision has been reached on its final disposition.

SUMMARY TABLES OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table F.4-2 provides a summary of nuclear and industrial safety related risks to humans and impacts to important physical Hanford site resources.

Human Health

A Facility Worker is deemed to be an individual located anywhere within the physical boundaries of the individual reactor buildings while conducting S&M; a Co-located Person (CP) is an individual located 100 meters from the facility; and Public is an individual located at the closest point on the Hanford Site boundary not subject to DOE access control, which in this instance is the west bank of the Columbia River. The nuclear related risks to humans are based on unmitigated (unprotected or controlled conditions) dose exposures expressed in a range of from Not Discernible (ND) to High. The estimated mitigated exposure that takes engineered and administrative controls and protections into consideration is shown in parentheses.

Groundwater and Columbia River

Direct impacts to groundwater resources and the Columbia River have been rated based on available information for the current status and estimates for future time periods. These impacts are also expressed in a range of from *Not Discernible* (*ND*) to *Very High*.

Ecological Resources[1]

The risk ratings are based on the degree of physical disruption (and potential additional exposure to contaminants) in the current status and as a potential result of remediation options.

Cultural Resources[1]

No risk ratings are provided for Cultural Resources. The Table identifies the three overlapping Cultural Resource landscapes that have been evaluated: Native American (approximately 10,000 years ago to the present); Pre-Hanford Era (1805 to 1943) and Manhattan/Cold War Era (1943 to 1990); and provides initial information on whether an impact (both direct and indirect) is KNOWN (presence of cultural resources established), UNKNOWN (uncertainty about presence of cultural resources), or NONE (no cultural resources present) based on written or oral documentation gathered on the entire EU and buffer area. Direct impacts include but are not limited to physical destruction (all or part) or alteration such as diminished integrity. Indirect impacts include but are not limited to the introduction of visual, atmospheric, or audible elements that diminish the cultural resource's significant historic features. Impacts to Cultural Resources as a result of proposed future cleanup activities will be evaluated in depth under Section 106 of the National Historic Preservation Act (16 USC 470, et. seq.) during the planning for remedial action.

[1] References throughout this Evaluation Unit Summary Template supporting analyses related to Ecological Resources and/or Cultural Resources may be found in Appendices J and K, respectively. Refer to the specific EU when searching for the reference.

Table F.4-2. Risk Rating Summary (for Human Health, unmitigated nuclear safety basis indicated, mitigated basis indicated in parentheses (e.g., "High" (Low)).

Population or Resource		Evaluation Time Period Active Cleanup (to 2064) **Current Condition:** ISS and S&M	 **From Cleanup Actions:** Final D&D
Human Health	Facility Worker	***S&M***: Low (Not Discernible (ND))	***Proposed method***: ND ***Alternative***: Low
	Co-located Person	***S&M***: Low (ND)	***Proposed method***: ND ***Alternative***: Low
	Public	***S&M***: ND	***Proposed method***: ND ***Alternative***: Low
Environmental	Groundwater[(a)]	ND	ND
	Columbia River[(a)]	ND	ND
	Ecological Resources[(b)]	Low to Medium	High to Very High
Social	Cultural Resources[(b)]	**Native American** Direct: Known Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: Known Indirect: Known	**Native American** Direct: Known Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: Known Indirect: Known

a. Threat to groundwater or the Columbia River from Group A and B primary contaminants (PCs) (Table 6-1, CRESP 2015) remaining in the vadose zone. There are no vadose zone inventories associated with this EU (i.e., cocooned reactors are considered isolated from the vadose zone during the evaluation period), and thus no threat to the vadose zone, groundwater, or the Columbia River.

b. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report.

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH POPULATION OR RESOURCE HUMAN HEALTH

Current

The six reactors in RC-DD-3 are in an interim safe storage state. They will remain in that condition until at least 75 years from the issuance of the Record of Decision (ROD) (58 Federal Register [FR] 48509) that followed the environmental impact statement (EIS), *Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland Washington* (DOE 1992). The 75 year safe-storage period was determined to be an adequate time for decay of cobalt-60 and partial decay of cesium-137, radionuclides that contribute significantly to occupational dose. This period permits the reactors to be

decommissioned with less occupational radiation dose than in the case of immediate one-piece removal. The safe-storage period for all but the first reactor is actually longer than 75 years because the reactors would be decommissioned in sequence at estimated 1- to 2-year intervals. During the safe storage period, surveillance, site and facility inspections, radiological and environmental surveys, and site and facility maintenance would be carried out.[2]

Seismic Event: A 2004 Auditable Safety Analysis[3] postulated that a seismic event would result in a structural failure of the 105-KE and 105-C Reactor Buildings. The 105-KE Reactor was selected for analysis because its graphite stack inventory is larger than the 105-B, 105-C, 105-DR, or 105-F graphite stack inventories also being reviewed. The 105-C Reactor Building was selected because of its high cobalt-60 inventory. The impact of the building collapse onto the reactor block was assumed to breach the biological and thermal shields and crush 1% of the graphite into a fine (i.e., respirable) powder. The radiological consequences were calculated assuming a ground-level, point source release and adverse atmospheric dispersion conditions. The estimated dose to the FW (in this instance anyone within 30 meters of the point of release) is 1.7 rems, the Co-located Person is 0.22 rems, and to the Public is $4.6x10^{-3}$ rems.

Unmitigated Risk: Facility Worker – Low; CP – Low; Public – ND

The major receptor at risk is the facility worker inside the SSE at the time of this NRH event. Based on the hazard evaluation, there are no safety class or safety-significant structures, systems, or components. The low relative risk of S&M activities is primarily maintained by passive barriers (e.g., asphalt emulsion covering the FSB walls and floor and the thermal and biological shields surrounding the reactor core) and work control processes and safety management programs.

Mitigation: Facility Worker – ND; CP – ND; Public – ND

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Proposed: The currently proposed final disposition involves SSE for 75 years followed by a one-piece removal of the reactor block and transport via truck to ERDF.

Transportation Accident: It is postulated that the reactor block falls off the tractor-transporter, breaking the shielding, and releases powdered graphite, which is resuspended by wind action for 8 hours before recovery crews cover the block. (A small fraction of the graphite will be in the form of powder, a caused by thermal expansion and contraction and by past removal of some of the metal channel liners that extend through the graphite block.) The short duration is postulated because of the presence onsite of firefighting crews and other emergency-response crews who would quickly bring the accident under control. The dose to the maximally exposed individual would vary with the time of year, and be an estimated 80 millirem in the autumn.[4]

Unmitigated Risk: FW, CP and Public – ND

The 75-year delay before such removal would take place would allow radioactive decay of short- and intermediate-half-life radionuclides such as cobalt-60, thereby reducing both worker radiation exposure during disposal operations and the total radionuclide inventory in the material removed. Such a delay

[2] US Department of Energy, *Addendum (Final Environmental Impact Statement): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F, December 1992.
[3] US Department of Energy, Richland Operation Office, *Surplus Reactor Auditable Safety Analysis*, BHI-01172. Rev. 3, August 13, 2004.
[4] US Department of Energy, *Draft Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, March 1989

would, therefore, also mitigate the radiological impact to the general public resulting from potential accident scenarios.[5]

Alternative: The Alternative disposition proposal involves an immediate removal and dismantlement of the reactor block and transportation of most of the materials by rail car to ERDF.

Transportation Accident: It is postulated that a collision occurs at a railroad crossing with a vehicle transporting a flammable liquid such as gasoline. While the graphite would not burn, the impact results in powdered graphite being resuspended for 8 hours within the updraft caused by the fire. Here again, the short duration is postulated because of the presence onsite of firefighting crews and other emergency-response crews who would quickly bring the accident under control. The dose to the maximally exposed individual would vary with the time of year, and be an estimated 0.2 rems in the autumn.[3]

Unmitigated Risk: FW, CP and Public – Low

Groundwater, Vadose Zone, and Columbia River

There are no reported vadose zone inventories (i.e., reported inventories are in the cocooned reactors that are considered isolated from the environment during the evaluation period) and thus no significant threats to the vadose zone, groundwater, or the Columbia River for the purposes of this Review.

Ecological Resources

Current

Past activities have degraded the resources within the EU and to some extent, within the buffer area. The impacts are mitigated by creation of habitat for bats and roosting birds. Note, habitat restoration for bats is within the 100-F buffer area. While infrequent, the monitoring and surveillance of the reactor buildings has the potential of introducing exotic species. River bank habitat is within the EU and buffer zone of 100-N reactor.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Remediation options will affect the river corridor resources, such as disruption of ecological communities, introduction of exotic species, disruption of soil communities (including invertebrates) due to soil compaction by heavy equipment and truck traffic. The potential for contamination in the soil and vadose zone below the reactors may require extensive excavation that would affect the river corridor resources. Construction activity and noise can disrupt loggerhead shrike and other sensitive wildlife. Construction of temporary buildings associated with cleanup will increase pedestrian, car and truck traffic on a daily basis. The widening of roads necessary for remediation and transport of reactors will result in disruption of ecological communities outside the EU and buffer area.

Cultural Resources

Current

Known eligible TCP located within the 100-N Area. Known National Register eligible and listed archaeological sites, districts and TCPs located within 500 meters of various portions of the EU. Area within the EU is heavily disturbed, but the entire area is extremely culturally sensitive based on historic

[5] US Department of Energy, *Supplemental Analysis: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F-SA, July 2010

land use in the area. Known National Register eligible archaeological sites associated with the farming landscape located within 500 meters of the 100-F & 100-H Areas.

Manhattan Project/Cold War significant resources have already been mitigated; B-Reactor (a National Historic Landmark) has been selected for preservation and inclusion in the Manhattan Project National Historic Park.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Due to high cultural sensitivity of area, consultation may need to occur. Archaeological investigations or monitoring may also need to occur. Direct and indirect effects are likely to archaeological sites and traditional cultural places. The widening of roads necessary for remediation and transport of reactors will result in disruption of ecological communities outside the EU and buffer area.

Considerations for Timing of the Cleanup Actions

The 75-year safe-storage period in the proposed final reactor disposition plan was determined to be an adequate time for decay of cobalt-60 and partial decay of cesium-137, radionuclides that contribute significantly to occupational dose. This period permits the reactors to be decommissioned with less occupational radiation dose than in the case of immediate one-piece removal.

Near-Term, Post-Cleanup Risks and Potential Impacts

"No significant additional cumulative impact from decommissioning the surplus production reactors is expected in conjunction with existing or reasonably foreseeable future actions at the Hanford Site."[1]

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

100-BC-2, 100-DR-2, 100-FR-2, 100-HR-S, AND 100-KR-2

COMMON NAME(S) FOR EU

Final Reactor Disposition, 105-C, 105-D, 105-DR, 105-F, 105-H, and 105-N Reactors

KEY WORDS

D&D, Reactors, Interim safe storage ("cocooned"), residual radioactivity, final disposition

REGULATORY STATUS:

Regulatory basis

CERCLA

Applicable regulatory documentation

Record of Decision; Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, WA (58 Federal Register [FR] 48509)

Draft Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EIS-0119D, March 1989

Addendum (Final Environmental Impact Statement): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EIS-0119F, December 1992.

Supplemental Analysis: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EIS-0119F-SA, July 2010

Applicable Consent Decree or TPA milestones

Milestone M-093-00 "Complete final disposition of 100 Area surplus production reactor buildings" has a TBD compliance date.[6]

RISK REVIEW EVALUATION INFORMATION

Completed

August 19, 2016, updated February 20, 2017

Evaluated by

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Ratings/Impacts Reviewed by

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PART III. SUMMARY DESCRIPTION

CURRENT LAND USE

Industrial

DESIGNATED FUTURE LAND USE

Conservation, Unrestricted[7]

PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

Not applicable

High-Level Waste Tanks and Ancillary Equipment

Not applicable

Groundwater Plumes

Not applicable

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[6] US Department of Energy, *2016 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL.2015-10, Revision 0. December 2015

[7] US Department of Energy, *Addendum (Final Environmental Impact Statement): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F, December 1992.

Operating Facilities

Not applicable

D&D of Inactive Facilities

The report entitled *Surplus Reactor Auditable Safety Analysis*, BHI-01172 Rev.3, prepared by Bechtel Hanford and approved in August of 2004, provides information on estimated radionuclide inventories as of March 1, 1985 for B, C, DR, F, KE and KW reactors. It concluded that B, C, DR, F, KE and KW buildings "all have equivalent inventories of transuranics (e.g., Pu 239 and Americium 241), which are the primary dose contributors."

The principal radiological contaminants of interest (greater than 10 curies in aggregate within each reactor) in the 105-C, 105-D, 105-DR, 105-F and 105-H Reactors are:

Carbon-14
Tritium (H-3)
Cobalt-60
Nickel-63
Cesium-137
Europium-152
Calcium-41
Chlorine-36.

The 105-N Reactor also has the following additional contaminants of interest:

Europium-154
Niobium-93m
Nickel-59
Strontium-90
Zirconium-89
Yttrium-90.

LOCATION AND LAYOUT MAPS

The six reactors are located in the 100 Area along the Columbia River.

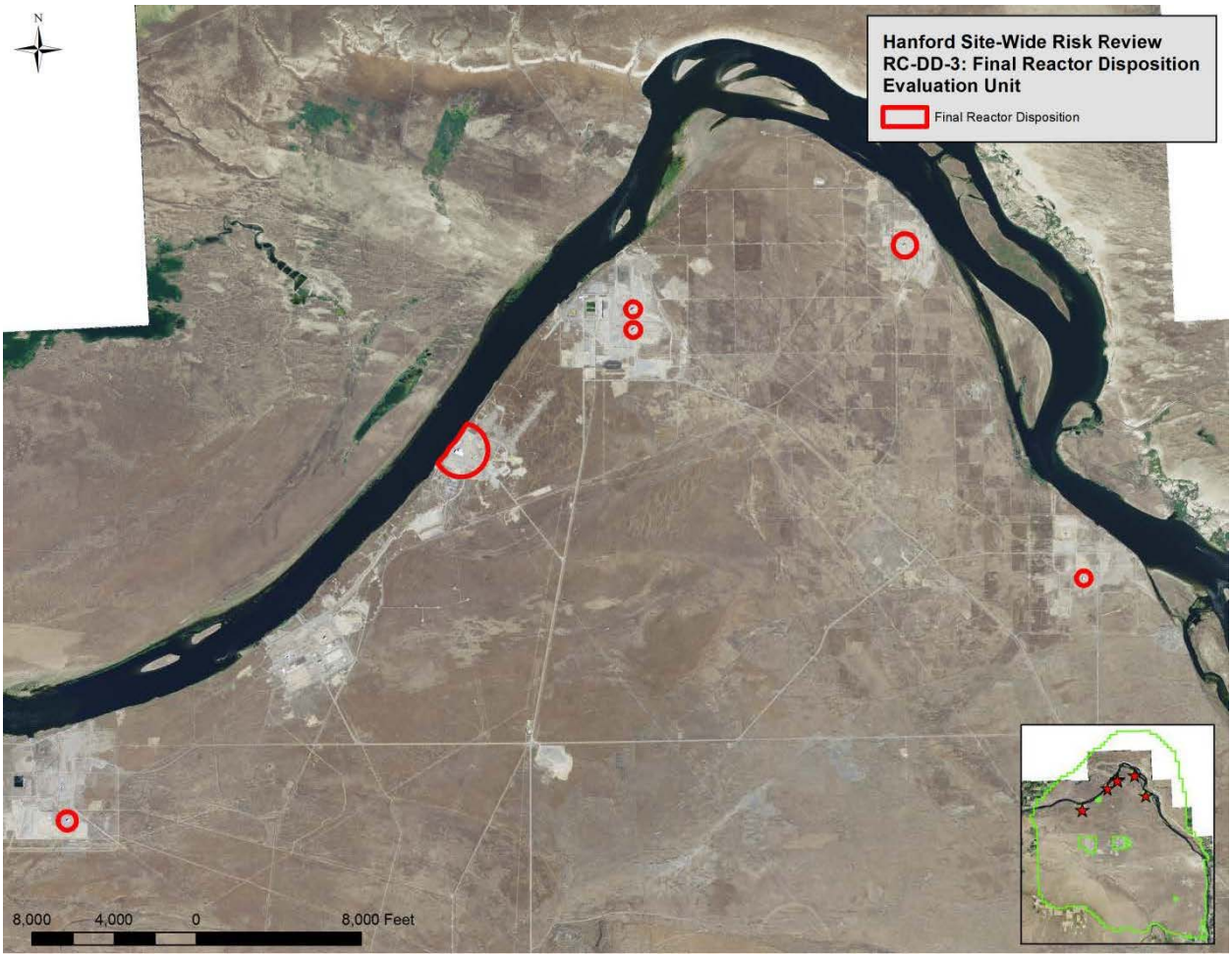

Figure F.4-1. Reactor Locations along Columbia River.

PART IV. UNIT DESCRIPTION AND HISTORY

EU FORMER/CURRENT USE(S)

This EU discusses six of the nine water-cooled, graphite-moderated reactors constructed along the Columbia River by the US. Government within the Hanford Site's 100 Areas (Figure 1) to support the plutonium production effort initiated in 1942. Two of these reactors were built during World War II (1944–1945) and four were built during the Cold War (1949–1963). The reactor buildings contain the nuclear reactor and equipment directly associated with reactor operations. Cooling water for the reactors was withdrawn from the Columbia River, filtered and treated, pumped through the reactor block, and then returned to the river in a single-pass process. Each reactor has been placed in final shutdown, declared surplus by DOE and placed in Interim Safe Storage (cocooned) pending final disposition in the future.

LEGACY SOURCE SITES

Not applicable

GROUNDWATER PLUMES

Not applicable

D&D OF INACTIVE FACILITIES

The six reactors of this EU are currently in an interim safe storage state. The DOE defines interim safe storage as "the process of demolishing all but the shield walls surrounding the reactor core, removing or stabilizing all loose contamination within the facility, and placing a new roof on the remaining structure. A single doorway in the structure is installed to provide access for surveillance and maintenance work. This doorway is welded shut, and all other openings in the shield walls are sealed to prevent intrusions and the release of radioactive materials."[8] See Figures 2, 3 and 4 for examples of cocooned reactor buildings.

Figure F.4-2. H Reactor Building Cocooned.

Figure F.4-3. F Reactor Building Cocooned.

[8] US Department of Energy, *Supplemental Analysis: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F-SA, July 2010

Figure F.4-4. C Reactor Building Cocooned.

The reactor buildings will remain in this cocooned state until at least 75 years from the issuance of the Record of Decision (ROD) (58 Federal Register [FR] 48509) that followed the environmental impact statement (EIS), *Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland Washington* (DOE 1992). The 75-year safe-storage period was determined to be an adequate time for decay of cobalt-60 and partial decay of cesium-137, radionuclides that contribute significantly to occupational dose. This period permits the reactors to be decommissioned with less occupational radiation dose than in the case of immediate one-piece removal. The safe-storage period for all but the first reactor is actually longer than 75 years because the reactors would be decommissioned in sequence at estimated 1- to 2-year intervals. During the safe storage period, surveillance, site and facility inspections, radiological and environmental surveys, and site and facility maintenance will be carried out every five and more extensively every twenty years.

The ninth reactor in the 100 Area, N Reactor, has been cocooned like the others but it not within the scope of the Final EIS or ROD, and its final disposition will be determined by a subsequent NEPA or CERCLA decision process.[6,9]

The B Reactor will not be removed from its building, as it is being preserved as a National Historic Landmark and is part of the newly established Manhattan Project National Historical Park).[8]

DOE prepared a supplemental analysis to the EIS in July 2010 (*Supplement Analysis, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* [DOE/EIS-0119F-SA-01]) to broaden the possible decommissioning approach, retaining the one-piece removal option and including the option for immediate dismantlement.

Table C in the 2016 Hanford Lifecycle Scope, Schedule and Cost Report (DOE/RL-2015-10, Revision 0) indicates that the final reactor disposition program will begin about 2054 and be completed about 2068.

The 105-C, 105-D, 105-DR, 105-F and 105-H Reactors

Each of these five reactor buildings, designated as a 105 building, were similar in design when constructed and contained a reactor block, a reactor control room, a spent-fuel discharge area, a fuel storage basin, fans and ducts for ventilation and recirculating inert gas systems, water cooling systems, and supporting offices, shops, and laboratories. A typical reactor facility is a reinforced concrete and concrete-block structure approximately 76 meters long, by 70 meters wide, by 29 meters high. Outside

[9] US Department of Energy, *2016 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL.2015-10, Revision 0. December 2015

the reactor block, the building has massive reinforced concrete walls (0.9 meter to 1.5 meters thick) that extend upward to the height of the reactor block to provide shielding, with lighter construction above. Roof construction is primarily precast concrete slab or poured insulating concrete.

As a result of the ISS Project activities, the remaining reactor building consists only of a reactor block and adjacent work areas. The original fuel storage basin is partially removed, and the top 15 ft of wall is removed while the remaining wall sections are coated with a fixative and covered with soil. The fuel examination facility adjacent to the FSB; inner and outer HCR rooms; fans and ducts for ventilation and recirculating inert gas systems; water cooling systems; supporting offices, shops, and laboratories; and fuel transfer pits and their contents are all demolished and removed during the decontamination and decommissioning efforts associated with the ISS Project. Steel siding is installed on the upper portions of the building exterior. A new steel roof is installed over the remaining structure using the existing shield walls as the "new" outside walls of the building to enclose the reactor within a weather-protected structure.

Penetrations into the shield walls are closed to prevent animal and insect intrusion and water in-leakage into the final safe storage structure. Accessible loose contamination within the shield walls is either removed or fixed to the greatest extent possible. A remote monitoring system and permanent power and lighting are installed, as well as a provision for ventilation air exchange if required to support S&M activities. A single entryway allows access for periodic inspection of portions of the facility.

The reactor block is located near the center of the building, and typically consists of a graphite moderator stack (36 ft high by 36 ft wide by 28 ft deep) encased in a cast iron thermal shield (8 to 10 in. thick) and a biological shield consisting of alternating layers of steel and Masonite (52 in. thick). The entire block rests on a massive concrete foundation. The block weighs approximately 8,930 tons.

Horizontal control-rod penetrations are on the left side of the reactor block (when facing the reactor front face), and vertical safety-rod penetrations are on top of the reactor. Process tubes, which held the uranium fuel and carried the cooling water, penetrate the block from front to rear. Fuel discharge and storage areas are located adjacent to the rear face of the reactor. Experimental test penetrations are located on the right side of most of the reactors.

As noted above, at the conclusion of the 75-year safe-storage period each of the reactor blocks (graphite core, surrounding shielding, and support base) will be removed in one piece and transported on a tractor-transporter over specially constructed haul roads to a burial site in the 200-West Area. All remaining contaminated materials, equipment, and soils will be dismantled and removed, and all uncontaminated equipment and structures will be demolished and disposed of. The site will then be backfilled, graded, seeded, and released for other use.

The deferred one-piece removal of the first reactor would take about 3 years. The remaining seven reactors are estimated to require 2.5 years per reactor for decommissioning. The 3-year schedule for the first reactor includes the initial engineering and preparation of the work plan, construction and operational testing of the ground-water monitoring systems at the 200-West Area burial ground, procurement of the tractor-transporter and other necessary equipment, mobilization of the decommissioning team, construction activities at the 200-West Area burial ground, and construction of the haul roads leading from the reactor sites to the burial ground. The schedule is subject to change if detailed engineering studies reveal a more efficient sequence of activities.

When removal of one reactor has progressed to the midpoint of its overall schedule, work on the next reactor would begin, thus permitting efficient use of workers and equipment resources. Removal of the first reactor would begin after 75 years of safe storage, but removal of the eighth reactor would not

begin until 9 years after the start of dismantlement of the first reactor. This would result in an 84-year safe-storage period for the eighth reactor.[10]

The 105-N Reactor and 109-N Heat Exchanger Buildings

The 105-N Reactor was the last constructed and was designed as a 4,000-megawatt (thermal) nuclear dual-purpose reactor. The reactor core is a graphite-moderated, light water-cooled, horizontal pressure-tube facility designed to produce plutonium. By-product steam was routed to the now demolished 185-N Hanford Generating Plant (HGP), which was a privately operated electrical generation facility that produced approximately 860 megawatts of electricity for use by the public.

The 109-N Heat Exchanger building is located on the south side of 105-N. It shares a common wall with the 105-N reactor building and is included in the 105-N ISS due to structural integrity concerns over separating the two facilities. Reactor primary coolant from 105-N was circulated through the reactor to steam generators located in the 109-N facility and then routed back to the reactor via primary coolant pumps. Steam from the steam generators was either dumped into water-cooled dump condensers or piped to the HGP to generate electricity. Circulation of the highly radioactive reactor primary coolant through 109-N caused equipment, piping, and steam generators to be contaminated to levels similar to those within 105-N Reactor equipment and piping. Tube leaks in the 109-N Heat Exchanger Building's steam generators allowed radiologically contaminated primary water to be carried to the HGP's secondary systems.

Structural modifications when building the SSE included removal of the fuel storage basin, ancillary support buildings, and most portions of the 105-N Building structure outside of the shield walls that surrounded the reactor. In addition, the heat exchanger building was removed up to the steam generator cells. This portion was left because of high radiation levels in the cells and structural integrity concerns with the reactor building because of the shared wall. The pressurizer and its surrounding building were left in place as part of the SSE and a new roof installed where it extends above the main roof of the 109-N Building. A new steel roof was installed over the remaining structures using the existing concrete shield walls as the "new" outside walls of the buildings to enclose both the reactor and heat exchanger building within a weather-protected structure. All existing siding was removed and new siding installed over exposed structural-steel framing/supports.

Final disposition of 105-N Reactor will be determined by a future NEPA or CERCLA decision process.

Range of Plausible Alternatives[11]

- Demolition of the reactor block in ISS and transport the reactor block intact on a tractor transporter from the present 100 Area location to the 200 West Area for disposal.
- Safe storage for a period of up to 75 years of surveillance, monitoring, and maintenance at the end of the safe storage period, demolition of the reactor block and transport of the reactor block intact on a tractor transporter from the present 100 Area location to the 200 West Area for disposal.
- Safe storage for a period of up to 75 years of surveillance, monitoring, and maintenance at the end of the safe storage period, demolition of the reactor buildings and piece-by-piece dismantlement of the reactor core and burial of radioactive waste to the 200 West Area.

[10] US Department of Energy, *Draft Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, March 1989

[11] US Department of Energy, *2016 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL.2015-10, Revision 0. December 2015

- Demolition of the reactor buildings and SSE and filling voids beneath and around the reactor block, the reactor block, adjacent shield walls, and the spent fuel storage basin together with the contained radioactivity, gravel, and grout covered to a depth of at least 5 meters with a mound containing earth and gravel.

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

Revegetated areas at the 105-C, 105-F, and 105-N sites are classified as level 3 biological resources, the highest level found within the EU. And due to their proximity to the ¼-mile river corridor buffer (DOE/RL-96-32 2013), substantial portions of the 105-H and 105-N sites are considered level 3 biological resources (Appendix J, Figure J.80 and Table J.67), despite having ground cover and vegetation befitting a lower classification. Additionally, bat roosting areas located at 105-F and 105-H and near 105-D/DR are classified as level 3 resources. Overall, 88.0 acres of level 3 resources occur within the Final Reactor Disposition EU, making up 56.5% of the EU (Appendix J, Table J.67).

Disturbed and bare ground (level 0 resources) makes up the second-most significant portion of the EU, with a combined total of 43.7 acres (28.1%). Only the 105-N section does not include any level 0 resources (Appendix J, Figure J.80 and Table J.67). Small patches of non-native and successional vegetation (level 1 and 2 resources) occur in small patches within most of the reactor areas, they account for a combined total of 24.0 acres, or 15.4% of the EU.

The amount and proximity of biological resources surrounding the Final Reactor Disposition EU were examined within the adjacent landscape buffer areas, which extend 728-2,592 feet (222-790 m) from the geometric centers of each EU section (Appendix J, Figure J.80). Approximately 42.5% (241.3 ac) of the combined total area (EU plus adjacent landscape buffer for all sections) consists of level 3 resources. The proportion of level 3 resources lost from remediation actions in the EU would be approximately 19.7% (Appendix J, Table J.67). Levels 0, 1, and 2 make up approximately 20%, 11%, and 25% of the total combined area, respectively. The 105-N landscape buffer contains a small amount (~7 ac) of level 4 biological resources in the narrow riparian zone. There are no level 5 resources identified within the combined EU and buffer area.

Field Survey

The Final Reactor Disposition EU is comprised of six discrete reactor buildings (105-C, 105-D, 105-DR, 105-F, 105-H, and 105-N) and their immediate vicinities (Appendix J, Figure 1). Surveys of each of the sites were conducted between July 9 and July 17, 2015. The D-105 and DR-105 sites are very near each other and share a landscape buffer area, so they are generally discussed together throughout this report. The individual sites range in size from 9 acres to 90 acres, though all but 105-N are less than 25 acres in size.

Each site consists of a “cocooned” reactor structure and the disturbed ground surrounding it which is a result of demolition and remediation activities. Much of the ground surface within the EU sites consists of bare gravel or cobble. However, small and scattered patches of sparse vegetation can be found at each site; these are generally characterized by successional shrubs such as gray rabbitbrush (*Ericameria nauseosa*) in the overstory with non-native cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*) in the understory (Appendix J, Table J.66). Revegetation efforts have been undertaken in several locations, with varying degrees of success. Revegetated areas containing good cover (approximately 10%) of the climax native shrub big sagebrush (*Artemisia tridentata*) are located in the southwest corner

of the 105-C site and in the north end of the 105-F site. Replanting of big sagebrush was also done near the 105-N site, though this effort was more recent and current shrub cover is only approximately 2%.

Bird and bat activity was noted at several sites. An active red-tailed hawk (*Buteo jamaicensis*) nest was located on the 105-C building and an active great horned owl (*Bubo virginianus*) nest was located on the 105-H building during spring 2015 (MSA 2015). Cliff swallows were observed nesting on the 105-D and 105-H buildings. The 105-F building is a known bat roost site (roost boxes are attached to the building and nearby poles) and one bat (unidentified species) was observed flying near and roosting on the building during the visual survey. Entrances to underground bat roosts (with protective structures above ground) are located near the 105-D/DR buildings (primarily in the landscape buffer area, though a portion of one entrance site is within the 105-DR EU section). The 105-H building is also identified as a bat roost site (personal communication and data from MSA)[12]. The Field Data Records section in the EU description of Appendix J provides the full lists of plant and animal species recorded during the 2015 surveys.

CULTURAL RESOURCES SETTING

100 B/C

Portions of the 100 B/C segment of the EU have been inventoried for archaeological resources. There is one National Register-eligible Manhattan Project and Cold War Era building, C Reactor (105-C), located within the 100 B/C portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

No additional archaeological sites/isolates, TCPs and/or structures are located within this portion of the EU.

There is one National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100 B/C portion of the EU (contributing property recommended for individual documentation). This building, B Reactor (105-B) is a National Historic Landmark and has been identified as part of the Manhattan Project National Historic Park by the National Park Service.

Additionally, a segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100 B/C portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements for these two properties have been completed. Two archaeological sites have been recorded within 500 meters of the 100 B/C portion of the EU. One of these resources is associated with the Native American Precontact and Ethnographic Landscape, and remains unevaluated for the National Register of Historic Places. The other archaeological site is associated with the Manhattan Project and Cold War Era Landscape and has been determined not eligible for listing in the National Register of Historic Places.

Historic Maps and aerial imagery suggests a moderate potential for resources associated with the Pre-Hanford Early Settlers/Farming Landscape to be present. The geomorphology within the 100 B/C portion of the EU suggests a low potential for archaeological resources associated with the Native American

[12] MSA (Mission Support Alliance) maintains biological resource information for the Hanford Site for the Department of Energy.

Precontact and Ethnographic to be present within the surface and subsurface components of this portion of the EU. A review of recent aerial imagery of the EU suggest heavily disturbed through the construction, operation, maintenance of the 100 B/C Area facilities and supporting infrastructure. The highly disturbed nature of the EU suggests a low potential for intact archaeological resources to exist within this portion of the EU boundary.

100-N Area

Portions of the 100-N segment of the EU have been inventoried for archaeological resources. There is one known TCP located within the 100-N portion of the RC-DD-3, Final Reactor Disposition EU. A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within the 100-N portion of the EU. There are 4 National Register-eligible Manhattan Project and Cold War Era buildings located within the 100-N portion of the Final Reactor Disposition EU (all 4 are contributing within the Manhattan Project and Cold War Era Historic District, 3 recommended for individual documentation and 1 with no additional documentation required). Mitigation for contributing these properties have been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing. Appendix K, Table 35, lists the four remaining buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within the 100-N portion of the RC-DD-3, Final Reactor Disposition EU.

In addition, one archaeological site associated with the Pre-Hanford Early Settlers/Farming Landscape has been recorded within the 100-N portion of the EU and this resource has been determined not eligible for listing in the National Register of Historic Places.

There are 2 National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100-N portion of the EU (both are contributing to the historic district, 1 recommended for individual documentation and 1 with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing. In addition, 5 archaeological sites and one National Register of Historic Places listed Archaeological District have been recorded within 500 meters of the 100-N portion of the EU. All 5 of these resources as well as the recorded archaeological district are associated with the Native American Precontact and Ethnographic Landscape. One of the archaeological sites has been determined eligible for listing in the National Register of Historic Places, one remains unevaluated, one has been determined a contributing component to the National Register Listed Archaeological District, and the remaining two have been determined contributing components to the National Register eligible TCP that lies within the 100-N Area vicinity.

Historic Maps and aerial imagery suggests a moderate potential for archaeological resources associated with the Pre-Hanford Early Settlers/Farming Landscape. The geomorphology within the 100-N portion of the EU suggests a moderate potential for archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the surface and subsurface components of this portion of the EU. A review of recent aerial imagery of the EU suggest heavily disturbed through the construction, operation, maintenance of the 100-N Area facilities and supporting infrastructure. Small pockets of undisturbed areas do appear, particularly in the northern and western portion of the EU. The highly disturbed nature of the EU suggests a low degree of potential for intact archaeological resources. Resources, if present, would likely be limited to these small pockets of intact, undisturbed sediments along the western and northern margins of the 100-N portion of the EU.

100 D/DR Area

Small portions of the 100 D/DR segment of the EU have been inventoried for archaeological resources. There are 2 National Register-eligible Manhattan Project and Cold War Era building located within the 100-D portion of the Final Reactor Disposition EU (both are contributing within the Manhattan Project and Cold War Era Historic District with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing. Appendix K, Table 36, lists the two remaining buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within the 100-R portion of the RC-DD-3, Final Reactor Disposition EU.

There are 2 National Register-eligible Manhattan Project and Cold War Era buildings located within 500 meters of the 100 D/DR portion of the EU (both are contributing to the historic district with no additional documentation required). Additionally, a segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100 D/DR portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for these properties.

Historic Maps and aerial imagery indicate suggests a low potential for archaeological resources associated with the Pre-Hanford Early Settlers/Farming Landscape to be present in the 100D-DR portion of the EU. The geomorphology within the 100 D/DR portion of the EU suggests a moderate potential for archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the surface and subsurface components of this portion of the EU. A review of recent aerial imagery of the EU suggest the 100D/DR EU is heavily disturbed through the construction, operation, maintenance of the 100-D/DR Area facilities and supporting infrastructure. The highly disturbed nature of the EU suggests a low potential for intact archaeological resources. Resources, if present, would likely be limited to areas of intact or undisturbed soils.

100-H Area

Most of the 100-H portion of the EU has been inventoried for archaeological resources. There is one National Register-eligible Manhattan Project and Cold War Era building, H Reactor (105-H), located within the 100-H portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

There is one National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100-H portion of the EU (contributing to the historic district with no additional documentation required). Additionally, a segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100-H portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property. Three archaeological sites/isolates and one National Register Listed Archaeological District have been recorded within 500 meters of the 100-H portion of the EU. One of these archaeological resources (1 isolate) and the Archaeological District are associated with the Native American Precontact and Ethnographic Landscape. This resource has not been formerly evaluated for listing in the National Register of Historic

Places, however isolates are often considered not eligible. The remaining two archaeological sites are associated with the Pre-Hanford Early Settlers/Farming Landscape. One of these resources has been determined eligible for listing in the National Register of Historic Places, while the other remains unevaluated.

Review of historic maps and aerial imagery indicate farmsteads are present in the 100-H portion of the EU and there is a high potential for archaeological resources associated with the Pre-Hanford Early Settlers/Farming landscape to be present. The geomorphology within the 100-H portion of the EU suggests a low potential for archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the surface and subsurface components of this portion of the EU. Examination of recent aerial imagery indicates that the 100-H portion of the EU has been heavily disturbed through the construction, operation and maintenance of the 100-H Area facilities and supporting infrastructure. The highly-disturbed nature of the EU suggests a low degree of potential for intact archaeological resources. Resources, if present, would likely be limited to areas of intact or undisturbed soils.

100-F Area

The 100-F portion of the EU has not been inventoried for cultural resources. There is one National Register-eligible Manhattan Project and Cold War Era building, F Reactor (105-F), located within the 100-F portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100-F portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property. Additionally, one archaeological site associated with the Pre-Hanford Early Settlers/Farming Landscape has been recorded within 500 meters of the 100-F portion of the EU. This site currently remains unevaluated for listing in the National Register of Historic Places.

Review of historic maps and aerial imagery suggest a moderate potential for archaeological resources associated with the Pre-Hanford Early Settlers/Farming landscape to be present. The geomorphology within the 100-F portion of the EU suggests a high potential for archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the surface and subsurface components of this portion of the EU. Examination of recent aerial imagery indicates that the 100-F portion of the EU has been heavily disturbed through the construction, operation and maintenance of the 100-F Area facilities and supporting infrastructure. The highly-disturbed nature of the EU suggests a low degree of potential for intact archaeological resources. Resources, if present, would likely be limited to areas of intact or undisturbed soils.

Because of the potential for intact archaeological deposits within portions of the RC-DD-3, Final Reactor Disposition EU, it may be appropriate to conduct surface and subsurface archaeological investigations in these areas prior to initiating any remediation activities. Indirect effects are always possible when TCPs are known to be located in the general vicinity. Consultation with Hanford Tribes (Confederated Bands of the Yakama Nation, Wanapum, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce) and other groups who may have an interest in the areas (e.g. East Benton Historical Society, Prosser Cemetery Association, Franklin County Historical Society, the Reach, and the B-Reactor Museum

Association) may need to occur. Consultation with Hanford Tribes may also be necessary to provide input on indirect effects to both recorded and potential unrecorded TCPs in the area and other cultural resource issues of concern.

PART V. WASTE AND CONTAMINATION INVENTORY

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

Not applicable

Vadose Zone Contamination

The reported inventories for RC-DD-3 (Table F.4-3 through Table F.4-5) are contained in cocooned reactors that are considered isolated from the environment for the period of evaluation. Thus there is no reported vadose zone inventory to be evaluated.

Groundwater Plumes and Columbia River

Not applicable

Facilities for D&D

The principal radiological contaminants of interest greater than 10 curies in aggregate within each of the 105-C, 105-D, 105-DR, 105-F and 105-H Reactors (as of 1998[13,14]) are:

Carbon-14
Tritium (H-3)
Cobalt-60
Nickel-63
Cesium-137
Europium-152
Calcium-41
Chlorine-36.

The 105-N Reactor also has the following additional contaminants of interest (as of 2005)[15]:

Europium-154
Niobium-93m
Nickel-59
Strontium-90
Zirconium-89
Yttrium-90.

[13] US Department of Energy, Surveillance and Maintenance Plan for the 105-C Reactor Safe Storage Enclosure, DOE/RL-98-44, Rev. 1, March 2002
[14] US Department of Energy, Surveillance and Maintenance Plan for the 105-H Reactor Safe Storage Enclosure, DOE/RL-2005-67, Rev. 0, November 2005
[15] US Department of Energy, Surveillance and Maintenance Plan for the 105-N/109-N Reactor Safe Storage Enclosure, DOE/RL-2011-106, Rev. 0, December 2011

Table F.4-3. Inventory of Primary Contaminants [(a)]

WIDS	Description	Decay Date	Reference	Am-241 (Ci)	C-14 (Ci)	Cl-36 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	H-3 (Ci)	I-129 (Ci)
All	Sum[(b)]			1.9	28,920	200	24,315	150	200	92	51,000	NR
105C	Reactor	1998	DOE/RL-98-44, Rev. 1	0.29	4,490	12	1,870	22	21	7.5	4,300	NR
105D	Reactor	1998	DOE/RL-2004-59 Rev.0	0.29	4,290	34	142	22	21	7.3	3,700	NR
105DR	Reactor	1998	DOE/RL-2002-28 Rev. 1	0.29	3,200	26	915	23	22	7.9	2,500	NR
105F	Reactor	1998	DOE/RL-2009-45 Rev. 0	0.29	3,700	33	951	22	21	7.3	2,800	NR
105H	Reactor	1998	DOE/RL-2005-67, Rev. 0	0.29	3,490	17	837	22	21	7.3	2,700	NR
105N	Reactor	2005	DOE/RL-2011-106, Rev. 0	0.40	9,550	75	19,600	38	93	55	35,000	NR

a. NR = Not reported

b. Inventories summed without decay correction.

Table F.4-4. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Decay Date	Reference	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum[(b)]			12,137	5,640	13.0	57.7	0.014	NR
105C	Reactor	1998	DOE/RL-98-44, Rev. 1	7.1	800	4.8	7.5	0.002	NR
105D	Reactor	1998	DOE/RL-2004-59 Rev.0	9.1	1,000	1.0	7.5	0.002	NR
105DR	Reactor	1998	DOE/RL-2002-28 Rev. 1	6.1	630	1.0	7.7	0.002	NR
105F	Reactor	1998	DOE/RL-2009-45 Rev. 0	8.1	800	4.8	7.5	0.002	NR
105H	Reactor	1998	DOE/RL-2005-67, Rev. 0	6.1	710	1.0	7.5	0.002	NR
105N	Reactor	2005	DOE/RL-2011-106, Rev. 0	12,100	1,640	1.4	20	0.004	NR

a. NR = Not reported

b. Inventories summed without decay correction.

Table F.4-5. Inventory of Primary Contaminants (cont)[a]

WIDS	Description	Reference	CCl4 (kg)	CN (kg)	Cr (kg)	Cr-VI (kg)	Hg (kg)	NO3 (kg)	Pb (kg)	TBP (kg)	TCE (kg)	U (total) (kg)
All	Sum		NR	NR	NR	NR	NR	NR	365,000	NR	NR	NR
105C	Reactor	DOE/RL-98-44, Rev. 1	NR	NR	NR	NR	NR	NR	73,000	NR	NR	NR
105D	Reactor	DOE/RL-2004-59 Rev.0	NR	NR	NR	NR	NR	NR	73,000	NR	NR	NR
105DR	Reactor	DOE/RL-2002-28 Rev. 1	NR	NR	NR	NR	NR	NR	73,000	NR	NR	NR
105F	Reactor	DOE/RL-2009-45 Rev. 0	NR	NR	NR	NR	NR	NR	73,000	NR	NR	NR
105H	Reactor	DOE/RL-2005-67, Rev. 0	NR	NR	NR	NR	NR	NR	73,000	NR	NR	NR
105N	Reactor	DOE/RL-2011-106, Rev. 0	NR	NR	NR	NR	NR	NR	73,000[b]	NR	NR	NR

a. NR = Not reported

b. Not reported, but assumed to be same as other reactors

Table F.4-6. Summary of the Evaluation of Current Threats to Groundwater as a Protected Resource from Saturated Zone (SZ) and Remaining Vadose Zone (VZ) Contamination associated with the Evaluation Unit

PC	Group	WQS	Porosity[a]	K_d (mL/g)[a]	ρ (kg/L)[a]	VZ Source M^{Source}	SZ Total M^{SZ}	Treated[c] M^{Treat}	VZ Remaining M^{Tot}	VZ GTM (Mm^3)	VZ Rating[d]
C-14	A	2000 pCi/L	0.18	0	1.84	---	---	---	---	---	*ND*
I-129	A	1 pCi/L	0.18	0.2	1.84	---	---	---	---	---	*ND*
Sr-90	B	8 pCi/L	0.18	22	1.84	---	---	---	---	---	*ND*
Tc-99	A	900 pCi/L	0.18	0	1.84	---	---	---	---	---	*ND*
CCl4	A	5 µg/L	0.18	0	1.84	---	---	---	---	---	*ND*
Cr	B	100 µg/L	0.18	0	1.84	---	---	---	---	---	*ND*
Cr-VI	A	10 µg/L[b]	0.18	0	1.84	---	---	---	---	---	*ND*
TCE	B	5 µg/L	0.18	2	1.84	---	---	---	---	---	*ND*
U(tot)	B	30 µg/L	0.18	0.8	1.84	---	---	---	---	---	*ND*

a. Parameters obtained from the analysis provided in Attachment 6-1 to Methodology Report (CRESP 2015).

b. Criteria for chronic exposure in fresh water, WAC 173-201A-240. "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances," Table 240(3).

c. Treatment amounts from the 2015 Hanford Annual Groundwater Report (DOE/RL-2016-09, Rev. 0).

d. Groundwater Threat Metric rating based on Table 6-3, Methodology Report (CRESP 2015).

PART VI. POTENTIAL RISK/IMPACT PATHWAYS AND EVENTS

CURRENT CONCEPTUAL MODEL

Pathways and Barriers

Briefly describe the current institutional, engineered and natural barriers that prevent release or dispersion of contamination, risk to human health and impacts to resources:

1. What nuclear and non-nuclear safety accident scenarios dominate risk at the facility? What are the response times associated with each postulated scenario?

A seismic event is the only significant risk scenario for the six reactor buildings in their current ISS condition.

2. What are the active safety class and safety significant systems and controls?

There are no safety class or safety-significant structures, systems, or components at these structures.

3. What are the passive safety class and safety significant systems and controls?

Work control processes and safety management programs during the multi-decade S&M activities.

4. What are the current barriers to release or dispersion of contamination from the primary facility? What is the integrity of each of these barriers? Are there completed pathways to receptors or are such pathways likely to be completed during the evaluation period?

The low relative risk of S&M activities is primarily maintained by passive barriers, e.g., asphalt emulsion covering the FSB walls and floor and the thermal and biological shields surrounding the reactor core.

5. What forms of initiating events may lead to degradation or failure of each of the barriers?

A seismic event would cause the building to collapse onto the reactor block and breach the biological and thermal shields, crushing 1% of the graphite into a fine (i.e., respirable) powder.

6. What are the primary pathways and populations or resources at risk from this source?

The facility worker and Co-located person would receive an estimated Low dose (0.22-1.7 rems) from such a release, but Public exposure would be ND.

7. What is the time frame from each of the initiating events to human exposure or impacts to resources?

Within seconds of the event

8. Are there current on-going releases to the environment or receptors?

None

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

Low risk to Facility Worker of postulated seismic scenario

Co-Located Person (CP)

Low risk to Facility Worker of postulated seismic scenario (0.22 rems)

Public

Not applicable

Groundwater and Columbia River

Reported information for the RC-DD-3 waste sites are associated with cocooned reactors that are considered isolated from the environment for the period of this evaluation; thus there are no threats to groundwater or the Columbia River. The ratings for all Group A and B primary contaminants are *Not Discernible* (*ND*) (Table F.4-6).

Ecological Resources

Summary of Ecological Review:

- The Final Reactor Disposition EU is comprised of 6 distinct sections spread across 5 different locations. Though similar in the sense of being based on cocooned reactor buildings, each section has unique characteristics which will need to be assessed independently at the time of remediation.
- Approximately 56.5% of the EU consists of level 3 biological resources, based on three criteria:
    - Sections 105-H and 105-N are located within ¼ mile of the river shore and thus have significant portions classified as level 3.
    - Sections 105-F and 105-N contain revegetated areas characterized by climax shrub-steppe vegetation that are classified as level 3.
    - Areas within or near the 105-F, 105-H, and 105-D/DR sections contain bat roost sites and are afforded level 3 classification. A loss of 15.5% of level 3 resources would occur at the landscape level from remediation actions.

Cultural Resources

The RC-DD-3, Final Reactor Disposition EU is located in the 100 Areas (B/C, N, D/DR, H and F) of the Hanford Site, along the Columbia River.

100 B/C Area

Portions of the EU have been inventoried for cultural resources under, HCRC# 2011-100-049 (DeMaris et al. 2011b), HCRC# 2011-100-080 (Mendez & Christensen 2011), HCRC# 2013-100-018 (Harrison and Purtzer 2013), HCRC# 2013-100-033 (Purtzer et al. 2013) and HCRC# 2014-100-005 (McFarland et al. 2014).

100-N Area

Portions of the EU have been inventoried for cultural resources under, HCRC# 89-100-005 (Cadoret 1989), HCRC# 92-600-026 (Longenecker 1993), HCRC# 97-100-021 (Sharpe 1997), HCRC# 99-600-011 (Cadoret 1999), HCRC# 2001-600-033b (Woody 2002), HCRC# 2010-100-097 (Harrison & Sharpe 2010), HCRC# 2011-100-044 (Sheldon et al. 2011a), HCRC# 2011-100-048 (Harrison et al. 2012), HCRC# 2011-100-049 (DeMaris et al. 2011b), HCRC# 2011-100-050 (DeMaris et al. 2011a), HCRC# 2011-100-099 (Harrison et al. 2011), HCRC# 2014-100-006 (Sharpe 2014) and HCRC# 2015-100-008 (Mendez 2015).

100 D/DR Area

Small portion of the EU have been inventoried for cultural resources under, HCRC# 2011-100-049 (DeMaris 2011a) and HCRC# 2011-100-091 (Sheldon et al 2011b).

100-H Area

Most of the EU has been inventoried for cultural resources under, HCRC# 2011-100-038 (Purtzer at al. 2011) and HCRC# 2011-100-041 (Sheldon 2011).

100-F Area

This portion of the EU has not been inventoried for cultural resources.

The entire EU is heavily disturbed from the installation, operations and maintenance of the reactors and supporting infrastructure, suggesting a low potential for intact surface and subsurface archaeological resources.

Archaeological sites, buildings and Traditional Cultural Properties (TCPs) located within the EU[16]

100 B/C Area

- There is one National Register-eligible Manhattan Project and Cold War Era building located within the 100 B/C portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

- Appendix K, Table 26 provides more information about the 105-C building that is the only National Register-eligible Manhattan Project and Cold War Era building located within the 100 B/C portion of the RC-DD-3, Final Reactor Disposition EU. No additional archaeological sites and/or TCPs are known to exist within the 100 B/C Area of the EU.

100-N Area

- There is one known Traditional Cultural Property (TCP) located within the 100-N portion of the Final Reactor Disposition EU.

- A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within the 100-N portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.

- There are 4 National Register-eligible Manhattan Project and Cold War Era buildings located within the 100-N portion of the RC-DD-3, Final Reactor Disposition EU (all 4 are contributing within the Manhattan Project and Cold War Era Historic District, 3 recommended for individual documentation and 1 with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 26 provides more information about the four building that are National Register-eligible Manhattan Project and Cold War Era building located within the 100-N portion of the RC-DD-

[16] Traditional cultural property has been defined by the National Park Service as "a property, a place, that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices and beliefs that are (a) rooted in the history of a community, and (b) are important to maintaining the continuity of that community's traditional beliefs and practices" (Parker & King 1998).

3, Final Reactor Disposition EU. In addition, one archaeological site associated with the Pre-Hanford Early Settlers/Farming Landscape has been recorded within the 100-N portion of the EU and this resource has been determined not eligible for listing in the National Register of Historic Places.

100 D/DR Area

- There are 2 National Register-eligible Manhattan Project and Cold War Era buildings located within the 100 D/DR portion of the RC-DD-3, Final Reactor Disposition EU (both are contributing within the Manhattan Project and Cold War Era Historic District with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 28, provides more information about the two buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within the 100 D/DR portion of the RC-DD-3, Final Reactor Disposition EU.

100-H Area

- There is one National Register-eligible Manhattan Project and Cold War Era building located within the 100-H portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 29, provides more information about the 105-H buildings that is National Register-eligible Manhattan Project and Cold War Era buildings located within the 100-H portion of the RC-DD-3, Final Reactor Disposition EU.

100-F Area

- There is one National Register-eligible Manhattan Project and Cold War Era building located within the 100-F portion of the EU (contributing with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 30, provides more information about the 105-F buildings that is National Register-eligible Manhattan Project and Cold War Era building located within the 100-F portion of the RC-DD-3, Final Reactor Disposition EU.

Archaeological sites, buildings and TCPs located within 500 meters of the EU

100 B/C Area

- The B-Reactor, a National Historic Landmark, is located within 500 meters of the 100 B/C portion of the EU (contributing property recommended for individual documentation). This building has been selected for preservation, and HAER level documentation has been completed. Additionally, the B Reactor (105-B) has been identified as part of the Manhattan Project National Historic Park by the National Park Service.

Appendix K, Table 31, provides more information about the 105-B buildings that is National Historic Landmark, as part of the Manhattan Project National Historic Park, located within 500 meters of the 100 B/C portion of the RC-DD-3, Final Reactor Disposition EU.

- A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100 B/C portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.

- Two archaeological sites have been recorded within 500 meters of the 100 B/C portion of the EU. One of these resources is associated with the Native American Precontact and Ethnographic Landscape, and remains unevaluated for the National Register of Historic Places. The other archaeological site is associated with the Manhattan Project and Cold War Era Landscape and has been determined not eligible for listing in the National Register of Historic Places.

100-N Area

- There are 2 National Register-eligible Manhattan Project and Cold War Era buildings located within 500 meters of the 100-N portion of the EU (both are contributing to the historic district, 1 recommended for individual documentation and 1 with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 32, provides more information about the two buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within 500 meters of the 100-N portion of the RC-DD-3, Final Reactor Disposition EU.

- Five archaeological sites and one National Register of Historic Places listed Archaeological District have been recorded within 500 meters of the 100-N portion of the EU. All 5 of these resources as well as the recorded archaeological district are associated with the Native American Precontact and Ethnographic Landscape. One of the archaeological sites has been determined eligible for listing in the National Register of Historic Places, one remains unevaluated, one has been determined a contributing component to the National Register Listed Archaeological District, and the remaining two have been determined contributing components to the National Register eligible TCP that lies within the 100-N Area vicinity.

100 D/DR Area

- There are 2 National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100 D/DR portion of the EU (both are contributing to the historic district with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 32, provides more information about the two buildings that are National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100 D/DR portion of the RC-DD-3, Final Reactor Disposition EU.

- A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100 D/DR portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.

- No additional archaeological sites and/or TCPs are currently recorded within 500 meters of the 100-D/DR portion of the EU boundary.

100-H Area

- There is one National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100-H portion of the EU (contributing to the historic district with no additional documentation required). Mitigation for contributing buildings/structures has been completed in accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and buildings demolition is ongoing.

  Appendix K, Table 34, provides more information about the 1713-H Warehouse that is National Register-eligible Manhattan Project and Cold War Era building located within 500 meters of the 100-H portion of the RC-DD-3, Final Reactor Disposition EU.

- A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100-H portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.

- Three archaeological sites/isolates and one National Register Listed Archaeological District have been recorded within 500 meters of the 100-H portion of the EU. One of these archaeological resources (1 isolate) and the Archaeological District are associated with the Native American Precontact and Ethnographic Landscape. This isolate has not been formally evaluated for listing in the National Register of Historic Places, however it should be noted that isolates are typically considered not eligible. The remaining two archaeological sites are associated with the Pre-Hanford Early Settlers/Farming Landscape. One of these resources has been determined eligible for listing in the National Register of Historic Places, while the other remains unevaluated.

100-F Area

- A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, is located within 500 meters of the 100-F portion of the EU. In accordance with the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56) (DOE-RL 1998), all documentation requirements have been completed for this property.

- One archaeological site associated with the Pre-Hanford Early Settlers/Farming Landscape has been recorded within 500 meters of the 100-F portion of the EU. This site currently remains unevaluated for listing in the National Register of Historic Places.

Closest Recorded TCP

100 B/C

There are 2 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the 100 B/C portion of the EU.

100-N

There are 3 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the 100-N portion of the EU.

100 D/DR

There are 3 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the 100 D/DR portion of the EU.

100-H

There are 2 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the 100-H portion of the EU.

100-F

There are 2 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the 100-F portion of the EU.

CLEANUP APPROACHES AND END-STATE CONCEPTUAL MODEL

Selected or Potential Cleanup Approaches

Pursuant to the 1992 ROD, the reactor blocks (graphite core, surrounding shielding, and support base) of five of the six reactors will be removed in one piece and transported on a tractor-transporter over specially constructed haul roads to a burial site in the 200-West Area at the conclusion of the 75 year safe-storage period. All remaining contaminated materials, equipment, and soils will be dismantled and removed, and all uncontaminated equipment and structures will be demolished and disposed of. The site will then be backfilled, graded, seeded, and released for other use.

The deferred one-piece removal of the first reactor would take about 3 years. The remaining seven reactors are estimated to require 2.5 years per reactor for decommissioning. The 3-year schedule for the first reactor includes the initial engineering and preparation of the work plan, construction and operational testing of the ground-water monitoring systems at the 200-West Area burial ground, procurement of the tractor-transporter and other necessary equipment, mobilization of the decommissioning team, construction activities at the 200-West Area burial ground, and construction of the haul roads leading from the reactor sites to the burial ground. The schedule is subject to change if detailed engineering studies reveal a more efficient sequence of activities.

When removal of one reactor has progressed to the midpoint of its overall schedule, work on the next reactor would begin, thus permitting efficient use of workers and equipment resources. Removal of the first reactor would begin after 75 years of safe storage, but removal of the eighth reactor would not

begin until 9 years after the start of dismantlement of the first reactor. This would result in an 84-year safe-storage period for the eighth reactor.[17]

In July 2010, DOE prepared a supplemental analysis to the EIS (*Supplement Analysis, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* [DOE/EIS-0119F-SA-01]) to broaden the possible decommissioning approach, retaining the one-piece removal option and including the option for immediate dismantlement.

Final disposition of 105-N Reactor will be determined by a future NEPA or CERCLA decision process.

Range of Plausible Alternatives[18]

- Demolition of the reactor block in ISS and transport the reactor block intact on a tractor transporter from the present 100 Area location to the 200 West Area for disposal.
- Safe storage for a period of up to 75 years of surveillance, monitoring, and maintenance at the end of the safe storage period, demolition of the reactor block and transport of the reactor block intact on a tractor transporter from the present 100 Area location to the 200 West Area for disposal.
- Safe storage for a period of up to 75 years of surveillance, monitoring, and maintenance at the end of the safe storage period, demolition of the reactor buildings and piece-by-piece dismantlement of the reactor core and transport of radioactive waste to the 200 West Area for burial.
- Demolition of the reactor buildings and SSE and filling voids beneath and around the reactor block, the reactor block, adjacent shield walls, and the spent fuel storage basin together with the contained radioactivity, gravel, and grout covered to a depth of at least 5 meters with a mound containing earth and gravel.

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

All of the radionuclides noted in the Inventory section would remain, but the 75-year delay before removal of the reactor block will allow radioactive decay of short- and intermediate-half-life radionuclides such as cobalt-60, thereby reducing both worker radiation exposure during disposal operations and the total radionuclide inventory in the material removed.

Risks and Potential Impacts Associated with Cleanup

The primary risk of the proposed cleanup would be an accident during the transporting of the full or demolished reactor block to ERDF.

[17] US Department of Energy, *Draft Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, March 1989

[18] US Department of Energy, *2016 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL.2015-10, Revision 0. December 2015

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED DURING OR AS A CONSEQUENCE OF CLEANUP ACTIONS

Facility Worker (FW)

Exposure in the postulated transportation accident involving moving the full reactor block would be ND, and Low in moving the demolished parts.

Co-located Person

Same as FW

Public

Same as FW

Groundwater and Columbia River

Not applicable

Ecological Resources

Remove, Treat and Dispose of waste involves personnel through the target (remediation) area, car and pickup truck traffic through the non-target and target (remediation) area, truck, heavy equipment (including drill rigs) traffic on roads through the non-target and target area, caps (and other containment), soil removal and contamination in the soil, vegetation control, and irrigation (for revegetation) will cause the following disturbance from remediation activities: Carry seeds or propagules (pieces of vegetation or other biological parts that can grow and/or reproduce) on tires of vehicles or blowing from heavy equipment; injure or kill vegetation or small invertebrates or small animals; vehicle traffic can make paths, compact soil, scare or displace animals, can impact animal behavior or reproductive success; affect animal dispersion and habitat use (e.g., some birds avoid nesting near roads because of song masking); displacement of animals from near roads due to increased noise or other disturbances; and heavy equipment may permanently destroy areas of the site with intense activity. Soil removal can cause more severe effects because of blowing soil (and seeds). During remediation, radionuclides or other contaminants could be released or spilled on the surface, and depending upon the type and quantity, could have adverse effects on the plants and animals on-site. Use of non-specific herbicides for vegetation control results in some mortality of native vegetation (especially native forbes), and allows exotic species to move in; it may change species composition of native communities, but it also could make it easier for native species to move in; improved methods could yield positive results. Irrigation requires a system of pumps and water, resulting in physical disturbance; repeated irrigation from the same locations could result in some soil compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area.

Alternatively, barriers could be the remediation option and involves personnel car and pickup truck traffic through the non-target and target (remediation) area, truck and heavy equipment traffic on roads through the non-target and target area, dust suppression, and irrigation (for revegetation) will cause the following disturbance from remediation activities: Carry seeds or propagules (pieces of vegetation or other biological parts that can grow and/or reproduce) on person (boots, clothes, equipment) or tires of vehicles or blowing from heavy equipment; injure vegetation or small invertebrates or small animals (e.g., insects, snakes); make paths or compact soil; scare or displace animals. Caps and other containment can cause compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the

area. Destruction of soil invertebrates at depths of pits. Potential bringing up of dormant seeds from soil layers; disruption of ground-living small mammals and hibernation sites of snakes and other animals on-site of containment; often disrupts local aquatic environment and drainage; often non-native plants used on caps (which can become exotic/alien adjacent to the containment site). Additional water from dust suppression could lead to more diverse and abundant vegetation in areas that receive water, which could encourage invasion of exotic species; the latter could displace native plant communities; excessive dust suppression activities could lead to compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. Irrigation requires a system of pumps and water, resulting in physical disturbance; repeated irrigation from the same locations could result in some soil compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. These effects will be higher in the EU itself.

Cultural Resources

Potential direct effects are possible from personnel, car, pick-up, truck and heavy equipment traffic/use through both target (remediation) and non-target areas. These activities may inadvertently expose resources close to the surface. Additionally, traffic through these areas may lead to the introduction of invasive species and/or a decrease in the presence of native plants used for medicinal or tribal religious purposes. Heavy equipment use for remedial activities (such as the remediation of buildings, structures and associated near-surface contaminated soils) may lead to an alteration of the landscape. Utilization of caps and/or other containments may destroy resources located close to the surface. If resources are not destroyed, containments may disturb or adversely affect resources. Lastly, during remediation, radionuclides or other contamination released or spilled on the surface could have long-term effects if the contamination remains and resources become contaminated and/or plants having cultural importance to Tribes do no recolonize or thrive.

Potential indirect effects are possible from personnel traffic through target (remediation) areas as well as car, pick-up, truck and heavy equipment traffic/use through both target (remediation) and non-target areas. It is possible that these activities may decrease viewshed values and/or impact viewshed through the introduction of increased dust, the creation of trails, etc. Heavy equipment use for remedial actions and the utilization of caps and/or other containments could potentially cause alterations to the landscape and impacts to viewsheds. Lastly, during remediation, radionuclides or other contamination released or spilled on the surface could have long-term effects if the contamination remains and resources become contaminated and/or plants having cultural importance to Tribes do no recolonize or thrive.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

There are no known additional risks of delaying the cleanup beyond the 75-year period. Radionuclides would continue to decay which would further reduce risks during cleanup. The 105-F, 105-H, 105-D, 105-C and 105-N/109-N SSE's were inspected in 2014-2015[19] and no conditions were identified that would require immediate corrective action on the exteriors. The steel structures were found to be in very good condition and the original concrete portions are in fair to good condition. Interior inspections revealed that, with few exceptions, the original concrete structures are aging very well and appear structurally sound. The newer steel SSE also shows very little if any structural deterioration. The inside

[19] Mission Support Alliance, *Five-Year Surveillance Report for the 105-F, 105-H, 105-D, 105-C and 105-N/109-N Safe Storage Enclosures*, HNF-59342, Revision 0, March 2016

conditions were dry in all of the SSEs and little or no evidence of water intrusion was noted. No evidence of groundwater intrusion was noted in any of the basement floors. “Structural and radiological findings provide evidence that the SSE structures are functioning as designed and are protective of the public and environment.”[19]

NEAR-TERM, POST-CLEANUP STATUS, RISKS AND POTENTIAL IMPACTS

Insufficient information available

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED AFTER CLEANUP ACTIONS (FROM RESIDUAL CONTAMINANT INVENTORY OR LONG-TERM ACTIVITIES)

Table F.4-7. Summary of Populations and Resources at Risk or Potentially Impacted after Cleanup.

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	Not Discernible (ND)-Low	Exposure in the postulated transportation accident involving moving the full reactor block would be ND, and Low in moving the demolished parts.
	Co-located Person	ND-Low	
	Public	ND-Low	
Environmental	Groundwater	*ND*	Reported inventories are in cocooned reactors isolated from the environment.
	Columbia River	*ND*	
	Ecological Resources[a]	Low to High	Uncertainties in the remediation activities and the potential for contamination of the subsurface below the reactors make it difficult to predict the extent and magnitude of impacts to the river corridor. That is, if the remediation is similar to the excavations of the "big digs" in the 100 Areas, then the impacts will continue to be high in the footprint created by the excavation. If the remediation is less disruptive than excavation, then the impacts will be substantially reduced.
Social	Cultural Resources[a]	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: Known **Manhattan/Cold War:** Direct: Known Indirect: Known	Permanent direct and indirect effects are likely due to high sensitivity of area. Manhattan Project/Cold War Era buildings will be demolished, except for the B-Reactor (a National Historic Landmark).

a. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report.

LONG-TERM, POST-CLEANUP STATUS – INVENTORIES AND RISKS AND POTENTIAL IMPACT PATHWAYS

Insufficient information available

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

Table F.4-8. RC-DD-3 (Final Reactor Disposition) Facility List

Site Code	Name, Aliases, Description	Feature Type	Site Status	ERS Classification	ERS Reclassification	Site Type	Site Type Category	Operable Unit	Exclude from Evaluation
105H	COCOONED REACTOR BUILDING	Facility	INACTIVE			BUILDING	Process Building		
105C	COCOONED REACTOR BUILDING	Facility	ACTIVE			BUILDING	Process Building		
105DR	COCOONED REACTOR BUILDING	Facility	INACTIVE			BUILDING	Process Building		
105D	COCOONED REACTOR BUILDING	Facility	INACTIVE			BUILDING	Process Building		
105F	COCOONED REACTOR BUILDING	Facility	INACTIVE			BUILDING	Process Building		
105N	COCOONED REACTOR BUILDING AND FUEL STORAGE BASIN	Facility	INACTIVE			BUILDING	Process Building		

BIBLIOGRAPHY

CRESP 2015. *Methodology for the Hanford Site-Wide Risk Review Project*, Consortium for Risk Evaluation with Stakeholder Participation (CRESP), Nashville, Tennessee. Available at: http://www.cresp.org/hanford/.

DOE/RL-2016-09, Rev. 0. Hanford Site Groundwater Monitoring Report for 2015, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Mission Support Alliance, *Five-Year Surveillance Report for the 105-F, 105-H, 105-D, 105-C and 105-N/109-N Safe Storage Enclosures*, HNF-59342, Revision 0, March 2016

PNNL, *Final Reactor Disposition RC-DD-3*, Fact Sheet

US Department of Energy, *2016 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL.2015-10, Revision 0, December 2015

US Department of Energy, *Surveillance and Maintenance Plan for the 105-N/109-N Reactor Safe Storage Enclosure*, DOE/RL-2011-106, Rev. 0, December 2011

US Department of Energy, *Supplemental Analysis: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F-SA, July 2010

US Department of Energy, *Surveillance and Maintenance Plan for the 105-H Reactor Safe Storage Enclosure*, DOE/RL-2005-67, Rev. 0, November 2005

US Department of Energy, *Surveillance and Maintenance Plan for the 105-D Reactor Safe Storage Enclosure*, DOE/RL-2004-59 Rev.0, September 2004.

US Department of Energy, Richland Operation Office, *Surplus Reactor Auditable Safety Analysis*, BHI-01172, Rev. 3, August 13, 2004

US Department of Energy, *Surveillance and Maintenance Plan for the 105-DR Reactor Safe Storage Enclosure*, DOE/RL-2002-28 Rev. 1, July, 2004.

US Department of Energy, *Evaluation of Final Configuration Alternatives for the 105-B Reactor Facility*, DOE/RL-2002-43, Draft B, February 2003

US Department of Energy, *Surveillance and Maintenance Plan for the 105-F Reactor Safe Storage Enclosure*, DOE/RL-2009-45 Rev. 0, December, 2003.

US Department of Energy, *Surveillance and Maintenance Plan for the 105-C Reactor Safe Storage Enclosure*, DOE/RL-98-44, Rev. 1, March 2002

US Department of Energy, *Addendum (Final Environmental Impact Statement): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F, December 1992.

US Department of Energy, *Record of Decision; Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, WA* (58 Federal Register [FR] 48509)

US Department of Energy, *Draft Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, March 1989

General Information on Hanford Reactors, http://www.hanford.gov/page.cfm/AboutHanfordCleanup