ECF-HANFORD-17-0128
Revision 2

Radiological and Toxic Air Emissions for the REDOX Complex

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

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

P.O. Box 1464
Richland, Washington 99352

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Freestone Environmental, Inc.

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ENVIRONMENTAL CALCULATION COVER PAGE

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Revision History

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0	Initial release	05/29/2018	All
1	Revision incorporates the use of CAP88 software to calculate TEDE to the MEI.	11/04/2020	All

ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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Terms

APQ	annual possession quantity
CM	conservatism multiplier
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
ECF	environmental calculation file
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
HEPA	high-efficiency particulate air
HSTF	Hexone Storage and Treatment Facility
LIGO	Laser Interferometer Gravitational-Wave Observatory
MEI	maximally exposed individual
NESHAP	National Emission Standards for Hazardous Air Pollutants
PTE	potential-to-emit
RAWP	removal action work plan
REDOX	Reduction-Oxidation
S&M	surveillance and maintenance
TEDE	total effective dose equivalent
WDOH	Washington State Department of Health

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1 Introduction

This environmental calculation file (ECF) provides air emission estimates to support a non-time-critical removal action at the Reduction-Oxidation (REDOX) Complex, located in the 200 West Area of the Hanford Site. This ECF summarizes the assumptions, inputs, and methodology used to calculate the potential-to-emit (PTE) radionuclide airborne emissions and the total effective dose equivalent (TEDE) to the maximally exposed individual (MEI). This ECF also documents the determination of criteria and toxic air emissions resulting from this removal action. Revision 2 of this ECF modifies the inventory input and revises the stack flow rate for the point source emission cases to reflect modifications to the REDOX ventilation system that are anticipated to be online in 2023. In addition, the exhauster scenario is removed from this revision because the modifications to the ventilation system will make an exhauster unnecessary.

This ECF supports the current removal action scope as defined in DOE/RL-2017-06, *Removal Action Work Plan for the Reduction-Oxidation Complex* (hereinafter called the REDOX Removal Action Work Plan [RAWP]). The removal activities outlined in the REDOX RAWP implement DOE/RL-2016-52, *Action Memorandum for the REDOX Complex*.

The REDOX Complex structures addressed in this removal action are the 202S Building (including canyon, silo, and annex), the 293S Nitric Acid and Iodine Recovery Building (293S Building), and the *Resource Conservation and Recovery Act of 1976* 276S Hexone Storage and Treatment Facility (276S HSTF) (Figure 1). The closest operational building is the 222S Laboratory and associated support structures. The 222S Laboratory and associated support structures are not included in the scope of this removal action.

As described in the REDOX RAWP (DOE/RL-2017-06), the removal action for the REDOX Complex includes the following activities:

- Continued surveillance and maintenance (S&M) of the REDOX Complex
- Hazard abatement[1] of the 202S Canyon Galleries
- Demolition preparation[2] of the 202S Silo Service Area, 202S Annex, and abovegrade areas of the 202S Canyon
- Demolition of the 293S Building, the 276S HSTF, and the 202S Annex
- Grouting of belowgrade areas of the 293S Building

The canyon process cells are not in the scope of this removal action. The removal action includes characterization of remaining hazardous substances to facilitate demolition and waste disposal, to determine worker controls, and to document post-removal conditions for a future remedial action. Characterization activities will be performed in accordance with DOE/RL-2017-05, *Sampling and Analysis Plan for the REDOX Complex*. These activities have the potential to result in radiological or chemical emissions.

[1] Hazard abatement is proactive hazard mitigation by decontamination, stabilization (e.g., applying fixatives), or equipment removal.

[2] Demolition preparation, preceded by hazard abatement, is a more aggressive removal of hazards and equipment.

Figure 1. REDOX Complex Structures

2 Background

This chapter provides brief descriptions and past deactivation activities for the structures associated with the removal action at the REDOX Complex. Removal activities, as currently defined in the REDOX RAWP (DOE/RL-2017-06), are also described for each structure. Other REDOX Complex structures included in the S&M scope are identified in this chapter. The REDOX ventilation system description is also provided in this document as it will be modified to support the removal activities. Additional information on these structures can be found in the REDOX RAWP.

2.1 202S Building

The 202S Canyon Building (REDOX), also known as S Plant, was constructed between 1950 and 1952 and began operations in 1952. It was the first large-scale, continuous-flow, solvent extraction process plant in the United States. The 202S Building and support buildings were designed to separate uranium, plutonium, and neptunium as individual product streams from fission products in the irradiated fuel. The building consists of three major substructures: canyon, silo, and annex (Figure 2). The canyon and silo are large, heavily shielded metal and concrete structures. The annex is a concrete structure with three subsections: North, Southwest, and East. Figure 3 and Figure 4 provide cross-sectional views of the 202S Building along the west-east and north-south building axes.

Figure 2. 202S Building

Shutdown activities began in 1967 and were completed in 1969 (HNF-13830, *Documented Safety Analysis for the Reduction-Oxidation Facility*). Initial deactivation included multiple flushes using water, diluted hot nitric acid, permanganate, and oxalic acid. The facility piping systems and vessels were then systematically flushed regularly with water for nearly 1 year thereafter to remove additional contaminants and decontamination fluids (ISO-1108, *REDOX Deactivation Manual*). After deactivation, the REDOX Complex was transferred to long-term S&M status.

2.1.1 202S Canyon

The 202S Canyon is a large, multistory, concrete structure with reinforced concrete walls. The building is 142.6 m (468 ft) long, 49.1 m (161 ft) wide, and 25.3 m (83 ft) high with 18.3 m (60 ft) abovegrade. The canyon, which lies on an east-west axis, contains all the equipment for dissolving fuel elements; preparing radioactive column feeds; distilling solvents; concentrating and neutralizing waste; separating uranium, plutonium, and neptunium as product streams from fission products; and treating process gaseous wastes. Abovegrade areas include the Canyon Deck, North and South Pipe Galleries, North and South Operating Galleries, and the south Crane Cab Gallery. Approximately one-fourth of the building is constructed belowgrade, with processes performed in process cells located below the Canyon Deck for shielding purposes (Figure 4). Belowgrade areas include the North and South Sample Galleries and the Storage Gallery (located on the south side of 202S). The east end rooms, located at the east end of the canyon, are a maintenance area consisting of a special work permit lobby (used as a central staging area) and the remote shop, decontamination room, and regulated shop. The process cells, hot pipe trench, and wind tunnel (Figure 4) are outside the removal action scope.

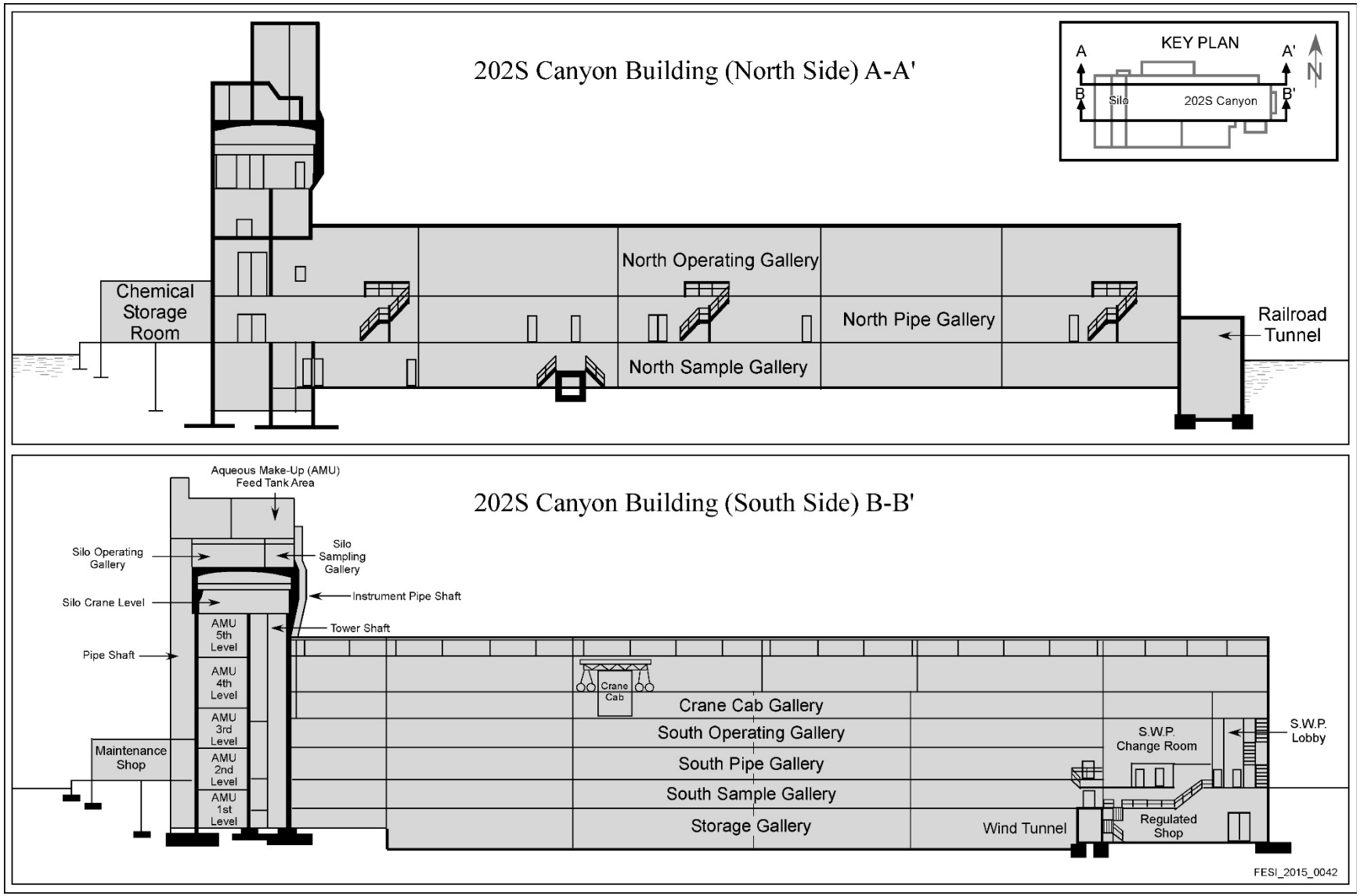


Figure 3. 202S Building Cross Section West to East

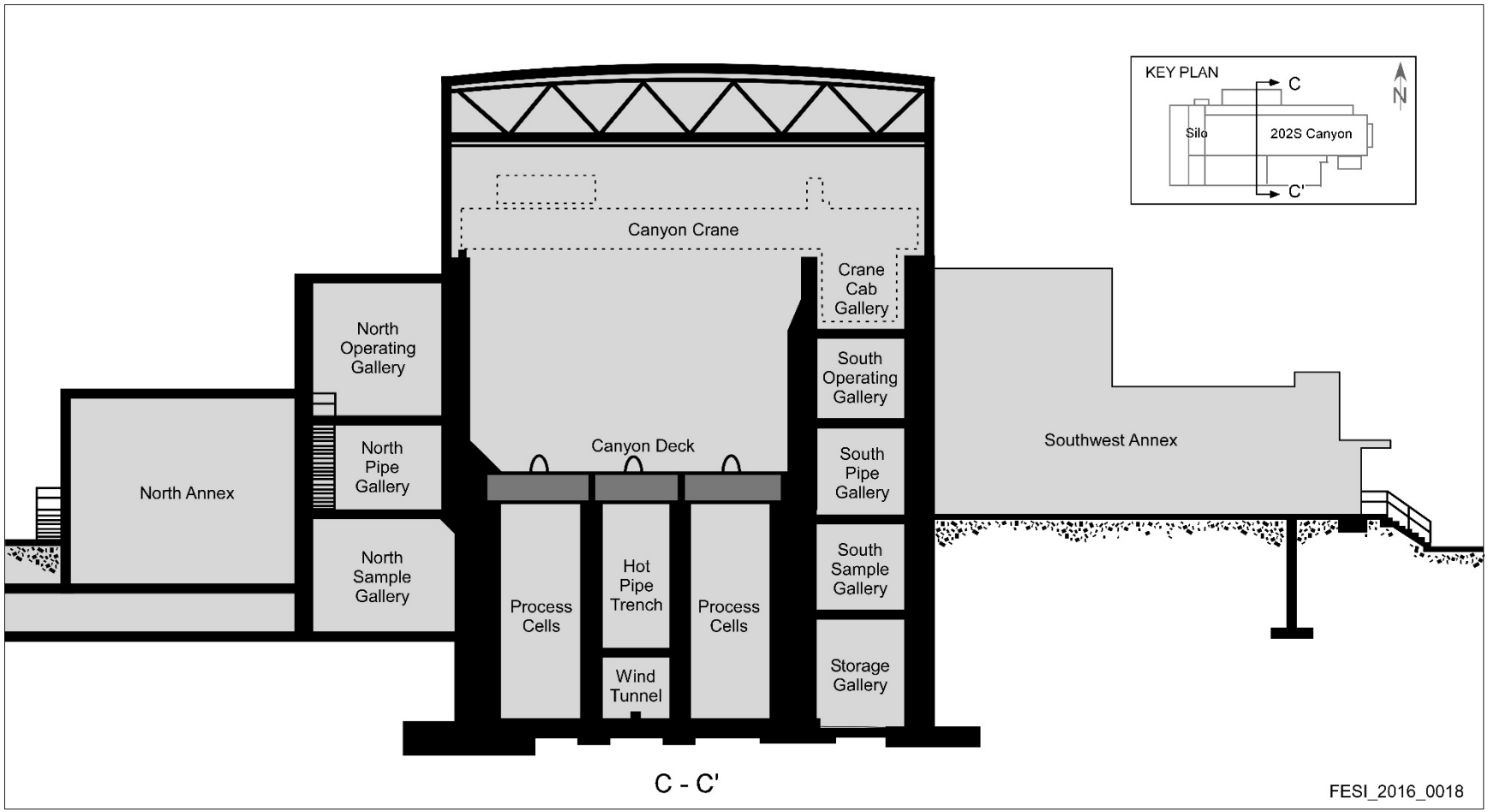


Figure 4. 202S Building Cross Section North to South (Facing East)

The Plutonium Loadout Hood, also referred to as the Product Receiver Cage, is located at the west end of the North Sample Gallery. The hood was used to concentrate the plutonium product solution prior to shipment. The Plutonium Loadout Hood operated from 1951 to 1955. During operations, plutonium solutions from separation activities were transferred to the hood. The solutions were then concentrated and loaded out as a liquid plutonium nitrate product. In 1955, the system was deactivated as operations in the hood ceased because improved capabilities were provided by the 233S Plutonium Concentration Facility (demolished in 2004). The hood was serviced by a dedicated ventilation system including the 296S002 Stack that is no longer active. Currently, minimal ventilation to the hood is supplied by the 291S Ventilation System.

Under the current removal action, hazard abatement will occur in the belowgrade Sample Galleries, including removal of the Plutonium Loadout Hood and its contents. Demolition preparation will occur in the abovegrade galleries (Pipe, Operating, and Crane Cab), including the Canyon Deck. The process cells, Wind Tunnel, Waste Line Tunnel, and Hot Pipe Trench are outside the scope of the removal action.

2.1.2 202S Silo

The 202S Silo is an eight-story structure located at the west end of the 202S Building. The silo houses solvent-extraction columns and aqueous makeup unit vessels. The silo is 25.6 m (84 ft) long, 12.5 m (41 ft) wide, and 40.2 m (132 ft) high, with 35.7 m (117 ft) abovegrade (Figure 5). The silo is segregated into two parts: Silo Service Area (operating area) and silo tower shaft (process area). The Silo Service Area has eight levels—the first five are aqueous makeup unit levels, and the sixth level is occupied by the silo crane. The Silo Operating Gallery and Sample Gallery are on the seventh level. The eighth level contains the Blower Room and Feed Tank Area. Silo service area vessels and piping were flushed with demineralized water during deactivation in the 1960s. Some existing silo equipment was reactivated in the 1970s and 1980s to support operating several test assemblies.

In-scope areas of the silo will undergo demolition preparation. These areas include levels one through five, seven, and eight. The Silo Crane Level, Silo Tower Shaft, and Column Laydown Trench are not included in the removal action scope.

2.1.3 202S Annex

The 202S Annex is separated from the main canyon structure by a massive concrete wall. Three subannexes (Figure 6 and Figure 7) comprise the REDOX Annex: North, Southwest, and East. These areas contain offices, administrative support areas, maintenance shops, and equipment rooms for ventilation and electrical components. Historically, they are minimally contaminated due to cross-contamination vectors. The annex buildings were part of the original construction of the 202S Building.

The 202S Annex will be demolished to grade, and the belowgrade areas will be backfilled to grade and contoured. Demolition of the 202S Annex includes removal of previously isolated ventilation ducting from the blower rooms to the 202S Canyon.

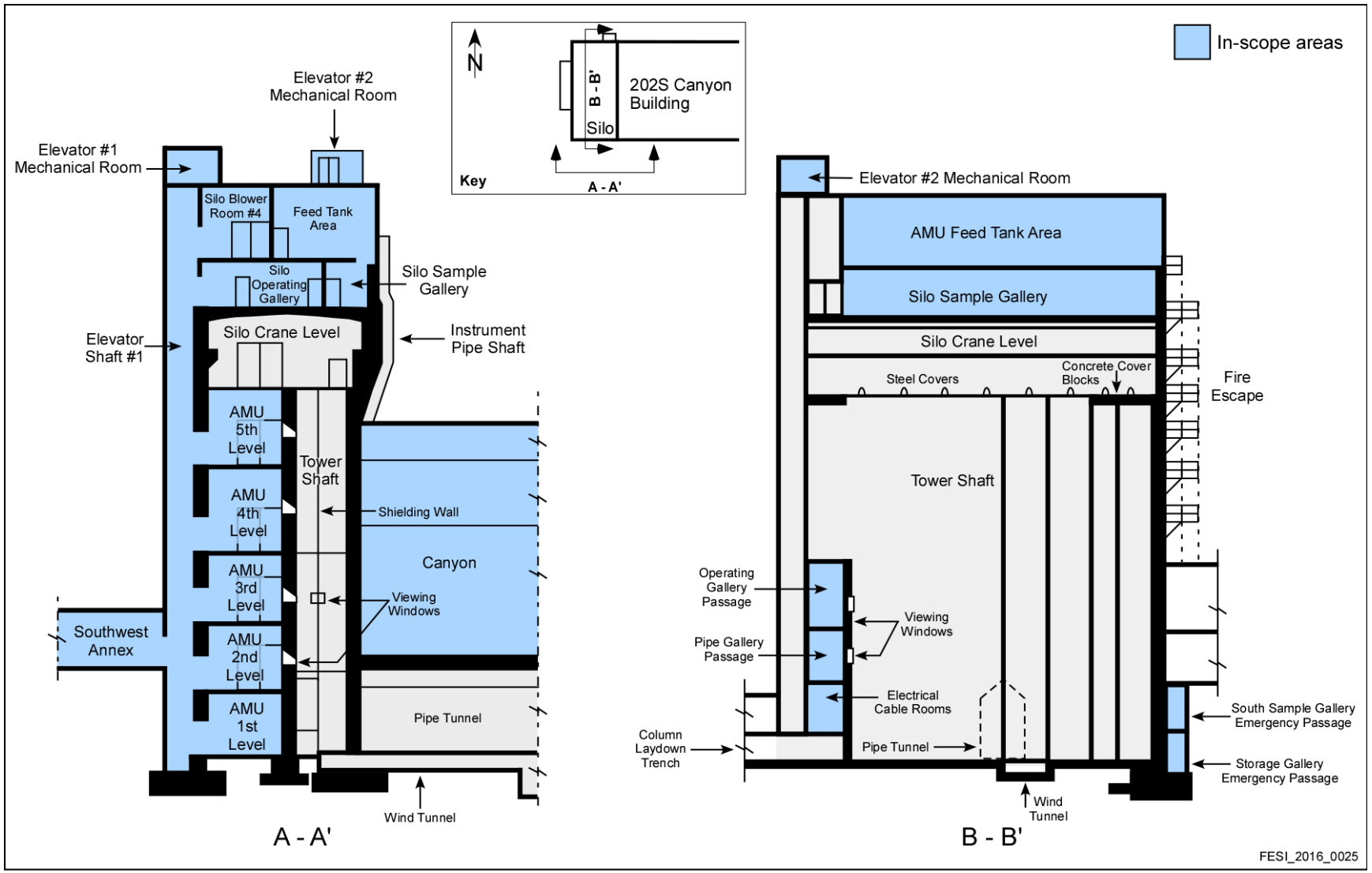


Figure 5. 202S Silo Cross Sections

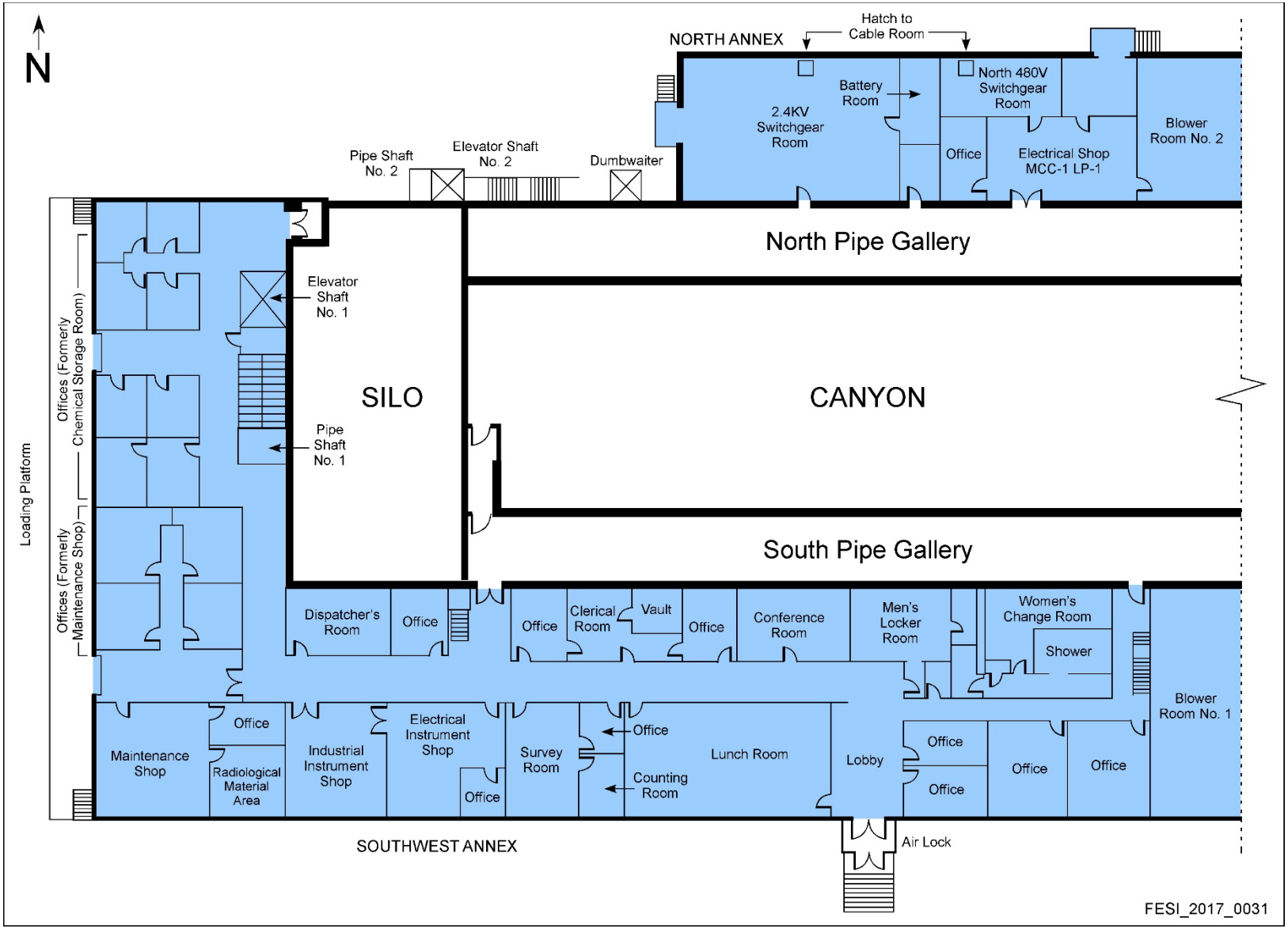


Figure 6. 202S Annex Plan View at the Pipe Gallery Level – West End of Building

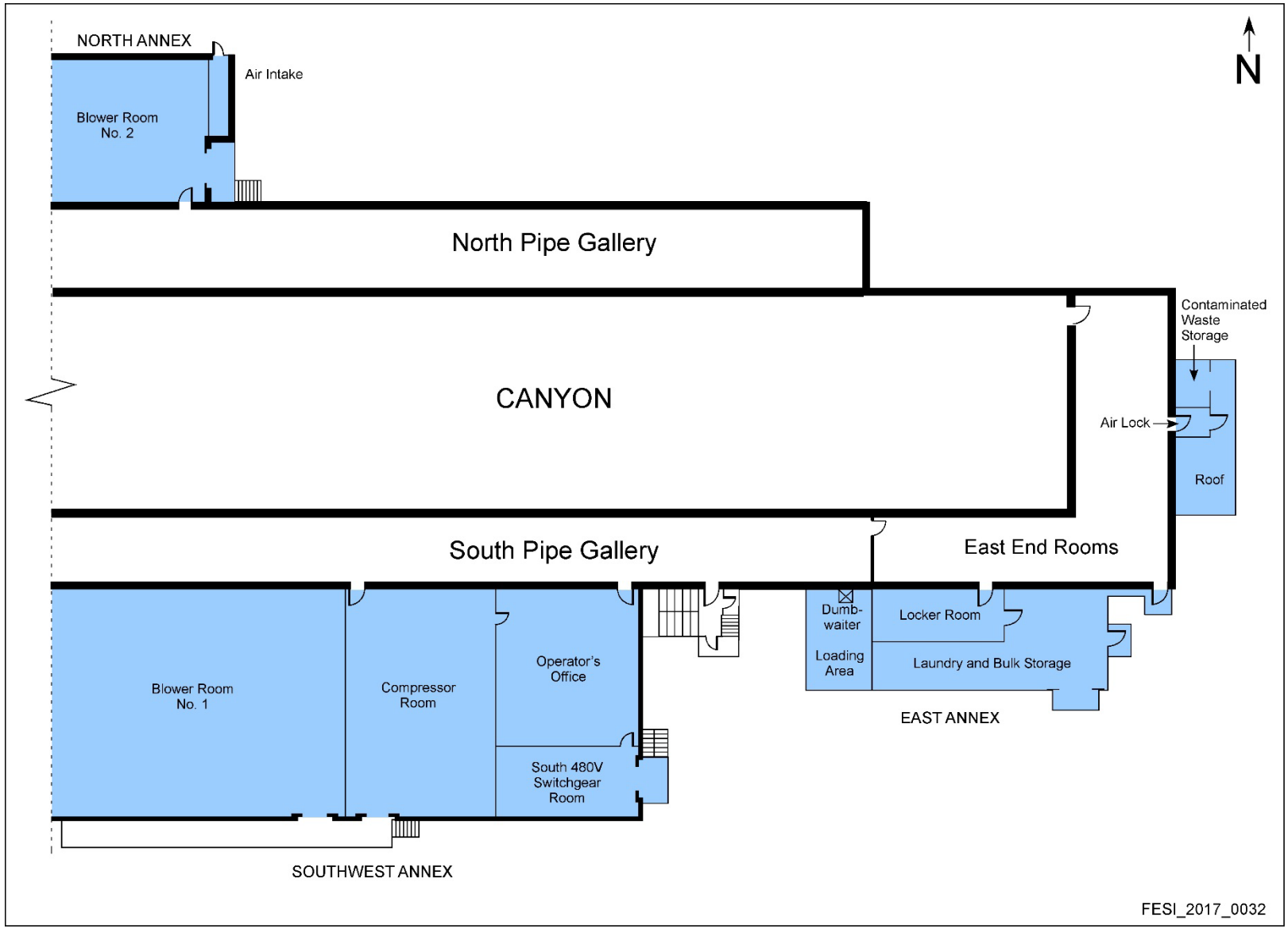


Figure 7. 202S Annex Plan View at the Pipe Gallery Level – East End of Building

2.2 276S Hexone Storage and Treatment Facility

The 276S HSTF consists of the following:

- Two hexone[3] storage tanks (276S141 [S141] and 276S142 [S142]) including ancillary equipment (i.e., centrifugal transfer pumps, abovegrade ventilation piping, mercury manometers, and weight factor liquid level instrumentation)
- A distillation system (removed)
- Four railroad container cars (removed)

Figure 8 presents a schematic of the 276S HSTF. These tanks and associated ancillary components were permitted under the *Resource Conservation and Recovery Act of 1976* as the 276S HSTF treatment, storage, and disposal unit (TS-2-2).

Two underground hexone storage tanks (S141 and S142) were installed in 1951 and received commercial-grade hexone from vendors by railcar. The storage tanks are cylindrical carbon-steel tanks placed horizontally with the tops of the tanks about 0.9 m (3 ft) belowground. The tanks are 8.5 m (28 ft) in length and 3.6 m (12 ft) in diameter. The capacity of each tank is 89,200 L (23,575 gal), with a working capacity of 81,400 L (21,500 gal). The two underground tanks were used for hexone storage until 1967 and liquid mixed waste from REDOX thereafter. Tank S141 contained contaminated hexone, which had been used as a solvent at REDOX. Tank S142 contained hexone, normal paraffin hydrocarbons,[4] and tributyl phosphate. The normal paraffin hydrocarbons and tributyl phosphate were used in a one-time 1966 campaign to separate americium, curium, and rare earth fission products from reactor blanket fuel.

The distillation system was on the railroad spur east of the hexone tanks and consisted of two sets of distillation equipment mounted on a railroad car with a secondary containment system. Four railroad container cars were used for storage of hexone after the waste was distillated. Secondary containment structures were placed under each railcar, in the gaps between railcars, and under all threaded fittings on pipes carrying hexone. Except for the railroad track, all other equipment, including the distillation system, railcars, and the secondary containment, were removed for reuse or disposed. The railroad track was covered with about 0.6 m (2 ft) of clean soil in 2003 to 2004 to allow vehicle traffic.

From 1990 through 1992, a combined 132,000 L (35,000 gal) of the solvent remaining in the tanks was recovered, distilled, and then transported and incinerated at an offsite location (WHC-EP-0570, *The Distillation and Incineration of 132,000 Liters (35,000 Gallons) of Mixed-Waste Hexone Solvents from Hanford's REDOX Plant*). An estimated 492 L (130 gal) of residual sludge remained in each tank from the distillation process. Distillation system operating records, including daily operating logbooks, indicated that there were no documented spills or releases during the distillation campaign (93-ERB-087, "Hexone Remediation"). A nitrogen purge system was implemented in 1990 during the distillation campaign to prevent the accumulation of flammable gases in the tanks. Results of sampling of the sludge in 2001 and video surveys of the tank interiors are documented in BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*. Principle radionuclides detected were americium-241 (Am-241), plutonium isotopes, strontium-90 (Sr-90), and cesium-137 (Cs-137). No ponding of liquid was observed in either tank. The remaining residuals appeared as a uniform tar-like layer across the bottom with a dried, cracked crust surface, which extended the length of each tank. There was no evidence to suggest that either tank was leaking; however, no soil samples around the tanks were taken.

[3] Hexone is also known as methyl isobutyl ketone (MIBK) or 4-methyl-2-pentanone.

[4] Normal paraffin hydrocarbons are a purified derivative of kerosene containing straight-chain hydrocarbons in the range of $C_{10}H_{22}$ through $C_{18}H_{38}$.

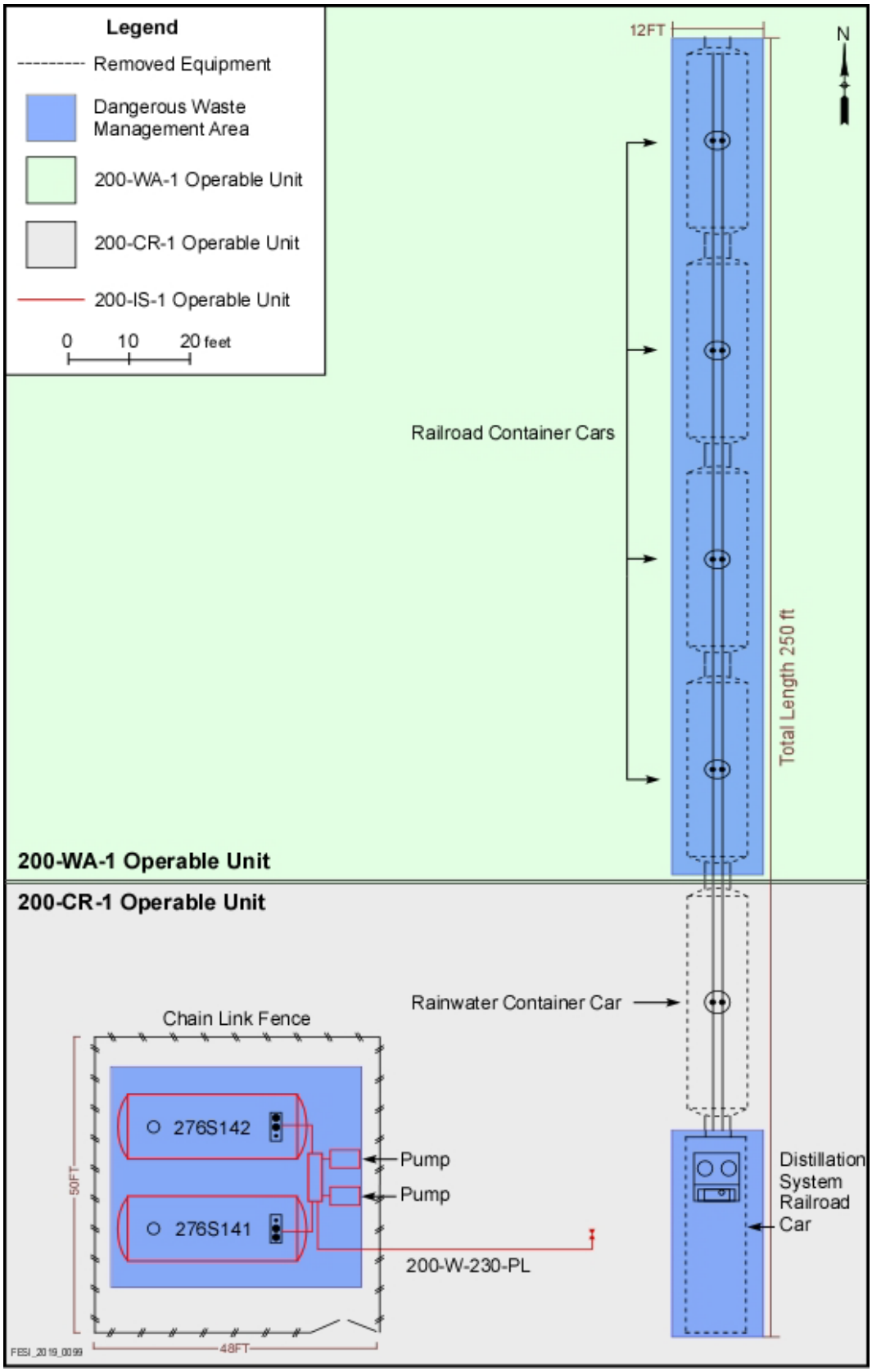


Figure 8. 276S Hexone Storage and Treatment Facility Schematic

Residual sludge in the tanks from the distillation process was grouted as an interim closure activity in 2002 (HNF-13830). The remaining void space in the tanks was subsequently grouted, and the tanks were left in place. The nitrogen purge system was deactivated. Closure of the 276S HSTF will be conducted in accordance with an approved closure plan. Waste generated during closure activities will be disposed under this removal action.

2.3 293S Building

The 293S Building was built in 1957 after REDOX operations began. The 293S Building was put into operation to provide more efficient radioactive iodine removal and nitric acid recovery from off-gases generated by the 202S Building dissolvers located in three of the canyon cells. The acid fumes were captured in a nitric acid absorber, and radioactive iodine was removed using a caustic scrubber system. The recovered nitric acid was stored in a belowgrade stainless-steel storage tank (3 m [10 ft] high by 3 m [10 ft] in diameter) on the west side of the basement. The tank is accessed via a removable slab at grade.

The two-story 293S Building was constructed of steel and concrete with a corrugated asbestos-cement (transite) exterior siding. The concrete basement houses control piping and a valve pit (Figure 9). The concrete portion of the ground level houses the absorber and scrubber and is 8.8 m (29 ft) long by 4.9 m (16 ft) wide, extending to 9.1 m (30 ft) abovegrade. Attached to the south side of the building is a 3 m (10 ft) tall steel and transite structure containing a control room and Special Work Permit Area.

The 293S Building was deactivated in 1969 in conjunction with deactivation of the 202S Building. The vessels (absorber and scrubber) and piping were drained and blown with air during shutdown, as necessary to prevent freezing (ISO-1108). Therefore, only trace residuals are expected. The belowgrade nitric acid storage tank is documented as being empty (HNF-13830). Following removal of all building equipment (including the belowgrade nitric acid storage tank) and demolition of the abovegrade structure, belowgrade areas of the 293S Building will be grouted.

2.4 291S Ventilation System

The original ventilation system for the 202S Building relied on several supply and exhaust fans which have been deactivated. The 291S Ventilation System provides active filtration of radiological particulates before the exhausted air is released to the environment. Although the 291S Ventilation System is not a part of the removal action scope, an upgrade to the system is being conducted to replace the aging sand filter with a high-efficiency particulate air (HEPA) filtration system (Figure 10). It is anticipated that the new filtration system will be online in 2023. The Wind Tunnel connection to the sand filter will be blocked with an isolation weldment and grout. The contaminated air from the 202S Building will be diverted through a new abovegrade metal duct to the new HEPA filtration system and then to the existing 291S001 Stack. The original exhaust fans (291S-EF-1 and 291S-EF-2) located adjacent to the 291S Exhaust Building will be deactivated and decommissioned. The sand filter will be isolated and abandoned in place.

The Wind Tunnel is an original, reinforced concrete, belowgrade structure that runs the length of the 202S Building. After completion of the modification, the Wind Tunnel will route contaminated air to the newly tied-in air duct located just upstream of the sand filter. From this tie-in location, the air will be routed through a riser that connects to an abovegrade metal duct and feeds into the new HEPA filtration system. The new filtration system consists of three skid-mounted exhausters, each of which is made up of a set of prefilters, two sets of HEPA filters, a 125-hp fan, and control instruments. Each HEPA filter is rated for 0.94 m^3/sec (2,000 ft^3/min) yielding a maximum airflow of 18.88 m^3/sec (40,000 ft^3/min) per filter housing. Two fans are planned to be used in operation at a time, with the third fan placed on standby. Each fan is equipped with a variable frequency drive to enable fan speed adjustment.

Incoming air will passively flow into the galleries and other areas (e.g., Silo, Canyon airspace, East End Rooms), then into the canyon cells and Wind Tunnel and through the HEPA filtration system before exhausting out the 291S001 Stack.

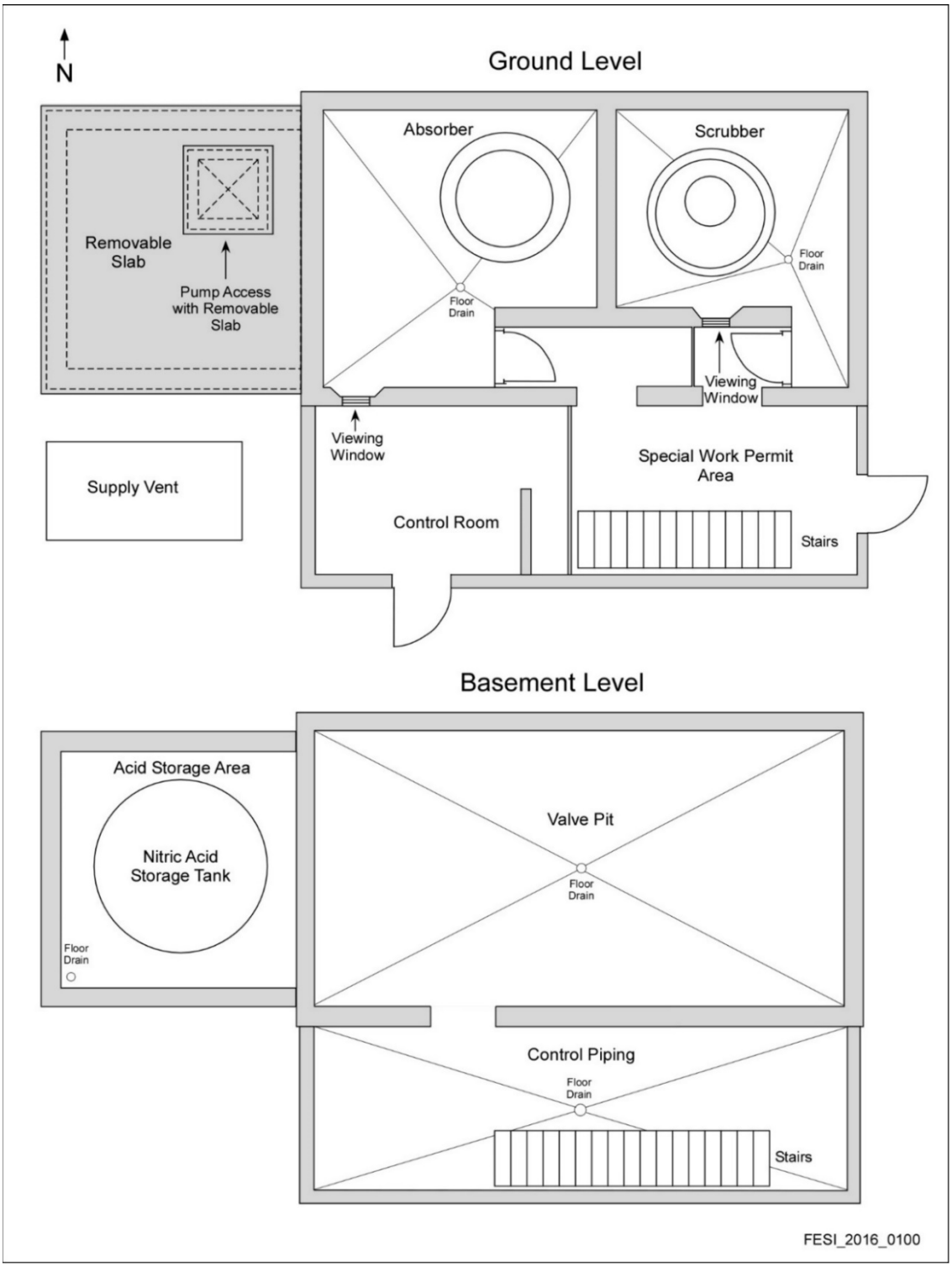
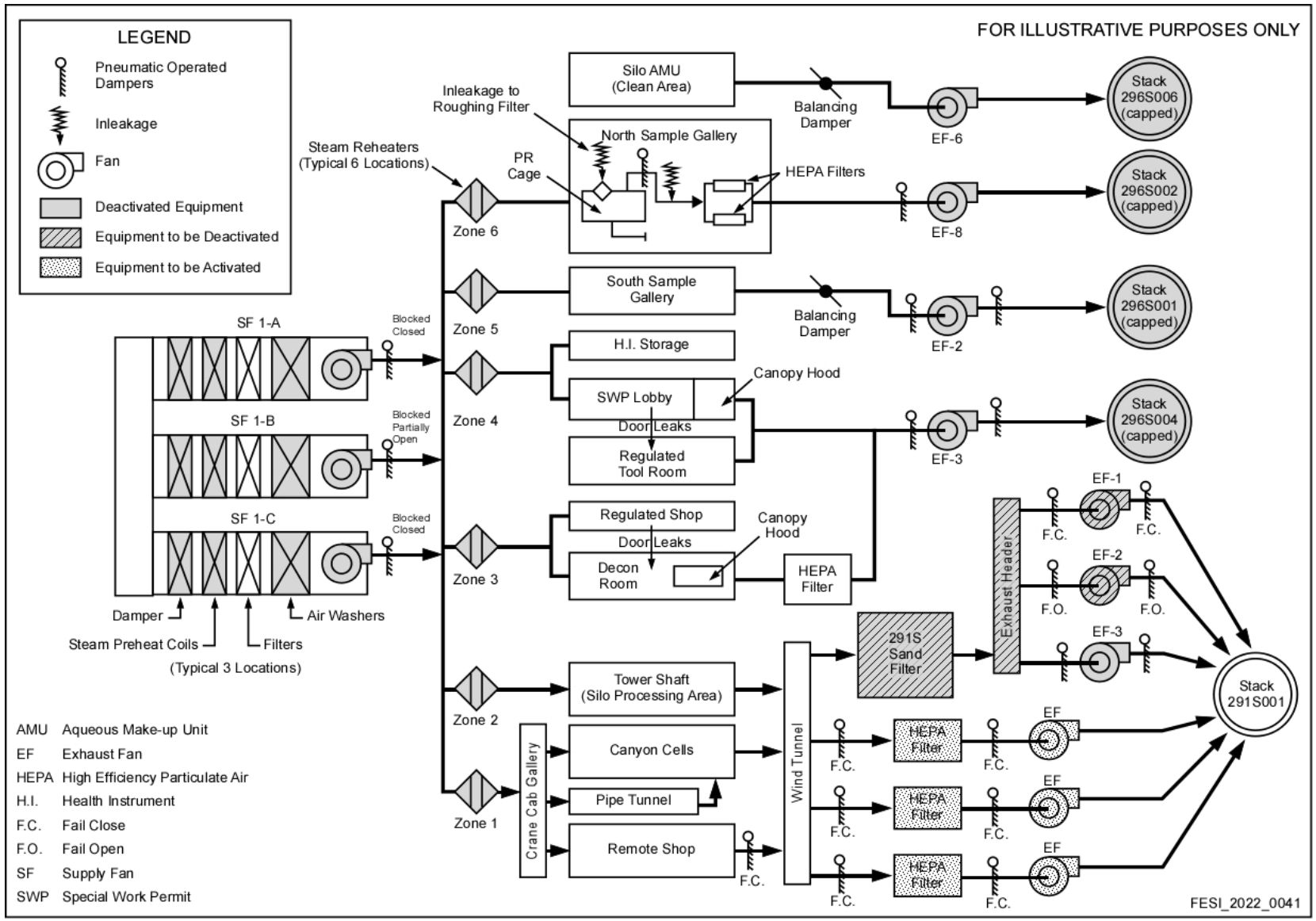


Figure 9. 293S Nitric Acid and Iodine Recovery Building – Plan View



Modified from Figure 2-27 in HNF-13830, *Documented Safety Analysis for the Reduction-Oxidation Facility.*

Figure 10. REDOX Facility Air Flow Diagram

Inactive stacks 296S001, 296S002, and 296S004 are mounted to the exterior of the 202S Canyon (i.e., not attached to an annex structure) and are not associated with the current ventilation system. Inactive stack 296S006, also not associated with the current ventilation system, exits out of the northern end of the 202S Silo roof. Therefore, it is assumed that these four ventilation stacks are not included as part of the demolition of the 202S Annex.

2.5 Reduction-Oxidation Complex Surveillance and Maintenance Structures

S&M of the REDOX Complex includes the 202S Building and ancillary buildings within the REDOX implementation area, which are listed in Table 1 and shown in Figure 11. The objectives of S&M activities are to ensure adequate containment of contaminants left in place, to provide physical safety and security measures, and to maintain the facility in a manner that will minimize risk to human health or the environment. S&M will be conducted for major structures and operations of active systems at the REDOX Complex until the S&M activity is rendered obsolete by the removal action activities. S&M work activities are performed and documented using the contractor's procedures, permits, and work plans.

Table 1. REDOX Complex Structures and Components for Surveillance and Maintenance

Identification No.	Building Description/Components
202S	Canyon and service building
211S	Liquid chemical storage tank farm
233S & SA	Slabs (remaining after demolition)
2706S	Slab (remaining after demolition)
2708S	Lager storage building
2710S	Slab (remaining after demolition)
2711S	Slab (remaining after demolition)
2715S	Storage building
2718S	Slab (remaining after demolition)
276S	Solvent handling facility
276S HSTF	Hexone Storage and Treatment Facility
2904SA	Cooling water sampling building
291S	Canyon ventilation system (HEPA filtration system, ducting, exhaust building, sand filter, fans, and stack)
291S001	Exhaust stack
292S	Control and jet pit house
293S	Nitric acid recovery and iodine backup building

Source: Table 2-1 in DOE/RL-2017-06, *Removal Action Work Plan for the Reduction-Oxidation Complex.*

HEPA = high-efficiency particulate air

HSTF = Hexone Storage and Treatment Facility

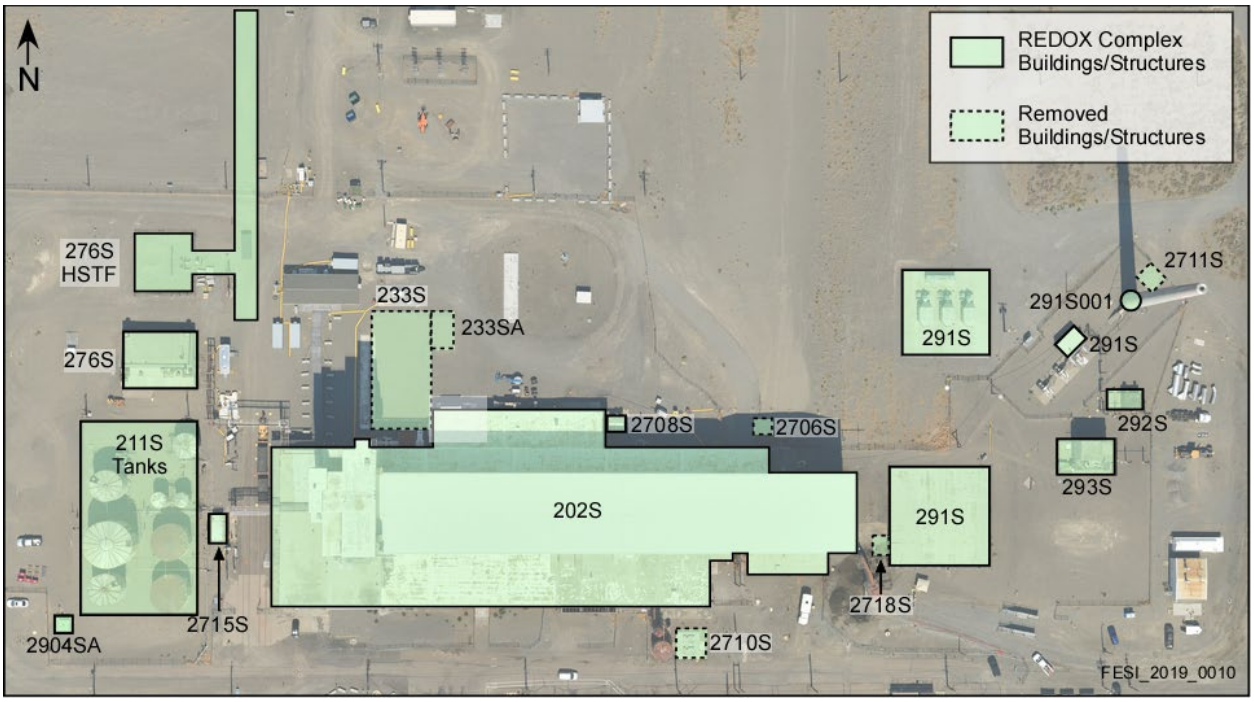


Figure 11. REDOX Complex Structures for Surveillance and Maintenance

3 Radiological Air Emissions

The potential for radiological release exists at the REDOX Complex. The state-implementing regulations (WAC 246-247, "Radiation Protection—Air Emissions") address potential radioactive airborne emissions from point, fugitive, or diffuse sources that require monitoring. The 291S001 Stack has transitioned from the Hanford Site Air Operating Permit to regulation under the *Comprehensive Environmental Response, Compensation, and Liability Act* authority (19-ESQ-0086, "Transition of the Reduction-Oxidation Facility (REDOX) and Stack P-291S001-001 to Regulation Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)").

Potential radiological releases from the REDOX Complex removal action would be considered point source (291S001 Stack) and diffuse and fugitive emissions (demolition of 276S HSTF, 293S Building, and 202S Annex). The Hanford Site Environmental Monitoring Program, which serves as the monitoring system for all site activities, is described in detail in DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*. Near-facility ambient air monitoring stations N441, N442, N956, and N963 are upwind, downwind, or near the REDOX Complex area and will be used for monitoring during the removal action (Figure 12).

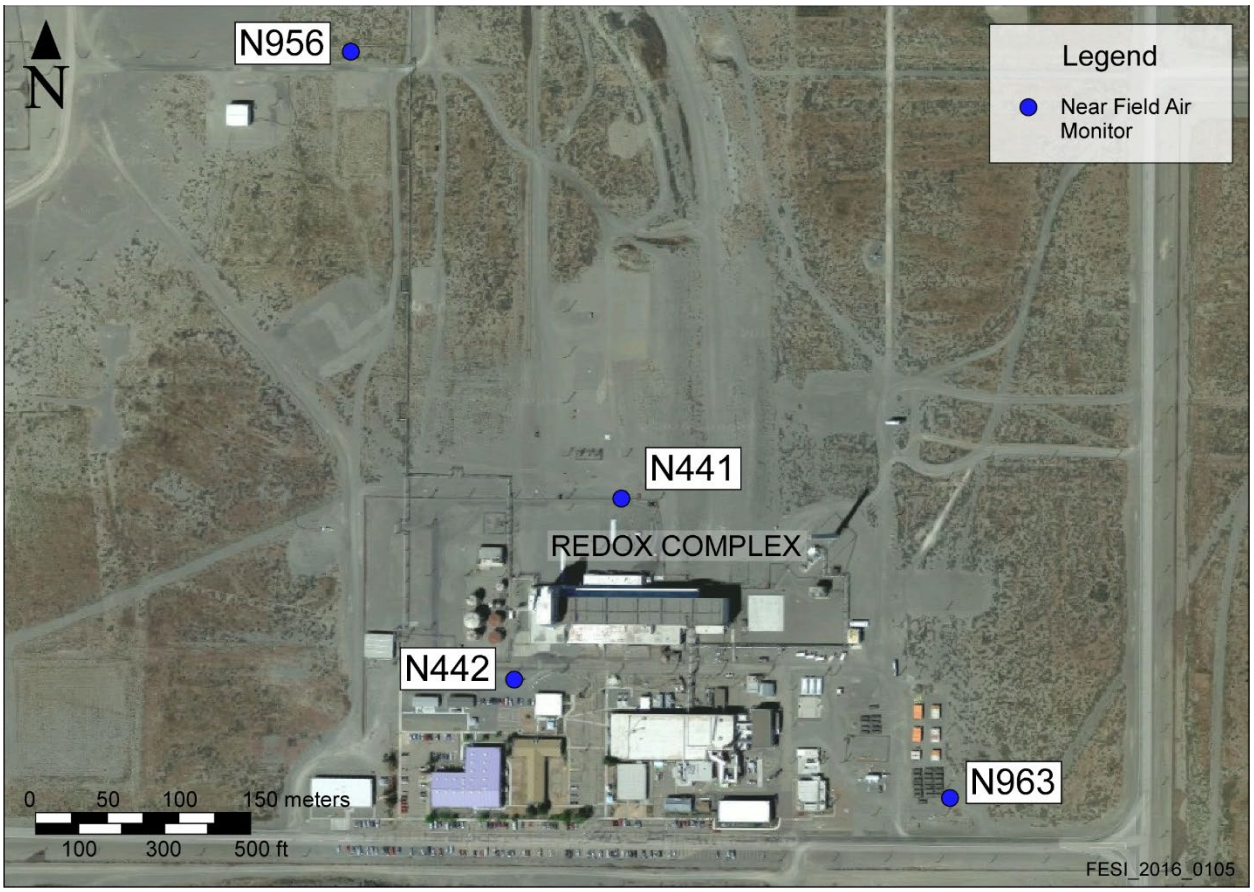


Figure 12. Near-Facility Air Monitoring Stations for the REDOX Complex

CAP88-PC[5] software was used to calculate the TEDE to the MEI. Airborne emissions control and monitoring requirements for radiological air emissions will be identified as needed, based on the calculated value of the potential emissions and resultant public exposure.

3.1 Assumptions and Inputs

This section provides the assumptions and inputs used to calculate PTE and the TEDE to the onsite and offsite MEI associated with the REDOX Complex removal action. The assumptions and inputs are derived from site features, physical parameters, sample results, and historical data.

[5] A regulatory compliance tool under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," the Clean Air Act Assessment Package-1988 (CAP-88) model is a set of computer programs, databases, and associated utility programs for estimating dose and risk from radionuclide emissions to the air. CAP88-PC, version 4.0, allows modeling on a personal computer and is a recent version of the code.

3.1.1 Assumptions

This section contains the following assumptions used in the calculations.

1. The removal activities described in the REDOX RAWP (DOE/RL-2017-06) will be conducted over multiple years. For conservatism, a 1-year project duration is assumed for all cases.
2. The use of plutonium-239 (Pu-239) for alpha inventory and Sr-90 for beta inventory is conservative in radiological consequence calculation purposes.
3. Currently, most contaminated areas within the 202S Building are ventilated through the 291S001 Stack. Mitigation activities (e.g., vessel and pipe removals) within the 202S Silo and in the 202S Canyon galleries (including the Canyon Deck) will generate emissions through the 291S001 Stack.
4. Emissions from the following activities are assumed to be diffuse and fugitive:
    a. Demolition of the 276S HSTF
    b. Demolition and grouting of the 293S Building
    c. Demolition of the 202S Annex
5. Emissions from the REDOX Complex S&M activities for buildings other than 202S are diffuse and fugitive and assumed to be negligible in comparison to the demolition of 276S HSTF, 293S Building, and 202S Annex.

3.1.2 Inputs

This section identifies inputs to the calculations.

3.1.2.1 Point Source

1. Table 2 contains the radiological inventory values for the 202S Building that were obtained from the REDOX Complex safety analysis (HNF-13830, Table 3-4). The remaining areas of the 202S Building that are not identified in Table 2 are included in the inventory estimate for the canyon. As the 291S Ventilation System modification will bypass the sand filter (Section 2.4), the inventory in Table 3-4 of HNF-13830 associated with the sand filter (340 Ci alpha and 8,000 Ci beta) is excluded from this calculation. Based on the review of the documented safety analysis (HNF-13830), radionuclide characterization data (i.e., form, quantity, and location) for the areas within the 202S Canyon Building do not exist. The values in Table 2 are based on best available information (HNF-13830). These inventory values were first decay corrected to May 2022 values, as shown in Table 3.

Table 2. Total 202S Building Inventory

Location	Inventory[a]	Remarks in HNF-13830
202S Canyon Building (including silo, railroad tunnel, process cells, piping, equipment, and ancillaries)	1,500 Ci alpha 4,500 Ci beta	Based on historical published data (SD-DD-FL-001), the basis is unknown. Based on review of deactivation records (FH-0400890), the distribution of the residual contamination in the canyon process area is approximately 46% in vessel piping, 44% surface contamination in canyon cells, and 10% surface contamination in the silo and Column Laydown Trench. Conservative assumption is that all alpha is Pu-239 and all fission products are bounded by beta assumed as Sr-90.[b] Being that SD-DD-FL-001 is dated 1982 and 38 years have passed, the beta source term has been reduced by one half-life (Sr-90 half-life = 28.8 years; Cs-137 half-life = 30.2 years).
202S North Sample Gallery (including the Plutonium Loadout Hood)	140 Ci alpha 840 Ci beta	Inventory basis as established in BHI-01142. Conservative assumption is that all alpha is Pu-239 and all fission products are bounded by beta assumed as Sr-90.[b]

Notes: Complete reference citations are provided in Chapter 5.

a. This inventory is for the entire 202S Building and represents both in and out of scope areas.

b. These assumptions are conservative for radiological consequence calculation purposes in that Pu-239 and Sr-90 have the largest dose conversion factors of the radionuclides potentially present in significant quantities (HNF-13830).

1

Table 3. Decay Correction of Inventory from the REDOX Safety Analysis (HNF-13830)

Location	Safety Analysis Inventory[a]	Safety Analysis Inventory Date	May 2022 Inventory[b]
202S Canyon Building	1,500 Ci alpha (Pu-239)	July 19, 1982[c]	1,498 Ci Pu-239
	9,000 Ci beta (Sr-90)		3,450 Ci Sr-90
202S North Sample Gallery	140 Ci alpha (Pu-239)	January 17, 1997[d]	139.9 Ci Pu-239
	840 Ci beta (Sr-90)		456.5 Ci Sr-90

Notes: Complete reference citations are provided in Chapter 5.

a. Inventories from Table 3-4 in HNF-13830, *Documented Safety Analysis for the Reduction-Oxidation Facility*. These isotope assumptions are conservative for radiological consequence calculation purposes in that Pu-239 and Sr-90 have the largest dose conversion factors of the radionuclides potentially present in significant quantities (HNF-13830). Original value of 9,000 Ci beta from SD-DD-FL-001, *Rockwell Retired Contaminated Facility Listing and Description*, was used for the 202S Building (i.e., undoes the reduction by one-half cited in Table 3-4 of HNF-13830).

b. Values were decayed from the "Safety Analysis Inventory Date" to May 2022 using the Health Physics Society Decay Calculator accessed at https://hps.org/hpspublications/decay.cfm. The Decay Calculator uses a half of 2.411E+04 years for Pu-239 and 28.79 years for Sr-90.

c. Issuance date of SD-DD-FL-001; date of the 202S Building inventory is not documented.

d. Date of last radiation survey report on page 80 of BHI-00994, *In-Situ Non-Destructive Radiological Characterization of Selected 202-S Reduction Oxidation (REDOX) Facility Sample Gallery Pipes and Vessels*.

2

To determine the in-scope point source inventory for the 202S Building, a methodology similar to that used in BHI-01142, *REDOX Facility Safety Analysis Report*, is applied. When determining the material at risk for a seismic event, only a small percentage of the 202S Building inventory was used, following the reasoning stated in Section 3.4.2.1.2 of BHI-01142:

> "The distribution of this activity inside the building has not been characterized. Based on the discussion in Section 2.4.1 of this SAR [safety analysis report] (i.e., likely failure of the canyon roof), for conservatism it is assumed that all the inventory is located in the Canyon Building, railroad tunnel, and process cells, piping, and equipment. Further based on engineering judgment, existing radiation surveys, and discussions with the REDOX Facility operating personnel, the vast majority of the source is thought to be present inside process equipment and piping located within the process cells. This material is not available for suspension and release, given the fact that the process cell cover blocks remain in place. Thus, the material that is available for suspension and release is that present as contamination on surfaces external to the process cells. It is estimated that the MAR [material at risk] is 0.1% of the total building inventory (Smith 1996)."

Since the process cell cover blocks will remain in place during this removal action, the material available for suspension and potential emissions would also be that present as surface contamination outside the process cells – estimated as 0.1% of the total building inventory. Calculation of the in-scope point source inventory for the 202S Building is provided in Table 4. The total point source inventory is the summation of the decayed inventory of the North Sample Gallery and Plutonium Loadout Hood plus 0.1% of the decayed inventory for the 202S Building.

Table 4. In-Scope Point Source Inventory for the 202S Building

Isotope	Inventory (Ci)		
	202S Building[a,b]	North Sample Gallery[b]	Total
Pu-239 (alpha)	0.1% × 1,498 = 1.5	139.9	141.4
Sr-90 (beta)	0.1% × 3,450 = 3.5	456.5	460.0

a. 0.1% of the 202S Building inventory represents the material available for suspension and potential emissions that would be present as surface contamination outside the process cells.

b. Decayed inventory values from Table 3 of this calculation.

2. The 291S001 Stack rises 60.96 m (200 ft) abovegrade with a diameter of 1.98 m (6.5 ft) (previously identified within the FF-01, *Radioactive Air Emissions License for the Department of Energy Richland Office Hanford Site*, Emission Unit 332).

3. The recommended operating flow rate of the 291S001 Stack after the ventilation modifications go online is 28.32 m^3/sec (60,000 ft^3/min) (CP-ENG-0141, *291S Stack Sampling for New Exhauster System*). This is the recommended limited operating flow rate when two of the three fans are in operation at a time with the third fan in standby. Dividing the stack flow rate by the stack area determines the stack exit velocity as shown in Equation 1:

$$V = \frac{28.32\ \frac{m^3}{sec}}{\pi\left(\frac{1.98\ m}{2}\right)^2} = 9.20\frac{m}{sec} = 30.18\frac{ft}{sec} \qquad \textbf{(Eq. 1)}$$

4. The radionuclides of concern are particulate solids; therefore, a release fraction of 1.0E-03 is used in accordance with WAC 246-247-030(21)(a), "Definitions, Abbreviations, and Acronyms," and 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP), Appendix D, "Methods for Estimating Radionuclide Emissions."

3.1.2.2 Diffuse and Fugitive

1. Table 5 presents the inventory for the 276S141 and 276S142 hexone tanks. Values in Table 5 are calculated from results of samples taken in 2001 of the remaining sludge in the tanks prior to grouting (presented in Appendix A of this ECF). Sample results are documented in BHI-01521. Maximum sample results were used; therefore, no conservatism multiplier (CM) is applied (i.e., CM = 1). As no spills or releases were documented during the distillation campaign (Section 2.2), any additional inventory for the railcar and railroad track area is negligible.

Table 5. 276S Hexone Tank Inventory

Isotope	276S141 Inventory[a] (Ci)	276S142 Inventory[b] (Ci)	Total Inventory (Ci)
H-3	9.53E-04	3.43E-04	1.30E-03
C-14	6.19E-05	5.02E-05	1.12E-04
Total Sr (assume all Sr-90)	7.92E-04	1.28E-02	1.35E-02
Sb-125	4.76E-06	6.67E-05	7.15E-05
Cs-137	6.85E-05	6.26E-04	6.94E-04
Eu-154	1.16E-04	5.16E-04	6.32E-04
Eu-155	3.16E-05	1.10E-04	1.41E-04
U-233/234 (assume all U-234)	8.93E-06	4.37E-05	5.26E-05
U-238	5.00E-06	4.61E-05	5.11E-05
Pu-238	2.55E-03	8.03E-03	1.06E-02
Pu-239/240 (assume all Pu-239)	3.47E-03	1.17E-02	1.52E-02
Am-241	6.43E-03	2.81E-02	3.45E-02
Cm-244	4.47E-04	1.41E-03	1.86E-03
		Total	**7.87E-02**

a. Values from Table A-2 (Appendix A of this calculation).
b. Values from Table A-3 (Appendix A of this calculation).

2. The documented inventory for the 293S Building is 1 Ci alpha and 4 Ci beta (SD-DD-FL-001, *Rockwell Retired Contaminated Facility Listing and Description*). The basis of these values is unknown, and it is unclear if this includes the inventory of the belowgrade tank that is to be removed. It is conservatively assumed that all alpha is Pu-239 and all beta is Sr-90. Radioactive iodine associated with the processes at the 293S Building would have long since decayed. A CM of 4 is applied to the values from SD-DD-FL-001 to account for uncertainty in the basis of the values and the inclusion of the belowgrade tank.

3. There are some contamination areas posted within the 202S Annex. The available inventory for the unventilated 202S Annex is calculated using the structure floor areas and the upper limit for a contamination area (2,000 dpm/100 cm^2 alpha and 100,000 dpm/100 cm^2 beta/gamma for removable surface contamination). For conservatism, the annexes are assumed to be contamination areas, so the entire floor surface area will be used (calculated in Table 6). This assumption also accounts for possible radiological contamination of the ducting from the Southwest Annex to the 202S Canyon. It is also assumed that any high contamination areas will be addressed prior to demolition and those activities would be bounded by the 291S001 Stack point source calculation.

   Using the total floor area (in m^2) from Table 6, the 202S Annex inventory is calculated using Equation 2:

$$\text{Inventory } (Ci) = \text{Area } (m^2) \times \left(\frac{10{,}000\ cm^2}{1\ m^2}\right) \times Limit\ \left(\frac{dpm}{100\ cm^2}\right) \times \left(\frac{1\ Ci}{2.22E{+}12\ dpm}\right) \quad \textbf{(Eq. 2)}$$

   Equation 2 yields an inventory for the 202S Annex of 2.75E-04 Ci of alpha and 1.37E-02 Ci of beta/gamma. It is conservatively assumed that all alpha is Pu-239 and all beta/gamma is Sr-90. The assumption that the entire 202S Annex is a contamination area is sufficiently conservative; therefore, no CM is applied (i.e., CM=1).

Table 6. 202S Annex Floor Area

Annex	Gallery Level	Rooms	Length[a] (ft)	Width[a] (ft)	Area[b] (ft^2)
North	Pipe Gallery	All	143.50	30.00	4,305.00
	Sample Gallery	Cable Room #1	39.00	30.00	1,170.00
		Cable Room #2	27.00	15.50	418.50
East	Pipe Gallery	South Leg	50.58	21.17	1,070.78
		East Leg	8.50	32.17	273.45
Southwest	Pipe Gallery	West Leg	48.67	130.50	6,351.44
		South Leg	312.58	47.00	14,691.26
	Sample Gallery	Cable Room #3	33.00	47.00	1,551.00
	Operating Gallery	Blower Room #3	42.33	47.00	1,989.51
		Blower Room #5	44.17	23.17	1,023.42
Total Annex Area (ft^2) =					**32,844.35**
Total Annex Area[c] (m^2) =					**3,051.34**

References: Drawings H-2-7423, H-2-7424, H-2-7432, and H-2-30501. Complete reference citations are provided in Chapter 5.

a. Length is measured east to west. Width is measured north to south. Loading docks are excluded.

b. Calculate area: Area = Length × Width.

c. Conversion factor: 1 m^2 = 10.76391 ft^2.

4. The radionuclides of concern are primarily particulate solids; therefore, a release fraction of 1.0E-03 is used in accordance with WAC 246-247-030(21)(a), and 40 CFR 61, Appendix D. The exception is H-3 and C-14 in the 276S inventory; a release fraction of 1.0 is used for these gaseous radionuclides in accordance with WAC 246-247-030(21)(a) and 40 CFR 61, Appendix D.

5. The diffuse and fugitive area sources are based on the footprints of the 276S HSTF, 293 Building, and 202S Annex, as calculated in Table 7, including loading docks.

Table 7. Footprints of the 276S HSTF, 293 Building, and 202S Annex

Building	Portion	Drawing No.	Length (ft)[a]	Width (ft)[a]	Area (ft^2)	Total Area[b] (ft^2 [m^2])
276S HSTF	Storage tanks[c]	H-2-5368	48.00	50.00	2400.00	5,400.00 [501.7]
	Railroad tracks[d]	--	12.00	250.00	3000.00	
293S Building	All	H-2-31048	42.00	25.00	1050.00	1,050.00 [97.5]
202S North Annex	All	H-2-7423	143.50	30.00	4,305.00	27,169.70 [2,524.1]
202S East Annex	South	H-2-30501	67.83	21.17	1,435.96	
	East		12.00	32.17	386.04	
202S Southwest Annex	West leg	H-2-7423	48.67	130.50	6,351.44	
	South leg	H-2-7424	312.58	47.00	14,691.26	

Notes: Complete reference citations are provided in Chapter 5.

a. Length is measured east to west. Width is measured north to south. Loading docks are included.

b. Conversion factor: 1 m^2 = 10.76391 ft^2.

c. Footprint is the area within the fence line that surrounds the tanks and equipment.

d. Footprint of the nonhazardous rainwater container car is included to account for the footprint of partial pipeline 200-E-W-230-PL between the storage tanks and the railroad cars (Figure 8). The footprint is conservatively estimated.

HSTF = Hexone Storage and Treatment Facility

3.2 Methodology

Building radiological reports and process knowledge are used to estimate annual possession quantity (APQ), which is the assumed quantity of contamination present. The APQ is used to calculate the PTE, which is an estimate of the radionuclides that could potentially be emitted during the REDOX Complex removal action. The PTE is used to determine the TEDE to the offsite and onsite MEIs.

3.2.1 Annual Possession Quantity

The APQ is measured as total annual activity in curies. The point source inventory (i.e., building activity) is specified in Section 3.1.2.1, Item 1, and the diffuse and fugitive inventories are specified in Section 3.1.2.2, Items 1 through 3. The project duration is specified in Section 3.1.1, Item 1. The inventory, multiplied by a CM (if applicable), divided by the project duration is equal to the APQ, as shown in Equation 3.

$$\text{APQ}\left(\frac{Ci}{yr}\right) = \frac{Activity\ (Ci) \times CM}{Duration\ (yr)} \qquad \textbf{(Eq. 3)}$$

where:

APQ = annual possession quantity

Activity = building activity or inventory

CM = conservatism multiplier

Duration = project duration.

3.2.2 Potential-to-Emit

The PTE is calculated using the APQ and a release fraction, in accordance with NESHAP (40 CFR 61, Appendix D). Release fractions are specified in Section 3.1.2.1, Item 4, and Section 3.1.2.2, Item 4. Equation 4 shows this process:

$$\text{PTE}\left(\frac{Ci}{yr}\right) = \text{APQ}\left(\frac{Ci}{yr}\right) \times \text{RF} \qquad \textbf{(Eq. 4)}$$

where:

PTE = potential-to-emit

RF = release fraction.

3.2.3 Total Effective Dose Equivalent to the Maximally Exposed Individual

CAP88-PC, version 4.0.1.17, was used to calculate the dose to the MEI using the PTE values calculated in Section 3.4 for each radionuclide as inputs into the CAP88-PC model runs.

Hanford Site-specific wind files were used in the CAP88-PC model runs based on average data collected between 2004 and 2013:

- Points source models – Station #21 at the 200 Area Hanford Meteorological Station at the 61 m (200 ft) level (a13200HMS61.wnd).
- Diffuse and fugitive models – Station #7 in the 200 West Area at the 10 m (32.8 ft) level (a13200W10.wnd).

Both wind files are shown in Appendix B of this ECF.

The distances used in the CAP88-PC model runs are shown in Appendix C of this ECF. In accordance with WAC 246-247-030(15), the MEI is any member of the public (real or hypothetical) who abides or resides in an unrestricted area and may receive the highest TEDE from the emission unit(s) under

remediation considering all exposure pathways by the radioactive emissions. For the purposes of this calculation, the MEI was assumed to be located at the Hanford Site boundary at a compass bearing from the source that yielded the highest dose from all air pathways, as computed by the CAP88-PC program. The exception is where the Columbia River defines the eastern site boundary; hence, the east bank is considered the closest habitable location. Also, as agreed upon between the U.S. Department of Energy, Richland Operations Office (DOE-RL), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Health (WDOH) (AIR 00-1012, "New Maximally Exposed Individual Definition"), the Laser Interferometer Gravitational-Wave Observatory (LIGO) and Energy Northwest are considered onsite for the purpose of determining the location of the MEI. Distances to the site boundary were computed using the Hanford Geographic Information System. The southern boundary on the map shown in Appendix C reflects land that was transferred on September 30, 2015, from DOE to the Tri-City Development Council .

Distances to the site boundary in 16 compass directions are input into the CAP88-PC model to show the dose at the site boundary in all directions. A separate CAP88-PC model was created using the distances to other potential non-DOE-related business locations (i.e., LIGO and Energy Northwest). In both cases, CAP88-PC automatically calculates the individual effective dose equivalent (EDE) for each distance in all directions (see CAP88-PC model runs in Appendices D though G of this ECF). By default, CAP88-PC will take the maximum individual EDE regardless of direction or distance and use it as the basis for the dose to the MEI and report it as the EDE in the nuclide-specific dose equivalent summary. This scenario results in the maximum individual EDE selected from the matrix of individual EDEs at a location not on the site boundary or in any other non-DOE-related business location. To determine the maximum EDE at the site boundary or non-DOE-related business location, a review of the CAP88-PC summary reports (Appendices D through G) is conducted to determine which of the 16 compass directions at the site boundary or non-DOE-related business location distance inputs result in the maximum individual EDE.

The following assumptions were made for the CAP88-PC model runs:

- The lid is the inner layer of the atmosphere, within which there is normally a steady decrease of temperature with increasing altitude. Nearly all clouds form and weather conditions manifest themselves within this region. Its thermal structure is primarily caused by the heating of the earth's surface by solar radiation, followed by heat transfer through turbulent mixing and convection. The lid height (1,000 m [3,281 ft]) is the rounded average of winter and summer mean afternoon mixing heights (500 and 2,000 m [1,640 and 6,562 ft], respectively) for southeastern Washington State (Holzworth, 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States)*.

- The average annual precipitation for the Hanford Site from 1945 to 2018 is 18.13 cm (7.14 in.) as reported in Table 1-1 of DOE/RL-2019-33, *Hanford Site Environmental Report for Calendar Year 2018*.

- The average annual temperature for the Hanford Site from 1945 to 2018 is 12.2ºC (53.9ºF) as reported in Table 1-1 of DOE/RL-2019-33.

- The CAP88-PC default value for humidity of 8 g/m^3 was used, which compares well to Hanford Site-specific historical data.

- Radionuclide decay chains were limited to five (a CAP88-PC default).

- Buildup time in years was set to 50 consistent with Attachment 9, Exhibit 1, of DOE/RL-2007-53, *Methods for Calculating Doses to Demonstrate Compliance with Air Pathway Radiation Dose Standards at the Hanford Site*.

- Three area sources were included in the diffuse and fugitive models: 276S HSTF, 293S Building, and 202S Annex (Table 7). The largest area source (202S Annex) equals an area of 2,524 m^2 (27,170 ft^2). As discussed in Trinity, 2014, *CAP88-PC Version 4.0 User Guide*, the ratio of distance to the receptor or source diameter is greater than 2.5; therefore, CAP88-PC automatically models the area source as a point source, assumes the source is a circular area, and calculates a source diameter as shown in Equation 5:

$$2{,}524\ \text{m}^2 = (\pi)(\text{Diameter}/2)^2 \qquad \textbf{(Eq. 5)}$$

  The largest source diameter is calculated as 56.7 m (186 ft), which is far less than the distance to the offsite MEI determined to be 30,401 m (99,741 ft) away at the Hanford Site boundary; thus, the CAP88-PC code assumes each source to be a point source. Also discussed in Trinity, 2014, is that multiple sources are modeled by CAP88-PC as if located at the same point, and errors arising from this assumption will have a negligible effect for assessments where the distance to the exposed individuals is large compared to the size. As previously stated, this is the case for the REDOX Complex.

3.3 Software Applications

CAP88-PC, version 4.0.1.17, was used to calculate the EDE to the MEI. Software quality assurance of CAP88-PC version 4.0.1.17 is addressed by CHPRC-03392, *Clean Air Act Assessment Package-1988 – Combined Software Management Plan*. The Software Installation and Checkout Form for CAP88-PC is included as Appendix H of this ECF.

3.4 Calculations

Table 8 provides the APQ and PTE calculation for potential point source air emissions from the 291S001 Stack for the REDOX Complex radiological constituents of concern. Table 9 provides the APQ and PTE calculation for potential diffuse and fugitive air emissions from demolition of the 276S HSTF, 293S Building, and 202S Annex for the REDOX Complex radiological constituents of concern. These calculations follow the methodology described in Section 3.2 using the assumptions and inputs stated in Section 3.1. The unabated PTE values in Column D of Table 8 and Column F of Table 9 are the source inputs for the CAP88-PC models in Appendices D through G of this ECF.

Table 8. PTE Calculation for the REDOX Complex (291S001 Stack Point Source)

A	B	C	D
Isotopes	**Inventory[a] (Ci)**	**APQ[b] (Ci/yr)**	**Unabated PTE[c] (Ci/yr)**
Pu-239 (α)	1.41E+02	1.41E+02	1.41E-01
Sr-90 (β)	4.60E+02	4.60E+02	4.60E-01
Totals	**6.01E+02**	**6.01E+02**	**6.01E-01**

a. Inventory for the 202S Building (as specified in Table 4 in Section 3.1.2.1).

b. APQ is calculated as follows: **Column C** (APQ) = **Column B** (Inventory) / **Duration**

- Duration = 1 year (as specified in Section 3.1.1, Item 1)

c. PTE is calculated as follows: **Column D** (PTE) = **Column C** (APQ) × **Release Fraction**

- Release Fraction = 1.0E-03 (as specified in Section 3.1.2.1, Item 4)

APQ = annual possession quantity

PTE = potential-to-emit

1

Table 9. PTE Calculation for the REDOX Complex (Diffuse and Fugitive)

A	B	C	D	E	F
Isotopes	**Inventory (Ci)**	**Conservatism Multiplier[a]**	**APQ[b] (Ci/yr)**	**Release Fraction[c]**	**Unabated PTE[d] (Ci/yr)**
276S HSTF[e]					
H-3	1.30E-03	1.0	1.30E-03	1.00E+00	1.30E-03
C-14	1.12E-04	1.0	1.12E-04	1.00E+00	1.12E-04
Sr-90	1.35E-02	1.0	1.35E-02	1.00E-03	1.35E-05
Sb-125	7.15E-05	1.0	7.15E-05	1.00E-03	7.15E-08
Cs-137	6.94E-04	1.0	6.94E-04	1.00E-03	6.94E-07
Eu-154	6.32E-04	1.0	6.32E-04	1.00E-03	6.32E-07
Eu-155	1.41E-04	1.0	1.41E-04	1.00E-03	1.41E-07
U-234	5.26E-05	1.0	5.26E-05	1.00E-03	5.26E-08
U-238	5.11E-05	1.0	5.11E-05	1.00E-03	5.11E-08
Pu-238	1.06E-02	1.0	1.06E-02	1.00E-03	1.06E-05
Pu-239	1.52E-02	1.0	1.52E-02	1.00E-03	1.52E-05
Am-241	3.45E-02	1.0	3.45E-02	1.00E-03	3.45E-05
Cm-244	1.86E-03	1.0	1.86E-03	1.00E-03	1.86E-06

Table 9. PTE Calculation for the REDOX Complex (Diffuse and Fugitive)

A	B	C	D	E	F
Isotopes	**Inventory (Ci)**	**Conservatism Multiplier[a]**	**APQ[b] (Ci/yr)**	**Release Fraction[c]**	**Unabated PTE[d] (Ci/yr)**
293S Building[f]					
Pu-239	1.00E+00	4.0	4.00E+00	1.00E-03	4.00E-03
Sr-90	4.00E+00	4.0	1.60E+01	1.00E-03	1.60E-02
202S Annex[g]					
Pu-239	2.75E-04	1.0	2.75E-04	1.00E-03	2.75E-07
Sr-90	1.37E-02	1.0	1.37E-02	1.00E-03	1.37E-05

a. Conservatism multiplier added for 293S Building inventory (as specified in Section 3.1.2.2, Item 2).

b. APQ is calculated as follows: **Column D** (APQ) = {**Column B** (Inventory) × **Column C**} / **Duration**

- Duration = 1 year (as specified in Section 3.1.1, Item 1)

c. Release fractions per NESHAP (40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Appendix D, "Methods for Estimating Radionuclide Emissions"), as specified in Section 3.1.2.2, Item 4.

- 1.0E+00 for gases
- 1.0E-03 for liquids or particulate solids

d. PTE is calculated as follows: **Column F** (PTE) = **Column D** (APQ) × **Column E** (Release Fraction)

e. Inventory for the 276S HSTF (as specified in Section 3.1.2.2, Item 1).

f. Inventory for the 293S Building (as specified in Section 3.1.2.2, Item 2).

g. Inventory for 202S Annex (as specified in Section 3.1.2.2, Item 3).

APQ = annual possession quantity
HSTF = Hexone Storage and Treatment Facility
NESHAP = National Emission Standards for Hazardous Air Pollutants
PTE = potential-to-emit

3.5 Radiological Air Emission Results

Potential radionuclide air emission estimates were calculated by CAP88-PC for the REDOX Complex removal action described in the REDOX RAWP (DOE/RL-2017-06). Table 10 provides the total TEDE for onsite and offsite MEIs by summing the onsite and offsite emissions for both point source and diffuse and fugitive emissions. Abated values were determined by multiplying the unabated values by 1% (assuming a conservative 99% HEPA filter efficiency).

Table 10. Total Effective Dose Equivalent to the Maximally Exposed Individual

Emission Type	Unabated TEDE (mrem/yr)		Abated TEDE[a] (mrem/yr)	
	Offsite MEI	Onsite MEI[b]	Offsite MEI	Onsite MEI[b]
Point source – 291S001 Stack	9.19E-02[c]	2.05E-01[d]	9.19E-04	2.05E-03
Diffuse and fugitive – demolition of 276S HSTF, 293S Building, and 202S Annex	6.15E-03[e]	1.95E-02[f]	6.15E-05	1.95E-04
Totals	**9.81E-02**	**2.25E-01**	**9.81E-04**	**2.25E-03**

Note: CAP88-PC, version 4.0, allows modeling on a personal computer and is a recent version of CAP-88, a regulatory compliance tool under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."

a. Conservatively assuming a minimum HEPA filter efficiency of 99%, the abated TEDE is calculated as follows: abated TEDE = unabated TEDE x 1%.

b. TEDE to the onsite MEI is provided in accordance with the agreement reached between DOE-RL, EPA, and WDOH (AIR 00-1012, "New Maximally Exposed Individual Definition").

c. See Appendix D for CAP88-PC synopsis and summary reports. The offsite MEI is located at the Hanford Site boundary 30,401 m (99,741 ft) east-southeast of the REDOX Complex.

d. See Appendix E for CAP88-PC synopsis and summary reports. The onsite MEI is located at LIGO 14,717 m (48,284 ft) east-southeast of the REDOX Complex.

e. See Appendix F for CAP88-PC synopsis and summary reports. The offsite MEI is located at the Hanford Site boundary 30,401 m (99,741 ft) east-southeast of the REDOX Complex.

f. See Appendix G for CAP88-PC synopsis and summary reports. The onsite MEI is located at LIGO 14,717 m (48,284 ft) east-southeast of the REDOX Complex.

DOE-RL = U.S. Department of Energy, Richland Operations Office
EPA = U.S. Environmental Protection Agency
HEPA = high-efficiency particulate air
HSTF = Hexone Storage and Treatment Facility
LIGO = Laser Interferometer Gravitational-Wave Observatory
MEI = maximally exposed individual
REDOX = Reduction-Oxidation (Facility)
TEDE = total effective dose equivalent
WDOH = Washington State Department of Health

TEDE to the onsite MEI is provided in accordance with the agreement reached between DOE-RL, EPA, and WDOH (AIR 00-1012).

As determined by CAP88-PC, the unabated TEDE to the MEIs for the REDOX Complex are below the 0.1 mrem/yr limit in WAC 246-247-075, "Monitoring, Testing, and Quality Assurance," that requires continuous monitoring of radionuclide emissions, and below the 10 mrem/yr ambient air requirement in NESHAP (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities"). The TEDE also complies with WAC 246-221, "Radiation Protection Standards," and WAC 246-221-060, "Dose Limits for Individual Members of the Public," which requires that Hanford Site operations not result in a dose to an individual member of the public above 10 mrem/yr.

4 Criteria and Toxic Air Determination

This chapter documents the determination of criteria and toxic air emissions resulting from the removal action at the REDOX Complex. This determination supports the REDOX RAWP (DOE/RL-2017-06) and subsequent fieldwork packages. The nonradioactive emissions resulting from this removal action will be fugitive particulate matter. Under WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," requirements are established for the regulation of emissions of criteria and toxic air pollutants. In accordance with WAC 173-400-040, "General Standards for Maximum Emissions," reasonable precautions must be taken to prevent the release of air contaminants associated with fugitive emissions resulting from materials handling, demolition, or other operations if criteria and toxic emissions are expected.

To support separation operations at the REDOX Complex, various chemicals were added at different stages in the process. Table 11 provides the bounding chemical contaminants of concern for the REDOX Complex. These chemicals are identified through review of the REDOX process flowsheets and other historical documents, in addition to knowledge of contaminants found in building materials used at the time of construction. The chemical contaminants identified in Table 11 were compared to WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values," to identify regulated contaminants. Table 12 includes those chemicals from Table 11 that are regulated and their de minimis emission values.

Table 11. Chemical Contaminants of Concern

Acetylene tetrabromide	Semivolatile organics:* • Di-n-butylphthalate, $C_{16}H_{22}O_4$ • 2,4-Dinitrotoluene, $C_7H_6N_2O_4$ • Hexachlorobenzene, C_6Cl_6 • Hexachlorobutadiene, C_4Cl_6 • Hexachloroethane, C_2Cl_6 • 2-Methylphenol (o-cresol), C_7H_8O • 3+4-Methylphenol (m+p-cresol), C_7H_8O • Nitrobenzene, $C_6H_5NO_2$ • Pentachlorophenol, C_6HCl_5O • 2,4,5-Trichlorophenol, $C_6H_3Cl_3O$ • 2,4,6-Trichlorophenol, $C_6H_3Cl_3O$	Other chemicals, including: • Aluminum nitrate, $Al(NO_3)_3$ • Aluminum nitrate nonahydrate, $Al(NO_3)_3•9H_2O$ • Ammonium fluoride, NH_4F • Ammonium nitrate, NH_4NO_3 • Boric acid, BH_3O_3 • Chromate, CrO_4^{2-} • Chromium nitrate, $Cr(NO_3)_3$ • Ferric nitrate, $Fe(NO_3)_3$ • Ferrous sulfamate, $Fe(H_2NO_3S)_2$ • Hexone (methyl isobutyl ketone), $C_6H_{12}O$ • Mercuric nitrate, $Hg(NO_3)_2$ • Nitric acid, HNO_3 • Normal paraffin hydrocarbons • Oxalic acid, $C_2H_2O_4$ • Plutonium nitrate, $Pu(NO_3)_4$ • Potassium permanganate, $KMnO_4$ • Sodium aluminate, $NaAlO_2$ • Sodium carbonate, Na_2CO_3 • Sodium dichromate, $Na_2Cr_2O_7$ • Sodium hydroxide, NAOH • Sodium nitrate, $NaNO_3$ • Sodium nitrite, $NaNO_2$ • Sodium phosphate, Na_3PO_4 • Sulfamic acid, H_3NSO_3
Anions: • Bromide • Chloride • Fluoride • Nitrate • Nitrite • Phosphate • Sulfate		
Asbestos and asbestos-containing material		
Beryllium		
Lubricants/oils		
Metals: • Aluminum • Arsenic • Barium • Cadmium • Chromium • Hexavalent chromium • Iron • Lead • Mercury • Nickel • Selenium • Silver • Sodium • Sulfur • Zinc	Volatile organics:* • Acetone, C_3H_6O • Benzene, C_6H_6 • 2-butanone, C_4H_8O • Carbon tetrachloride, CCl_4 • 1,4-Dichlorobenzene, $C_6H_4Cl_2$ • 1,2-Dichloroethane, $C_2H_4Cl_2$ • 1,1-Dichloroethylene, $C_2H_2Cl_2$ • Ethylbenzene, C_8H_{10} • n-Butyl alcohol, $C_4H_{10}O$ • Tetrachloroethene, C_2Cl_4 • 1,1,2-Trichloroethane, $C_2H_3Cl_3$	

Table 11. Chemical Contaminants of Concern

Polychlorinated biphenyls	• Trichloroethylene, C_2HCl_3	• Tributyl phosphate, $C_{12}H_{27}O_4P$
Total organic halides	• Vinyl chloride, C_2H_3Cl • Xylenes (total), C_8H_{10}	• Uranyl nitrate hexahydrate, $UO_2(NO_3)_2 \cdot 6H_2O$

Reference: DOE/RL-2017-05, *Sampling and Analysis Plan for the REDOX Complex*.
* These organics only apply to the 276S Hexone Storage and Treatment Facility.

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Table 12. De Minimis Emission Values for REDOX Complex Chemicals

Name	Chemical Abstracts Service Number	De Minimis Emission*
Ammonia	7664-41-7	1.9E+00 lb/d
Arsenic and inorganic arsenic compounds, NOS	--	2.5E-03 lb/yr
Asbestos	1332-21-4	3.5E-05 fibers/cm^3/yr
Benzene	71-43-2	1.0E+00 lb/yr
Beryllium and compounds, NOS	--	3.4E-03 lb/yr
2-Butanone (methyl ethyl ketone)	78-93-3	1.9E+01 lb/d
Cadmium and compounds, NOS	--	1.9E-03 lb/yr
Carbon tetrachloride	56-23-5	1.4E+00 lb/yr
Chromium (III), insoluble particulates, NOS	--	1.9E-02 lb/d
Chromium (III), soluble particulates, NOS	--	3.7E-04 lb/d
Chromium (VI) and compounds, NOS	--	3.3E-05 lb/yr
1,1-Dichloroethylene (ethylidene dichloride)	75-35-4	7.4E-01 lb/d
1,2-Dichloroethane (ethylene dichloride)	107-06-2	3.1E-01 lb/yr
1,4-Dichlorobenzene	106-46-7	7.4E-01 lb/yr
2,4-Dinitrotoluene	121-14-2	9.1E-02 lb/yr
Ethylbenzene	100-41-4	3.2E+00 lb/yr
Fluorides (fluoride containing chemicals), NOS	--	4.8E-02 lb/d
Hexachlorobenzene	118-74-1	1.8E-02 lb/yr
Hexachlorobutadiene	87-68-3	3.7E-01 lb/yr
Hexachloroethane	67-72-1	7.4E-01 lb/yr
Hexone (methyl isobutyl ketone)	108-10-1	1.1E+01 lb/d
Lead and compounds, NOS	--	1.0E+01 lb/yr
Mercury, elemental	7439-97-6	1.1E-04 lb/d
2-Methylphenol (o-cresol)	95-48-7	2.2E+00 lb/d
3-Methylphenol (m-cresol)	108-39-4	2.2E+00 lb/d

Table 12. De Minimis Emission Values for REDOX Complex Chemicals

Name	Chemical Abstracts Service Number	De Minimis Emission*
4-Methylphenol (p-cresol)	106-44-5	2.2E+00 lb/d
Nickel and compounds, NOS	--	3.1E-02 lb/yr
Nitric acid	7697-37-2	8.0E-03 lb/hr
Nitrobenzene	98-95-3	2.0E-01 lb/yr
Pentachlorophenol	87-86-5	1.8E+00 lb/yr
Polychlorinated biphenyls, NOS	1336-36-3	1.4E-02 lb/yr
Selenium and compounds (other than hydrogen selenide)	--	7.4E-02 lb/d
Sodium hydroxide	1310-73-2	7.4E-04 lb/hr
Tetrachloroethene (perchloroethylene)	127-18-4	1.3E+00 lb/yr
1,1,2-Trichloroethane (vinyl trichloride)	79-00-5	5.1E-01 lb/yr
Trichloroethylene	79-01-6	1.7E+00 lb/yr
2,4,6-Trichlorophenol	88-06-2	2.6E+00 lb/yr
Vinyl chloride	75-01-4	9.2E-01 lb/yr
Xylene (mixture), including m-xylene, o-xylene, p-xylene	1330-20-7	8.2E-01 lb/d

*Values from WAC 173-460-150, "Controls for New Sources of Toxic Air Pollutants," "Table of ASIL, SQER and de Minimis Emission Values."

NOS = not otherwise specified

Several process chemicals, organic compounds, arsenic, beryllium, cadmium, chromium, nickel, and selenium have low de minimis values. The toxic contaminants of concern historically at the Hanford Site are those with vapor pressures of greater than 1 mmHg at ambient temperature (20°C [68°F]), which means that metals and mercury should be considered nonvolatile at room temperature (i.e., will not produce any toxic emissions during the work) and below the WAC 173-460-150 de minimis threshold. Hexone, organic compounds, nitric acid, and sodium hydroxide have vapor pressures greater than 1 mmHg at ambient temperature and could have some emissions if any liquid is left and exposed to ambient air.

The 276S hexone tanks will be cut into pieces during removal to meet waste packaging and/or onsite transportation restrictions. New emissions of hexone and other organic compounds above de minimis levels from removal of the 276S hexone tanks are not anticipated as follows:

- The volume of remaining sludge in the tanks is relatively small – a total of 984 L (260 gal).
- Remaining sludge in the tanks is a tar-like consistency (semisolid) with no free liquids (Section 2.2), meaning that remaining organic solvents had evaporated and been removed from the tanks with the flowing nitrogen purge gas.

New emissions of nitric acid from demolition and grouting of the 293S Building are not anticipated as the vessels and piping were drained and blown with air during deactivation. The nitric acid storage tank is documented as being empty.

As stated in Section 2.1, tanks and piping in the 202S Building were rinsed and repeatedly flushed during deactivation activities over 45 years ago. This greatly reduced the potential chemical inventory within the building. Tanks and piping would not be removed in such a manner to create emissions (e.g., crimping of piping, cutting tanks or piping in secondary containment). Emissions of hexone, nitric acid, and sodium hydroxide exceeding the de minimis values in WAC 173-460-150 are not anticipated from the 202S Building due to the reduced chemical inventory combined with standard work practices.

Polychlorinated biphenyls are associated with painted surfaces and electrical equipment (light ballasts) and are unlikely to become airborne due to the techniques employed during the removal activities. Toxic air requirements associated with asbestos-containing materials at the REDOX Complex will be addressed in accordance with applicable NESHAP (40 CFR 61) requirements. A thorough asbestos NESHAP inspection will be performed by an *Asbestos Hazard Emergency Response Act of 1986*-certified building inspector prior to abatement activities.

5 References

19-ESQ-0086, 2019, "Transition of the Reduction-Oxidation Facility (REDOX) and Stack P-291S001-001 to Regulation Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)" (external letter to J. Martell, Washington State Department of Health; A.K. Smith, Washington State Department of Ecology; and K. Viswanathan, U.S. Environmental Protection Agency; from B.T. Vance), U.S. Department of Energy, Richland Operations Office, Richland, Washington, August 5. Available at: https://pdw.hanford.gov/document/AR-02755.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*. Available at: https://www.govinfo.gov/content/pkg/CFR-2020-title40-vol10/pdf/CFR-2020-title40-vol10-part61.pdf.

Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

Appendix D, "Methods for Estimating Radionuclide Emissions."

93-ERB-087, 1993, "Hexone Remediation" (external letter to D.B. Jansen, Washington State Department of Ecology, from J.D. Bauer and R.E. Lerch), U.S. Department of Energy, Richland Field Office, Richland, Washington, February 16. Available at: https://pdw.hanford.gov/document/0064444H.

AIR 00-1012, 2000, "New Maximally Exposed Individual Definition" (letter to S.H. Wisness, U.S. Department of Energy, Richland Operations Office, from A.W. Conklin), Washington State Department of Health, Olympia, Washington, October 18. Available at: https://pdw.hanford.gov/document/AR-03321.

Asbestos Hazard Emergency Response Act of 1986, Pub. L. No. 99-519, 15 USC 2614-2656, et seq. Available at: https://www.govinfo.gov/content/pkg/USCODE-2018-title15/pdf/USCODE-2018-title15-chap53-subchapII.pdf.

BHI-00994, 1997, *In-Situ Non-Destructive Radiological Characterization of Selected 202-S Reduction Oxidation (REDOX) Facility Sample Gallery Pipes and Vessels*, Rev. 0, Bechtel Hanford Inc., Richland, Washington. Available at: https://pdw.hanford.gov/document/0071629H.

BHI-01142, 2001, *REDOX Facility Safety Analysis Report*, Rev. 3, Bechtel Hanford, Inc., Richland, Washington. Available at: https://pdw.hanford.gov/document/0074336H.

BHI-01521, 2001, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*, Draft B, Bechtel Hanford, Inc., Richland, Washington. Available at: https://pdw.hanford.gov/document/D8793559.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

CHPRC-03392, 2018, *Clean Air Act Assessment Package-1988 – Combined Software Management Plan*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

CP-ENG-0141, 2022, *291S Stack Sampling for New Exhauster System*, Central Plateau Cleanup Company, Richland, Washington. Available at: https://pdw.hanford.gov/document/AR-19850.

DOE/RL-91-50, 2018, *Hanford Site Environmental Monitoring Plan,* Rev. 8, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://www.hanford.gov/files.cfm/2018_EMP_estars.pdf.

DOE/RL-2007-53, 2008, *Methods for Calculating Doses to Demonstrate Compliance with Air Pathway Radiation Dose Standards at the Hanford Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2016-52, 2019, *Action Memorandum for the REDOX Complex*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/AR-01150.

DOE/RL-2017-05, 2021, *Sampling and Analysis Plan for the REDOX Complex*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/AR-13002.

DOE/RL-2017-06, 2022, *Removal Action Work Plan for the Reduction-Oxidation Complex*, Rev. 2 pending, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2019-33, 2019, *Hanford Site Environmental Report for Calendar Year 2018*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://hmis.hanford.gov/files.cfm/DOE-RL-2019-33_Rev0_public.pdf.

FF-01, 2019, *Radioactive Air Emissions License for the Department of Energy Richland Office Hanford Site*, Office of Radiation Protection, Washington State Department of Health, Olympia, Washington, Available at: https://fortress.wa.gov/ecy/nwp/permitting/AOP/renewal/Three/AOP_00-05-06_Renewal_3_Att_2.pdf.

FH-0400890, 2004, *REDOX Facility Safety Analysis Report Addendum Submittal*, Fluor Hanford, Inc., Richland, Washington.

H-2-5368 (drawing), 1950, *Organic Solvent Make Up Tanks & Equipment Arrangement*, Rev. 3, General Electric Company, Richland, Washington.

H-2-7423 (drawing), 1951, *Arch. Plan – North & West Service Areas & Cable Rooms #1 & #2*, Rev. 3, General Electric Company, Richland, Washington.

H-2-7424 (drawing), 1951, *Arch. Plans – South Service Area & Cable Room #3*, Rev. 3, General Electric Company, Richland, Washington.

H-2-7432 (drawing), 1998, *Arch. Plans – Blower Rooms No. 3 & 5 & South Service Area Roof*, Rev. 4, General Electric Company, Richland, Washington.

H-2-30501 (drawing), 1957, *Modifications to REDOX SWP Facilities – Foundation Plans & Details*, Rev. 0, General Electric Company, Richland, Washington.

H-2-31048 (drawing), 1958, *S Plant Off-Gas Treatment Facility – Architectural Plans & Sections*, Rev. 2, General Electric Company, Richland, Washington.

HNF-13830, 2019, *Documented Safety Analysis for the Reduction-Oxidation Facility*, Rev. 8, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: https://pdw.hanford.gov/document/AR-04271.

Holzworth, G.C., 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, Office of Air Programs, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. Available at: https://www.nrc.gov/docs/ML1408/ML14084A177.pdf.

ISO-1108, 1966, *REDOX Deactivation Manual*, Isochem Inc., Richland, Washington. Available at: https://pdw.hanford.gov/document/0071627H.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Pub. L. 94-580, 90 Stat. 2795. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

SD-DD-FL-001, 1982, *Rockwell Retired Contaminated Facility Listing and Description*, Rev. 0, Rockwell Hanford Operations, Richland, Washington. Available at: https://pdw.hanford.gov/document/0077155H.

Trinity, 2014, *CAP88-PC Version 4.0 User Guide*, Trinity Engineering Associates, Inc., Cincinnati, Ohio.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, Olympia, Washington. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-400.

173-400-040, "General Standards for Maximum Emissions."

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, Olympia, Washington. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-460.

173-460-150, "Table of ASIL, SQER and de Minimis Emission Values."

WAC 246-221, "Radiation Protection Standards," *Washington Administrative Code*, Olympia, Washington. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=246-221.

246-221-060, "Dose Limits for Individual Members of the Public."

WAC 246-247, "Radiation Protection—Air Emissions," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=246-247.

246-247-030, "Definitions, Abbreviations, and Acronyms."

246-247-075, "Monitoring, Testing, and Quality Assurance."

WHC-EP-0570, 1992, *The Distillation and Incineration of 132,000 Liters (35,000 Gallons) of Mixed-Waste Hexone Solvents from Hanford's REDOX Plant*, Westinghouse Hanford Company, Richland, Washington. Available at: https://pdw.hanford.gov/document/D196107914.

Appendix A

Inventory Calculation for 276S Hexone Tanks

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Contents

Figures

Tables

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A1 Introduction

This appendix calculates the inventory in the 276S141 and 276S142 hexone tanks based on results of samples taken in 2001 of the remaining sludge in the tanks. Samples were obtained prior to grouting of the remaining tank headspaces in 2002. Sample results are documented in BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*. Excerpts of the radionuclide results from BHI-01521 are shown in Figures A-1 through A-3. Nondetect results, shown with a "U" flag, were excluded.

The radionuclide sample results are given as pCi/g (activity per unit mass). Therefore, the mass of sludge remaining in each tank is needed. The sludge mass is calculated as shown in Equation A-1 with results for each tank in Table A-1. A conversion factor (CF) is used to convert volume from standard to metric units (CF1: 1 gal = 3,785.41 mL).

$$\text{Mass}\ (g) = Volume\ (gal) \times\ CF1\ \left(\frac{mL}{gal}\right) \times\ Density\left(\frac{g}{mL}\right) \qquad \textbf{(Eq. A-1)}$$

Table A-1. Mass of Remaining Sludge in 276S Hexone Tanks

Property	Tank 276S141	Tank 276S142
Volume[a]	130.0 gal	130.0 gal
Density[b]	1.21 g/mL	1.20 g/mL
Mass[c]	595,445 g	590,524 g

a. BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*, Section 4.1.

b. BHI-01521, Section 4.2 (value is the maximum of east and west sample results).

c. Calculate mass: Mass = Volume × CF1 × Density.
- Conversion factor 1: 1 gal = 3,785.41 mL

To obtain the inventory for each tank, the maximum sample result for each isotope is multiplied by the remaining sludge mass in that tank and then converted to Ci using CF2 (1 Ci = 1.0E+12 pCi), as shown by Equation A-2.

$$\text{Inventory}\ (Ci) = Mass\ (g) \times\ Maximum\ Result\left(\frac{pCi}{g}\right) \times CF2\ \left(\frac{Ci}{pCi}\right) \qquad \textbf{(Eq. A-2)}$$

Table A-2 and Table A-3 present the inventory for tank 276S141 and tank 241S142, respectively. Average sample results are shown in Tables A-2 and A-3 for information only. The inventory summation for the two tanks is presented in Table 3 of the main body of this calculation.

Table A-2. Inventory Calculation for Tank 276S141

Isotope	Sample Results (pCi/g)[a]					Average Result (pCi/g)	Maximum Result (pCi/g)	Inventory (Ci)[b]
	B11D03/ B11D08	B11D10	B11D05/ B11D11	B11D12	B11D13			
H-3	650	--	1600	--	--	1,125	1,600	9.53E-04
C-14	104	--	89	--	--	97	104	6.19E-05
Total Sr	1,330	--	1,220	--	--	1,275	1,330	7.92E-04
Sb-125	8.0	--	2.4	--	--	5.2	8.0	4.76E-06
Cs-137	74	--	115	--	--	95	115	6.85E-05
Eu-154	194	--	38	--	--	116	194	1.16E-04
Eu-155	53	--	8.3	--	--	31	53	3.16E-05
U-233/234	15	--	U	--	--	15	15	8.93E-06
U-238	8.4	--	U	--	--	8.4	8.4	5.00E-06
Pu-238	2,210	2,910	1,260	4,280	3,460	2,824	4,280	2.55E-03
Pu-239/240	3,100	3,590	1,320	5,820	4,100	3,586	5,820	3.47E-03
Am-241	6,830	5,980	2,780	9,770	10,800	7,232	10,800	6.43E-03
Cm-244	579	279	135	750	535	456	750	4.47E-04

a. Sample results from BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*, Tables 4-1 and 4-3. Nondetect ("U") values were excluded.

b. Calculate inventory: Inventory = Mass (Table A-1) × Maximum Result × CF2.
• Conversion factor 2: 1 Ci = 1.0E+12 pCi

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Table A-3. Inventory Calculation for Tank 276S142

Isotope	Sample Results (pCi/g)[a]					Average Result (pCi/g)	Maximum Result (pCi/g)	Inventory (Ci)[b]
	B11D06/ B11D15	B11D17	B11D07/ B11D14	B11D16	B11H76			
H-3	467	--	581	--	--	524	581	3.43E-04
C-14	84	--	85	--	--	85	85	5.02E-05
Total Sr	9,020	--	21,600	--	--	15,310	21,600	1.28E-02
Sb-125	38	--	113	--	--	76	113	6.67E-05
Cs-137	1,040	--	1,060	--	--	1,050	1,060	6.26E-04
Eu-154	379	--	874	--	--	627	874	5.16E-04
Eu-155	75	--	186	--	--	131	186	1.10E-04
U-233/234	31	--	74	--	--	53	74	4.37E-05
U-238	29	--	78	--	--	54	78	4.61E-05
Pu-238	8,000	9,160	10,100	10,000	13,600	10,172	13,600	8.03E-03

Table A-3. Inventory Calculation for Tank 276S142

Isotope	Sample Results (pCi/g)[a]					Average Result (pCi/g)	Maximum Result (pCi/g)	Inventory (Ci)[b]
	B11D06/ B11D15	B11D17	B11D07/ B11D14	B11D16	B11H76			
Pu-239/240	9,960	11,400	14,600	13,200	19,800	13,792	19,800	1.17E-02
Am-241	26,000	21,500	36,100	34,400	47,600	33,120	47,600	2.81E-02
Cm-244	1,970	1,360	2,090	1,370	2,390	1,836	2,390	1.41E-03

a. Sample results from BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*, Tables 4-2 and 4-3. Nondetect ("U") values were excluded.

b. Calculate inventory: **Inventory** = **Mass** (Table A-1) × **Maximum Result** × **CF2**
• Conversion factor 2: 1 Ci = 1.0E+12 pCi

1

Characterization of Hazards

Table 4-1. 276-S Hexone Tank Sludge – Tank 141 Sludge Sample Final Results. (4 Pages)

Contaminant of Concern	West Composite Sample (B11D03/D08)	West Replicate Sample (B11D04/D09)	East Sample (B11D05/D11)
2-butanone	4.4	4.1	4.5
2-hexanone	34	34	22
Acetone	47	60	153
Hexone	8,430	9,790	13,700
Semi-Volatile Organics (µg/g)			
Aroclor 1254	7.2	7.1	3.3
DNB-phth[a]	630 U	120 J	260 J
Tributyl phosphate	55,000	41,000	11,000
NPH[b]	55,600 J	43,600 J	60,600 J
Radionuclides (pCi/g)			
Hydrogen-3	650	781	1600
Carbon-14	104	75	89
Cobalt-60	0.59 U	0.65 U	0.24 U
Total strontium	1,330	1,020	1,220
Technetium-99	11 U	11 U	4.2 U
Antimony-125	8.0	8.6	2.4
Cesium-137	74	64	115
Europium-152	2.1 U	2.9 U	1.2 U
Europium-154	194	182	38
Europium-155	53	45	8.3
Uranium-233/234	15	16	9.6 U
Uranium-235	11 U	12 U	12 U
Uranium-238	8.4	14	9.6 U
Plutonium-238	2,210	2,520	1,260
Plutonium-239/240	3,100	3,610	1,320
Americium-241	6,830	7,210	2,780
Curium-244	579	390	135

Reference: BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*.

Figure A-1. Radionuclides Excerpt from Table 4-1 in BHI-01521

Table 4-2. 276-S Hexone Tank Sludge – Tank 142 Sludge Sample Final Results. (3 Pages)

Contaminant of Concern	West Composite Sample (B11D06/D15)	East Sample (B11D07/D14)	Equipment Blank (B11CX1)	Equipment Blank (B11CX2)
Radionuclides (pCi/g)				
Hydrogen-3	467	581	0.16 U	0.16 U
Carbon-14	84	85	0.046 U	0.044 U
Cobalt-60	1.0	2.1 U	0.016 U	0.008 U
Total strontium	9,020	21,600	0.00050 U	0.00050 U
Techtetium-99	15 U	49 U	0.011 U	0.012 U
Antimony-125	38	113	NA	NA
Cesium-137	1,040	1,060	0.0015 U	0.0008 U
Europium-152	2.4 U	9.3 U	0.038 U	0.022 U
Europium-154	379	874	0.052 U	0.028 U
Europium-155	75	186	0.021 U	0.021 U
Uranium-233/234	31	74	0.000026 U	0.000023 U
Uranium-235	11 U	36 U	0.000025 U	0.000022 U
Uranium-238	29	78	0.000021 U	0.000018 U
Plutonium-238	8,000	10,100	0.00024 U	0.00019 U
Plutonium-239/240	9,960	14,600	0.00024 U	0.00019 U
Americium-241	26,000	36,100	0.00024 U	0.00029 U
Curium-244	1,970	2,090	0.00030 U	0.00029 U
Other Analytes				
Ignitability (°F)	NA	NA	Not Ignitable	Not Ignitable
Total organic carbon	>10%	>10%	0.50 U	0.50 U
pH (units)	4.1	4.6	7.9	6.5
Density (g/mL)	0.91	1.20	NA	NA

[a] Di-n-butyl phthalate.
[b] Normal paraffin hydrocarbon (sum of all straight-chain hydrocarbons detected).
J = parameter detected below the reporting limit
NA = parameter not analyzed
TCLP = toxic characteristic leachate procedure
U = parameter not detected above the reported limit

Reference: BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*.

Figure A-2. Radionuclides Excerpt from Table 4-2 in BHI-01521

Table 4-3. 276-S Hexone Tank Sludge Samples TRU Evaluation.

Contaminant of Concern	West Sample (B11D08)	Middle Sample (B11D10)	East Sample (B11D11)	North Sample (B11D12)	South Sample (B11D13)
Tank 141 Sludge TRU Final Results					
TRU Radionuclides (pCi/g)					
Plutonium-238	2,210	2,910	1,260	4,280	3,460
Plutonium-239/240	3,100	3,590	1,320	5,820	4,100
Americium-241	6,830	5,980	2,780	9,770	10,800
Curium-244	579	279	135	750	535
TRU Calculations (nCi/g)					
Total TRU	12.7	12.8	5.5	20.6	18.9
Number of samples	5				
Average TRU	14.1				
Standard deviation	5.4				
Z-statistic	1.6				
95% UCL[a]	18.0				
Tank 142 Sludge TRU Final Results					
Contaminant of Concern	**West Sample (B11D15)**	**Middle Sample (B11D17)**	**East Sample (B11D14)**	**North Sample (B11D16)**	**South Sample (B11H76)**
TRU Radionuclides (pCi/g)					
Plutonium-238	8,000	9,160	10,100	10,000	13,600
Plutonium-239/240	9,960	11,400	14,600	13,200	19,800
Americium-241	26,000	21,500	36,100	34,400	47,600
Curium-244	1,970	1,360	2,090	1,370	2,390
TRU Calculations (nCi/g)					
Total TRU	45.9	43.4	62.9	59.0	83.4
Number of samples	5				
Average TRU	58.9				
Standard deviation	14.3				
Z-statistic	1.6				
95% UCL[a]	69.4				

[a] Remedial Design Report/Remedial Action Work Plan for the 100 Area, Rev. 2, Appendix G, DOE/RL-96-17 (DOE-RL 2000a).
TRU = transuranic
UCL = upper confidence limit

Reference: BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*.

Figure A-3. Excerpt of Table 4-3 in BHI-01521

1

A2 Reference

BHI-01521, 2001, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*, Draft B, Bechtel Hanford, Inc., Richland, Washington. Available at: https://pdw.hanford.gov/document/D8723187.

Appendix B

Hanford Site Wind Files

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200 Area Hanford Meteorological Station (Station #21) at the 61 m (200 ft) Level for 2004 – 2013 (A13200HMS61.WND)

4.543
0.031 0.034 0.041 0.033 0.032 0.027 0.032 0.038 0.045 0.059 0.139 0.198 0.098 0.078 0.073 0.041
2.31 2.02 2.09 2.05 1.97 1.98 2.24 2.35 2.36 2.45 3.37 4.24 3.03 3.50 4.43 2.93
1.93 2.05 1.90 1.86 1.83 1.77 1.87 2.18 2.37 2.33 3.10 3.53 2.52 2.98 3.90 2.91
2.02 1.93 1.97 1.72 1.76 1.70 1.72 1.79 2.11 2.24 3.06 3.76 3.23 3.92 4.11 3.15
2.00 1.79 1.55 1.50 1.54 1.40 1.45 1.55 1.64 1.89 2.79 3.68 2.61 3.31 3.88 3.08
2.13 1.89 1.62 1.48 1.58 1.60 1.56 1.80 1.70 1.98 3.44 4.72 3.72 3.61 3.75 3.06
1.84 1.85 1.67 1.40 1.52 1.34 1.39 1.47 1.59 2.05 3.12 3.98 3.23 3.08 2.58 2.10
1.52 1.72 1.44 1.35 1.21 1.14 1.38 1.24 1.48 1.87 3.25 3.32 2.86 2.88 2.34 1.98
3.33 2.77 2.67 2.54 2.59 2.82 3.37 3.64 3.35 3.34 4.97 6.38 4.72 6.00 7.05 4.78
2.88 2.87 2.45 2.40 2.43 2.36 2.85 3.34 3.21 3.14 4.41 5.44 4.09 5.06 6.33 4.73
3.13 2.88 2.54 2.36 2.51 2.41 2.72 2.70 2.97 3.03 4.49 5.49 4.96 6.02 7.00 5.93
4.11 3.09 2.24 2.14 2.27 2.06 2.57 2.78 2.56 2.77 4.58 6.02 4.59 6.11 7.25 6.66
4.71 3.68 2.61 2.25 2.49 2.61 2.76 3.58 2.73 3.10 5.46 6.83 5.42 5.89 7.00 6.80
3.39 2.99 2.48 2.03 2.33 2.02 2.24 2.36 2.55 3.06 4.60 5.52 4.64 4.95 4.96 4.64
2.52 2.98 2.20 1.90 1.72 1.48 2.22 2.07 2.35 2.81 4.87 5.03 4.07 4.46 3.89 3.22
0.1275 0.0523 0.0556 0.2255 0.2908 0.1797 0.0686
0.1335 0.0445 0.0475 0.2077 0.2878 0.2018 0.0772
0.1456 0.0558 0.0607 0.2330 0.2670 0.1796 0.0583
0.1611 0.0790 0.0821 0.2675 0.2219 0.1398 0.0486
0.1636 0.0864 0.0833 0.2809 0.2191 0.1265 0.0401
0.1873 0.0824 0.0936 0.2846 0.2022 0.1161 0.0337
0.1905 0.0857 0.0889 0.3270 0.1746 0.1016 0.0317
0.1789 0.0947 0.0895 0.2895 0.2026 0.1105 0.0342
0.1774 0.0843 0.0931 0.2905 0.1796 0.1353 0.0399
0.1229 0.0724 0.0758 0.2694 0.2155 0.1818 0.0623
0.0975 0.0513 0.0578 0.2209 0.2773 0.2079 0.0874
0.0662 0.0293 0.0303 0.1732 0.3899 0.2343 0.0768
0.0510 0.0265 0.0255 0.1398 0.3857 0.2786 0.0929
0.0954 0.0425 0.0464 0.1830 0.3312 0.2216 0.0799
0.1462 0.0648 0.0648 0.2303 0.3007 0.1393 0.0538
0.1338 0.0657 0.0608 0.2263 0.3090 0.1460 0.0584
extended data
StationName=200 AREA HMS (Station 21) - 61 M - Pasquill A - G (2004-2013)
State=WA
Latitude=46.563
Longitude=-119.599
TimeZone=8
RecordPeriod=2004-2013
AveragePeriodTemperature=12.01
Comments=Formatted 7/13/20 SFS, Created,mod 10/2015 Hanf Met Staff. Wspd Classes(m/s):.89 2.65
4.7 7.15 9.8 12.7 15.6 19.0

200 West Area (Station #7) at the 10 m (32.8 ft) Level for 2004 – 2013 (A13200W10.WND)

```
 0.000
0.028 0.033 0.048 0.045 0.033 0.026 0.031 0.040 0.063 0.088 0.154 0.148 0.101 0.075 0.054 0.032
 1.57 1.56 1.80 1.89 1.63 1.48 1.79 2.25 2.47 3.15 4.40 3.24 3.60 4.21 3.51 2.13
 1.61 1.55 1.77 1.79 1.54 1.48 1.60 1.92 2.20 2.56 3.41 2.29 2.92 3.68 3.05 2.36
 1.44 1.31 1.68 1.63 1.37 1.29 1.38 1.60 2.02 2.43 3.13 2.41 2.77 3.72 3.13 2.08
 1.31 1.28 1.49 1.44 1.22 1.16 1.26 1.48 1.69 2.07 2.94 2.08 2.39 3.01 2.57 1.86
 1.28 1.23 1.35 1.31 1.16 1.07 1.19 1.31 1.37 1.54 2.21 2.34 2.18 2.14 2.20 1.77
 1.02 1.07 1.15 1.12 1.01 0.97 0.98 1.02 1.18 1.22 1.48 1.58 1.44 1.27 1.16 1.05
 0.97 1.01 1.04 1.01 0.97 1.02 0.95 1.05 1.08 1.06 1.23 1.41 1.17 1.03 1.10 0.99
 2.38 2.14 2.46 2.67 2.19 2.03 2.62 3.30 3.30 4.49 6.43 4.82 5.76 6.32 5.42 3.36
 2.31 2.12 2.38 2.48 2.09 2.00 2.30 2.74 2.88 3.56 5.21 3.84 4.97 5.84 4.99 3.71
 2.15 1.84 2.38 2.42 1.92 1.78 2.03 2.29 2.71 3.45 5.04 3.92 4.92 5.80 5.48 3.55
 2.33 1.91 2.22 2.18 1.75 1.63 1.88 2.40 2.51 3.19 4.85 3.63 4.35 5.83 5.74 3.89
 2.41 2.06 2.08 1.99 1.65 1.41 2.00 2.42 2.13 2.57 3.85 3.59 3.55 4.26 4.99 3.87
 1.26 1.36 1.60 1.52 1.25 1.11 1.13 1.26 1.66 1.78 2.12 2.29 2.24 1.99 1.88 1.47
 1.10 1.20 1.28 1.21 1.11 1.22 1.07 1.30 1.40 1.38 1.69 1.97 1.62 1.31 1.91 1.42
   0.0919   0.0495   0.0459   0.2297   0.3039   0.2191   0.0601
   0.0901   0.0480   0.0511   0.2492   0.2763   0.2162   0.0691
   0.1104   0.0604   0.0708   0.2875   0.2438   0.1708   0.0563
   0.1527   0.0885   0.0929   0.2765   0.2146   0.1261   0.0487
   0.1662   0.1118   0.0997   0.2568   0.1813   0.1360   0.0483
   0.1506   0.1236   0.1004   0.2664   0.1737   0.1236   0.0618
   0.1607   0.1016   0.0951   0.2754   0.1803   0.1213   0.0656
   0.1784   0.0955   0.0980   0.2688   0.1734   0.1206   0.0653
   0.1629   0.0942   0.0958   0.2907   0.1645   0.1358   0.0559
   0.1503   0.0763   0.0809   0.2642   0.2084   0.1617   0.0581
   0.0920   0.0343   0.0376   0.2203   0.3189   0.2184   0.0784
   0.0372   0.0135   0.0149   0.1103   0.4161   0.3024   0.1055
   0.0584   0.0287   0.0317   0.1563   0.4115   0.2354   0.0781
   0.1375   0.0547   0.0507   0.2243   0.3418   0.1509   0.0401
   0.1179   0.0534   0.0645   0.2357   0.3591   0.1326   0.0368
   0.0872   0.0561   0.0530   0.2492   0.3458   0.1620   0.0467
extended data
StationName=Hanford 200 AREA West (Station 7) - 10m - Pasquill A-G (2004-13)
State=WA
Latitude=46.54272
Longitude=-119.66264
TimeZone=8
RecordPeriod=2004-2013
AveragePeriodTemperature=12.01
Comments=Formatted 10/21/14 SFS, Created 07/24/14 KWB; Windspeed Classes (m/s): .89  2.65  4.7
7.15  9.8  12.7  15.6  19.0
```

Appendix C

Map Showing Distance to the Maximally Exposed Individual from the Reduction-Oxidation Complex

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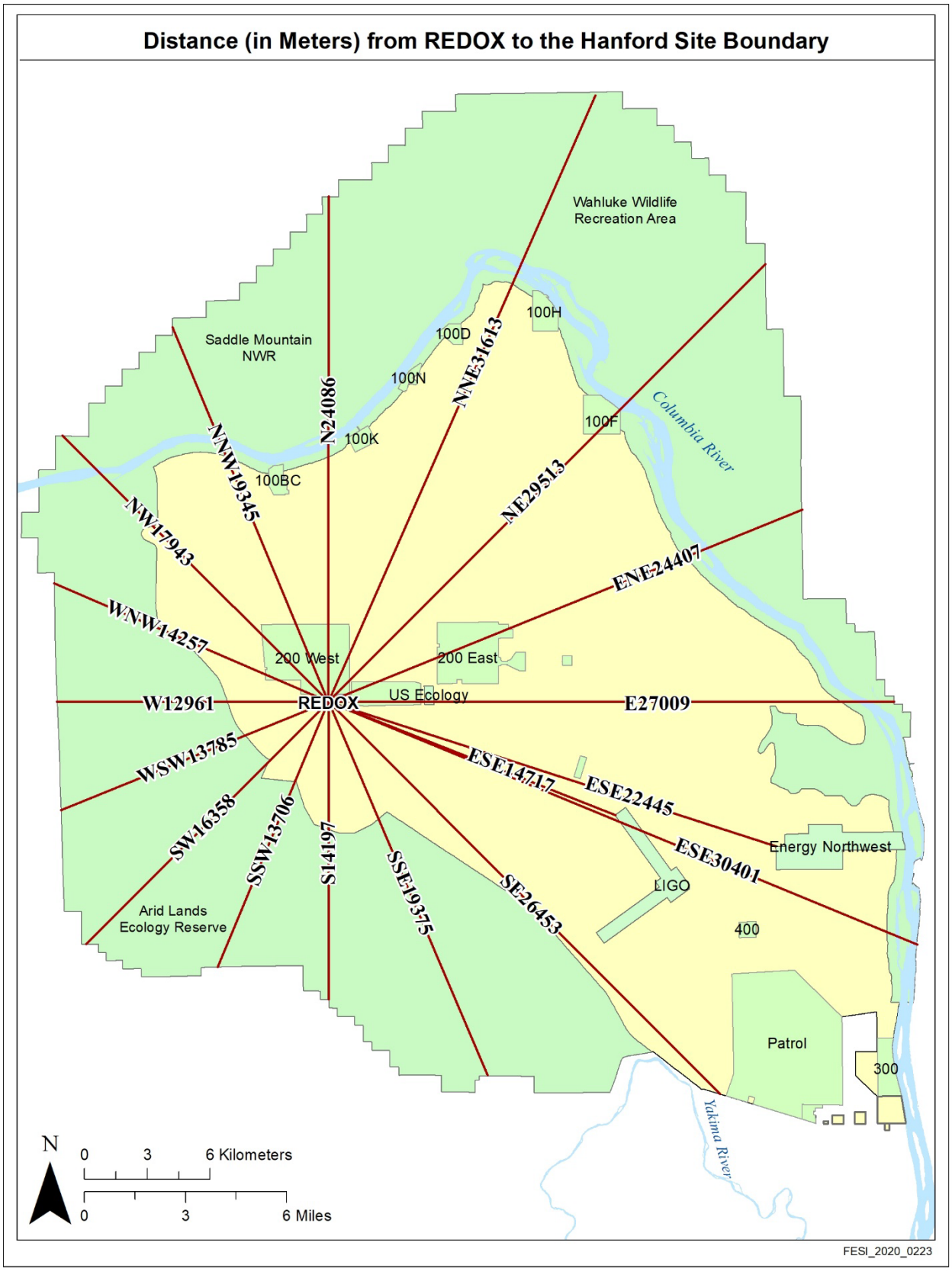
Distance (in Meters) from REDOX to the Hanford Site Boundary
Wahluke Wildlife Recreation Area
Saddle Mountain NWR
100H
100D
100N
100K
100BC
100F
Columbia River
N24086
NNE31613
NNW19345
NW17943
NE29513
ENE24407
WNW14257
200 West
200 East
US Ecology
REDOX
W12961
E27009
WSW13785
ESE14717
ESE22445
ESE30401
Energy Northwest
SW16358
SSW13706
S14197
SSE19375
SE26453
LIGO
400
Arid Lands Ecology Reserve
Patrol
300
Yakima River
N
0 3 6 Kilometers
0 3 6 Miles
FESI_2020_0223

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Appendix D

CAP88-PC Synopsis and Summary Reports for the 291S001 Stack – Offsite Maximally Exposed Individual

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C A P 8 8 - P C

Version 4.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Wed May 25 08:10:41 2022

Facility: REDOX Complex (202S) with Vent. mods
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Stack
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R2
Point source (stack) emissions - Offsite

Committed Effective Dose Equivalent
(mrem)

9.19E-02

At This Location: 30401 Meters East Southeast

Dataset Name: 202S_StkOffsite.
Dataset Date: May 25, 2022 08:10 AM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200HMS61.wnd

Wed May 25 08:10:41 2022 SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 30401 Meters East Southeast
Lifetime Fatal Cancer Risk: 6.02E-09

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem)
Adrenal	4.53E-03
UB_Wall	5.02E-03
Bone_Sur	2.54E+00
Brain	4.53E-03
Breasts	4.57E-03
St_Wall	4.69E-03
SI_Wall	4.84E-03
ULI_Wall	7.77E-03
LLI_Wall	1.76E-02
Kidneys	9.95E-03
Liver	4.84E-01
Muscle	4.56E-03
Ovaries	3.07E-02
Pancreas	4.53E-03
R_Marrow	2.15E-01
Skin	2.17E-01
Spleen	4.54E-03
Testes	3.13E-02
Thymus	4.54E-03
Thyroid	4.55E-03
GB_Wall	4.53E-03
Ht_Wall	4.53E-03
Uterus	4.53E-03
ET_Reg	1.17E-02
Lung_66	3.97E-02
Effectiv	9.19E-02

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source #1 Ci/y	TOTAL Ci/y
Pu-239	M	1.000	1.4E-01	1.4E-01
Sr-90	M	1.000	4.6E-01	4.6E-01

SITE INFORMATION

Temperature:	12.200 degrees C
Precipitation:	18.130 cm/y
Humidity:	8.000 g/cu m
Mixing Height:	1000.0 m

User specified location of max exposed individual.
(ILOC, JLOC): ESE,30401 meters

Wed May 25 08:10:41 2022 SYNOPSIS
Page 2

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 60.96
Diameter (m): 1.98

Plume Rise
Momentum (m/s): 9.20
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	1.0000	1.0000	1.0000
Fraction From Assessment Area:	0.0000	0.0000	0.0000
Fraction Imported:	0.0000	0.0000	0.0000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

12961 13706 13785 14197 14257 16358 17943
19345 19375 24086 24407 26453 27009 29513
30401 31613

D O S E A N D R I S K S U M M A R I E S

Non-Radon Individual Assessment
Wed May 25 08:10:41 2022

Facility: REDOX Complex (202S) with Vent. mods
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Stack
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R2
Point source (stack) emissions - Offsite

Dataset Name: 202S_StkOffsite.
Dataset Date: May 25, 2022 08:10 AM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200HMS61.wnd

Wed May 25 08:10:41 2022 SUMMARY
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	4.53E-03
UB_Wall	5.02E-03
Bone_Sur	2.54E+00
Brain	4.53E-03
Breasts	4.57E-03
St_Wall	4.69E-03
SI_Wall	4.84E-03
ULI_Wall	7.77E-03
LLI_Wall	1.76E-02
Kidneys	9.95E-03
Liver	4.84E-01
Muscle	4.56E-03
Ovaries	3.07E-02
Pancreas	4.53E-03
R_Marrow	2.15E-01
Skin	2.17E-01
Spleen	4.54E-03
Testes	3.13E-02
Thymus	4.54E-03
Thyroid	4.55E-03
GB_Wall	4.53E-03
Ht_Wall	4.53E-03
Uterus	4.53E-03
ET_Reg	1.17E-02
Lung_66	3.97E-02
Effectiv	9.19E-02

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	1.86E-02
INHALATION	7.10E-02
AIR IMMERSION	3.31E-09
GROUND SURFACE	2.24E-03
INTERNAL	8.96E-02
EXTERNAL	2.24E-03
TOTAL	9.19E-02

NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-239	7.32E-02
U-235m	0.00E+00
U-235	2.94E-11
Th-231	3.00E-12
Pa-231	2.20E-15
Sr-90	1.65E-02
Y-90	2.20E-03
TOTAL	9.19E-02

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	3.00E-10
INHALATION	5.45E-09
AIR IMMERSION	4.61E-16
GROUND SURFACE	2.68E-10
INTERNAL	5.75E-09
EXTERNAL	2.68E-10
TOTAL	6.02E-09

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-239	5.40E-09
U-235m	0.00E+00
U-235	1.59E-17
Th-231	1.37E-18
Pa-231	1.15E-21
Sr-90	3.55E-10
Y-90	2.62E-10
TOTAL	6.02E-09

Wed May 25 08:10:41 2022 SUMMARY
Page 5

INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

Direction	Distance (m) 12961	13706	13785	14197	14257	16358	17943
N	6.4E-02	6.0E-02	6.0E-02	5.8E-02	5.8E-02	4.9E-02	4.4E-02
NNW	7.5E-02	7.0E-02	6.9E-02	6.7E-02	6.7E-02	5.7E-02	5.1E-02
NW	9.6E-02	9.0E-02	9.0E-02	8.7E-02	8.6E-02	7.3E-02	6.6E-02
WNW	7.7E-02	7.2E-02	7.2E-02	6.9E-02	6.9E-02	5.8E-02	5.2E-02
W	7.3E-02	6.8E-02	6.7E-02	6.5E-02	6.5E-02	5.5E-02	4.9E-02
WSW	6.2E-02	5.8E-02	5.7E-02	5.5E-02	5.5E-02	4.6E-02	4.1E-02
SW	7.2E-02	6.7E-02	6.7E-02	6.4E-02	6.4E-02	5.4E-02	4.8E-02
SSW	8.0E-02	7.5E-02	7.5E-02	7.2E-02	7.2E-02	6.0E-02	5.4E-02
S	9.2E-02	8.6E-02	8.6E-02	8.2E-02	8.2E-02	6.9E-02	6.2E-02
SSE	1.1E-01	1.1E-01	1.1E-01	1.0E-01	1.0E-01	8.7E-02	7.7E-02
SE	1.9E-01	1.8E-01	1.8E-01	1.7E-01	1.7E-01	1.5E-01	1.3E-01
ESE	2.4E-01	2.2E-01	2.2E-01	2.1E-01	2.1E-01	1.8E-01	1.7E-01
E	1.5E-01	1.4E-01	1.4E-01	1.3E-01	1.3E-01	1.1E-01	1.0E-01
ENE	1.1E-01	1.0E-01	1.0E-01	1.0E-01	1.0E-01	8.6E-02	7.8E-02
NE	9.0E-02	8.5E-02	8.4E-02	8.1E-02	8.1E-02	6.9E-02	6.3E-02
NNE	6.3E-02	6.0E-02	5.9E-02	5.7E-02	5.7E-02	4.9E-02	4.4E-02

Direction	Distance (m) 19345	19375	24086	24407	26453	27009	29513
N	4.0E-02	4.0E-02	3.1E-02	3.0E-02	2.8E-02	2.7E-02	2.4E-02
NNW	4.7E-02	4.7E-02	3.6E-02	3.5E-02	3.2E-02	3.1E-02	2.8E-02
NW	6.0E-02	6.0E-02	4.5E-02	4.5E-02	4.0E-02	3.9E-02	3.6E-02
WNW	4.7E-02	4.7E-02	3.6E-02	3.5E-02	3.2E-02	3.1E-02	2.8E-02
W	4.4E-02	4.4E-02	3.3E-02	3.3E-02	3.0E-02	2.9E-02	2.6E-02
WSW	3.7E-02	3.7E-02	2.8E-02	2.8E-02	2.5E-02	2.4E-02	2.2E-02
SW	4.3E-02	4.3E-02	3.2E-02	3.2E-02	2.9E-02	2.8E-02	2.5E-02
SSW	4.9E-02	4.9E-02	3.7E-02	3.6E-02	3.3E-02	3.2E-02	2.8E-02
S	5.6E-02	5.6E-02	4.2E-02	4.2E-02	3.8E-02	3.7E-02	3.3E-02
SSE	7.1E-02	7.0E-02	5.4E-02	5.3E-02	4.8E-02	4.7E-02	4.2E-02
SE	1.2E-01	1.2E-01	9.4E-02	9.3E-02	8.4E-02	8.2E-02	7.5E-02
ESE	1.5E-01	1.5E-01	1.2E-01	1.2E-01	1.1E-01	1.0E-01	9.5E-02
E	9.5E-02	9.4E-02	7.4E-02	7.3E-02	6.7E-02	6.5E-02	5.9E-02
ENE	7.2E-02	7.2E-02	5.7E-02	5.6E-02	5.1E-02	5.0E-02	4.6E-02
NE	5.7E-02	5.7E-02	4.4E-02	4.4E-02	4.0E-02	3.9E-02	3.5E-02
NNE	4.0E-02	4.0E-02	3.1E-02	3.1E-02	2.8E-02	2.7E-02	2.5E-02

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INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	30401	31613
N	2.3E-02	2.2E-02
NNW	2.7E-02	2.6E-02
NW	3.4E-02	3.3E-02
WNW	2.7E-02	2.5E-02
W	2.5E-02	2.4E-02
WSW	2.1E-02	2.0E-02
SW	2.4E-02	2.3E-02
SSW	2.7E-02	2.6E-02
S	3.2E-02	3.0E-02
SSE	4.1E-02	3.9E-02
SE	7.2E-02	6.9E-02
ESE	9.2E-02	8.8E-02
E	5.7E-02	5.5E-02
ENE	4.5E-02	4.3E-02
NE	3.4E-02	3.3E-02
NNE	2.4E-02	2.3E-02

- Underlined numbers are the MEI values at the Hanford Site boundary.
- Shaded number is the maximum value to the offsite MEI at the Hanford Site boundary.

Wed May 25 08:10:41 2022 SUMMARY
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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	12961	13706	13785	14197	14257	16358	17943
N	4.2E-09	3.9E-09	3.9E-09	3.8E-09	3.8E-09	3.2E-09	2.9E-09
NNW	4.9E-09	4.6E-09	4.5E-09	4.4E-09	4.4E-09	3.7E-09	3.3E-09
NW	6.3E-09	5.9E-09	5.9E-09	5.7E-09	5.6E-09	4.8E-09	4.3E-09
WNW	5.0E-09	4.7E-09	4.7E-09	4.5E-09	4.5E-09	3.8E-09	3.4E-09
W	4.7E-09	4.4E-09	4.4E-09	4.2E-09	4.2E-09	3.6E-09	3.2E-09
WSW	4.0E-09	3.8E-09	3.7E-09	3.6E-09	3.6E-09	3.0E-09	2.7E-09
SW	4.7E-09	4.4E-09	4.3E-09	4.2E-09	4.2E-09	3.5E-09	3.1E-09
SSW	5.2E-09	4.9E-09	4.9E-09	4.7E-09	4.7E-09	3.9E-09	3.5E-09
S	6.0E-09	5.6E-09	5.6E-09	5.4E-09	5.3E-09	4.5E-09	4.0E-09
SSE	7.4E-09	7.0E-09	6.9E-09	6.7E-09	6.7E-09	5.6E-09	5.1E-09
SE	1.3E-08	1.2E-08	1.2E-08	1.1E-08	1.1E-08	9.7E-09	8.7E-09
ESE	1.5E-08	1.5E-08	1.4E-08	1.4E-08	1.4E-08	1.2E-08	1.1E-08
E	9.6E-09	9.0E-09	9.0E-09	8.7E-09	8.7E-09	7.5E-09	6.7E-09
ENE	7.2E-09	6.8E-09	6.8E-09	6.6E-09	6.5E-09	5.6E-09	5.1E-09
NE	5.9E-09	5.5E-09	5.5E-09	5.3E-09	5.3E-09	4.5E-09	4.1E-09
NNE	4.1E-09	3.9E-09	3.9E-09	3.7E-09	3.7E-09	3.2E-09	2.9E-09

	Distance (m)						
Direction	19345	19375	24086	24407	26453	27009	29513
N	2.6E-09	2.6E-09	2.0E-09	2.0E-09	1.8E-09	1.8E-09	1.6E-09
NNW	3.1E-09	3.0E-09	2.3E-09	2.3E-09	2.1E-09	2.0E-09	1.8E-09
NW	3.9E-09	3.9E-09	3.0E-09	2.9E-09	2.6E-09	2.6E-09	2.3E-09
WNW	3.1E-09	3.1E-09	2.3E-09	2.3E-09	2.1E-09	2.0E-09	1.8E-09
W	2.9E-09	2.9E-09	2.2E-09	2.1E-09	1.9E-09	1.9E-09	1.7E-09
WSW	2.4E-09	2.4E-09	1.8E-09	1.8E-09	1.6E-09	1.6E-09	1.4E-09
SW	2.8E-09	2.8E-09	2.1E-09	2.1E-09	1.9E-09	1.8E-09	1.6E-09
SSW	3.2E-09	3.2E-09	2.4E-09	2.3E-09	2.1E-09	2.1E-09	1.8E-09
S	3.6E-09	3.6E-09	2.8E-09	2.7E-09	2.4E-09	2.4E-09	2.1E-09
SSE	4.6E-09	4.6E-09	3.5E-09	3.4E-09	3.1E-09	3.0E-09	2.7E-09
SE	7.9E-09	7.9E-09	6.1E-09	6.0E-09	5.5E-09	5.4E-09	4.9E-09
ESE	1.0E-08	9.9E-09	7.8E-09	7.7E-09	7.0E-09	6.8E-09	6.2E-09
E	6.2E-09	6.2E-09	4.8E-09	4.8E-09	4.4E-09	4.3E-09	3.9E-09
ENE	4.7E-09	4.7E-09	3.7E-09	3.6E-09	3.4E-09	3.3E-09	3.0E-09
NE	3.7E-09	3.7E-09	2.9E-09	2.9E-09	2.6E-09	2.5E-09	2.3E-09
NNE	2.6E-09	2.6E-09	2.0E-09	2.0E-09	1.8E-09	1.8E-09	1.6E-09

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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	30401	31613
N	1.5E-09	1.5E-09
NNW	1.8E-09	1.7E-09
NW	2.2E-09	2.1E-09
WNW	1.7E-09	1.7E-09
W	1.6E-09	1.5E-09
WSW	1.4E-09	1.3E-09
SW	1.6E-09	1.5E-09
SSW	1.8E-09	1.7E-09
S	2.1E-09	2.0E-09
SSE	2.6E-09	2.5E-09
SE	4.7E-09	4.5E-09
ESE	6.0E-09	5.8E-09
E	3.7E-09	3.6E-09
ENE	2.9E-09	2.8E-09
NE	2.2E-09	2.1E-09
NNE	1.6E-09	1.5E-09

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Appendix E

CAP88-PC Synopsis and Summary Reports for the 291S001 Stack – Onsite Maximally Exposed Individual

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C A P 8 8 - P C

Version 4.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Wed May 25 07:58:47 2022

Facility: REDOX Complex (202S) with Vent. mods
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Stack
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R2
Point source (stack) emissions - Onsite

Committed Effective Dose Equivalent
(mrem)

2.05E-01

At This Location: 14717 Meters East Southeast

Dataset Name: 202S_StkOnsite.
Dataset Date: May 25, 2022 07:58 AM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200HMS61.wnd

Wed May 25 07:58:47 2022 SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 14717 Meters East Southeast
Lifetime Fatal Cancer Risk: 1.35E-08

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem)
Adrenal	1.01E-02
UB_Wall	1.12E-02
Bone_Sur	5.69E+00
Brain	1.01E-02
Breasts	1.02E-02
St_Wall	1.05E-02
SI_Wall	1.08E-02
ULI_Wall	1.73E-02
LLI_Wall	3.91E-02
Kidneys	2.23E-02
Liver	1.08E+00
Muscle	1.02E-02
Ovaries	6.87E-02
Pancreas	1.01E-02
R_Marrow	4.81E-01
Skin	4.83E-01
Spleen	1.02E-02
Testes	7.00E-02
Thymus	1.02E-02
Thyroid	1.02E-02
GB_Wall	1.01E-02
Ht_Wall	1.01E-02
Uterus	1.01E-02
ET_Reg	2.63E-02
Lung_66	8.89E-02
Effectiv	2.05E-01

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source #1 Ci/y	TOTAL Ci/y
Pu-239	M	1.000	1.4E-01	
Sr-90	M	1.000	4.6E-01	

SITE INFORMATION

Temperature:	12.200 degrees C
Precipitation:	18.130 cm/y
Humidity:	8.000 g/cu m
Mixing Height:	1000.0 m

User specified location of max exposed individual.
(ILOC, JLOC): ESE,14717 meters

Wed May 25 07:58:47 2022 SYNOPSIS
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SOURCE INFORMATION

Source Number: 1

Stack Height (m): 60.96
Diameter (m): 1.98

Plume Rise
Momentum (m/s): 9.20
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	1.0000	1.0000	1.0000
Fraction From Assessment Area:	0.0000	0.0000	0.0000
Fraction Imported:	0.0000	0.0000	0.0000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

14717 22445

D O S E A N D R I S K S U M M A R I E S

Non-Radon Individual Assessment
Wed May 25 07:58:47 2022

Facility: REDOX Complex (202S) with Vent. mods
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Stack
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R2
Point source (stack) emissions - Onsite

Dataset Name: 202S_StkOnsite.
Dataset Date: May 25, 2022 07:58 AM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200HMS61.wnd

Wed May 25 07:58:47 2022 SUMMARY
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ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	1.01E-02
UB_Wall	1.12E-02
Bone_Sur	5.69E+00
Brain	1.01E-02
Breasts	1.02E-02
St_Wall	1.05E-02
SI_Wall	1.08E-02
ULI_Wall	1.73E-02
LLI_Wall	3.91E-02
Kidneys	2.23E-02
Liver	1.08E+00
Muscle	1.02E-02
Ovaries	6.87E-02
Pancreas	1.01E-02
R_Marrow	4.81E-01
Skin	4.83E-01
Spleen	1.02E-02
Testes	7.00E-02
Thymus	1.02E-02
Thyroid	1.02E-02
GB_Wall	1.01E-02
Ht_Wall	1.01E-02
Uterus	1.01E-02
ET_Reg	2.63E-02
Lung_66	8.89E-02
Effectiv	2.05E-01

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	4.14E-02
INHALATION	1.59E-01
AIR IMMERSION	6.87E-09
GROUND SURFACE	4.97E-03
INTERNAL	2.00E-01
EXTERNAL	4.97E-03
TOTAL	2.05E-01

Wed May 25 07:58:47 2022 SUMMARY
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NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-239	1.64E-01
U-235m	0.00E+00
U-235	6.54E-11
Th-231	6.67E-12
Pa-231	4.89E-15
Sr-90	3.67E-02
Y-90	4.89E-03
TOTAL	2.05E-01

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	6.66E-10
INHALATION	1.22E-08
AIR IMMERSION	9.28E-16
GROUND SURFACE	5.96E-10
INTERNAL	1.29E-08
EXTERNAL	5.96E-10
TOTAL	1.35E-08

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-239	1.21E-08
U-235m	0.00E+00
U-235	3.54E-17
Th-231	3.04E-18
Pa-231	2.55E-21
Sr-90	7.89E-10
Y-90	5.82E-10
TOTAL	1.35E-08

Wed May 25 07:58:47 2022 SUMMARY
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INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	14717	22445
N	5.5E-02	3.4E-02
NNW	6.4E-02	3.9E-02
NW	8.3E-02	5.0E-02
WNW	6.6E-02	3.9E-02
W	6.2E-02	3.7E-02
WSW	5.3E-02	3.1E-02
SW	6.1E-02	3.6E-02
SSW	6.9E-02	4.0E-02
S	7.9E-02	4.6E-02
SSE	9.8E-02	5.9E-02
SE	1.7E-01	1.0E-01
ESE	2.1E-01	1.3E-01
E	1.3E-01	8.0E-02
ENE	9.7E-02	6.1E-02
NE	7.8E-02	4.8E-02
NNE	5.5E-02	3.4E-02

- Double underlined number is the MEI value at the LIGO boundary.
- Wavy underlined number is the MEI value at the nearest Energy Northwest boundary.
- Shaded number is the maximum value to the onsite MEI at LIGO or Energy Northwest.

Wed May 25 07:58:47 2022 SUMMARY
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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	14717	22445
N	3.6E-09	2.2E-09
NNW	4.2E-09	2.5E-09
NW	5.4E-09	3.2E-09
WNW	4.3E-09	2.5E-09
W	4.1E-09	2.4E-09
WSW	3.4E-09	2.0E-09
SW	4.0E-09	2.3E-09
SSW	4.5E-09	2.6E-09
S	5.1E-09	3.0E-09
SSE	6.4E-09	3.8E-09
SE	1.1E-08	6.7E-09
ESE	1.3E-08	8.4E-09
E	8.4E-09	5.2E-09
ENE	6.3E-09	4.0E-09
NE	5.1E-09	3.2E-09
NNE	3.6E-09	2.2E-09

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Appendix F

CAP88-PC Synopsis and Summary Reports for Demolitions – Offsite Maximally Exposed Individual

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C A P 8 8 - P C

Version 4.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Thu Sep 24 13:30:58 2020

Facility: REDOX Complex (202S)
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Area
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R1
Diffuse (demolition) emissions - Offsite

Committed Effective Dose Equivalent
(mrem)

6.15E-03

At This Location: 30401 Meters East Southeast

Dataset Name: 202S_DifOffsite.
Dataset Date: Sep 24, 2020 01:30 PM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200W10.wnd

Thu Sep 24 13:30:58 2020 SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 30401 Meters East Southeast
Lifetime Fatal Cancer Risk: 4.02E-10

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem)
Adrenal	3.02E-04
UB_Wall	3.37E-04
Bone_Sur	1.69E-01
Brain	3.02E-04
Breasts	3.05E-04
St_Wall	3.13E-04
SI_Wall	3.23E-04
ULI_Wall	5.30E-04
LLI_Wall	1.23E-03
Kidneys	6.61E-04
Liver	3.17E-02
Muscle	3.04E-04
Ovaries	2.04E-03
Pancreas	3.01E-04
R_Marrow	1.48E-02
Skin	1.55E-02
Spleen	3.02E-04
Testes	2.07E-03
Thymus	3.02E-04
Thyroid	3.03E-04
GB_Wall	3.02E-04
Ht_Wall	3.02E-04
Uterus	3.02E-04
ET_Reg	7.80E-04
Lung_66	2.65E-03
Effectiv	6.15E-03

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source #1 Ci/y	Source #2 Ci/y	Source #3 Ci/y	TOTAL Ci/y
H-3	V	0.000	1.3E-03	0.0E+00	0.0E+00	1.3E-03
C-14	M	1.000	1.1E-04	0.0E+00	0.0E+00	1.1E-04
Sr-90	M	1.000	1.4E-05	1.6E-02	1.4E-05	1.6E-02
Sb-125	M	1.000	7.1E-08	0.0E+00	0.0E+00	7.1E-08
Cs-137	F	1.000	6.9E-07	0.0E+00	0.0E+00	6.9E-07
Eu-154	M	1.000	6.3E-07	0.0E+00	0.0E+00	6.3E-07
Eu-155	M	1.000	1.4E-07	0.0E+00	0.0E+00	1.4E-07
U-234	M	1.000	5.3E-08	0.0E+00	0.0E+00	5.3E-08
U-238	M	1.000	5.1E-08	0.0E+00	0.0E+00	5.1E-08
Pu-238	M	1.000	1.1E-05	0.0E+00	0.0E+00	1.1E-05
Pu-239	M	1.000	1.5E-05	4.0E-03	2.7E-07	4.0E-03
Am-241	M	1.000	3.5E-05	0.0E+00	0.0E+00	3.5E-05
Cm-244	M	1.000	1.9E-06	0.0E+00	0.0E+00	1.9E-06

SITE INFORMATION

Temperature: 12.200 degrees C
Precipitation: 18.130 cm/y
Humidity: 8.000 g/cu m
Mixing Height: 1000.0 m

User specified location of max exposed individual.
(ILOC, JLOC): ESE,30401 meters

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SOURCE INFORMATION

Source Number:	1	2	3
Source Height (m):	0.00	0.00	0.00
Area (sq m):	501.70	97.50	2524.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m):	None	None	None	None	None	None	None

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	1.0000	1.0000	1.0000
Fraction From Assessment Area:	0.0000	0.0000	0.0000
Fraction Imported:	0.0000	0.0000	0.0000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

12961	13706	13785	14197	14257	16358	17943
19345	19375	24086	24407	26453	27009	29513
30401	31613					

D O S E A N D R I S K S U M M A R I E S

Non-Radon Individual Assessment
Thu Sep 24 13:30:58 2020

Facility: REDOX Complex (202S)
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Area
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R1
Diffuse (demolition) emissions - Offsite

Dataset Name: 202S_DifOffsite.
Dataset Date: Sep 24, 2020 01:30 PM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200W10.wnd

Thu Sep 24 13:30:58 2020 SUMMARY
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ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	3.02E-04
UB_Wall	3.37E-04
Bone_Sur	1.69E-01
Brain	3.02E-04
Breasts	3.05E-04
St_Wall	3.13E-04
SI_Wall	3.23E-04
ULI_Wall	5.30E-04
LLI_Wall	1.23E-03
Kidneys	6.61E-04
Liver	3.17E-02
Muscle	3.04E-04
Ovaries	2.04E-03
Pancreas	3.01E-04
R_Marrow	1.48E-02
Skin	1.55E-02
Spleen	3.02E-04
Testes	2.07E-03
Thymus	3.02E-04
Thyroid	3.03E-04
GB_Wall	3.02E-04
Ht_Wall	3.02E-04
Uterus	3.02E-04
ET_Reg	7.80E-04
Lung_66	2.65E-03
Effectiv	6.15E-03

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	1.30E-03
INHALATION	4.69E-03
AIR IMMERSION	3.28E-10
GROUND SURFACE	1.60E-04
INTERNAL	5.99E-03
EXTERNAL	1.60E-04
TOTAL	6.15E-03

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NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
H-3	1.43E-08
C-14	5.41E-08
Sr-90	1.18E-03
Y-90	1.57E-04
Sb-125	5.01E-10
Te-125m	7.19E-12
Cs-137	3.79E-08
Ba-137m	3.43E-08
Eu-154	3.32E-08
Eu-155	2.32E-10
U-234	3.83E-09
Th-230	9.99E-16
Ra-226	6.20E-17
Rn-222	3.45E-18
Po-218	6.13E-23
U-238	3.11E-09
Th-234	5.83E-11
Pa-234m	7.95E-10
Pa-234	1.57E-11
Pu-238	1.16E-05
Pu-239	4.77E-03
U-235m	0.00E+00
U-235	1.72E-12
Th-231	1.75E-13
Pa-231	1.28E-16
Am-241	3.40E-05
Np-237	7.77E-13
Pa-233	6.37E-12
U-233	9.97E-19
Th-229	1.81E-19
Cm-244	1.14E-06
Pu-240	3.23E-13
U-236	8.34E-20
Th-232	0.00E+00
Ra-228	0.00E+00
TOTAL	6.15E-03

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	2.17E-11
INHALATION	3.61E-10
AIR IMMERSION	5.27E-17
GROUND SURFACE	1.92E-11
INTERNAL	3.83E-10
EXTERNAL	1.92E-11
TOTAL	4.02E-10

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NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
H-3	1.30E-14
C-14	2.02E-13
Sr-90	2.58E-11
Y-90	1.87E-11
Sb-125	2.64E-16
Te-125m	2.80E-18
Cs-137	6.31E-16
Ba-137m	1.85E-14
Eu-154	1.81E-14
Eu-155	1.32E-16
U-234	1.31E-15
Th-230	4.05E-22
Ra-226	3.37E-23
Rn-222	1.88E-24
Po-218	2.74E-29
U-238	9.49E-16
Th-234	3.01E-17
Pa-234m	1.39E-16
Pa-234	8.52E-18
Pu-238	9.89E-13
Pu-239	3.53E-10
U-235m	0.00E+00
U-235	9.29E-19
Th-231	7.99E-20
Pa-231	6.69E-23
Am-241	2.56E-12
Np-237	3.81E-19
Pa-233	3.44E-18
U-233	4.11E-25
Th-229	9.60E-26
Cm-244	1.23E-13
Pu-240	7.16E-20
U-236	2.74E-26
Th-232	0.00E+00
Ra-228	0.00E+00
TOTAL	4.02E-10

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INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	12961	13706	13785	14197	14257	16358	17943
N	4.3E-03	4.0E-03	3.9E-03	3.8E-03	3.7E-03	3.1E-03	2.7E-03
NNW	5.0E-03	4.7E-03	4.6E-03	4.5E-03	4.4E-03	3.7E-03	3.2E-03
NW	6.2E-03	5.8E-03	5.7E-03	5.5E-03	5.5E-03	4.5E-03	4.0E-03
WNW	5.1E-03	4.7E-03	4.7E-03	4.5E-03	4.5E-03	3.7E-03	3.3E-03
W	3.9E-03	3.6E-03	3.6E-03	3.4E-03	3.4E-03	2.8E-03	2.4E-03
WSW	3.1E-03	2.9E-03	2.9E-03	2.8E-03	2.8E-03	2.3E-03	2.0E-03
SW	3.6E-03	3.4E-03	3.3E-03	3.2E-03	3.2E-03	2.6E-03	2.3E-03
SSW	4.4E-03	4.1E-03	4.1E-03	3.9E-03	3.9E-03	3.2E-03	2.8E-03
S	6.7E-03	6.2E-03	6.2E-03	5.9E-03	5.9E-03	4.9E-03	4.3E-03
SSE	9.7E-03	9.0E-03	8.9E-03	8.6E-03	8.5E-03	7.1E-03	6.2E-03
SE	1.9E-02	1.8E-02	1.8E-02	1.7E-02	1.7E-02	1.4E-02	1.2E-02
ESE	2.3E-02	2.1E-02	2.1E-02	2.0E-02	2.0E-02	1.7E-02	1.5E-02
E	1.4E-02	1.3E-02	1.3E-02	1.2E-02	1.2E-02	1.0E-02	9.0E-03
ENE	7.6E-03	7.1E-03	7.0E-03	6.8E-03	6.7E-03	5.6E-03	5.0E-03
NE	5.5E-03	5.1E-03	5.1E-03	4.9E-03	4.9E-03	4.1E-03	3.6E-03
NNE	3.9E-03	3.7E-03	3.6E-03	3.5E-03	3.5E-03	2.9E-03	2.5E-03

	Distance (m)						
Direction	19345	19375	24086	24407	26453	27009	29513
N	2.4E-03	2.4E-03	1.6E-03	1.5E-03	1.3E-03	1.2E-03	1.1E-03
NNW	2.9E-03	2.8E-03	1.9E-03	1.8E-03	1.5E-03	1.5E-03	1.3E-03
NW	3.5E-03	3.5E-03	2.4E-03	2.3E-03	1.9E-03	1.9E-03	1.7E-03
WNW	2.9E-03	2.9E-03	2.0E-03	1.9E-03	1.6E-03	1.5E-03	1.4E-03
W	2.2E-03	2.2E-03	1.4E-03	1.4E-03	1.2E-03	1.1E-03	1.0E-03
WSW	1.8E-03	1.8E-03	1.2E-03	1.1E-03	9.3E-04	9.0E-04	8.0E-04
SW	2.0E-03	2.0E-03	1.4E-03	1.3E-03	1.1E-03	1.0E-03	9.2E-04
SSW	2.5E-03	2.5E-03	1.7E-03	1.6E-03	1.3E-03	1.3E-03	1.1E-03
S	3.8E-03	3.8E-03	2.6E-03	2.5E-03	2.0E-03	2.0E-03	1.8E-03
SSE	5.6E-03	5.5E-03	3.7E-03	3.6E-03	3.0E-03	2.9E-03	2.6E-03
SE	1.1E-02	1.1E-02	7.6E-03	7.3E-03	6.0E-03	5.8E-03	5.2E-03
ESE	1.4E-02	1.3E-02	9.3E-03	8.9E-03	7.3E-03	7.1E-03	6.4E-03
E	8.1E-03	8.1E-03	5.5E-03	5.3E-03	4.4E-03	4.3E-03	3.8E-03
ENE	4.5E-03	4.5E-03	3.1E-03	3.0E-03	2.5E-03	2.4E-03	2.2E-03
NE	3.2E-03	3.2E-03	2.2E-03	2.1E-03	1.8E-03	1.8E-03	1.6E-03
NNE	2.3E-03	2.3E-03	1.5E-03	1.5E-03	1.2E-03	1.2E-03	1.1E-03

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INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

Direction	Distance (m) 30401	31613
N	1.1E-03	1.0E-03
NNW	1.2E-03	1.2E-03
NW	1.6E-03	1.5E-03
WNW	1.3E-03	1.2E-03
W	9.7E-04	9.2E-04
WSW	7.7E-04	7.3E-04
SW	8.9E-04	8.4E-04
SSW	1.1E-03	1.0E-03
S	1.7E-03	1.6E-03
SSE	2.5E-03	2.4E-03
SE	5.0E-03	4.8E-03
ESE	6.2E-03	5.9E-03
E	3.7E-03	3.5E-03
ENE	2.1E-03	2.0E-03
NE	1.5E-03	1.5E-03
NNE	1.0E-03	9.9E-04

- Underlined numbers are the MEI values at the Hanford Site boundary.
- Shaded number is the maximum value to the offsite MEI at the Hanford Site boundary.

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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	12961	13706	13785	14197	14257	16358	17943
N	2.8E-10	2.6E-10	2.6E-10	2.5E-10	2.4E-10	2.0E-10	1.8E-10
NNW	3.3E-10	3.0E-10	3.0E-10	2.9E-10	2.9E-10	2.4E-10	2.1E-10
NW	4.0E-10	3.8E-10	3.7E-10	3.6E-10	3.6E-10	2.9E-10	2.6E-10
WNW	3.3E-10	3.1E-10	3.0E-10	2.9E-10	2.9E-10	2.4E-10	2.1E-10
W	2.5E-10	2.3E-10	2.3E-10	2.2E-10	2.2E-10	1.8E-10	1.6E-10
WSW	2.0E-10	1.9E-10	1.9E-10	1.8E-10	1.8E-10	1.5E-10	1.3E-10
SW	2.4E-10	2.2E-10	2.2E-10	2.1E-10	2.1E-10	1.7E-10	1.5E-10
SSW	2.9E-10	2.6E-10	2.6E-10	2.5E-10	2.5E-10	2.1E-10	1.8E-10
S	4.3E-10	4.0E-10	4.0E-10	3.8E-10	3.8E-10	3.2E-10	2.8E-10
SSE	6.3E-10	5.9E-10	5.8E-10	5.6E-10	5.6E-10	4.6E-10	4.0E-10
SE	1.2E-09	1.2E-09	1.1E-09	1.1E-09	1.1E-09	9.2E-10	8.1E-10
ESE	1.5E-09	1.4E-09	1.4E-09	1.3E-09	1.3E-09	1.1E-09	9.8E-10
E	9.0E-10	8.4E-10	8.3E-10	8.0E-10	8.0E-10	6.7E-10	5.9E-10
ENE	5.0E-10	4.6E-10	4.6E-10	4.4E-10	4.4E-10	3.7E-10	3.2E-10
NE	3.6E-10	3.3E-10	3.3E-10	3.2E-10	3.2E-10	2.6E-10	2.3E-10
NNE	2.6E-10	2.4E-10	2.4E-10	2.3E-10	2.3E-10	1.9E-10	1.7E-10

	Distance (m)						
Direction	19345	19375	24086	24407	26453	27009	29513
N	1.6E-10	1.6E-10	1.0E-10	1.0E-10	8.3E-11	8.1E-11	7.2E-11
NNW	1.9E-10	1.9E-10	1.2E-10	1.2E-10	9.8E-11	9.5E-11	8.4E-11
NW	2.3E-10	2.3E-10	1.5E-10	1.5E-10	1.2E-10	1.2E-10	1.1E-10
WNW	1.9E-10	1.9E-10	1.3E-10	1.2E-10	1.0E-10	9.9E-11	8.8E-11
W	1.4E-10	1.4E-10	9.3E-11	9.0E-11	7.5E-11	7.3E-11	6.5E-11
WSW	1.1E-10	1.1E-10	7.5E-11	7.2E-11	6.0E-11	5.8E-11	5.1E-11
SW	1.3E-10	1.3E-10	8.7E-11	8.4E-11	6.9E-11	6.7E-11	5.9E-11
SSW	1.6E-10	1.6E-10	1.1E-10	1.0E-10	8.4E-11	8.2E-11	7.2E-11
S	2.5E-10	2.5E-10	1.7E-10	1.6E-10	1.3E-10	1.3E-10	1.1E-10
SSE	3.6E-10	3.6E-10	2.4E-10	2.3E-10	1.9E-10	1.9E-10	1.7E-10
SE	7.3E-10	7.2E-10	4.9E-10	4.8E-10	3.9E-10	3.8E-10	3.4E-10
ESE	8.8E-10	8.8E-10	6.1E-10	5.8E-10	4.8E-10	4.7E-10	4.2E-10
E	5.3E-10	5.3E-10	3.6E-10	3.5E-10	2.9E-10	2.8E-10	2.5E-10
ENE	2.9E-10	2.9E-10	2.0E-10	1.9E-10	1.6E-10	1.6E-10	1.4E-10
NE	2.1E-10	2.1E-10	1.4E-10	1.4E-10	1.2E-10	1.2E-10	1.0E-10
NNE	1.5E-10	1.5E-10	1.0E-10	9.6E-11	8.1E-11	7.9E-11	7.0E-11

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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	30401	31613
N	6.9E-11	6.6E-11
NNW	8.1E-11	7.7E-11
NW	1.0E-10	9.7E-11
WNW	8.5E-11	8.0E-11
W	6.2E-11	5.9E-11
WSW	4.9E-11	4.7E-11
SW	5.7E-11	5.4E-11
SSW	7.0E-11	6.6E-11
S	1.1E-10	1.0E-10
SSE	1.6E-10	1.5E-10
SE	3.3E-10	3.1E-10
ESE	4.0E-10	3.8E-10
E	2.4E-10	2.3E-10
ENE	1.4E-10	1.3E-10
NE	9.9E-11	9.4E-11
NNE	6.8E-11	6.4E-11

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Appendix G

CAP88-PC Synopsis and Summary Reports for Demolitions – Onsite Maximally Exposed Individual

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C A P 8 8 - P C

Version 4.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Thu Sep 24 13:15:13 2020

Facility: REDOX Complex (202S)
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Area
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R1
Diffuse (demolition) emissions - Onsite

Committed Effective Dose Equivalent
(mrem)

1.95E-02

At This Location: 14717 Meters East Southeast

Dataset Name: 202S_DifOnsite.
Dataset Date: Sep 24, 2020 01:15 PM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200W10.wnd

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MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 14717 Meters East Southeast
Lifetime Fatal Cancer Risk: 1.28E-09

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem)
Adrenal	9.57E-04
UB_Wall	1.07E-03
Bone_Sur	5.37E-01
Brain	9.58E-04
Breasts	9.67E-04
St_Wall	9.92E-04
SI_Wall	1.02E-03
ULI_Wall	1.67E-03
LLI_Wall	3.85E-03
Kidneys	2.10E-03
Liver	1.01E-01
Muscle	9.65E-04
Ovaries	6.47E-03
Pancreas	9.56E-04
R_Marrow	4.66E-02
Skin	4.84E-02
Spleen	9.59E-04
Testes	6.59E-03
Thymus	9.59E-04
Thyroid	9.62E-04
GB_Wall	9.57E-04
Ht_Wall	9.58E-04
Uterus	9.57E-04
ET_Reg	2.48E-03
Lung_66	8.42E-03
Effectiv	1.95E-02

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source #1 Ci/y	Source #2 Ci/y	Source #3 Ci/y	TOTAL Ci/y
H-3	V	0.000	1.3E-03	0.0E+00	0.0E+00	1.3E-03
C-14	M	1.000	1.1E-04	0.0E+00	0.0E+00	1.1E-04
Sr-90	M	1.000	1.4E-05	1.6E-02	1.4E-05	1.6E-02
Sb-125	M	1.000	7.1E-08	0.0E+00	0.0E+00	7.1E-08
Cs-137	F	1.000	6.9E-07	0.0E+00	0.0E+00	6.9E-07
Eu-154	M	1.000	6.3E-07	0.0E+00	0.0E+00	6.3E-07
Eu-155	M	1.000	1.4E-07	0.0E+00	0.0E+00	1.4E-07
U-234	M	1.000	5.3E-08	0.0E+00	0.0E+00	5.3E-08
U-238	M	1.000	5.1E-08	0.0E+00	0.0E+00	5.1E-08
Pu-238	M	1.000	1.1E-05	0.0E+00	0.0E+00	1.1E-05
Pu-239	M	1.000	1.5E-05	4.0E-03	2.7E-07	4.0E-03
Am-241	M	1.000	3.5E-05	0.0E+00	0.0E+00	3.5E-05
Cm-244	M	1.000	1.9E-06	0.0E+00	0.0E+00	1.9E-06

SITE INFORMATION

Temperature:	12.200 degrees C
Precipitation:	18.130 cm/y
Humidity:	8.000 g/cu m
Mixing Height:	1000.0 m

User specified location of max exposed individual.
(ILOC, JLOC): ESE,14717 meters

Thu Sep 24 13:15:13 2020 SYNOPSIS
Page 2

SOURCE INFORMATION

Source Number:	1	2	3
Source Height (m):	0.00	0.00	0.00
Area (sq m):	501.70	97.50	2524.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m):	None	None	None	None	None	None	None

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	1.0000	1.0000	1.0000
Fraction From Assessment Area:	0.0000	0.0000	0.0000
Fraction Imported:	0.0000	0.0000	0.0000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

14717 22445

D O S E A N D R I S K S U M M A R I E S

Non-Radon Individual Assessment
Thu Sep 24 13:15:13 2020

Facility: REDOX Complex (202S)
Address: Hanford Site
City: Richland
State: WA Zip: 99352

Source Category:
Source Type: Area
Emission Year: 2020
DOSE Age Group: Adult

Comments: Removal action under DOE/RL-2017-06 R1
Diffuse (demolition) emissions - Onsite

Dataset Name: 202S_DifOnsite.
Dataset Date: Sep 24, 2020 01:15 PM
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200W10.wnd

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ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	9.57E-04
UB_Wall	1.07E-03
Bone_Sur	5.37E-01
Brain	9.58E-04
Breasts	9.67E-04
St_Wall	9.92E-04
SI_Wall	1.02E-03
ULI_Wall	1.67E-03
LLI_Wall	3.85E-03
Kidneys	2.10E-03
Liver	1.01E-01
Muscle	9.65E-04
Ovaries	6.47E-03
Pancreas	9.56E-04
R_Marrow	4.66E-02
Skin	4.84E-02
Spleen	9.59E-04
Testes	6.59E-03
Thymus	9.59E-04
Thyroid	9.62E-04
GB_Wall	9.57E-04
Ht_Wall	9.58E-04
Uterus	9.57E-04
ET_Reg	2.48E-03
Lung_66	8.42E-03
Effectiv	1.95E-02

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	4.06E-03
INHALATION	1.49E-02
AIR IMMERSION	9.02E-10
GROUND SURFACE	4.99E-04
INTERNAL	1.90E-02
EXTERNAL	4.99E-04
TOTAL	1.95E-02

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NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
H-3	3.23E-08
C-14	1.72E-07
Sr-90	3.69E-03
Y-90	4.91E-04
Sb-125	1.57E-09
Te-125m	2.25E-11
Cs-137	1.18E-07
Ba-137m	1.07E-07
Eu-154	1.04E-07
Eu-155	7.27E-10
U-234	1.22E-08
Th-230	2.99E-15
Ra-226	1.94E-16
Rn-222	1.08E-17
Po-218	1.92E-22
U-238	9.86E-09
Th-234	1.82E-10
Pa-234m	2.49E-09
Pa-234	4.90E-11
Pu-238	3.67E-05
Pu-239	1.52E-02
U-235m	0.00E+00
U-235	5.36E-12
Th-231	5.47E-13
Pa-231	4.01E-16
Am-241	1.08E-04
Np-237	2.42E-12
Pa-233	1.99E-11
U-233	3.12E-18
Th-229	5.67E-19
Cm-244	3.63E-06
Pu-240	8.19E-13
U-236	2.61E-19
Th-232	1.44E-28
Ra-228	6.31E-29
TOTAL	1.95E-02

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CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	6.78E-11
INHALATION	1.15E-09
AIR IMMERSION	1.41E-16
GROUND SURFACE	6.01E-11
INTERNAL	1.22E-09
EXTERNAL	6.01E-11
TOTAL	1.28E-09

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NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
H-3	2.93E-14
C-14	6.42E-13
Sr-90	8.08E-11
Y-90	5.84E-11
Sb-125	8.27E-16
Te-125m	8.73E-18
Cs-137	1.97E-15
Ba-137m	5.80E-14
Eu-154	5.66E-14
Eu-155	4.14E-16
U-234	4.15E-15
Th-230	1.24E-21
Ra-226	1.05E-22
Rn-222	5.89E-24
Po-218	8.56E-29
U-238	3.02E-15
Th-234	9.42E-17
Pa-234m	4.35E-16
Pa-234	2.66E-17
Pu-238	3.14E-12
Pu-239	1.12E-09
U-235m	0.00E+00
U-235	2.90E-18
Th-231	2.50E-19
Pa-231	2.09E-22
Am-241	8.15E-12
Np-237	1.19E-18
Pa-233	1.08E-17
U-233	1.28E-24
Th-229	3.00E-25
Cm-244	3.90E-13
Pu-240	2.09E-19
U-236	8.55E-26
Th-232	5.63E-35
Ra-228	1.92E-35
TOTAL	1.28E-09

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INDIVIDUAL COMMITTED EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	14717	22445
N	3.6E-03	1.9E-03
NNW	4.2E-03	2.2E-03
NW	5.2E-03	2.8E-03
WNW	4.3E-03	2.3E-03
W	3.2E-03	1.7E-03
WSW	2.6E-03	1.4E-03
SW	3.1E-03	1.6E-03
SSW	3.7E-03	1.9E-03
S	5.6E-03	3.0E-03
SSE	8.2E-03	4.3E-03
SE	1.6E-02	8.8E-03
ESE	1.9E-02	1.1E-02
E	1.2E-02	6.4E-03
ENE	6.5E-03	3.5E-03
NE	4.7E-03	2.5E-03
NNE	3.3E-03	1.8E-03

- Double underlined number is the MEI value at the LIGO boundary.
- Wavy underlined number is the MEI value at the nearest Energy Northwest boundary.
- Shaded number is the maximum value to the onsite MEI at LIGO or Energy Northwest.

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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)	
Direction	14717	22445
N	2.3E-10	1.2E-10
NNW	2.8E-10	1.4E-10
NW	3.4E-10	1.8E-10
WNW	2.8E-10	1.5E-10
W	2.1E-10	1.1E-10
WSW	1.7E-10	8.8E-11
SW	2.0E-10	1.0E-10
SSW	2.4E-10	1.3E-10
S	3.7E-10	1.9E-10
SSE	5.3E-10	2.8E-10
SE	1.1E-09	5.7E-10
ESE	1.3E-09	7.0E-10
E	7.7E-10	4.2E-10
ENE	4.2E-10	2.3E-10
NE	3.0E-10	1.7E-10
NNE	2.2E-10	1.2E-10

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Appendix H

CAP88-PC Software Installation and Checkout Form

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CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM

Software Owner Instructions:
Complete Fields 1-13, then run test cases in Field 14. Compare test case results listed in Field 15 to corresponding Test Report outputs. If results are the same, sign and date Field 19. If not, resolve differences and repeat above steps.

Software Subject Matter Expert Instructions:
Assign test personnel. Approve the installation of the code by signing and dating Field 21, then maintain form as part of the software support documentation.

GENERAL INFORMATION:

1. Software Name: CAP88-PC Software Version No.: 4

EXECUTABLE INFORMATION:

2. Executable Name (include path):

   C:\Program Files (x86)\CAP88\CAP88-PC 4\Cap88PC.exe

3. Executable Size (bytes): 895 KB

COMPILATION INFORMATION:

4. Hardware System (i.e., property number or ID):

   Computer Property Number: WF44831

5. Operating System (include version number):

   Windows 10 Enterprise

INSTALLATION AND CHECKOUT INFORMATION:

6. Hardware System (i.e., property number or ID):

   Computer Property Number: WF44831

7. Operating System (include version number):

   Windows 10 Enterprise

8. Open Problem Report? (●) No ( ) Yes PR/CR No.

TEST CASE INFORMATION:

9. Directory/Path:

   C:\Program Files (x86)\CAP88\CAP88-PC 4\Cap88PC

10. Procedure(s):

    Per SMP, CHPRC-03392 Rev 0, Clean Air Act Assessment - 1988

11. Libraries:

    C:\Users\h0110065\Documents\CAP88\Population Files

12. Input Files:

    C:\Users\h0110065\Documents\CAP88\Datasets

13. Output Files:

    C:\Users\h0110065\Documents\CAP88\Datasets

14. Test Cases:

    Same seven cases as those ran in SMP (CHPRC-03392) and provided with CAP88

15. Test Case Results:

    Pass. All seven cases had exact same results as those in SMP and provided with CAP88

16. Test Performed By: Tom Rodovsky

17. Test Results: (●) Satisfactory, Accepted for Use ( ) Unsatisfactory

18. Disposition (include HISI update):

    Accepted; Installation added to Hanford user list.

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1

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM (continued)

1. Software Name: CAP88-PC Software Version No.: 4

Prepared By:

19. Borlaug, William A (Digitally signed by Borlaug, William A Date: 2022.04.18 12:57:02 -07'00')	Bill Borlaug	
Software Owner (Signature)	Print	Date

20. Test Personnel:

	Tom Rodovsky	4/15/22
Sign	Print	Date
Sign	Print	Date
Sign	Print	Date

Approved By:

21.	N/R per SMP	
Software SME (Signature)	Print	Date