APPENDIX H.15

222-S LABORATORY (CP-OP-15, CENTRAL PLATEAU) EVALUATION UNIT SUMMARY TEMPLATE

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PART I. EXECUTIVE SUMMARY

EU LOCATION

200 West Area

RELATED EUS

222-S Laboratory is exposed to potential hazards from radioactive and toxicological releases from the Plutonium Finishing Plant[1] (PFP) [CP-DD-5]. Other facilities in the 200 West Area with ongoing operations that have a potential for affecting 222-S Laboratory include the high-level radioactive waste storage tanks [Tank Farms, CP-TF-1 through CP-TF-9], Environmental Restoration Disposal Facility (ERDF) [CP-OP-06], Central Waste Complex (CWC) [CP-OP-1], T Plant [CP-OP-02], and low-level burial grounds [CP-LS-12]. In addition, 222-S provides input to the engineering specifications for each of the 242-A Evaporator [CP-OP-10] campaigns.

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

To keep 222-S Lab below the Category 2 thresholds with respect to radioactivity of various radionuclides, the radioactive inventory within 222-S Lab at any one time must remain below the threshold planning quantities (TPQs)[2]. Historically, the laboratory source term included 15 isotopes. Conclusions presented in HNF-10754[3] indicate that plutonium, americium, cesium, and strontium account for approximately 97% of the dose equivalent curies (DE-Ci) for accident analysis. Therefore, the incremental contribution to dose consequences from all the other isotopes is considered negligible and not included in the 222-S Lab DSA. The components of the materials at risk (MAR) for the accident analysis include the plutonium isotopes, Pu-238, Pu-239, Pu-240, Pu-241 and Pu-242; Am-241, Cs-137, Sr-90, and Y-90. The Y-90 is included because it is in equilibrium with Sr-90 and will contribute to the dose consequences.[4]

The 222-S Laboratory does not routinely generate transuranic (TRU) waste; however, future commitments cannot preclude having both TRU and low-level waste (LLW) at the facility. Both releases of TRU and LLW are given in terms of DE-Ci values.

BRIEF NARRATIVE DESCRIPTION

The 222-S Laboratory Complex, located in the 200 West Area of the Hanford Nuclear Reservation, provides analytical chemistry services for the Hanford Site projects, operations, and environmental cleanup activities. Laboratory personnel complete organic, inorganic, and radioisotope analysis of liquid

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[1] The laboratory is within the emergency planning zone of the PFP and is connected to the Patrol Operations Center, which would communicate emergencies via the Site emergency notification system. The PFP is located approximately 3 km (1.9 mi) northwest of 222-S Laboratory [HNF-12125, Rev 11 pg. ES-1].

[2] HNF-12125, Rev. 11 Table 3-7 on pg. 3-12

[3] "222-S Laboratory Radiological Inventory Comparison with Accident Dose Consequences" [Excerpt from HNF-12125 Rev 11, pg. 2-15]

[4] HNF-12125, Rev 11 pg. 2-16

and solid samples brought to the laboratory by the Hanford Site customers. Currently, the 222-S Laboratory long-term mission is to support the Hanford Site environmental cleanup and restoration activities.[5] Several upgrades and maintenance tasks were identified approach in the 222-S Life Extension Strategic Management Plan [RPP-RPT-40632, Rev 2] to support the 222-S Laboratory mission through fiscal year 2052. Major upgrades include numerous improvements to the Laboratory equipment, facilities, and supporting infrastructure. Many of the proposed 222-S Laboratory upgrades are necessary to maintain and restore the facility to operate safely and in compliance with current requirements, standards, and practices for nuclear and hazardous waste analysis. Some of the upgrades will be required to meet anticipated future analytical requirements. Because the 222-S Lab building-wide fire is the worst anticipated accident scenario, it is noted that the 222-S Fire Protection system will need to be upgraded with the replacement of the existing fire alarm panel. The fire alarm panel located in the front lobby will become obsolete. Minimal rewiring and conduit is expected although detectors/devices will be replaced. The present fire alarm panel was installed around 2001 and will require replacement of the panel and devices in approximately FY2028.[6]

Summary Tables of Risks and Potential Impacts to Receptors

Table H.15-1 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 222-S Lab Complex or immediate areas around the outside of the building; a Co-located Person is an individual located 100 meters from the Lab Complex boundary; 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 13.0 km (8.1 miles) directly west of the laboratory[7]. The nuclear-related risks to humans are based on unmitigated (unprotected or controlled conditions) dose exposures expressed in a range of from “low” to “high” according to the consequence levels considered by the CRESP team. 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[8]

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.

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[5] HNF-12125, Rev. 11 pg. ES-1

[6] RPP-RPT-40632, Rev 2 pg. 45

[7] HNF-12125, Rev. 11 pg. 1-2

[8] 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.

Cultural Resources[7]

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.

Table H.15-1. 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: Stabilization & Deactivation	**From Cleanup Actions:** Final D&D[c]
Human Health	Facility Worker	***S&D***: High (IS)	***Proposed method***: IS[e]
	Co-located Person	***S&D***: Med (IS)	***Proposed method***: IS
	Public	***S&D***: ND (IS)	***Proposed method***: IS
Environmental	Groundwater[a]	*Not Discernible* (*ND*)	*ND*
	Columbia River[a]	*ND*	*ND*
	Ecological Resources[b]	ND	Estimated to be Low[d]
Social	Cultural Resources[b]	**Native American** Direct: Unknown Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: Known Indirect: Known	Estimated to be:[d] **Native American** Direct: Unknown 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 (because of the nature of the facilities comprising the EU), 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. (IS = Insufficient Information).
c. Dependent on D&D Methods yet to be determined.
d. No cleanup decisions have been made for this EU.
e. Insufficient information

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

Current

An uncontrolled release of radioactive material could adversely affect the facility worker. No quantitative dose value was provided in the 222-S Hazard Analysis (HA) or the Documented Safety Analysis (DSA) but a Consequence Category of "A" was designated by the 222-S Lab DSA[9] that represents a prompt fatality or serious injury from falling debris caused by a collapsing part of the structure from a building-wide fire. The human health rating is considered "High" for a facility worker if prompt death or serious injury is estimated.

A building-wide fire that starts in the 222-S Laboratory Building is selected as the bounding accident for the 222-S Laboratory Complex. The resulting estimated unmitigated dose to the co-located person is approximately 8.3 rem.[10] The human health rating is considered "Medium" for a co-located person if the unmitigated dose calculated is between 5 rem and 25 rem.

The hazard and accident analysis for the 222-S Laboratory considers the closest Offsite Public to be 13.0 km (8.1 miles) directly west of the laboratory. The resulting estimated unmitigated dose to a member of the offsite public is approximately 0.01 rem. The human health rating is considered "Non-discernible, ND" for an offsite member of the public if the unmitigated dose calculated is less than 0.1 rem.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

No cleanup decisions have been made.

Groundwater, Vadose Zone, and Columbia River

There are no reported vadose zone inventories (because of the nature of the facilities that comprise the EU) and thus no significant threats to the vadose zone, groundwater, or the Columbia River for the purposes of this Review.

Ecological Resources

Current

0% of EU and 22% of the buffer area are level 3 or higher resource. There are few resources in the buffer.

[9] HNF-12125, Rev 11 Appendix C on pg. C-19 and HNF-12652, Rev 0 within Appendix A on pg. A-20. The Consequence Categories and descriptions are found within Table 3-3 in HNF-12125 (Rev 11).

[10] HNF-12125, Rev 11 Table 3-10 pg. 3-24

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

No cleanup decisions have been made, and as a result, the potential effects of cleanup on ecological resources is uncertain for the active cleanup evaluation period.

Cultural Resources

Current

The EU has been heavily disturbed. The EU has not been inventoried for cultural resources. Geomorphology indicates a high potential to contain intact archaeological resources on the surface and/or subsurface. Traditional cultural places are visible from EU. Three archaeological resources are located within 500 meters of the EU.

The National Register eligible Manhattan Project/Cold War Era significant resources located within the EU and within 500 meters of the EU will be demolished, but they have already been mitigated.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

No cleanup decisions have been made for the deep vadose zone, and archaeological investigations and monitoring may need to occur prior to remediation. The geomorphology indicates a high potential for intact archaeological resources. Remediation disturbance may result in impacts to archaeological resources if they are present in the subsurface. No cleanup decisions have been selected, however the potential range of impacts could include: Temporary indirect effects during remediation; Permanent indirect effects are possible if contamination remains after remediation and from capping.

The National Register eligible Manhattan Project/Cold War Era significant resources located within the EU and within 500 meters of the EU will be demolished, but they have already been mitigated.

Considerations for Timing of the Cleanup Actions

Because the radiological inventory is kept to limits according the requirements of a Hazard Category 3 facility, the 222-S Laboratory and auxiliary buildings are of lower priority compared to other facilities if the basis were solely on the radiological inventory within the facility.

Near-Term, Post-Cleanup Risks and Potential Impacts

No cleanup decisions have been made

PART II. ADMINISTRATIVE INFORMATION

OU and/or TSDF Designation(s)

Not ApplicableCP-OP-15

Common name(s) for EU

222-S Lab; 222-S Laboratory; 222-S Laboratory Complex

Key Words

222-S Laboratory; 222-S Lab

REGULATORY STATUS: (RCRA, CERCLA, ROD IN DISPOSITION TABLE FOR MANY)

Regulatory basis

The 222-S Laboratory and auxiliary buildings are collectively a Hazard Category 3 nonreactor nuclear facility.[11]

General radiological hazards are subject to Title 10, Code of Federal Regulations Part 835, "Occupational Radiation Protection" (10 CFR 835)[12]

Current requirements for the evaluation of hazards are contained in DOE O 420.1B, *Facility Safety,* and Title 10 *Code of Federal Regulations* Part 830 (10 CFR 830) Subpart B, "Safety Basis Requirements."[13]

Effluents from the operation of the 222-S Laboratory including liquid and airborne environmental discharges of low-level radioactive, nonradiological, potentially hazardous, or nonhazardous chemical wastes shall be managed in accordance with the guidelines and requirements of DOE, Washington State, and Federal regulations.

The Hanford Site RCRA permit, WA 7890008967, was issued in August 1994. The 222-S Laboratory is continuing to operate under interim status until the 222-S Laboratory Part B permit is issued and incorporated into the site permit[14].

Toxicological Hazards[15]: The 222-S Laboratory provides analytical chemistry support to many Hanford missions. Reagents are stored for use in a variety of analytical chemistry forms. These reagents are often toxic chemicals; however, the quantities are mostly limited to bench scale applications in analysis and standard preparations. These chemicals are on at least one of the following lists: 40 CFR 302.4 as Hazardous substances, 40 CFR 355, Appendix A, as Extremely Hazardous substances, 40 CFR 68.130 as regulated toxic and flammable substances or 29 CFR 1910.119, Appendix A, as toxic and highly reactive hazardous chemicals. The Threshold Planning Quantities (TPQs) for emergency preparedness are significantly higher than the current inventory of these chemicals and substances. Therefore, the toxicological consequences to the offsite and onsite receptors are not significant and will not be further evaluated. The safety of the facility worker is emphasized through safety meetings, training, the installation of safety equipment (showers, eyewash, etc.), and the implementation of Industrial Health and Safety programs.

Applicable regulatory documentation

- Brey, S. L. (2008). *222-S Laboratory Radiological Inventory Control Program*. CH2M HILL Plateau Remediation Company. HNF-SD-CP-MA-002, Rev.8.
- Coles, G.A., & Pelto, P.J. (2003). *Hazards Analysis for the 222-S Laboratory Complex*. HNF-12652, Rev. 0 (HNF-EDC-03-14779)
- Keene, J. R. (2011). *222-S Laboratory Fire Hazards Analysis*. Washington River Protection Solutions. HNF-SD-CP-FHA-003, Rev. 3

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[11] HNF-12125, Rev. 11 pg. 2-2

[12] HNF-12125, Rev 11 pg. 2-14

[13] HNF-12125, Rev 11 pg. 1-1

[14] HNF-12125, Rev 11 pg. 2-14

[15] HNF-12125, Rev 11 pg. 2-9. The list of chemicals and reagents used within 222-S are listed in Table 2-1 (pgs. 2-10 and 2-11 of HNF-12125) and their associated Threshold Planning Quantities (TPQs).

- Roe, N. R. (2015). 222-S Life Extension Strategic Management Plan, ARES Corporation for Washington River Protection Solutions, LLC. **RPP-RPT-40632, Rev. 2:** 268 pages.
- Smith, R. D. (2014). *222-S Laboratory Documented Safety Analysis*. Washington River Protection Solutions (WRPS). HNF-12125, Rev. 11
- US Department of Energy (DOE). (2014). *222-S Laboratory Radiological Sample Inventory Control: Operating Procedure*. ATS-LO-180-107, Rev.O-0.

Applicable Consent Decree or TPA milestones

None

Risk Review Evaluation Information

Completed

March 10, 2017

Evaluated by

Bethany Burkhardt and Steve Krahn

Ratings/Impacts Reviewed by

Henry Mayer

PART III. SUMMARY DESCRIPTION

Current land use

The current land use of area 200 West is Industrial for the DOE Hanford Site.

Designated future land use

The DOE preferred alternative is the Industrial Exclusive Use Category for the 222-S area (and 200W area)[16].

Primary EU Source Components

Legacy Source Sites

Not applicable.

High-Level Waste Tanks and Ancillary Equipment

Not applicable.

Groundwater Plumes

Not applicable.

[16] DOE-EIS-0222 CLUP-EIS Summary document, Figure S-10 on page 45/131

D&D of Inactive Facilities

Not applicable.

Operating Facilities

The radiological and chemical inventory associated with 222-S Lab exists and was created by sample analysis of material brought into the lab from other Hanford site operations and activities. The operating inventory of the 222-S Laboratory is below the Category 2 threshold. To keep 222-S Lab below the Category 2 thresholds with respect to radioactivity of various radionuclides, the radioactive inventory within 222-S Lab at any one time must remain below the threshold planning quantities (TPQs)[17] as shown in **Part V** "Waste and Contamination Inventory.

LOCATION AND LAYOUT MAPS

The 222-S Laboratory Complex is located in the 200 West Area of the Hanford Nuclear Reservation. The site is bounded on the north by the Saddle Mountains, on the east by the Columbia River, on the south by the Yakima River, and on the west by the Rattlesnake Hills. The Hanford Site is a 1,517 km^2 (586 mi^2) tract of semiarid land located within the Pasco Basin of the Columbia Plateau in southeastern Washington State. Facilities and activities at the Hanford Site are consolidated in operating areas scattered across the site and occupy approximately 6% of the total site area.

The Site extends into Benton, Franklin, Grant, and Adams Counties. State Highways 24, 240, and 243 pass through the Hanford Site. The Hanford Patrol controls access to the Hanford Site for DOE and only persons authorized by DOE are allowed to enter. Although the public may travel on the Columbia River and State Route 240, both of which allow passage in close proximity to the facilities inside the Site boundary, the Benton County Sheriff's Department in cooperation with the Hanford Patrol may restrict such travel; thus, these routes are not considered public.[18]

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[17] HNF-12125, Rev. 11 Table 3-7 on pg. 3-12
[18] HNF-12125, Rev. 11 pg. 1-2

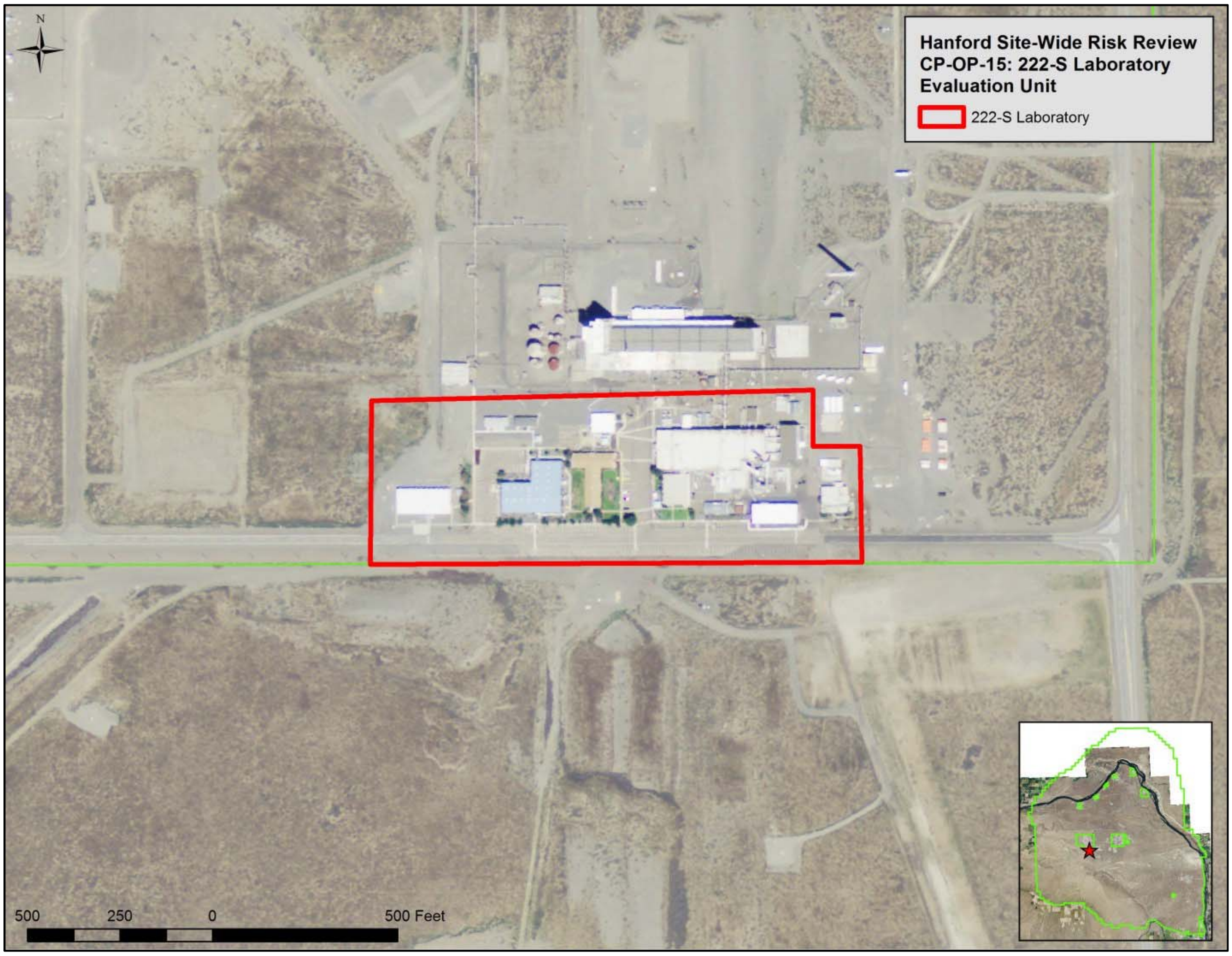

Figure H.15-1. CP-OP-15 (222-S Laboratory) Site Location Map

PART IV. UNIT DESCRIPTION AND HISTORY

EU Former/Current Use(s)

The 222-S Laboratory and auxiliary buildings are collectively a Hazard Category 3 nonreactor nuclear facility. [19] The 222-S Laboratory Complex, located in the 200 West Area of the Hanford Nuclear Reservation, provides analytical chemistry services for the Hanford Site projects, operations, and environmental cleanup activities. Laboratory personnel complete organic, inorganic, and radioisotope analysis of liquid and solid samples brought to the laboratory by the Hanford Site customers. Currently, the 222-S Laboratory long-term mission is to support the Hanford Site environmental cleanup and restoration activities.

The 222-S Laboratory was constructed between 1950 and 1951 and is located adjacent to the plutonium reduction-oxidation (REDOX) facility in the 200 West Area on the Central Plateau of the Hanford Site. The 222-S Lab was originally constructed to provide analytical and plant support for the REDOX

[19] HNF-12125, Rev. 11 pg. 2-2

Complex.[20] The laboratory and office space have been progressively enlarged and upgraded as the mission warranted. During 1974 the functional design criteria for exhaust ventilation improvements to the 222-S Laboratory Building were developed and approved. In compliance with these criteria, the 222-SB Filter Building and connecting ductwork were constructed. During 1980 two buildings were added to the 222-S Laboratory: the 222-SC Filter Building and the 222-S Laboratory Annex. In September 1980 the 222-SA Standards Laboratory was procured. This facility is a five-wide trailer. The units were purchased from a commercial manufacturer. Construction of a new exhaust filter building (222-SE) and a hot cell expansion to the 222-S Laboratory Building was completed in 1994.[21]

Legacy Source Sites

Not Applicable

Groundwater Plumes

Not Applicable

D&D of Inactive Facilities

Not Applicable

Operating Facilities

The 222-S Laboratory and auxiliary buildings are collectively a Hazard Category 3 nonreactor nuclear facility.[22] The 222-S Laboratory Complex, located in the 200 West Area of the Hanford Nuclear Reservation, provides analytical chemistry services for the Hanford Site projects, operations, and environmental cleanup activities. Laboratory personnel complete organic, inorganic, and radioisotope analysis of liquid and solid samples brought to the laboratory by the Hanford Site customers. Currently, the 222-S Laboratory long-term mission is to support the Hanford Site environmental cleanup and restoration activities.[23]

1. Processes that produced the radioactive material and waste contained in the facility

Sampling of liquid and solid samples brought to the Laboratory for testing and characterization produced the radioactive material and waste contained in the 222-S Lab Complex. The responsibilities of the laboratory include testing waste compatibility and physical characteristics to support tank to tank transfers, performing corrosion rate studies and chemical testing to support tank corrosion inhibition, providing input to the engineering specifications for each of the 242-A Evaporator campaigns, studying the physical and chemical characteristics of waste necessary to enable waste retrievals, tank closures and Vadose Zone Program support[24]. In addition, see answer to Question 6, below, that describes the processes and operations conducted within the facility.

2. Primary radioactive and non-radioactive constituents that are considered risk drivers

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[20] WHC-SP-1164, Rev 0 Appendix K (page 72 of 76 of the PDF report)

[21] HNF-12125, Rev. 11 pgs. 2-5, 2-6

[22] HNF-12125, Rev. 11 pg. 2-2

[23] HNF-12125, Rev. 11 pg. ES-1

[24] RPP-PLAN-58010, Rev 0 pg. 1

The 222-S Laboratory will be operated as a Hazard Category 3 nuclear facility by maintaining radioactive material inventories below Category 2 threshold quantities[25] provided in DOE-STD-1027-92.

Historically, the laboratory source term included 15 isotopes. Conclusions presented in HNF-10754[26] indicate that plutonium, americium, cesium, and strontium account for approximately 97% of the dose equivalent curies (DE-Ci) for accident analysis. Therefore, the incremental contribution to dose consequences of all the other isotopes is considered negligible and not included in the 222-S Lab DSA. The components of the materials at risk (MAR) for the accident analysis include the plutonium isotopes, Pu-238, Pu-239, Pu-240, Pu-241 and Pu-242; Am-241, Cs-137, Sr-90, and Y-90. The Y-90 is included because it is in equilibrium with Sr-90 and will contribute to the dose consequences[27].

The 222-S Laboratory does not routinely generate transuranic (TRU) waste; however, future commitments cannot preclude having both TRU and low-level waste (LLW) at the facility. Both releases of TRU and LLW are given in terms of DE-Ci values. The DE-Ci concept effectively converts radiological consequences for the inhalation pathway for either individual isotopes or mixes of isotopes to that of Pu-239. For TRU waste, the most abundant of these distributions are 6% (nominal) Pu-240 and 12% (nominal) Pu-240. The majority of waste containing plutonium will be waste containing contamination from weapons-grade plutonium (6% Pu-240) produced in Plutonium Finishing Plant (PFP) processing. However, significant contributions from other distributions come from reprocessed N Reactor fuel used for power generation (typically about 12% Pu-240) and Fast Flux Test Facility fuels development (also typically about 12% Pu-240). The majority of TRU waste received from offsite generators is related to breeder reactor fuel production, testing, etc., and should also be nominally 12% Pu-240.

For the 222-S Lab DSA (Rev 11) the bounding isotopic distribution of the plutonium contaminated waste samples is assumed to be that of 12% (nominal) Pu-240, 20-year aged waste. This is conservative because the 12% distribution has higher potential radiological consequences than 6% Pu-240. The added Sr-90, Y-90, and Cs-137 provide a reasonable consideration of the operational dose consequences to the facility worker since the DE-Ci contribution of these isotopes for accident analysis is very small.

The MAR is either the local inventory in the vicinity of the fire or the building contents in case of a building-wide fire. The MAR related to a local fire is very specific to the location of the fire. A building-wide fire is limited by the inventory of the 222-S Laboratory Complex and is estimated to be 39.11 DE-Ci [28]. The conversion calculation table of each major isotope is listed below in Table H.15-2.

[25] HNF-12125, Rev 11 pg. ES-2

[26] "222-S Laboratory Radiological Inventory Comparison with Accident Dose Consequences" [Excerpt from HNF-12125 Rev 11, pg. 2-15]

[27] HNF-12125, Rev 11 pg. 2-16

[28] HNF-12125, Rev. 11 pg. 3-19

Table H.15-2. Material at Risk and Dose Equivalent Curies[29]

Isotope	Mass Fraction of 12% Fuel	Isotope Mass (g)	Isotope (Ci)	ICRP 68 For Collocated Workers			ICRP 71/72 for Maximum Offsite Individual		
				Dose Conversion Factor [a] (Sv/Bq)	DE-Ci Factor	DE-Ci	Dose Conversion Factor [a] (Sv/Bq)	DE-Ci Factor	DE-Ci
^{238}Pu	0.0008	0.18	3.08	3.0E-05	0.94	2.89	4.6E-05	0.92	2.84
^{239}Pu	0.8395	188.89	11.71	3.2E-05	1.00	11.71	5.0E-05	1.00	11.71
^{240}Pu	0.1297	29.18	6.62	3.2E-05	1.00	6.62	5.0E-05	1.00	6.62
^{241}Pu	0.011	2.48	254.93	5.8E-07	0.02	4.62	9.0E-07	0.02	4.62
^{242}Pu	0.0003	0.07	2.65E-04	3.1E-05	0.97	2.6E-04	4.8E-05	0.96	2.54E-04
^{241}Am	0.0175	3.94	13.51	2.7E-05	0.84	11.34	4.2E-05	0.84	11.34
^{90}Sr		12.95	1800	3.0E-08	9.4E-04	1.69	3.6E-08	7.2E-04	1.30
^{90}Y		3.3E-03	1800	1.7E-09	5.3E-05	0.11	1.5E-09	3.0E-05	0.05
^{137}Cs		7.31	633	6.7E-09	2.1E-04	0.13	4.6E-09	9.2E-05	0.058
Total	0.9988					39.11			38.54

[a] Absorption values from RPP-5924, *Radiological Source Terms for Tank Farms Safety Analysis*.

The 222-S Laboratory complex contains less than 225 g of TRU with a composition equivalent to 20-year-aged 12% Pu-240 fuel and is physically separated from other facilities that contain fissionable materials by at least 6 feet edge to edge. The smallest mass of plutonium that will sustain a nuclear chain reaction under the most ideal conditions, the minimum critical mass, is 530 g. Therefore, at the facility limit of 225 g of TRU, a nuclear excursion is not a credible event. Even if a failure of the facility inventory tracking system allowed the quantity of fissionable material to be twice the limit and accumulate 450 g of TRU, the facility will not have enough mass to sustain a criticality. A criticality safety program, commensurate with the graded approach for the facility classification as described in procedures, is implemented. The fissionable material inventory will not exceed 225 g of plutonium equivalence, providing assurance that the risk of an inadvertent criticality is not credible. Therefore, a criticality alarm or criticality detection system is not required[4].

Due to the proximity of the REDOX Facility, potential hazard scenarios could lead to committed effective doses (CED) to the workers within the 222-S Laboratory. A CED of 13 rem is estimated to 222-S Lab workers if the REDOX Facility's roof should collapse from a seismic event with a ground acceleration of greater than 0.03g and the cover blocks are in place as designated as safety-significant design features. If the cover blocks were not in place during a seismic event causing the roof to collapse, the CED to laboratory personnel is postulated to exceed 1000 rem[30].

3. Containers or storage measures are used for radioactive materials at the facility

See answers to Question 2, above, and Question 6, below,

4. Classification of radioactive material and waste contained or stored within the facility

Solid waste will be low-level radioactive, mixed, or hazardous waste[31]. Radioactive liquid waste is generated in the 222-S Laboratory is classified as low-level waste[32]. The 222-S Laboratory does not

[29] HNF-12125, Rev 11 Table 3-1 on pg. 3-4

[30] HNF-12125, Rev 11 pg. 1-8

[31] HNF-12125, Rev 11 pg. 2-14

routinely generate transuranic (TRU) waste; however, future commitments cannot preclude having both TRU and low-level waste (LLW) at the facility[4]. Details of waste handling processes are described in the answer to Question 2, above, and Question 4 within Part VI.

5. Average and maximum occupational radiation doses incurred at the facility

The spectrum of radioactive materials handled in the laboratory is very broad. Dose rates from many low-level samples are at background radiation levels, whereas dose rates from some waste tank samples can be quite high. Analytical work is performed on samples with low dose rates by hands-on handling in fume hoods. High-dose-rate samples are normally subsampled in the hot cells to radiation levels suitable for fume hood work.[33]

Within RPP-RPT-57448 (Rev 1), a status update for the CY 2014 ALARA dose goals for the 222-S Laboratory is provided which includes Washington River Protection Solutions LLC and Advanced Technologies and Laboratories International, Inc. In an effort to maintain challenging, yet achievable, facility ALARA goals, these goals, are updated at minimum on a quarterly annual basis. Table H.15-3 shows that the whole body estimated doses are well below the ALARA 2014 goal.

Table H.15-3. Whole Body Collective Doses (2014 Goals and Annual Reports)[34]

1. **WHOLE BODY COLLECTIVE DOSE**

The 222-S Laboratory ALARA committee commits to maintaining the 222-S Laboratory annual collective whole body dose at ≤2.70 person-rem, with organizational goals of:

- WRPS ≤1.50 person-rem
- ATL ≤1.20 person-rem

ESTIMATED COMPLETION DATE (ECD): 12/31/2014
STATUS: Open

ANALYSIS OF PERFORMANCE:

Whole body estimated dose:	Through June 2014	2014 Goal
WRPS	0.971 person-rem	≤1.50 person-rem
ATL	0.113 person-rem	≤1.20 person-rem

WRPS (estimated whole body dose)	
Average year-to-date (YTD) dose to a radiological worker	0.007 person-rem
Maximum YTD dose to a radiological worker	0.096 person-rem
Number of YTD dose assessments for lost/damaged dosimeters	2
Maximum YTD neutron dose to a radiological worker (person-rem)	0 person-rem

ATL (estimated whole body dose)	
Average YTD dose to a radiological worker	0.002 person-rem
Maximum YTD dose to a radiological worker	0.41 person-rem
Number of YTD dose assessments for lost/damaged dosimeters	3
Maximum YTD neutron dose to a radiological worker	0 person-rem

6. Processes and operations conducted within the facility

[32] HNF-12125, Rev 11 pg. 2-12

[33] HNF-12125, Rev 11 pg. 2-3

[34] RPP-RPT-57448, Rev 1 pg. 1

The samples analyzed at 222-S come from sampling activities at Tank Farms and across the Hanford site. Most samples brought into the 222-S Laboratory for radiochemical analysis are from the tank farms[35]. Such activities include, but are not limited to:

- Tank waste sampling events. These samples may be liquid, solid (sludge), salt cake, or a mixture. Samples are drawn for a variety of purposes, such as corrosion monitoring, chemistry control, and caustic addition; physical, chemical and radiological characterization; waste compatibility assessments; tank closure; and hard heel (gibbsite and boehmite) dissolution studies.
- Vadose zone sampling. Samples consist of a soil matrix potentially contaminated with tank waste or separations process waste.
- Evaporator campaigns to reduce the volume of tank waste. Samples are composed of evaporator feed (tank supernate) or evaporator boildown.
- Emergent work in a variety of matrices. For example, soil, building materials, air and aqueous or organic liquids. Samples may be contaminated with tank waste, separations process waste or other hazardous chemical and/or radiological materials.
- Beryllium testing. Samples are primarily 100 cm2 swipes but may be other matrices, such as soil or building materials, contaminated with beryllium. Some beryllium samples may be radiologically contaminated.
- Support for demolition of Hanford’s Plutonium Finishing Plant. Samples may contain high alpha contamination.
- Industrial hygiene monitoring. Samples typically consist of vapor tubes which are tested for ammonia and mercury but may include air grab samples.
- Support for groundwater monitoring. Samples may contain water soluble radionuclide species, such as cesium or pertechnetate.

An estimated range of 15,000 to 25,000 analyses is performed annually on individual samples, field blanks and calibration standards[36]. The process is described below regarding receiving, logging, tracking, analyzing, archiving, storing, and disposing of radioactive waste samples:

Normally, samples are logged into tracking programs as they enter the laboratory. The container holding the sample material is typically transported to the laboratory inside closed transport containers. The contained samples are normally removed from the sealed transport carriers inside hoods or hot cells. A core sample cask is mated with the 11-A hot cell and the stainless steel sampler, about 310 ml volume, is removed. The sample is extruded from the sampler inside the hot cell. Any liquid portion of the core segment is captured in a glass jar during the extrusion, while the solids are usually photographed and scraped from the extrusion tray into a glass jar(s). The liquid samples are generally brought into the hot cell or hood where the volume and mass of sample is determined prior to transferring the sample into the storage jars. Samples are stored in the hot cell inside these jars until an aliquot or subsample is retrieved for sample analysis.

The requested sample analysis may be determined on samples as received, or samples may be diluted prior to analysis. Actual sample analysis is completed on small portions of the original sample referred to as an aliquot or sub-sample. The aliquot volume is carefully measured to be small enough to facilitate radiochemical analysis with a priority on as low as reasonably achievable (ALARA) concerns. The quantity of sample material actually outside the confines of the hot cell is very small compared to original sample

[35] HNF-12125, Rev 11 pg. 2-15

[36] Hanford 222-S Laboratory Analysis and Testing Services Draft Request for Proposal DE-SOL-0005750 pg. C-3.

volume. Sample analysis procedures may require small aliquots of liquid or solid samples to be dissolved in strong acids or bases (<pH 2.0 or >pH 12.5) or organic solvents, like formaldehyde. The quantity of these extremely hazardous chemicals required to facilitate analysis is very small and is normally used up in the analysis procedure. Aliquots that are mixed with extremely hazardous chemicals and must be stored during the sample analysis constitute a very small portion of the total facility radioactive material. The quantity of extremely hazardous chemicals in the facility is listed in Table H.15-8 and Table H.15-9. Aliquots are normally stored in Room 2-B (sample storage) or in Room 2-E, while sample analysis is being conducted. These areas provide convenient storage for the small quantity aliquot vials; however, they are carefully monitored and the room is managed to ensure the radiation dose is minimal. While the bulk of radioactive material is located inside the 11-A hot cell, all other areas may be used to store sample aliquots[35].

After sample analysis and final results are reported, the liquid waste from the sample is generally transferred to the 219-S Waste Handling Facility for treatment and storage until transferred to tank farms. Radioactive solid waste is packaged and stored in such areas as the 222-S Laboratory Solid Waste Handling/Storage System and Bone Yard until transfer to a Hanford Disposal Site. Mixed waste is accumulated in Satellite Accumulation Areas (SAA) and transferred to 90-Day Accumulation Areas or a Treatment, Storage, and Disposal (TSD) unit until it is transferred out of the facility.

In the individual laboratory rooms, radioactive materials are processed within open-face or arm-ported hoods where inlet-air velocities are maintained to prevent contamination of the laboratory room or personnel within the room. Other than the radioassay of contained sources in the basement counting room, laboratory technical functions (e.g., analysis of samples) are performed in the first-floor laboratory rooms. The size, shape, equipment layout, and work assignments vary from room to room.[11]

The auxiliary buildings are used for ventilation and electrical services, bulk material storage, and handling and transferring wastes to an onsite waste handling facility or offsite facilities.

A complete listing of the buildings included in the scope of the DSA is shown in the following.[11]

- 222-S Laboratory Building
- 222-S Laboratory Building Annex
- 222-SA Standards Laboratory
- 222-SB Filter Building
- 222-SC Filter Building
- 222-SE Filter Building
- 2716-S Storage Building
- 227-S Conditioned Storage Building
- 212-S Gas Storage Dock
- HS-0065 Chemical Storage Unit
- Waste Handling Facilities (includes 207-SL retention Basin, 225-WB, 218-W-7 Dry Waste Burial Ground, 219-S Waste Handling Facility, 222-SD Solid Waste Handling/Storage System, Bone Yard) and 222-S Laboratory Dangerous and Mixed Waste Storage Areas (HS-0082 and HS-0083)
- Administrative and office buildings (includes 2704-S and 2713-S Buildings and trailers/modular offices used for administrative support of the laboratory), Connex boxes

222-S Laboratory Building is divided into four general areas. The west end contains the lunch room, offices, and locker rooms, which are maintained free of radioactivity and toxic chemicals. The west central section contains laboratory rooms and service areas for work with radioactive and/or toxic materials. The east central section, commonly referred to as the multi-curie section, contains laboratory rooms, hot cells, and service areas for working with radioactive samples. The east end contains the Hot Cell Facility, room 11A. The Hot Cell Facility contains six cells for instrument analysis of high dose rate samples. The second floor includes the ventilation supply fans, supply and exhaust ductwork, the ventilation system control room, an electrical shop, a manipulator repair shop, and storage areas. The partial basement includes tunnels containing service piping and vacuum pumps, a counting room, an instrument maintenance shop, and a scanning electron microscopy laboratory.[37]

222-SA Standards Laboratory—The 222-SA Laboratory is a five-wide trailer located southeast of the 222-S Laboratory Building. Non-radioactive standard preparation and non-radiological process development were previously performed in this building. The building is no longer routinely used and is planned for removal.

222-SB Filter Building—The 222-SB Filter Building, located south of the 222-S Laboratory Building, houses 96 high-efficiency particulate air (HEPA) filters to provide final filtration for the 222-S Laboratory. Under normal operation of the ventilation system, three electrically powered fans exhaust air from the 222-S Laboratory. Exhaust air leaves the 222-SB Filter Building through the 296-S-21 stack. If exhaust plenum differential pressure becomes too low, supplementary exhaust ventilation will be provided through the 222-SE Filter Building via direct drive diesel powered exhaust fan. 222-SB Building, contains the second- and third-stage HEPA filtration for hot cells 1-A, 1-E-1, 1-E-2, 1-F, and 11-A-1 through 11-A-6. The hot cells in Rooms 1-A, 1-E, 1-F, and 11-A are serviced by the main building supply and exhaust ventilation.

The 222-SC Filter Building houses five parallel pairs of HEPA filters, which provide filtration to hot cell exhaust air before it enters the main exhaust plenum and final filtering in the 222-SB and 222-SE Filter Buildings.

222-SE Filter Building—The 222-SE Filter Building, located south of the 222-S Laboratory Building, is a facility that houses 56 HEPA filters. This building provides redundant backup filtering capabilities for the 222-S Laboratory exhaust utilizing a diesel powered exhaust fan.

212-S Gas Storage Dock—Storage area, located on the south side of the 222-S Laboratory, and will accommodate a large number of gas cylinders that support instruments in the laboratory. These docks allow separation of the cylinders into new and used, and into flammables and oxidizers.

Chemical Storage Unit (CSU)—The CSU (HS-0065) is located north of 222-SA Building and was used to provide safe storage of bulk chemicals. The unit is divided into two separate sections. Half of the unit is presently being used as a 90-day accumulation area for hazardous waste. The other half is used for storage of recyclables but may also be used for hazardous waste if necessary. The sections have numerous sump areas to prevent incompatible chemicals/waste from mixing in case of accidental breakage.

CFX Pit—The CFX Pit is located to the south of 222-SB Filter Building. It is a 5.2-m (17-ft) deep pit with a 3.7 m (12 ft) deep tank located therein. This tank was emptied of water and removed from service in 2012. The tank was previously used for storage and shielding of two 252Cf sources.[37]

Those facilities dedicated to the processing, storage, or handling of wastes from the 222-S Laboratory and auxiliary buildings are described in the following paragraphs.

207-SL Retention Basin—The 207-SL retention basin, located northeast of the 222-S Laboratory, provides temporary hold-up of wastewater with a low potential for having radioactive or hazardous

[37] HNF-12125, Rev. 11 Pgs. 2-6 through 2-9

constituents prior to discharge to the Treated Effluent Disposal Facility (TEDF) or the Effluent Treatment Facility (ETF). This facility is comprised of two below-grade 94,635-L (25,000 gal) compartments and three above-grade 75,708-L (20,000 gal) tanks. This facility allows batch collection, sampling, and discharge of the waste, provided the wastewater meets release/acceptance criteria. Water not meeting the release criteria will normally be transferred to the holding tanks and an action plan for disposal will be developed.

225-WB—The 225-WB Building houses the electronic interface to the TEDF.

218-W-7 Dry Waste Burial Ground—The 218-W-7 Dry Waste Burial Ground is located southeast of the 222-S Laboratory Building. This underground tank was removed from service before 1975. It was used primarily for disposal of contaminated dry hood waste generated by the 222-S Laboratory. It is classified as a Regulatory Past Practice (RPP) site in the 200-SW-2 Operable Unit.

219-S Waste Handling Facility[38]—The 219-S Waste Handling Facility, located north of the 11-A hot cell addition to the 222-S Laboratory Building, collects liquid mixed waste generated by the 222-S Laboratory operations. This facility consists of a below-grade containment vault, an operations building, and an attached concrete-walled sample gallery. The containment vault is divided into two sections, called cells A and B, which contain the liquid waste tanks and a moisture deentrainer tank. The waste tanks are vented through the deentrainer and a HEPA filter to the atmosphere via the 296-S-16 stack. The operations building contain the operating gallery, the pipe trench, a chemical addition drum that may be used to prepare waste for transfer and a caustic tank that may be used to neutralize the waste tanks. The concrete sample gallery contains the waste sampling hood, which is vented through HEPA filtration to the atmosphere via the 296-S-23 stack. This area is classified as a Resource Conservation and Recovery Act (RCRA) TSD component.

219-S Ventilation System—Two separate ventilation systems are used for contaminated areas in the 219-S Waste Handling Facility: an exhaust system for the vault storage tanks and an exhaust system for the sample gallery. Exhaust air from the venting of the 219-S vault waste tanks is discharged through the 296-S-16 stack. A moisture de-entrainer and a single HEPA filter provide filtration. During sample gallery use, ventilation air is exhausted from the sample gallery via an exhaust hood over the sample station, which is connected to an exhaust fan that maintains flow across the open portion of the hood. The exhaust air goes through double HEPA filtration and is discharged through the 296-S-23 stack. The operating gallery has no significant contamination; therefore, no inlet or exhaust HEPA filtration is provided.

222-SD Solid Waste Handling/Storage System[39]—The 222-SD Solid Waste Handling/Storage System, located north of the 222-S Laboratory Building, is a concrete-shielded drum storage area. This area is used for temporary storage of radioactive waste drums before transfer to the burial ground.

222-S Dangerous and Mixed Waste Storage Area (DMWSA)—This area consists of two metal storage lockers (HS-0082 and HS-0083), with RCRA compliant secondary containment, sited on a concrete pad north of the 222-S Laboratory Building, which can store drums of radioactive waste, mixed waste, and nonradioactive dangerous waste. The drums are stored until transferred to an onsite or offsite facility for treatment and disposal.

[38] Radioactive Liquid Waste Management is described for 219-S within section 2.5.2 (Pgs. 2-9 through 2-14 within HNF-12125, Rev. 11)

[39] Radioactive Solid Waste Management is described for 219-S within section 2.5.3 (Pg. 2-14 within HNF-12125, Rev. 11)

7. Process flow of material into and out of the facility

In addition to the information provided in the response to Question 6, above, there are a number of administrative controls in which inventory of radioactive materials are maintained below the quantities found in a Hazard Category 2 facility. Documents describing inventory controls are the following:

- HNF-SD-CP-MA-002_Rev-8 222-S Laboratory Radiological Inventory Program
  https://spteams1.pnnl.gov/sites/HSWRR/References/HNF-SD-CP-MA-002_Rev-8.pdf
- ATS-LO-180-107_O0_222-S_Laboratory_Radiological_Sample_Inventory_Control
  https://spteams1.pnnl.gov/sites/HSWRR/References/ATS-LO-180-107_O0_222-S_Laboratory_Radiological_Sample_Inventory_Control.pdf

The Functional Requirements of the radiological inventory control is to ensure the MAR limit for the facility is less than the derived radioactive material inventory of 39.11 DE-Ci, which produces the worst-case calculated dose to the collocated worker, to ensure that the bounding consequences are not exceeded as analyzed in the DSA.

This Specific Administrative Control is implemented through HNF-SD-CP-MA-002, *222-S Laboratory Radiological Inventory Program* and implementing procedures. This document describes the methodology and assumptions that provide the basis for tracking, reporting, and demonstrating compliance with the radioactive material inventory limits in the 222-S Laboratory to ensure the facility inventory does not exceed the dose equivalent curies used to calculate the dose consequences to the collocated worker as a result of the worst-case accident. Since this is strictly an inventory control there is no reasonable engineering control alternative such as SSC's. The hazard analysis does not assume a specific time frame to perform this activity. Radiological material that is received at the laboratory is entered into a sample tracking system or is credited to the facility holdup value which is pre-inventoried. Those samples containing radionuclides that contribute to the radiological MAR of the facility, based on process knowledge of the source, are assigned a conservative inventory value and added to the facility inventory. Fissionable material is inventoried separately, but into the same database. When additional information is acquired, such as weight of the sample, the inventory is adjusted. The radiological material is removed from the inventory after it is removed from the facility or sent to facility waste tanks, where it becomes part of the facility hold-up. A total facility inventory report is normally issued every day except for weekends and holidays, but at least weekly, and the present DE-Ci inventory is reviewed to ensure radioactive materials do not exceed the facility limits. The Hazard and Accident Analysis does not take credit for personnel actions to mitigate the consequences of the worst-case accident and does not assume a specific time to perform this activity. However, when radioactive material is received, a minimum of one qualified person is required to maintain radioactive material inventory control. Inventory control is a simple process performed in accordance with reference use procedures. There are no hazardous conditions involved with inputting the information. The personnel who receive radioactive material are qualified and trained on the procedures. Re-qualification is every two years. The radioactive material is inventoried upon receipt at the 222-S Laboratory. The inventory is input into a verified and validated computer software program or if necessary logged and manually calculated. The 222-S radiological inventory control procedures use conservative DE-Ci values for the radiological materials booked into the inventory system to enhance compliance. The inputs into the system are overviewed to ensure accuracy. There is no required time or distance separation for this action. A report is normally issued daily, except on weekends and holidays, but at least weekly. The reports provide the facility inventory in DE-Ci. The inventory control program and implementing procedures use a graded approach to ensure inventory of radioactive material shall not exceed the dose equivalent curies used to calculate the dose consequences to the collocated worker as a result of the worst-case accident. Although conservative values are already used, as the facility inventory reaches set limits, management notification or written approval will be required. Given the above, this control provides adequate assurance that the inventory of radioactive material shall not exceed the dose equivalent curies used to calculate the dose consequences to the collocated worker as a result of the worst-case accident[40].

The waste management system is an important part of the daily operations at the 222-S Laboratory, The majority of the material flow in and out of the facility deal with waste samples and the resultant radioactive waste forms that must be retained, treated, and then disposed. The following describes the configuration and operations of the retention basin waste system and the radioactive liquid waste system in the 222-S Laboratory Facility:

207-SL Retention Basin Waste System— The 222-S Laboratory retention basin, 207-SL, waste system handles water flushes, cooling water, and other liquid waste streams that have a low potential to contain radioactive contaminants or hazardous chemical waste. Effluents from the 222-S Laboratory, 222-SA Standards Laboratory, and the 219-S operating gallery are routed to the 207-SL retention basin. The effluent is sampled and verified to be within specified limits before transfer to the TEDF.[41]

219-S Waste Handling Facility— Sump 8 from the operating gallery within the 219-S Waste Handling Facility empties into a stainless steel utility drain that runs west out of the 219-S Building to manhole No. 4 where it connects to a fiberglass reinforced pipe (FRP). This FRP runs inside a concrete-encased vitrified clay pipe (VCP) to another FRP running inside a concrete-encased VCP. This line in turn empties into the 207-SL retention basin[42].

222-S Laboratory Drain System Description—The 222-S Laboratory Building can be divided into two sections; the analytical section occupies the western side of the building, and the multi-curie section occupies the eastern side. The analytical section retention basin effluents go to two drain lines in the basement tunnels. The multi-curie section retention basin effluents go to two different drain lines in the basement tunnels.

Basement Tunnels—All effluents from the 222-S Laboratory Building to the 207-SL retention basin are discharged through four different lines; a stainless-steel retention basin waste line and carbon-steel coolant and condensate line (no longer in service) for the analytical section, and a stainless-steel retention basin waste line and a carbon steel steam condensate drain (no longer in service) for the multi-curie section.

Cold tunnel sumps 1, 2, 3, 4, 5, and 6 function as floor drains and discharge into the analytical section retention basin waste line. Sump 5 also receives flow from a floor drain in the stairwell outside 222-S, near door No. 19, on the north side of the building. The analytical section retention basin waste, coolant, and condensate lines run north out to manhole No. 6. From the manhole the FRP lines flow to the 207-SL retention basin inlet weir box.

Cold tunnel sump 7 acts as a floor drain in the east end of the cold tunnels but it also receives flow from a floor drain outside door No. 18. Sump 7 discharges to the multi-curie section stainless steel retention basin waste line. The lines exit the north side of the building to manhole No. 5. At manhole No. 5 the lines connect to a FRP going to the 207-SL retention basin inlet weir box.

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[40] HNF-12125, Rev. 11 pgs. 4-2 to 4-3

[41] HNF-12125, Rev. 11 pg. 2-9

[42] HNF-12125, Rev. 11 pg. 2-11 through pg. 2-15

First-Floor Analytical Section—All laboratory sinks and hood condensate drains, except in Rooms 2-B and 2-B-2, go to the retention basin waste line. The laboratory hood drain in Room 2-B and all drains in 2-B-2 go to the 219-S Waste Handling Facility. All analytical section service sinks go to the analytical section retention basin waste line.

First-Floor Multi-curie Section—Generally, all multi-curie section laboratory sinks and hood condensate drains go to the multi-curie section retention basin waste line.

Second-Floor Equipment Room—The distilled water overflow and drain lines, firewater sprinkler system drain, backflush and drain from the deionized water unit, a floor drain near the deionized water unit, all go to the analytical section coolant and condensate line. A floor drain on the second floor in area S-1-A goes to the multi-curie section retention basin waste line.

French Drains—A french drain serves as an evaporative cooler drain for the 2716-S Storage Building. The french drains discharge directly into the ground instead of the 207-SL retention basin. The condensate from the evaporative cooler has not entered radiation zones prior to discharge to these drains and, as such, are not considered to have a potential for radiological contamination.

The following paragraphs describe the design and operation of the radioactive liquid waste system for the 222-S Laboratory Facility. All waste in this system is generated in the 222-S Laboratory and is classified as low-level waste.

From the laboratory hot sink drains and hot tunnel sumps, radioactive wastes flow or are jetted through stainless steel lines to waste tanks in the 219-S Waste Handling Facility. These lines are encased in stainless steel from the point of origin in the 222-S Laboratory Building into the 219-S vault. Waste that is transferred to tank farms is sampled, analyzed, and neutralized prior to the transfer.

Process Description—Radioactive liquid waste that is transferred to the 219-S Waste Handling Facility is generated from several locations throughout the 222-S Laboratory, as follows.

- Decontamination hood No. 16 in Room 2-B, the inductively coupled plasma spectrometers in Room 1-J, and the hot tunnel sump in T-4 are routed through tunnel T-4.
- Room 1-A hot cell, 1-E hot cells (1-E-1 and 1-E-2), 1-F hot cell, and the hot tunnel sumps in T-7, and T-8 are routed through tunnel T-8.
- Room 11-A hot cells are routed to the waste tanks in the 219-S Waste Handling Facility vault via two additional stainless-steel drain lines.

Each of the drain lines is encased in stainless steel from the point of origin in the 222-S Laboratory Building into the 219-S Waste Handling Facility and each is equipped with leak detection.

The 219-S Waste Handling Facility consists of an enclosed, below-grade, concrete vault containing stainless-steel waste tanks; transit building; the pipe trench and operating gallery; and an attached concrete-walled sample gallery. The waste tanks are vented by an electrical exhaust fan, through a deentrainer or demister and a HEPA filter, and to the atmosphere via the 296-S-16 stack.

Any leakage from the active waste tank in cell B is collected in sump 9, and leakage from the waste tanks in cell A is collected in sump 7. Leakage to the sumps will sound an alarm in the 219-S operating gallery and Room 3-B of 222-S. Pumps are used to transfer waste back into the tank system.

Process Technology—The waste level in all tanks is maintained below the high-level limit. Any leakage of waste can be pumped back into the tank system. The high liquid level alarms are normally set at 90% of the maximum tank volume. These limits are set to reduce the potential for overflow and allow for caustic and nitrite additions. There are several requirements for the composition of liquid waste generated by the 222-S Laboratory. No separable organic phases or emulsions are allowed in the liquid waste. To protect the piping and the tanks, no materials detrimental to 304 stainless steel are allowed in the liquid waste without prior neutralization or thorough flushing of the lines after transfer. Before the waste is transferred to tank farms, it must meet their acceptance criteria.

Process Control—Liquid level indicators monitor for waste leakage. Also, the hot tunnel sumps and the sumps in 219-S have lighted and audible alarms to indicate when the liquid-level limit is exceeded. The alarms for the tanks and the 219-S sumps are located in Room 3-B of the 222-S Laboratory Building and the 219-S operating gallery. The alarms for the hot tunnel sumps are located in the Control Room S-3-D and Room 3-B in the 222-S Laboratory.

The radioactive solid waste management system in the 222-S Laboratory Facility is described below:[43]

Solid waste will be low-level radioactive, mixed, or hazardous waste. Waste segregation techniques are employed to ensure packaged waste does not contain noncompatible waste materials. 222-S Laboratory generated waste materials consists of office paper, used surgeon's gloves, paper towels, tissues, rubber matting, glass vials, metal planchets, reagent bottles, wood, steel, tools, etc. Waste materials will be contaminated with low-level radioactive constituents, radioactive constituents plus hazardous materials (mixed waste), or hazardous materials. The solid low-level radioactive and mixed wastes are normally packaged for treatment or disposal in standard 55-gallon drums, burial boxes, or other approved containers. The waste containers used to accumulate waste are transferred to 90 Day Accumulation Areas or to a TSD unit prior to shipment. Radioactive contaminated organic liquid is classified as mixed waste and is collected in glass bottles inside the hoods. Hazardous waste, consisting primarily of expired chemicals, reagents, and analytical waste, is accumulated in Satellite Accumulation or in 90-Day Accumulation Areas. The placement of waste materials in 55-gallon drums, surrounded by absorbents, is considered lab packed. The lab-packed waste may be stored in a TSD unit or shipped directly to the offsite disposal facility. The 222-S Laboratory does not routinely generate transuranic (TRU) waste. Transuranic waste is, without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g. If a waste package is generated that is determined to be TRU, the containment, packaging, characterization, and shipping requirements of the waste receiver will be adhered to.

8. Potential effects of potential delays on the processes, operations, and radioactive materials in the facility

The 222-S Laboratory will be used through the end of the Tank Farm cleanup mission providing analytical support to both Tank Farms and the WTP, and is currently in need of numerous operating, analytical, and regulatory compliance upgrades. The 222-S Laboratory has some components that are not redundant and lead to a single-point failure which could shut down facility operations. Many of the components are long-lead and replacement will take extended periods of time, potentially impacting retrievals, the waste feed delivery, WTP schedule, or other operations depending on analytical results. The 222-S complex needs to have its useful life extended and reliability improved to support the Tank Farm cleanup mission[44].There is no available HA and/or DSA for future upgrades for the 222-S Laboratory.

The approach in the 222-S Life Extension Strategic Management Plan [RPP-RPT-40632, Rev 2] is to identify the upgrades that must be implemented to support the 222-S Laboratory mission through fiscal

[43] HNF-12125, Rev 11 pgs. 2-12 to

[44] RPP-RPT-40632, Rev 2 pg. 5 (pg 17 of 268 of the PDF report)

year 2052. Major upgrades include numerous improvements to the Laboratory equipment, facilities, and supporting infrastructure. This Strategic Management Plan also summarizes the description and assessment basis for each upgrade. Upgrades were identified to support plant safety, facility operations, replacement of analysis equipment, and modifications to maintain facility configuration management. Many of the proposed 222-S Laboratory upgrades are necessary to maintain and restore the facility to operate safely and in compliance with current requirements, standards, and practices for nuclear and hazardous waste analysis. Some of the upgrades will be required to meet anticipated future analytical requirements. The analytical equipment will need to be replaced on a periodic basis due to obsolescence of the equipment[45]. Other required upgrades to the 222-S Lab building structure, hot cells, ventilation/HVAC system, and fume hoods will be important in the near-term future to maintain full laboratory capabilities and to keep with demands from other Hanford-site operations. A summary of the required maintenance and upgrades can be found in Part VII ("Supplemental Information").

Because the 222-S Lab building-wide fire is the worst anticipated accident scenario, it is noted that the 222-S Fire Protection system will need to be upgraded with the replacement of the existing fire alarm panel. The fire alarm panel located in the front lobby will become obsolete. Minimal rewiring and conduit is expected although detectors/devices will be replaced. The present fire alarm panel was installed around 2001 and will require replacement of the panel and devices in approximately FY2028.[46]

9. Other facilities or processes that are involved in the flow of radioactive material into and out of the facility

The 222-S Laboratory's mission is to provide analytical chemistry services for the entire Hanford Site – projects, operations, and environmental cleanup activities. Chemistry services can be provided on a number of liquid and solid samples brought to the 222-S Laboratory by the Hanford Site Customers.[23] The majority of the facilities responsible for the inflow of radioactive materials into the 222-S Laboratory are from the environmental cleanup and restoration activities (e.g., tank farms and PFP).

Also, the 222-S Laboratory Complex provides quality analytical chemistry services in support of Hanford processing plants with emphasis on waste management, chemical processing, and environmental monitoring programs at B Plant, U03 Plant, Tank Farms, 242-A and 242-S Evaporators, Waste' Encapsulation Storage Facility (WESF), PUREX, PFP, process development/upset activities, and essential materials.

10. Shipping of material

See response to Question 7, above.

11. Infrastructure considered a part of the facility

See response to Question 6, above.

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

Within the EU boundary, 95% of the area is classified as a level 0 resource (Appendix J, Table J.113, Figure J.127). DOE/RL-96-32 (2013) includes landscaped areas and buildings as a level 0 resource unless birds are using the habitat for nesting/fledging. If landscaped areas or buildings are actively being used

[45] RPP-RPT-40632, Rev 2 pg. ii, and equipment to be replaced/repaired is listed on RPP-RPT-40632, Rev 2. pg. 10-19
[46] RPP-RPT-40632, Rev 2 pg. 45

for nesting/fledging, such areas are protected under the Migratory Bird Treaty Act; otherwise such areas are considered level 0 resources. Most of the birds observed in the EU were using the landscaping or buildings for nesting during the May survey.

The amount and proximity of biological resources surrounding the 222-S Laboratory EU were examined within the adjacent landscape buffer area, which extends 1395 ft (425 m) from the geometric center of the EU. A little over 0.5 acre of level 2 habitat is located within the northwest corner of the EU and is contiguous with a larger patch of level 2 vegetation observed in the adjacent landscape buffer area.

Field Survey

The 222-S Laboratory EU encompasses a complex of buildings and modular buildings surrounded by parking lots, bare ground and landscaped areas (Appendix J, Figure J. 127). A small patch of successional vegetation including gray rabbitbrush (*Ericameria nauseosa*) with an understory dominated by introduced grasses and forbs was noted in the northwest corner of the EU (Appendix J, Table J.112). The landscaping and buildings provide nesting and foraging habitat for several species of birds. Plant and animal species were recorded and datasheets are provided at the end of this EU description in Appendix J.

Cultural Resources Setting

While none of the CP-OP-15, 222-S Laboratory EU has been inventoried for archaeological resources, it seems unlikely that intact archaeological material is present within the EU due to the extensive soil disturbance associated with building construction and associated infrastructure installation and maintenance activities.

Cultural resources known to be recorded within the CP-OP-15, 222-S Laboratory EU are limited to the 3 National Register-eligible buildings associated with the Manhattan Project/Cold War Era Historic District (all 3 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 as per the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and building demolition is ongoing. Appendix K, Table 60, has more details about the 3 buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within the CP-OP-15, 222-S Laboratory EU.

All National-Register-eligible Manhattan Project and Cold War Era buildings been documented as described in the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998).

A segment of the National Register-eligible Hanford Site Plant Railroad, a contributing property within the Manhattan Project and Cold War Era Historic District is located within 500 meters of the CP-OP-15, 222-S Laboratory EU. Additionally there are three archaeological isolates identified within 500 meters of the EU, one associated with the Native American Precontact and Ethnographic Landscape, and two associated with the Pre-Hanford Early Settlers/Farming Landscape. None of these isolates have been formally evaluated for listing in the National Register of Historic Places, however it should be noted that isolate are typically considered not eligible.

Historic maps indicate a low potential for the presence of archaeological resources associated with the Pre-Hanford Early Settlers/Farming Landscape within the EU. Geomorphology indicates a high potential for the presence of Native American Precontact and Ethnographic cultural resources to be present within the EU boundary. Extensive ground disturbance within most of the EU, however, may negate this moderate potential. Resources, if present, would likely be limited to areas of intact, undisturbed soils.

Because the CP-OP-15, 222-S Laboratory has not been inventoried for archaeological resources, and because pockets of undisturbed soil may exist (although it is unlikely), it may be appropriate to conduct surface and subsurface archaeological investigations in these areas prior to initiating a remediation activity. 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

Vadose Zone Contamination

The reported inventories for CP-OP-15 (Table H.15-4 through Table H.15-6) are isolated from the environment because of the nature of the facilities comprising the EU. Thus there is no reported vadose zone inventory to be evaluated.

Groundwater Plumes and Columbia River

Not applicable

Operating Facilities

The radiological and chemical inventory associated with 222-S Lab exists and was created by sample analysis of material brought into the lab from other Hanford site operations and activities. To keep 222-S Lab below the Category 2 thresholds with respect to radioactivity of various radionuclides, the radioactive inventory within 222-S Lab at any one time must remain below the threshold planning quantities (TPQs)[47] as shown in Table H.15-8.

[47] HNF-12125, Rev. 11 Table 3-7 on pg. 3-12

Table H.15-4. Inventory of Primary Contaminants [(a)]

WIDS	Description	Decay Date	Ref	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			14	NR	NR	NR	720	NR	NR	NR	NR
218-W-7	Burial Ground	1986	EIS-S	NR	NR	NR	NR	84	NR	NR	NR	NR
222-S	Process Building	Radionuclides maintained at or below the radioactivity reported in this table at all times	HNF-12125, Rev 11 Table 3-12	14	NR	NR	NR	630	NR	NR	NR	NR

a. NR = Not reported

Table H.15-5. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Decay Date	Ref	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum			NR	NR	260	1900	NR	0.00023
218-W-7	Burial Ground	1986	EIS-S	NR	NR	0.051	78	NR	0.00023
222-S	Process Building	Radionuclides maintained at or below the radioactivity reported in this table at all times	HNF-12125, Rev 11 Table 3-12	NR	NR	260	1800	NR	NR

a. NR = Not reported

Table H.15-6. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Descrip-tion	Ref	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	NR	NR	NR	0.69
218-W-7	Burial Ground	EIS-S	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.69
222-S	Process Building	HNF-12125, Rev 11 Table 3-12	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

a. NR = Not reported

The operating inventory of the 222-S Laboratory is below the Category 2 thresholds and the sum of fractions is 0.883 (as shown below in Table H.15-7). The hazards evaluation and accident analysis presented show no potential for significant offsite or onsite consequences. This is consistent with a Hazard Category 3 designation of the 222-S Laboratory

Table H.15-7. 222-S Laboratory Inventory of Radioactive Material[48]

Isotope	Operating Inventory [Ci]	Category 2 Threshold [Ci]	Sum of Fractions [unitless]
Pu-238	3.08	62	4.97E-02
Pu-239	11.71	56	2.09E-01
Pu-240	6.62	55	1.20E-01
Pu-241	254.93	2900	8.79E-02
Pu-242	0.000265	55	4.81E-06
Am-241	13.51	55	2.46E-01
Sr-90	1800	22000	8.18E-02
Y-90	1800	22000	8.18E-02
Cs-137	633	89000	7.11E-03
Total			0.883

[48] HNF-12125, Rev. 11 Table 3-7 on pg. 3-12

The chemicals stored within 222-S Laboratory that are deemed to be extremely hazardous substances are listed below in Table H.15-8 and Table H.15-9 and are taken from the 222-S Laboratory DSA[49]. These chemicals are on at least one of the following lists: 40 CFR 302.4 as Hazardous substances, 40 CFR 355, Appendix A, as Extremely Hazardous substances, 40 CFR 68.130 as regulated toxic and flammable substances or 29 CFR 1910.119, Appendix A, as toxic and highly reactive hazardous chemicals. Table H.15-8 and Table H.15-9 indicate that the Threshold Planning Quantities (TPQs) for emergency preparedness are significantly higher than the current inventory of these chemicals and substances. Therefore, the toxicological consequences to the offsite and onsite receptors are not significant and will not be further evaluated.

Table H.15-8. Inventory of Extremely Hazardous Substances Stored within 222-S Laboratory

Listed Chemical Name	CAS Number	Quantity in Laboratory (lb)	Reportable Quantity (lb)	Threshold Planning Quantity (lb)
Acetylene	74-86-2	220		10,000
Aldrin	309-00-2	<0.005	1	500
Ammonia solutions (20% or greater) *as Ammonium hydroxide*	7664-41-7	20	100	500
Aniline	62-53-3	<0.005	5,000	1,000
Arsenous oxide	1327-53-3	<0.005	1	100
Boron trifluoride	7637-07-2	<0.005	1	500
Bromine	7726-95-6	1	1	500
Butane	106-97-8	1.1		10,000
Cadmium oxide	1306-19-0	<0.005	1	100
Carbon disulfide	75-15-0	<0.005	100	10,000
Cellulose nitrate (>12.6% nitrogen)	9004-70-0	0.5		2,500
Chlordane	57-74-9	<0.005	1	1,000
Chloroform	67-66-3	0.68	10	10,000
Cresol, o-	95-48-7	<0.005	1000	1,000
Cumene hydroperoxide	80-15-9	0.1		5,000
Dichloroethyl ether	111-44-4	<0.005	10	10,000
Dimethoate	60-51-5	<0.005	10	500
Dinitrocresol	534-52-1	<0.005	10	10
Dinoseb	88-85-7	<0.005	1,000	100
Disulfoton	298-04-4	<0.005	1	500
Endrin	72-20-8	<0.005	1	500
Ethyl ether	60-29-7	0.125		10,000
Ethyl chloride	75-00-3	<0.005		10,000
Ethylene oxide	75-21-8	<0.005	10	1,000
Ethylenediamine	107-15-3	1.5	5,000	10,000
Formaldhyde	50-00-0	1	100	500
Hexachlorocyclopentadiane	77-47-4	<0.005	10	100
Hydrazine *as hydrazine monohydrate*	302-01-2	6	1	1,000
Hydrogen fluoride	7664-39-3	26	100	100
Hydrogen chloride (conc. ≥37%)	7647-01-0	96		15,000
Hydrogen bromide	10035-10-6	10		5,000
Hydrogen peroxide (conc >52%) *as 30% hydrogen peroxide*	7722-84-1	29	1,000	1,000
Hydrogen	1333-74-0	8		10,000
Isobutane	75-28-5	30		10,000
Isodrin	465-73-6	<0.005	1	100
Lindane	58-89-9	<0.005	1	1,000
Mercuric oxide	21908-53-2	0.25	1	500
Mercuric chloride	7487-94-7	0.22	1	500
Methane	74-82-8	150		10,000

49 HNF-12125, Rev. 11 pgs. 2-10 and 2-11

Table H.15-9. Inventory of Extremely Hazardous Substances Stored within 222-S Laboratory (cont)

Listed Chemical Name	CAS Number	Quantity in Laboratory (lb)	Reportable Quantity (lb)	Threshold Planning Quantity (lb)
Methyl ether	115-10-6	11		10,000
Methyl chloride	74-87-3	<0.01		10,000
Methyl bromide	74-83-9	<0.005	1,000	1,000
Nitric acid	7697-37-2	350	1,000	1,000
Nitroaniline	100-01-6	<0.005		5,000
Nitrobenzene	98-95-3	<0.005	1,000	10,000
Nitrogen dioxide *As fuming nitric acid (conc 90%)*	10102-44-0	0.1	10	100
Nitromethane	75-52-5	0.13		2,500
Nitrosodimethylamine	62-75-9	<0.005	10	1,000
Parathion	56-38-2	<0.005	10	100
Parathion-methyl	298-00-0	<0.05	100	100
Phenol	108-95-2	0.6	1,000	500
Phorate	298-02-2	<0.005	10	10
Phosphorus	7723-14-0	0.1	1	100
Potassium cyanide	151-50-8	1	10	100
Propane	74-98-6	500		10,000
Propyne	74-99-7	5		10,000
Pyrene	129-00-0	<0.005	5,000	1,000
Selenious acid	7783-00-8	<0.005	10	1,000
Sodium cyanide	143-33-9	1	10	100
Sulfuric acid	7664-93-9	150	1,000	1,000
Tellurium	13494-80-9	<0.005	1	500
Thionazin	297-97-2	<0.005	100	500
Trimethylchlorosilane	75-77-4	<0.005	1	1,000
Vanadium pentoxide	1314-62-1	<0.005	1,000	100
Vinyl acetate monomer	108-05-4	<0.05	5,000	1,000
Vinyl chloride	75-01-4	<0.005		10,000
Vinylidene chloride	75-35-4	<0.005		10,000

Table H.15-10. Summary of the Evaluation of 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	0.23	0	1.84	---	---	---	---	---	*ND*
I-129	A	1 pCi/L	0.23	0.2	1.84	---	---	---	---	---	*ND*
Sr-90	B	8 pCi/L	0.23	22	1.84	---	---	---	---	---	*ND*
Tc-99	A	900 pCi/L	0.23	0	1.84	---	---	---	---	---	*ND*
CCl4	A	5 µg/L	0.23	0	1.84	---	---	---	---	---	*ND*
Cr	B	100 µg/L	0.23	0	1.84	---	---	---	---	---	*ND*
Cr-VI	A	48 µg/L[b]	0.23	0	1.84	---	---	---	---	---	*ND*
TCE	B	5 µg/L	0.23	2	1.84	---	---	---	---	---	*ND*
U(tot)	B	30 µg/L	0.23	0.8	1.84	---	---	---	---	---	*ND*

a. Parameters obtained from the analysis provided in Attachment 6-1 to Methodology Report (CRESP 2015).
b. "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level for hexavalent chromium.
c. Treatment amounts from the 2015 Hanford Annual Groundwater Report (DOE/RL-2016-9, 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?**

From the Preliminary Hazards Analysis (PHA) a wide-ranging set of hazardous conditions is formulated that could lead to release of radioactive or hazardous materials from contained locations within the facility vessels and piping. Based on the 104 postulated hazardous conditions within the PHA, a list of candidate representative accidents is selected that can be considered to represent and bound all hazardous conditions. From this candidate list, accidents are defined and analysis performed to quantitatively determine safety impacts. Six accident groups were identified using this approach. These groups are discussed along with the bounding hazardous condition for each group in Section 3.3.2.3.5 within HNF-12125 (Rev11). Chemical releases are provided for completeness but they are not considered part of the candidate representative accident selection.[50]

- Fire/Explosion
- Storage Tank Failure/Leaks
- Container Handling Accidents
- Container Overpressure Accidents
- Confinement System Failure
- Natural Phenomena/External Events

A building-wide fire is selected as the bounding accident for the 222-S Laboratory. Such a fire can be started by a failure of a compressed cylinder of flammable gas or gas line in a laboratory room. The building-wide fire scenario is assumed to result from the spread of either a local fire or a local deflagration and resulting fire. HNF-SD-CP-FHA-003, 222-S Laboratory Fire Hazards Analysis, presents a complete discussion of the fire hazards and fire related concerns in the 222-S Laboratory Complex.

The expectation for Hazard Category 3 facilities, according to the direction presented in HNF-8739, Hanford Safety Analysis and Risk Assessment Handbook (SARAH), is the establishment of an inventory limit based on quantification of unmitigated risk from bounding scenarios.

The MAR is either the local inventory in the vicinity of the fire or the building contents in case of a building-wide fire. The MAR related to a local fire is very specific to the location of the fire. A building-wide fire is limited by the inventory of the 222-S Laboratory Complex and is estimated to be 39.11 DE-Ci.[51]

No laboratory activities that are performed on a regular basis are foreseen that cannot be safely terminated either abruptly or within a very short time (a few minutes). Normally, during primary

[50] HNF-12125, Rev. 11 pg. ES-3
[51] HNF-12125, Rev. 11 pg. 3-19

ventilation shutdowns, a minimum amount of ventilation is needed to mitigate the release of airborne radioactive particulates to the laboratory environment. The direct-drive diesel fan is designed to automatically provide this backup ventilation capacity.[52]

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

No safety-class or safety-significant SSCs were identified by the hazard and accident analysis. Adherence to the Technical Safety Requirements (TSR) ensures that the facility will be operated within the established risk guidelines[53]. The engineering and administrative features identified in the PHA provide defense-in-depth against uncontrolled release of radioactive material that could adversely affect the public, the CW, the facility worker, and the environment. However, these features are not designated as safety-significant because the low dose consequences from this Hazard Category 3 facility are below the risk guidelines[54]. No credit is taken for engineered and administrative controls. The assumed source term is bounding because the entire 222-S Laboratory radiological inventory is exposed to the fire[55].

The Radioactive Material Inventory Control is implemented as a direct action Specific Administrative Control with the following requirements: The inventory of radioactive material shall not exceed the dose equivalent curies used to calculate the dose consequences to the collocated worker as a result of the worst-case accident[56].

Active fire protection and control systems include a sprinkler system supplied with raw water and sanitary water system, a fire protection and alarm control panel, and fire alarms situated with pullboxes throughout the 222-S laboratory complex (mostly located adjacent to emergency exits).[57]

There are radiation detection/survey monitors, safety communication devices and industry standard safety shower and eyewash stations located throughout the 222-S Laboratory complex. There are also high-liquid-level alarms are installed in the 207-SL retention basin, 219-S tanks, and 219-S sumps. When the liquid reaches a predetermined height, an annunciator light is activated locally and in Room 3-B of 222-S Laboratory Building. High-liquid-level alarms are also installed in the hot tunnel sumps and the cold (regulated) tunnel sumps. The hot tunnel sumps alarm in the S-3-D Control Room and Room 3-B, and the cold tunnel sumps alarm locally and in Room 3-B. These alarms, when activated, are acknowledged by 222-S Laboratory operating personnel who then take appropriate corrective action. During maintenance or outages of an alarm, increased surveillance frequencies can be invoked to ensure these parameters are not exceeded[57].

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

No safety-class or safety-significant SSCs were identified by the hazard and accident analysis. Adherence to the Technical Safety Requirements (TSR) ensures that the facility will be operated within the established risk guidelines.

Passive fire protection and control systems include fire-resistant construction materials and fire rated barriers (walls surrounding elevator shaft and interior stairway)[57].

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[52] HNF-12125, Rev. 11 pg. 2-3

[53] HNF-12125, Rev 11 pg. ES-3

[54] HNF-12125, Rev. 11 pg. 3-19

[55] HNF-12125, Rev. 11 pg. 3-23

[56] HNF-12125, Rev. 11 pg. 4-3

[57] HNF-12125, Rev. 11 pgs. 2-20 to 2-22

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?

An administrative control on the 222-S Laboratory Facility radioactive inventory is required to ensure that the consequences to the co-located person and the offsite public of this bounding accident remain within the guidelines. The engineering and administrative features identified in the PHA provide defense-in-depth against uncontrolled release of radioactive material that could adversely affect the public, the co-located person, the facility worker, and the environment. However, these features are not designated as safety-significant because the low dose consequences from this Hazard Category 3 facility are below the risk guidelines.

It is conservatively assumed that the fire impacts the total radiological inventory of the 222-S Laboratory. An accident involving fire and packaged waste was considered the bounding hazard scenario and was the only accident quantitatively analyzed in the 222-S DSA (HNF-12125, Rev 11). Packaged waste is defined as contaminated material contained by a noncontaminated barrier (i.e., a noncontaminated barrier such as a plastic bag between the waste and the environment). This category is intended to cover contaminated material in cans, bags, drums, and boxes but does not cover strong containers that result in smaller release fractions.

The worst-case accident scenario for the 222-S Laboratory is not complex, so the dose consequences were hand calculated. The consequences of the building-wide fire were calculated for the 100-m co-located person and the MOI at the closest Hanford site boundary. A ground level release was assumed and a building wake model was used. The release of radioactive material is primarily in the form of airborne particulates, which can be passed directly to the environment or released to the building and then to the environment. No credit was taken for an elevated release from the fire. Inhalation is the dominant radiation exposure pathway for this accident[58].

During normal operations, applicable current barriers within the primary facility when analytical work performed using wet chemical analyses are the following: Fume hoods, Ventilation exhaust airflows from the corridors and rooms (with a direct-drive diesel fan is designed to automatically providing backup ventilation capacity), hot cells, bricks are made available in the laboratory so small shielded enclosures can be constructed for temporary storage and shielding of small quantities of radioactive materials or shielding for survey equipment.

Analytical work is performed on samples with low dose rates by hands-on handling in fume hoods. High-dose-rate samples are normally subsampled in the hot cells to radiation levels suitable for fume hood work. Liquid samples are normally received at the laboratory in shielded containers (known as pigs) or in polybottles.

The following precautions are observed while handling radioactive liquids within the laboratory.[59]

- Radioactive liquids are transported in closed containers. The containers of liquids with significantly high dose rates are enclosed in shielded containers that may include the following:
  - Pigs
  - Minipigs
  - Sample carriers
  - Core sample casks

[58] HNF-12125, Rev. 11 pgs. 3-23 to 3-25
[59] HNF-12125, Rev. 11 pgs. 2-4, 2-5

- Containers of radioactive liquid are opened only in hoods or hot cells. Containment barriers against airborne radioactive particulates are provided by the walls of the hoods and hot cell, the laboratory ventilation system in the hood and hot cell HEPA filters (inlet and outlet).
- Isolated, high-integrity, corrosion-resistant piping and receiving tanks are the first containment barrier for radioactive aqueous waste in transit to and at the 219-S Waste Handling Facility. All waste lines in the laboratory building are double-contained, welded piping. The underground piping is double contained in stainless-steel casings, and the receiving tanks are enclosed in a concrete vault with stainless-steel liners for secondary containment. The stainless-steel liners provide secondary containment, which meets WDOE requirements. Flow from the laboratory drains to the receiving tanks is by gravity. The waste can be pumped between tanks within the 219-S vault and from the 219-S Waste Handling Facility to the tank farms
- Laboratory aqueous wastes, with a small potential for being contaminated with hazardous waste or radioactivity, flow by gravity and accumulate in concrete retention basins at the 207-SL retention basin. This waste is released to the Treated Effluent Disposal Facility (TEDF) or the Effluent Treatment Facility (ETF) only after analysis shows that the effluent is within release/acceptance criteria. Through the use of administrative procedures, the potential for hazardous material or radioactive contamination in this waste is low.

The solid low-level radioactive and mixed wastes are normally packaged for treatment or disposal in standard 55-gallon drums, burial boxes, or other approved containers. The waste containers used to accumulate waste are transferred to 90 Day Accumulation Areas or to a TSD unit prior to shipment. Radioactive contaminated organic liquid is classified as mixed waste and is collected in glass bottles inside the hoods. Hazardous waste, consisting primarily of expired chemicals, reagents, and analytical waste, is accumulated in Satellite Accumulation or in 90-Day Accumulation Areas. The placement of waste materials in 55-gallon drums, surrounded by absorbents, is considered lab packed. The lab-packed waste may be stored in a TSD unit or shipped directly to the offsite disposal facility.

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

No safety-class or safety-significant SSCs were identified by the hazard and accident analysis. Adherence to the Technical Safety Requirements (TSR) ensures that the facility will be operated within the established risk guidelines.

For the building-wide fire hazard scenario, no credit is taken for engineered and administrative controls. The assumed source term is bounding because the entire 222-S Laboratory radiological inventory is exposed to the fire.[60]

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

A building-wide fire that is started in the 222-S Laboratory Building is selected as the bounding accident for the 222-S Laboratory Complex. As shown in the PHA, such a fire can result from failure of a flammable compressed gas cylinder or gas line in a laboratory. The building-wide fire scenario is assumed to result from the spread of either a local fire or a local deflagration and resulting fire. The local fire or local deflagration is assumed to interact with flammable chemicals stored in the laboratory, and the fire is assumed to spread to adjacent laboratory rooms and throughout the 222-S Laboratory facility. Any deflagration is not large enough to cause building-wide damage. It may result in an immediate release of radioactivity in a laboratory hood or room but this release will be small compared to the release resulting from the fire spreading and burning the entire facility. No credit is taken for engineered

[60] HNF-12125, Rev. 11 pgs. 3-22 and 3-23

and administrative controls. The assumed source term is bounding because the entire 222-S Laboratory radiological inventory is exposed to the fire.

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

Immediate to hours for impacts to occur from the initiating event of a building-wide fire.

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

There no ongoing releases to the environment or to the receptors that is not controlled and managed.

The most severe environmental consequences of the hazards listed in Appendix C is Category E2 (significant discharge onsite) which is consistent with a Hazard Category 3 facility. The E2 consequences are from hazardous conditions that release the total radiological inventory and one scenario that releases 10% of the radiological inventory plus chemicals from 219-S. The frequency assigned to most these hazardous conditions is unlikely, therefore, no design or operational features that reduce the potential for large material releases to the environment are needed.[61]

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

A building-wide fire that starts in the 222-S Laboratory Building is selected as the bounding accident for the 222-S Laboratory Complex. An uncontrolled release of radioactive material could adversely affect the facility worker. No quantitative dose value was provided in the 222-S Hazard Analysis (HA) or the Documented Safety Analysis (DSA) but a Consequence Category of “A” was designated by the 222-S Lab DSA[62] that represents a prompt fatality or serious injury from falling debris caused by a collapsing part of the structure from the building-wide fire. The human health rating is considered “High” for a facility worker if prompt death or serious injury is estimated.

Co-Located Person (CP)

A building-wide fire that starts in the 222-S Laboratory Building is selected as the bounding accident for the 222-S Laboratory Complex. Risk Class Bin III was designated for the co-located person and the frequency rating is “unlikely”. The resulting estimated unmitigated dose to the co-located person is approximately 8.3 rem. The human health rating is considered ““Medium” for a co-located person if the unmitigated dose calculated is between 5 rem and 25 rem.

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[61] HNF-12125, Rev 11 Pg. 3-18

[62] HNF-12125, Rev 11 Appendix C on pg. C-19 and HNF-12652, Rev 0 within Appendix A on pg. A-20. The Consequence Categories and descriptions are found within Table 3-3 in HNF-12125 (Rev 11).

Table H.15-**11. Bounding Accident Analysis Summary for the Co-Located Person**[63]

Isotope	Operating Inventory (Ci)	Dose Conversion Factor ICRP 68 (Sv/Bq)	Dose Conversion Factor (rem/Ci)[a]	(OI*RF*BR) (Ci-m³/s)[b]	Dose to the 100 m Collocated Worker (rem)[c]
^{238}Pu	3.08	3.00E-05	1.11E+08	5.08E-07	6.15E-01
^{239}Pu	11.71	3.20E-05	1.18E+08	1.93E-06	2.48
^{240}Pu	6.62	3.20E-05	1.18E+08	1.09E-06	1.40
^{241}Pu	254.93	5.80E-07	2.15E+06	4.21E-05	9.87E-01
^{242}Pu	2.65E-04	3.10E-05	1.15E+08	4.38E-11	5.49E-05
^{241}Am	13.51	2.70E-05	9.99E+07	2.23E-06	2.43
^{90}Sr	1800	3.00E-08	1.11E+05	2.97E-04	3.59E-01
^{90}Y	1800	1.70E-09	6.29E+03	2.97E-04	2.04E-02
^{137}Cs	633	6.70E-09	2.48E+04	1.04E-04	2.81E-02
Total					8.32

[a] Converted ICRP 68 (Sv/Bq) to (rem/Ci) by multiplying (3.7E10 Bq/Ci) x (100 rem/Sv)
[b] Operating Inventory (Ci) x release fraction (5.0E-4) x breathing rate (3.3E-4 m³/s)
[c] Rem/Ci x (OI*RF*BR) x ?/Q; for the CW ?/Q = 1.09E-02 s/m³ (RPP-13482, Appendix L)

Public

The hazard and accident analysis for the 222-S Laboratory considers the closest Offsite Public to be 13.0 km (8.1 miles) directly west of the laboratory.

A building-wide fire that starts in the 222-S Laboratory Building is selected as the bounding accident for the 222-S Laboratory Complex. Risk Class Bin III was designated for the offsite public receptor and the frequency rating is “anticipated”. The resulting estimated unmitigated dose to a member of the offsite public is approximately 0.01 rem. The human health rating is considered “Non-discernible, ND” for an offsite member of the public if the unmitigated dose calculated is less than 0.1 rem.

Table H.15-**12. Bounding Accident Analysis Summary for the Maximum Offsite Individual.**

Isotope	Operating Inventory (Ci)	Dose Conversion Factor ICRP 71/72 (Sv/Bq)	Dose Conversion Factor (rem/Ci)[a]	(OI*RF*BR) (Ci-m³/s)[b]	Dose to the 13 km Maximum Offsite Individual (rem)[c]
^{238}Pu	3.08	4.60E-05	1.70E+08	5.08E-07	9.76E-04
^{239}Pu	11.71	5.00E-05	1.85E+08	1.93E-06	4.03E-03
^{240}Pu	6.62	5.00E-05	1.85E+08	1.09E-06	2.28E-03
^{241}Pu	254.93	9.00E-07	3.33E+06	4.21E-05	1.58E-03
^{242}Pu	2.65E-04	4.80E-05	1.78E+08	4.38E-11	8.81E-08
^{241}Am	13.51	4.20E-05	1.55E+08	2.23E-06	3.91E-03
^{90}Sr	1800	3.60E-08	1.33E+05	2.97E-04	4.46E-04
^{90}Y	1800	1.50E-09	5.55E+03	2.97E-04	1.86E-05
^{137}Cs	633	4.60E-09	1.70E+04	1.04E-04	2.00E-05
Total					0.0133

[a] Converted ICRP 71 (Sv/Bq) to (rem/Ci) by multiplying (3.7E10 Bq/Ci) x (100 rem/Sv)
[b] Operating Inventory (Ci) x release fraction (5.0E-4) x breathing rate (3.3E-4 m³/s)
[c] Rem/Ci x (OI*RF*BR) x ?/Q; for the MOI ?/Q = 1.13E-05 s/m³ (RPP-13482, Appendix L)

[63] HNF-12125, Rev 11 Table 3-10 pg. 3-24

Groundwater and Columbia River

Not applicable.

Ecological Resources

Summary of Ecological Review:

- The majority of the EU is a level 0 resource, and cleanup activities are not expected to remove significant habitat.
- Landscaped areas are considered level 0 resources except when birds are actively nesting or fledging, and the loss of structures outside of nesting season is not considered an impact to resources.

Cultural Resources

The CP-OP-15, 222-S Laboratory EU is located within the 200-West Area of the Hanford Site, an area known to have low potential to contain Native American Precontact and Ethnographic archaeological resources and Pre-Hanford Early Settlers/Farming resources. Much of the 200 Areas were addressed in a cultural resources report entitled *Archaeological Survey of the 200 East and 200 West Areas, Hanford Site* (Chatters and Cadoret 1990). The focus of this archaeological survey was on inventorying all undisturbed portions of the 200-East and 200-West Areas. This report concluded that much of the 200-East and 200-West Areas can be considered areas of low archaeological potential with the exception of intact portions of an historic/ethnohistoric trail/road corridor which runs through the 200-West Area.

None of the CP-OP-15, 222-S Laboratory EU has been inventoried for archaeological resources. It is unlikely that intact archaeological material is present in the areas that have not been inventoried for archaeological resources (both on the surface and in the subsurface), particularly because the soils in the 222-S Laboratory EU appear to be heavily disturbed from the installation of the laboratory, associated buildings and supporting infrastructure (roads, parking lots, etc.).

Archaeological sites, buildings and Traditional Cultural Properties (TCPs) located within the EU[64]

- No archeological sites or TCPS have been identified within the CP-OP-15, 222-S Laboratory EU.
- There are 3 National Register-eligible Manhattan Project and Cold War Era buildings located within the EU (all 3 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 as per the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56) (DOE-RL 1998) and building demolition is ongoing.

Appendix K, Table 59, has more details about the 3 buildings that are National Register-eligible Manhattan Project and Cold War Era buildings located within the CP-OP-15, 222-S Laboratory EU.

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

[64] 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).

is located within 500 meters of the 222-S Laboratory EU. In accordance with the 1998 *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 three archaeological isolates (one associated with the Native American Precontact and Ethnographic Landscape and two associated with the Pre-Hanford Early Settlers/Farming Landscape) that have been identified within 500 meters of the EU. These isolates have not been evaluated for listing in the National Register of Historic Places, however it should be noted that isolates are typically considered not eligible.

Closest Recorded TCP

There are two recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the CP-OP-15, 222-S Laboratory EU.

Cleanup Approaches and End-State Conceptual Model

Selected or Potential Cleanup Approaches

No cleanup decisions have been made for this Facility

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

No cleanup decisions have been made for this Facility

Risks and Potential Impacts Associated with Cleanup

No cleanup decisions have been made for this Facility

Populations and Resources at Risk or Potentially Impacted During or as a Consequence of Cleanup Actions

Facility Worker

No safety documentation has been developed (Hazards Analysis or Documented Safety Assessments).

Co-located Person

No safety documentation has been developed (Hazards Analysis or Documented Safety Assessments).

Public

No safety documentation has been developed (Hazards Analysis or Documented Safety Assessments).

Groundwater Plumes and Columbia River

Not applicable

Ecological Resources

No cleanup decisions have been made for this EU. As a result, the potential effects of cleanup on ecological resources cannot be made for the active cleanup evaluation period.

Cultural Resources

No cleanup decision for the remaining waste treatment, storage and disposition facilities.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

Because the radiological inventory is kept to limits according the requirements of a Hazard Category 3 facility, the 222-S Laboratory and auxiliary buildings are of lower priority compared to other facilities if the basis were solely on the radiological inventory within the facility.

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

No cleanup decisions have been made for this EU.

Populations and Resources at Risk or Potentially Impacted After Cleanup Actions (from residual contaminant inventory or long-term activities)

Table H.15-13. Summary of Populations and Resources at Risk or Potentially Impacted after Cleanup.

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	Insufficient information (IS)	
	Co-located Person	IS	
	Public	IS	
Environmental	Groundwater	*Not Discernible* (*ND*)	No risks because of the nature of the facilities that comprise the EU.
	Columbia River	*ND*	
	Ecological Resources[(a)]	No cleanup decisions have been made for this EU. Estimated to be ND to Low	Monitoring activities for post-closure conditions are expected to occur. Low impacts are likely if exotic species are introduced to buffer area with level 3 resources.
Social	Cultural Resources[(a)]	**Native American** Direct: Unknown Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: Known Indirect: Known	Permanent indirect effects are possible if residual contamination remains after remediation and from capping. The National Register eligible Manhattan Project/Cold War Era significant resources located within the EU and within 500 meters of the EU will be demolished, but they have already been mitigated.

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

No cleanup decisions have been made for this EU.

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

Potential effects of potential delays on the processes, operations, and radioactive materials in the facility

The approach in the 222-S Life Extension Strategic Management Plan [RPP-RPT-40632, Rev 2] is to identify the upgrades that must be implemented to support the 222-S Laboratory mission through fiscal year 2052. Major upgrades include numerous improvements to the Laboratory equipment, facilities, and supporting infrastructure. This Strategic Management Plan also summarizes the description and assessment basis for each upgrade. Upgrades were identified to support plant safety, facility operations, replacement of analysis equipment, and modifications to maintain facility configuration management. Many of the proposed 222-S Laboratory upgrades are necessary to maintain and restore the facility to operate safely and in compliance with current requirements, standards, and practices for nuclear and hazardous waste analysis. Some of the upgrades will be required to meet anticipated future analytical requirements. The analytical equipment will need to be replaced on a periodic basis due to obsolescence of the equipment[65]. Other required upgrades to the 222-S Lab building structure, hot cells, ventilation/HVAC system, and fume hoods will be important in the near-term future to maintain full laboratory capabilities and to keep with demands from other Hanford-site operations.

Because the 222-S Lab building-wide fire is the worst anticipated accident scenario, it is noted that the 222-S Fire Protection system will need to be upgraded with the replacement of the existing fire alarm panel. The fire alarm panel located in the front lobby will become obsolete. Minimal rewiring and conduit is expected although detectors/devices will be replaced. The present fire alarm panel was installed around 2001 and will require replacement of the panel and devices in approximately FY2028.[66]

The 222-S Facility is constructed mainly of concrete; however, it is over 55 years old and will have a continued mission through FY2052, making the facility 98 years old at that point. To date, over half of analytical laboratory rooms have been upgraded or are in the process of being upgraded to current code requirements. Two administrative areas were also converted to analytical lab rooms. Prior to 2010, the last room upgrade at 222-S Laboratory occurred in FY1997. The following work tasks and completion plan for the 222-S Lab structure are listed below[67]:

- **222-S Structural Evaluation:** A structural review study needs to be performed in order to ensure the 222-S Facility will remain safe for the duration of the mission through FY2052. A structural evaluation is scheduled to be performed on the 222-S Laboratory every 15 years beginning in FY2025.
- **222-S Roof Replacement**
- **222-S Facility Layout:** The engineering study to identify the optimum layout and requirements for the support facilities located around the 222-S Facility requires continuous updates
- **Facility Reliability Studies:** Non-compliance study on the Industrial Safety System consisting of eye washes and safety showers and flood control dealing with the water from safety showers and firewater.
- **222-S Room Renovations:** A number of recommendations regarding room renovations was made in the study, including the need for additional analytical laboratory space and rearrangement of the current analytical space to address the future needs of the Laboratory at a reduced cost. A number of rooms will be renovated in order to be compliant with NFPA, NEC, and OSHA regulations.

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[65] RPP-RPT-40632, Rev 2 pg. ii (page 7 of 268 of the PDF report), and equipment to be replaced/repaired is listed on RPP-RPT-40632, Rev 2. pg. 10-19

[66] RPP-RPT-40632, Rev 2 pg. 45

[67] RPP-RPT-40632, Rev 2 pg. 22-49.

- **Hot Cell Upgrades:** Upgrades and maintenance are needed to bring the hot cells up to working standards. The upgrades to hot cells will be expense funded and consist of decontamination of cells, replacing items as applicable such as floor pans, new hot cell windows, removal of epoxy, painting, electrical lighting upgrades, and electrical outlets, plus additional items as identified for a specific hot cell. It includes design, construction, and testing.
- **222-S Air Compressor Upgrades:** The 222-S Laboratory has two air compressors with a common dryer. The air compressors were installed in 1993 and have a design life of 20 years. Loss of both compressors would halt operation of the Laboratory making this system critical to the facility. An air compressor upgrade was completed in FY2014. A future air compressor upgrade is planned for 2033.
- **222-S Freight Elevator Upgrade:** The 222-S Laboratory freight elevator was last upgraded approximately 16 years ago and will require one more upgrade to extend its useful life until FY2052. The freight elevator upgrade is scheduled for FY2016.
- **1-A Hot Cell Air Filter Housing Relocation:** This WBS relocates Hot Cell 1-A inlet air filter housing. This will eliminate the interference with the #2 manipulator. These activities were planned for FY2015 (it is unknown if this task was completed).
- **2716-S Maintenance/Operations Support Facility Study:** This WBS performs an engineering study for a maintenance and operations support facility to accommodate the increase in maintenance and operations activities that will occur during the high-sample production needs for tank waste treatment. These activities are planned for FY2016
- **Reverse Osmosis:** The 222-S Laboratory reverse osmosis water unit was replaced in 2006. It has an expected life of 15 years. The distribution piping, however, is in need of major renovations (modifications or replacement) to allow it to be sanitized and (preferably) to add the ability to re-circulate the water to maintain its quality. Water quality is critical to some analytical methods, such as IC. This upgrade was planned to begin in FY2015 (it is unknown if this task began on schedule or was completed).
- **Ventilation System & HVAC System:** The 222-S Laboratory Building ventilation system is designed to ensure that air flows from areas of low contamination potential to areas of high-contamination potential and is operated by maintaining zone differential pressures. The primary ventilation is the main (aside from electrical) operating system in the Laboratory to ensure workers' safety when analyzing hazardous and radioactive samples. To continue safe sample analysis, support customer throughput (tank retrievals, tank transfers, WTP samples, etc.) and correct common mode resonance (causing duct cracking), selected systems will require replacement or repair. Anticipated replacements will include some ductwork, air handling units, chillers, exhaust fans, filter building (222-SB), main exhaust system, and diesel generators. The upgrade to the ventilation control system was completed in FY2012. The steam to electric heat conversion project began in FY2010 and was also completed in FY2012. The supply and exhaust fan replacements are scheduled for FY2016 and be complete in FY2017. Replacement of the counting room HVAC was scheduled for FY2012 but was not funded. Follow-on counting room HVAC replacement needs to occur 20 years after the next replacement, approximately FY2033. Replacement of the HEPA filters is scheduled to be replaced every ten years beginning in FY2016. The HVAC system for the 222-S Counting Room was installed in 1980 and should be replaced in the near-term, then every 20 years thereafter to last through FY2052. All duct work is assumed to be good. The units have failed multiple times for the past two or more summers. They are very costly to maintain.

- **Laboratory Fume Hood Ventilation and Hood Replacements:** Hoods will be replaced as each lab is remodeled. Specifically hood replacements should be planned for Rooms 1-GA, 4-C, 4-S, 2-B2, and 2-H. A study to determine requirements, cost, and schedule is required.
- **Miscellaneous 222-S Lab Facility: Lighting Replacement, 222-S Dumbwaiter Replacement**

The 219-S Waste Handling Facility, located north of the 11-A hot cell addition to the 222-S Laboratory Building, collects liquid mixed waste generated by the 222-S Laboratory operations. This facility consists of a below-grade containment vault, an operations building, and an attached concrete-walled sample gallery. Overflow prevention was added to the 219-S tank system in 2009. This system added automatic shutoff valves on the process water and distilled water systems via a new control panel. The 219-S Facility will require a new roof and is a RCRA-permitted facility, which means it must be maintained against deterioration and provide secondary containment functions. The 219-S Facility superstructure has had several leaks, which have been temporarily patched. A 1995 inspection of the 219-S gallery roof declared the roof unsafe for human traffic. A portion of the 219-S upgrade would replace the roof, bringing it up to code and eliminating the leaks. It should also be noted that the roofing material of this building contains asbestos. RPP-RPT-46803 was prepared in 2010. The study resulted in the following upgrade suggestions:

- Replacing the cell superstructure (including: Installing an overhead crane, Adding power receptacles, Improving lighting, Enhancing temperature controls, Replacing portable ladders, Replacing the Operations Gallery roof)
- Installing a fire protection system (including: Removing wood products or coat combustibles with a fire retardant, Adding sheetrock to reduce fire potential)
- Improving monitoring and remote viewing capabilities of the cell areas and platforms
- Improving the compressed air system
- Replacing waste transfer pump P-1
- Replacing and relocating sump pumps
- Adding cleanout capability to U-traps
- Increasing waste storage capacity
- Improving and/or replacing the existing tank ventilation system
- Upgrading and/or replacing the air jet sampling system
- Removing Tank 201 (caustic storage).

Based on the analysis conducted in RPP-RPT-46803, making the suggested upgrades to the existing facility would be more cost effective than packaging the waste and sending outside the complex for storage. For estimating purposes, the risk ranking and cost analysis assumes all suggestions detailed in the report are to be adopted, although implementation may require prioritizing the specific upgrades. The 219-S Facility is included in the RCRA Permit which requires periodic integrity assessments. The integrity assessment is required to be completed and submitted to the Washington State Department of Ecology in 2019. Requirements for the integrity assessment are unclear and it is recommended a study be performed to detail requirements for the integrity assessment, anticipated costs, and suggested schedule.

219-S Waste Transfer Flush System: The current waste drain lines from 222-S to 219-S are equipped with a siphon station designed to empty transfer lines. The siphon station does not empty the transfer line, resulting in significant waste holdup. This upgrade will flush the transfer lines from 219-S to SY Tank Farm. These activities are planned for FY2017.

222-SD Solid Waste Handling/Storage System: The 222-SD Crane Pad, located north of the 222-S Laboratory Building, is a concrete-shielded drum storage area. This area is used for temporary storage of radioactive waste drums before transfer to the burial ground. A study needs to be planned to further evaluate the current 222-SD systems and identify the renovations needed to safely store waste until FY2052. Perform a study to evaluate the current 222-SD systems and identify the renovations needed to safely store waste until FY2052. These activities were planned for FY2015 (it is unknown if this task began on schedule or was completed).

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