

# Radiological and Toxic Air Emissions for the Plutonium Uranium Extraction (PUREX) Complex

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

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-08RL14788

**CH2MHILL**  
Plateau Remediation Company

**P.O. Box 1600  
Richland, Washington 99352**

# Radiological and Toxic Air Emissions for the Plutonium Uranium Extraction (PUREX) Complex

Document Type: ECF

Program/Project: CPRM

Date Published  
January 2021

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

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-08RL14788

**CH2MHILL**  
Plateau Remediation Company  
P.O. Box 1600  
Richland, Washington 99352

**APPROVED**

*By Sarah Harrison at 12:16 pm, Feb 02, 2021*

---

Release Approval

Date

**TRADEMARK DISCLAIMER**

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

## ENVIRONMENTAL CALCULATION COVER PAGE

**SECTION 1 - Completed by the Responsible Manager**

Project: KBO&PR	<b>RELEASE / ISSUE</b>
Date: 10/20/2020	<div style="border: 2px solid red; padding: 5px; display: inline-block;"> <p style="color: red; margin: 0;"><b>DATE:</b> <b>Feb 02, 2021</b></p>  </div>
Calculation Title and Description: Radiological and Toxic Air Emissions for the Plutonium Uranium Extraction (PUREX) Complex	

**Qualifications Summary**
**Preparer(s):**

Name: Carolyn Ervin

Degree, Major, Institution, Year: M.S., Materials Science &amp; Engineering, Wa. State Univ., 1992

Professional Licenses: None

**Brief Narrative of Experience:** 28 years as an engineer for a wide variety of activities involving environmental cleanup, mechanical systems, and materials engineering.

**Checker(s):**

Name: Mitch Marrott

Degree, Major, Institution, Year: B.S., Environmental Science, Washington State University, 2003

Professional Licenses: None

**Brief Narrative of Experience:** 23 years of environmental remediation, environmental protection, nuclear operations and waste management experience at Pacific Northwest Laboratory, Hanford Nuclear Reservation, Idaho National Laboratory and private industry.

**Senior Reviewer(s):**

Name: Frank Carleo

Degree, Major, Institution, Year: B.S., Environmental Science, Washington State University, 2015

Professional Licenses: None

**Brief Narrative of Experience:** 11 years of experience in the radiological and environmental field developing, implementing, and reviewing environmental calculations and associated documentation needed to permit and ensure compliance for clean-up activities at the Hanford Site. He is the CH2M Hill Plateau Remediation Company authority in all matters related to the Clean Air Act as a Subject Matter Expert (SME).

**SECTION 2 - Completed by Preparer**

Calculation Number: ECF-HANFORD-20-0003

Revision Number: 0

### Revision History

Revision No.	Description	Date	Affected Pages
0	Initial release	10/20/2020	All

**ENVIRONMENTAL CALCULATION COVER PAGE (Continued)**

**SECTION 3 - Completed by the Responsible Manager**

**Document Control:**

Is the document intended to be controlled within the Document Management Control System (DMCS)?  Yes  No  
 Does document contain scientific and technical information intended for public use?  Yes  No  
 Does document contain controlled-use information?  Yes  No

**SECTION 4 - Document Review and Approval**

**Preparer(s):**

Carolyn Ervin Senior Env. Engineer Carolyn Ervin 10/20/2020  
 Print First and Last Name Position Signature Date

**Checker(s):**

Mitch Marrott CHPRC AIR SME MITCHELL MARROTT Digitally signed by MITCHELL MARROTT (Affiliate)  
 Print First and Last Name Position (Affiliate) Signature Date: 2020.10.20 14:15:09 -07'00'  
 Print First and Last Name Position Signature Date

**Senior Reviewer(s):**

Frank Carleo Digitally signed by FRANK CARLEO (Affiliate)  
 Print First and Last Name Position Signature Date: 2020.10.20 14:55:24 -07'00'  
 Print First and Last Name Position Signature Date

**Responsible Manager(s):**

Deborah Singleton DEBORAH SINGLETON Digitally signed by DEBORAH SINGLETON (Affiliate)  
 Print First and Last Name Position (Affiliate) Signature Date: 2020.10.22 05:55:12 -07'00'  
 Print First and Last Name Position Signature Date

**SECTION 5 - Applicable if Calculation is a Risk Assessment or Uses an Environmental Model**

**Prior to Initiating Modeling:**

Required training for modelers completed:

Integration Lead:

N/A  
 Print First and Last Name Signature Date

Safety Software Approved:

Integration Lead:

N/A  
 Print First and Last Name Signature Date

**Calculation Approved:**

Risk/Modeling Integration Manager:

N/A  
 Print First and Last Name Signature Date

## Contents

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
<b>2</b>	<b>Background.....</b>	<b>3</b>
	2.1 202A Building.....	3
	2.1.1 202A Canyon.....	3
	2.1.2 202A Annexes.....	9
	2.2 Plutonium Uranium Extraction Complex Surveillance and Maintenance Structures.....	9
	2.3 Plutonium Uranium Extraction Ventilation System.....	13
<b>3</b>	<b>Radiological Air Emissions.....</b>	<b>13</b>
	3.1 Assumptions and Inputs.....	16
	3.1.1 Assumptions.....	16
	3.1.2 Inputs.....	16
	3.2 Methodology.....	18
	3.2.1 Annual Possession Quantity.....	19
	3.2.2 Potential-to-Emit.....	19
	3.2.3 Total Effective Dose Equivalent to the Maximally Exposed Individual.....	19
	3.3 Software Applications.....	21
	3.4 Calculations.....	21
	3.5 Radiological Air Emission Results.....	21
	3.5.1 Total Effective Dose Equivalent to the Maximally Exposed Individual Summation.....	21
	3.5.2 Point Source Emissions Evaluation.....	23
<b>4</b>	<b>Criteria/Toxic Air Determination.....</b>	<b>24</b>
<b>5</b>	<b>References.....</b>	<b>26</b>

## Appendices

A	Hanford Site Wind Files.....	A-i
B	Map Showing Distance to the Maximally Exposed Individual from the Plutonium Uranium Extraction Complex.....	B-i
C	CAP88-PC Synopsis and Summary Reports for the 291A001 Stack – Offsite Maximally Exposed Individual.....	C-i
D	CAP88-PC Synopsis and Summary Reports for the 291A001 Stack – Onsite Maximally Exposed Individual.....	D-i
E	CAP88-PC Synopsis and Summary Reports for the 202A Annexes – Offsite Maximally Exposed Individual.....	E-i

F	CAP88-PC Synopsis and Summary Reports for the 202A Annexes – Onsite Maximally Exposed Individual.....	F-i
G	CAP88-PC Inputs for the 202A Building Exhauster .....	G-i
H	CAP88-PC Synopsis and Summary Reports for the 202A Building Exhauster – Offsite Maximally Exposed Individual .....	H-i
I	CAP88-PC Synopsis and Summary Reports for the 202A Building Exhauster – Onsite Maximally Exposed Individual .....	I-i

**Figures**

Figure 1.	PUREX Complex Structures .....	2
Figure 2.	202A Building Cross Section South to North (Facing West) .....	4
Figure 3.	202A Building Plan View – Storage Gallery Level.....	5
Figure 4.	202A Building Plan View – Sample Gallery Level.....	6
Figure 5.	202A Building Plan View – Pipe and Operating Gallery Level.....	7
Figure 6.	202A Building Plan View – Crane Cab Gallery Level.....	8
Figure 7.	PUREX Complex Structures for Surveillance and Maintenance.....	12
Figure 8.	PUREX Facility Air Flow Diagram.....	14
Figure 9.	Near-Facility Air Monitoring Stations for the PUREX Complex.....	15

**Tables**

Table 1.	PUREX Complex Structures for Surveillance and Maintenance.....	10
Table 2.	202A Building Inventory, Decayed to January 2018.....	16
Table 3.	202A East and West Annexes – Calculate Area.....	17
Table 4.	202A East and West Annexes – Calculate Footprint.....	18
Table 5.	PTE Calculations for PUREX Complex (Point Source – 291A001 Stack).....	22
Table 6.	PTE Calculation for PUREX Complex (Diffuse and Fugitive).....	22
Table 7.	Total Effective Dose Equivalent to the Maximally Exposed Individual .....	23
Table 8.	Chemical Contaminants of Concern .....	24
Table 9.	De Minimis Emission Values for PUREX Complex Chemicals .....	25

## Terms

AMU	aqueous makeup unit
APQ	annual possession quantity
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
ECF	environmental calculation file
EPA	U.S. Environmental Protection Agency
LIGO	Laser Interferometer Gravitational-Wave Observatory
MEI	maximally exposed individual
NESHAP	“National Emission Standards for Hazardous Air Pollutants” (40 CFR 61)
PTE	potential-to-emit
PUREX	Plutonium Uranium Extraction
RAWP	removal action work plan
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
S&M	surveillance and maintenance
TEDE	total effective dose equivalent
WDOH	Washington State Department of Health

This page intentionally left blank.

## 1 Introduction

This environmental calculation file (ECF) provides air emission estimates to support a non-time-critical removal action at the Plutonium Uranium Extraction (PUREX) Complex located in the 200 East 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/toxic air emissions resulting from this removal action and was written to the calculation procedure PRC-PRO-EP-40205, “CHPRC Environmental Calculation Preparation and Issue.”

This ECF supports the current removal action scope as defined in DOE/RL-2020-04, *Removal Action Work Plan for the PUREX Complex* (hereinafter called the PUREX Removal Action Work Plan [RAWP]). The removal activities outlined in the PUREX RAWP implement DOE/RL-2016-53, *Action Memorandum for the PUREX Complex*. Additional removal actions deemed necessary to protect human health and the environment may be identified in the future. This ECF also supports future removal activities as they are bounded within the scope of this calculation.

The PUREX Complex structures addressed in this removal action are the 202A Building, which is made up of the canyon building and attached annexes: 202A Canyon, 202A East Annex, and 202A West Annex (Figure 1). This removal action also addresses waste management from closure of the *Resource Conservation and Recovery Act of 1976* (RCRA) tank TK-156, located in the 202A West Annex. The closest operational facility is the 241-AW Tank Farm and associated support structures. These structures are not included in the scope of this removal action.

The current removal action for the PUREX Complex, as described in the PUREX RAWP (DOE/RL-2020-04), includes the following activities:

- Continued surveillance and maintenance (S&M) of the PUREX Complex
- Hazard abatement<sup>1</sup> of the 202A Canyon (Sample and Storage Galleries)
- Demolition preparation<sup>2</sup> of the 202A East Annex, 202A West Annex, and abovegrade areas of the 202A Canyon (Canyon Deck, Crane Cab Gallery, and Pipe and Operating Gallery)
- Demolition of the 202A East and West Annexes (including removal and disposal of tank TK-156)

Accessing the canyon process cells is not included in the scope of this removal action; however, the potential exists for these areas to be disturbed in future removal actions. The removal action also includes characterization of remaining hazardous substances to facilitate demolition and waste disposal, determine worker controls, and to document post-removal conditions for a future remedial action. Characterization activities will be performed in accordance with DOE/RL-2020-05, *Sampling and Analysis Plan for the PUREX Complex*. These activities have the potential to result in radiological and/or chemical emissions.

---

<sup>1</sup> Hazard abatement is proactive hazard mitigation by decontamination, stabilization (e.g., applying fixatives), or equipment removal.

<sup>2</sup> Demolition preparation, preceded by hazard abatement, is a more aggressive removal of hazards and equipment.



Figure 1. PUREX Complex Structures

## 2 Background

This chapter provides brief descriptions and past deactivation activities for the structures associated with the removal action at the PUREX Complex. Removal activities, as currently defined in the PUREX RAWP (DOE/RL-2020-04), for each structure are also described. Other PUREX Complex structures included in the S&M scope are identified. The PUREX ventilation system is also discussed as it may be modified to support the removal activities. Additional information on these structures can be found in the PUREX RAWP.

### 2.1 202A Building

The 202A Canyon Building (PUREX) was constructed between 1952 and 1956 and began operations in 1956. PUREX operated for the recovery of plutonium, uranium, and neptunium from irradiated fuel elements received from the reactors on the Hanford Site. Plant operations ceased in 1972 with transition to wet standby mode until 1978, with process and support equipment operating on a regular basis and failed equipment either upgraded or replaced. From 1978 to 1983, the plant progressed from wet standby, through cold startup tests, and then to full operations. PUREX was in full operation for the second time until 1988 when it was shut down again. Plant operations transitioned to cold standby from 1990 to 1992. In 1992, planning was initiated to change the status of PUREX from cold standby to deactivation.

Deactivation activities included the flushing of vessel system loops and tanks. All flushed vessels were emptied to a minimum heel, and associated piping was drained. Flushing continued until screening samples of the rinsate in the vessel heels no longer exhibited dangerous waste characteristics for the predominant criteria constituents (e.g., pH, cadmium, and chromium). Other deactivation activities in support of entering long-term S&M included removing bulk and easily removable materials (e.g., chemicals, batteries, pump oils, combustibles, and excess tools and equipment), shutting off utilities to the building, consolidating ventilation systems, and removing the need for the building to be occupied. Deactivation was completed in 1998, at which point the PUREX Complex was transferred to long-term S&M.

Figure 2 provides a cross-sectional view of the 202A Building along the south-north building axes.

#### 2.1.1 202A Canyon

The 202A Canyon is a large, multistory, concrete structure with reinforced concrete walls. The building is 306 m (1,005 ft) long, 9.30 m (30.5 ft) wide, and 32 m (104 ft) high, with about 12 m (40 ft) of this height belowgrade. The building is supported on a 1.68 m (5.5 ft) thick concrete slab with reinforcement in the top half. The roof is concrete, with no internal supporting trusses. A metal roof was installed over the top of the concrete roof in 2002. There are transverse expansion joints throughout the length of the building.

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, Pipe and Operating Gallery, and the 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 2). Belowgrade areas include the Sample Gallery and the Storage Gallery. The process cells, Hot Pipe Trench, and Air Tunnel (Figure 2) are not included in the removal action scope. Figure 3 through Figure 6 are detailed cross sections at each gallery level with current radiological and beryllium postings.

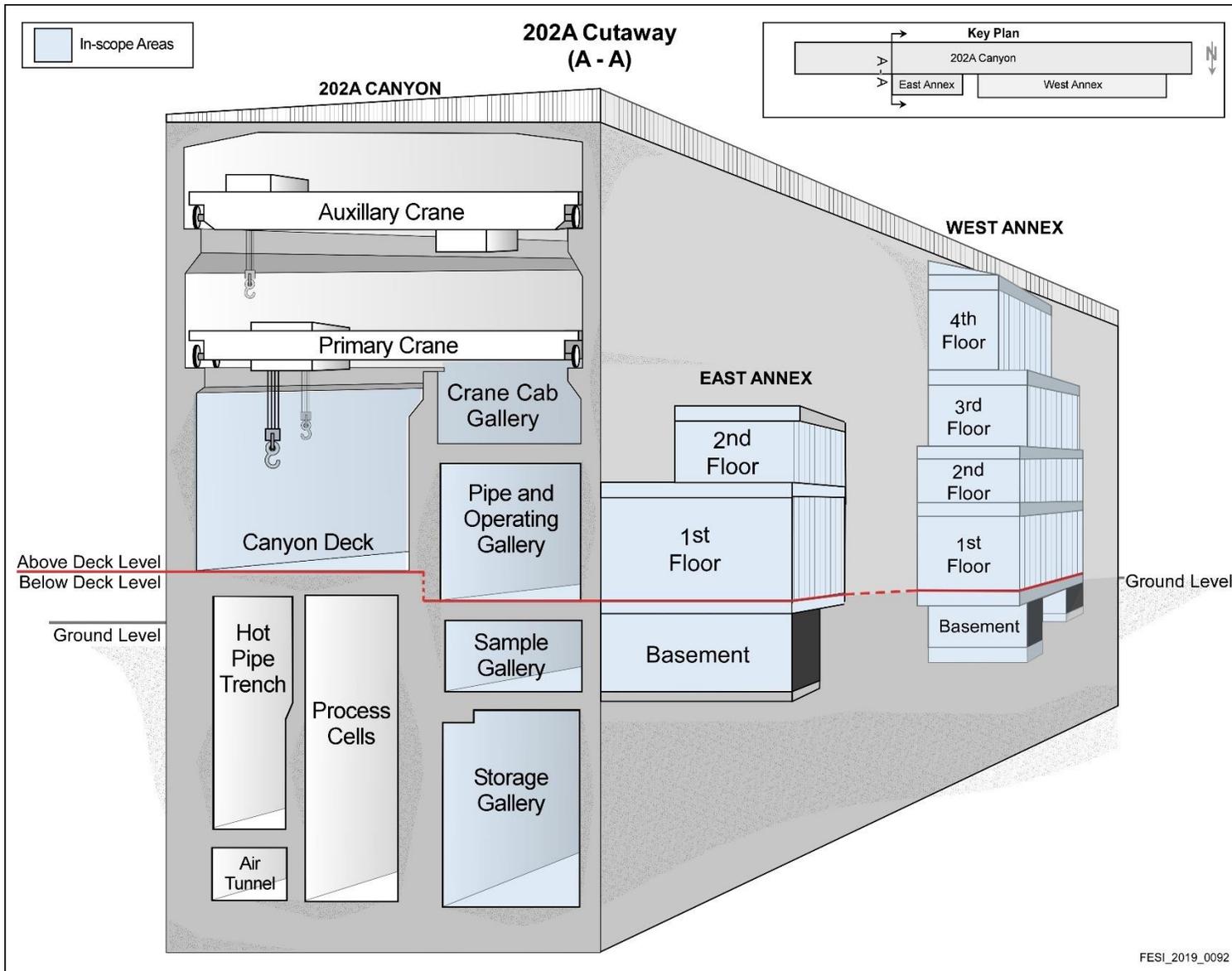


Figure 2. 202A Building Cross Section South to North (Facing West)

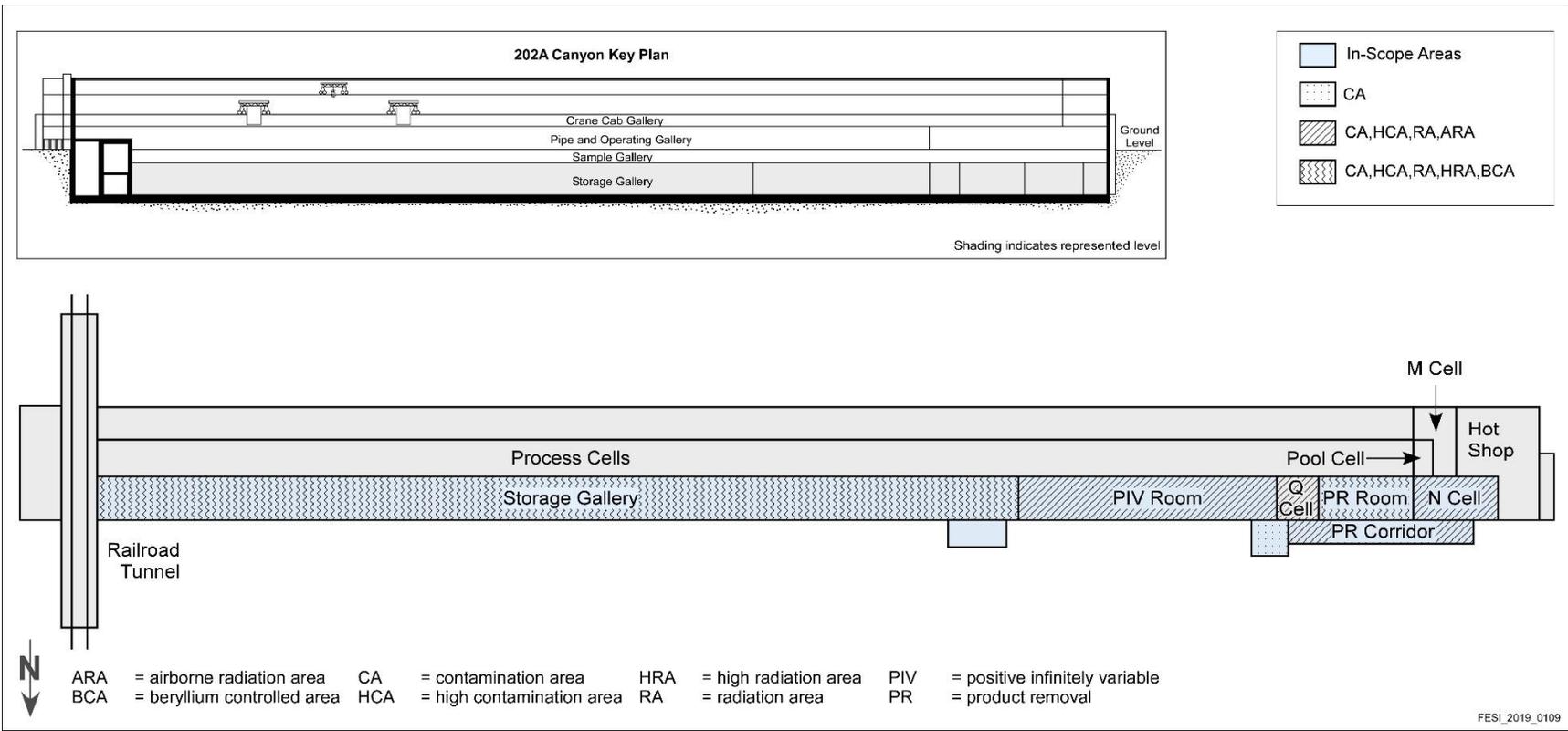


Figure 3. 202A Building Plan View – Storage Gallery Level

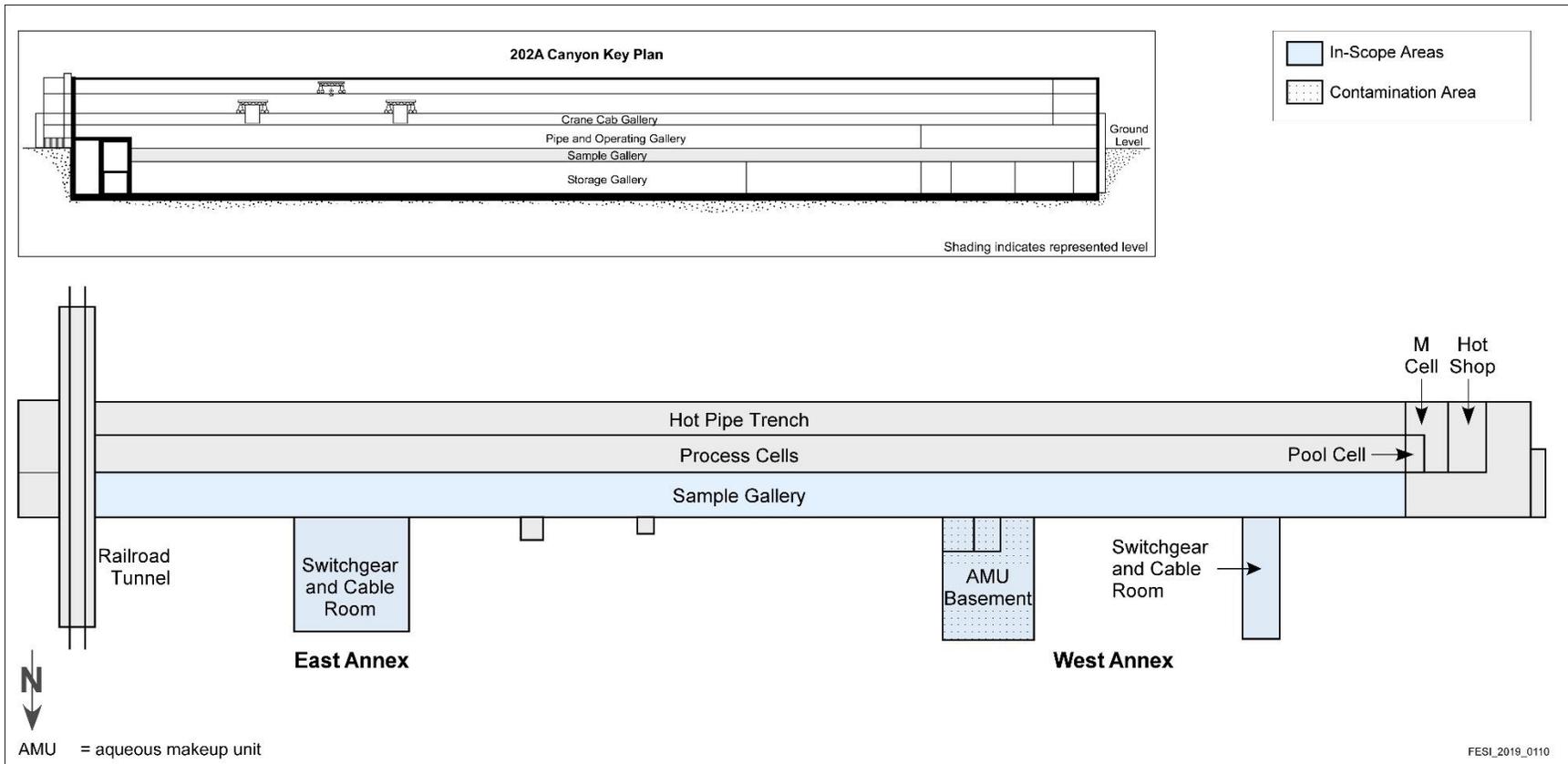


Figure 4. 202A Building Plan View – Sample Gallery Level

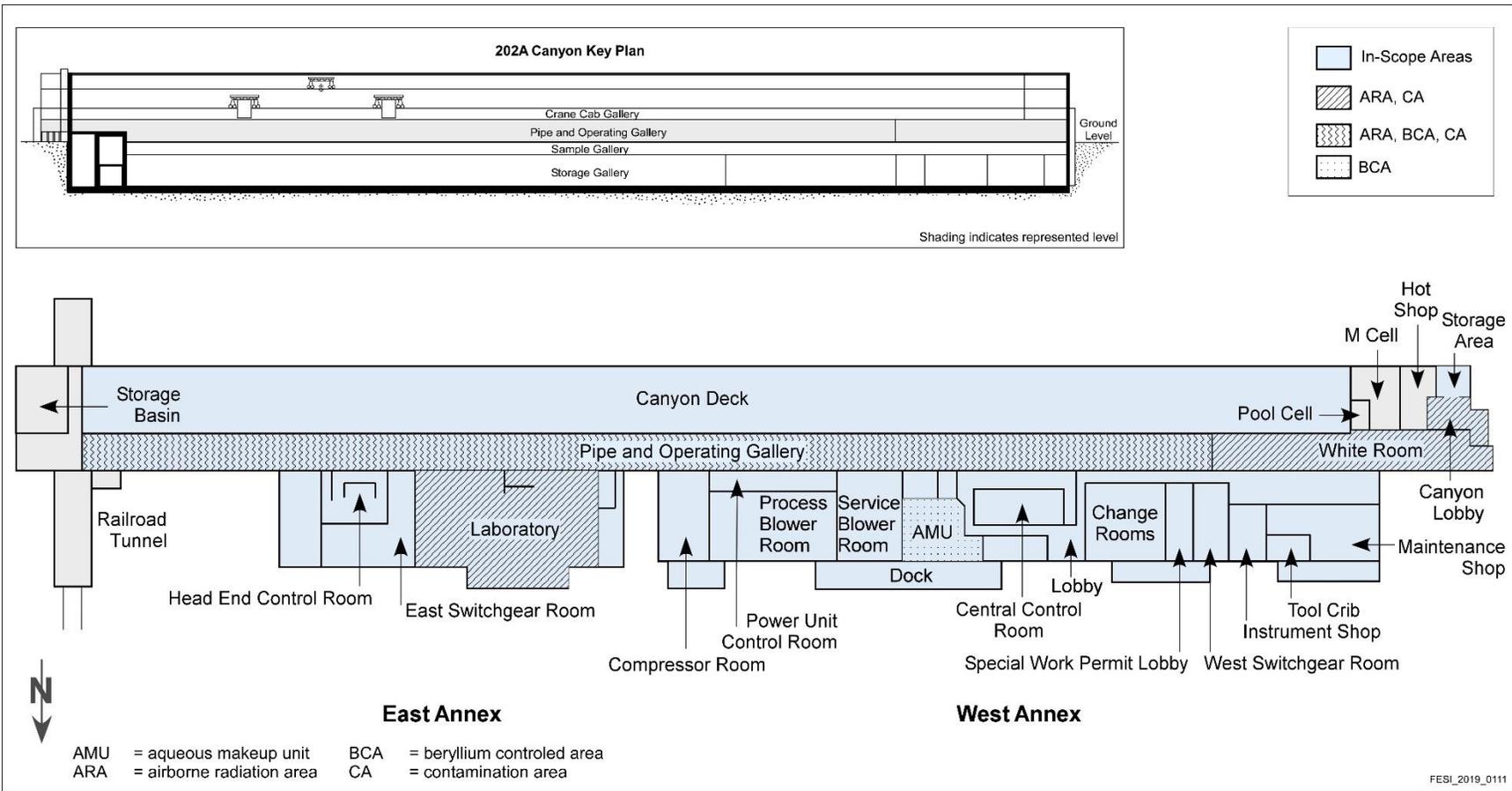


Figure 5. 202A Building Plan View – Pipe and Operating Gallery Level

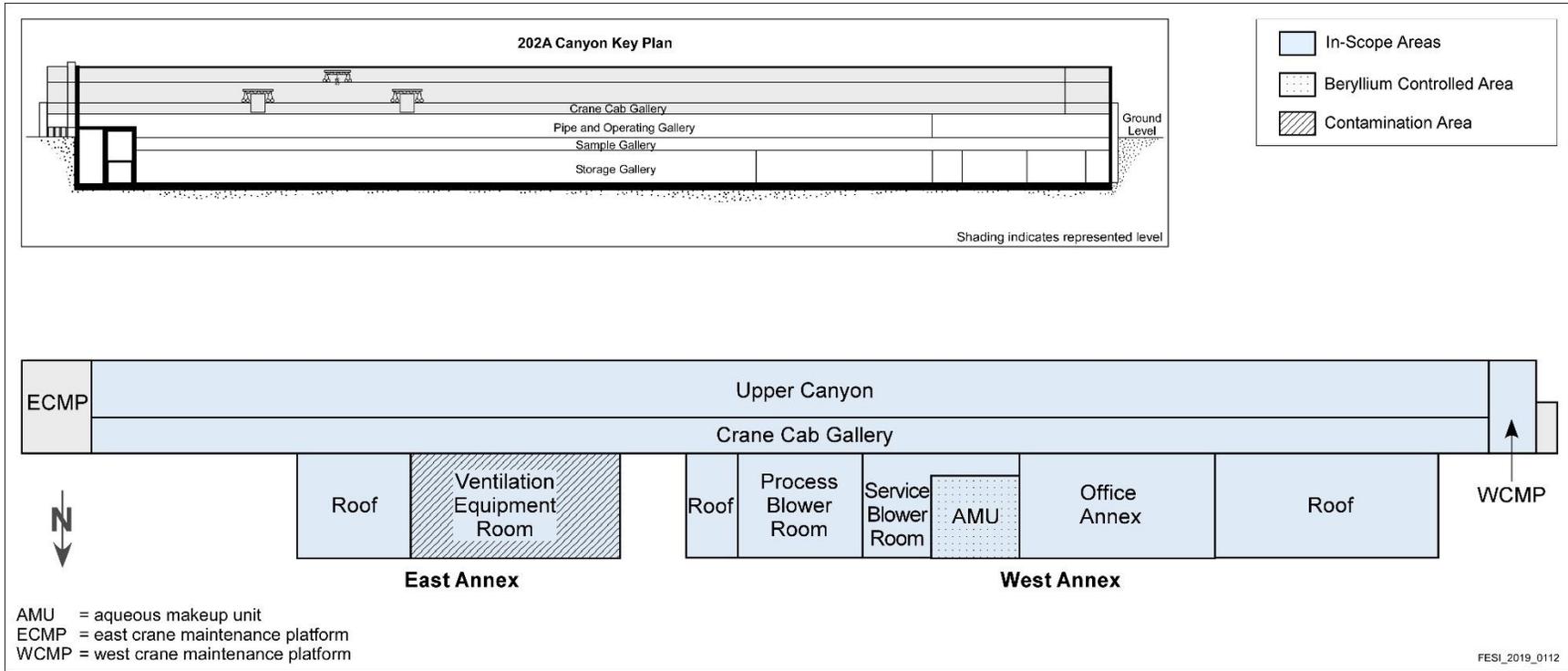


Figure 6. 202A Building Plan View – Crane Cab Gallery Level

Under the current removal action, hazard abatement will occur in the belowgrade galleries (Sample and Storage). Demolition preparation will occur in the abovegrade galleries (Pipe and Operating, and Crane Cab), including the Canyon Deck. While the process cells, Hot Pipe Trench, and Air Tunnel are outside the scope of this removal action, the inventories in these areas are included in this PTE calculation to encompass future removal activities.

### **2.1.2 202A Annexes**

The 202A Annexes are separated from the main canyon structure by a massive concrete wall. Two annexes, shown in Figure 3 through Figure 6, comprise the PUREX Annex: East and West. These areas contain an aqueous makeup unit (AMU), laboratory, offices, administrative support areas, maintenance shops, and equipment rooms for ventilation and electrical components. Historically, the nonlaboratory areas are slightly contaminated due to cross contamination vectors. The annex buildings were part of the original construction of the 202A Building.

The 202A East and West Annexes will both be demolished to grade, and the belowgrade areas will be backfilled to grade and contoured.

#### **2.1.2.1 East Annex**

The East Annex is a three-level, steel, and transite-sided structure that includes a basement. The East Annex is attached to the northeast side of the canyon and contains an analytical and control laboratory and multiple service rooms (e.g., east switchgear room, battery room, head end control room, and ventilation equipment room). The laboratory hoods and dedicated ventilation system are highly contaminated. The laboratory hoods were foamed to stabilize contamination in place. Batteries were removed during deactivation.

#### **2.1.2.2 West Annex**

The West Annex is a five-level, steel, and transite-sided structure that includes a basement. The West Annex is attached to the northwest side of the canyon and contains a five-story AMU, general office areas, and multiple service rooms (e.g., maintenance shop, instrument shop, west switchgear room, special work permit lobby, central control room, service blower room, process blower room, power unit control room, compressor room, and general offices).

All 37 AMU makeup tanks were flushed and drained during the deactivation period, and sampling was performed to ensure that the flushed water no longer exhibited dangerous waste characteristics. Tank TK-156 is a RCRA dangerous waste management unit located on the second floor of the AMU. The tank has a capacity of 405 gal (1,533 L) and was used to store nitric acid.

## **2.2 Plutonium Uranium Extraction Complex Surveillance and Maintenance Structures**

S&M of the PUREX Complex includes the 202A Building, ancillary buildings, and their associated equipment within the PUREX perimeter fence, which are listed in Table 1 and shown in Figure 7. 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 PUREX 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. PUREX Complex Structures for Surveillance and Maintenance**

<b>Structure Identification</b>	<b>Structure Name</b>
202A	PUREX (including Canyon, East Annex, and West Annex) (This also includes 204A [Acid Storage Vault, U Cell], 296A008 [Stack, PUREX Plant Pipe and Operating Gallery, and White Room Exhaust], and 296A010 [Stack, Storage Tunnel No. 2])
202A417	Steam Condensate Pump Pit
203A	Acid Storage Area and Pump House
206A	Vacuum Acid Fractionator Building
210A	Oil Drum Storage
211A	Chemical Storage Area and Pump House
212A	Fission Product Loadout Station
213A	Fission Product Load-In Station
214A	PUREX Warehouse
216A	Valve Control Facility
216A5A	Proportional Sampler Pit #4
216ATK1	Underground Neutralization Tank, (consolidated with waste site 200-E-189)
216ATK2	Underground Neutralization Tank, (consolidated with waste site 200-E-190)
217A	PUREX Surveillance and Monitoring and Control System Surveillance Controller
218E14	Storage Tunnel 1
218E15	Storage Tunnel 2
220A	Proportional Sampler Pit
221A	Former Pipefitter Shop
225EC	Treated Effluent Disposal Facility Local Control Unit 55C13
241A151 (includes 241A302A)	Diversion Box and Catch Tank (waste site 241-A-151 consolidated with 241-A-302A)
252A	Electrical Switching Transformer 13.8 kV
252AB	PUREX Electrical Substation
252AC	PUREX Mini Electrical Substation
2701AB	PUREX Badge House
2711A	Air Compressor Building
2712A	Vacuum Pump House
2714A	Dry Chemical Warehouse
271AB	PUREX Maintenance Support Facility
275EA	Warehouse Essential Materials (Slab remaining after demolition)
276A	Cold Solvent Storage, R Cell

**Table 1. PUREX Complex Structures for Surveillance and Maintenance**

<b>Structure Identification</b>	<b>Structure Name</b>
281A	Backup Generator Facility
2901A	Elevated Water Storage Tank
291A	PUREX Main Exhaust System
291A001	Stack 202A Main PUREX
291AA	Filter Cell #3
291AB	Exhaust Air Sampler House #1
291AC	Exhaust Air Sampler House #2
291AD	Ammonia Off-Gas Building
291AE	Filter Cell #4
291AF	#2 Filter and Drain Tank
291AG	Sample Station #2
291AH	Ammonia Off-Gas Sample Station
291AJ	Sample Station #3
291AK	Tunnel Spray Enclosure and Caissons
292AA	Plutonium Recovery Stack Sample House
292AB	PUREX Gas Effluent Monitoring Building
293A	Off-Gas Treatment Facility
294A	Off-Gas Treatment and Monitoring Station
295A (includes 295AZ)	Ammonia Scrubber Discharge Sample Station and Caisson
295AA	Steam Condensate Discharge Sample and Pumpout Station
295AB (includes 270A)	Process Distillate Discharge Sample Station and Underground Neutralization Tank
295AC	Chemical Sewer Line Sample Station
295AD	Sanitary Water Line Sample Station
295AE	Process Distillate Discharge Monitoring Building



Figure 7. PUREX Complex Structures for Surveillance and Maintenance

## 2.3 Plutonium Uranium Extraction Ventilation System

The 1990s PUREX deactivation project reduced the four separate ventilation systems in the original facility configuration to one cascaded flow scheme, and the original 13 effluent points from the facility and storage tunnels were reduced to one main exhaust stack (291A001). Of the 177 fans in the facility, only two main exhaust fans (one active and one on standby) continue to function. A third main exhaust fan has been abandoned-in-place. No supply fans are operational. The flow rates for the modified ventilation system are in the nominal range of 14.2 to 21.2 m<sup>3</sup>/sec (30,000 to 45,000 ft<sup>3</sup>/min), which is about 15% of the original capacity.

The 202A Building, including U Cell and R Cell, is ventilated by cascading systems into the canyon ventilation system. Airflow through the canyon galleries is routed to the canyon. Openings were made in existing gallery rooms and closed ventilation duct systems, so a cascade-type airflow supports the building exhaust ventilation system. The ventilation system will continue to flow air from clean areas to progressively more contaminated areas. Wherever possible, the engineered ventilation path cascades through portions of the existing ductwork and through as much of the building as possible.

The major portions of the ventilation system that remain active are Deep-bed Filter 2 (291AF), portions of Filter Bank 4 (291AE), 291A electric exhaust fans, air tunnels, 292AB, and sampling instrumentation (Figure 8). The 291A001 stack is of reinforced-concrete construction and rises 60.96 m (200 ft) abovegrade with a diameter of 2.13 m (7 ft). Service areas, including the process and canyon blower rooms, the compressor room, office areas, and AMU are not ventilated. All ventilation to the laboratory area has been shut down.

Although the PUREX ventilation system is not part of the removal action scope, it may be modified to support the removal activities. Removal of the independent laboratory ventilation system, including exhaust stacks 296A5A and 296A5B, is part of the demolition of the 202A East Annex.

## 3 Radiological Air Emissions

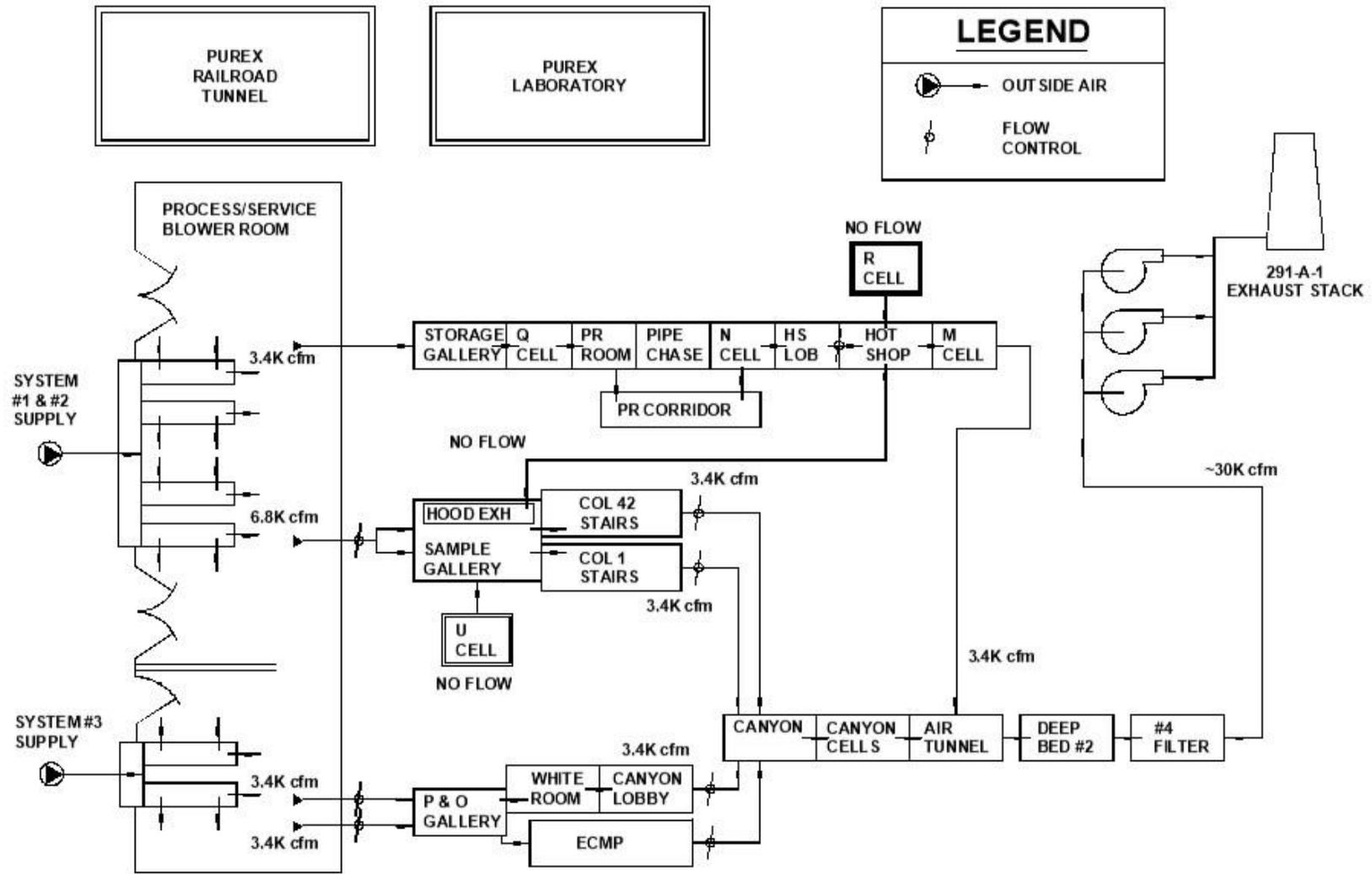
The potential for radiological release exists at the PUREX Complex. The state implementing regulations (WAC 246-247, "Radiation Protection—Air Emissions") address potential radioactive airborne emissions from point, fugitive, or diffuse sources that require monitoring. The 291A001 stack is currently part of the Hanford Site Air Operating Permit but will transition to regulation under the CERCLA authority after approval of the action memorandum (DOE/RL-2016-53) and PUREX RAWP (DOE/RL-2020-04).

Potential radiological releases from the PUREX Complex removal action would be considered point source (291A001 stack) and diffuse and fugitive emissions (202A East and West Annexes). The Hanford Site Environmental Monitoring Plan, which serves as the monitoring system for all site activities, is described in DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*. Near-facility ambient air monitoring stations N969, N970, N977, and N985 are upwind, downwind, or near the PUREX Complex area and are planned to be used for monitoring during the removal action (Figure 9).

CAP88-PC<sup>3</sup> 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.

---

<sup>3</sup> The CAP-88 (which stands for *Clean Air Act Assessment Package-1988*) computer model is a set of computer programs, databases, and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP-88 is a regulatory compliance tool under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants." CAP88-PC (Version 4.0) allows modeling on a personal computer and is a recent version of the code.



Reference: CP-14977, Plutonium Uranium Extraction Facility Documented Safety Analysis.

Figure 8. PUREX Facility Air Flow Diagram

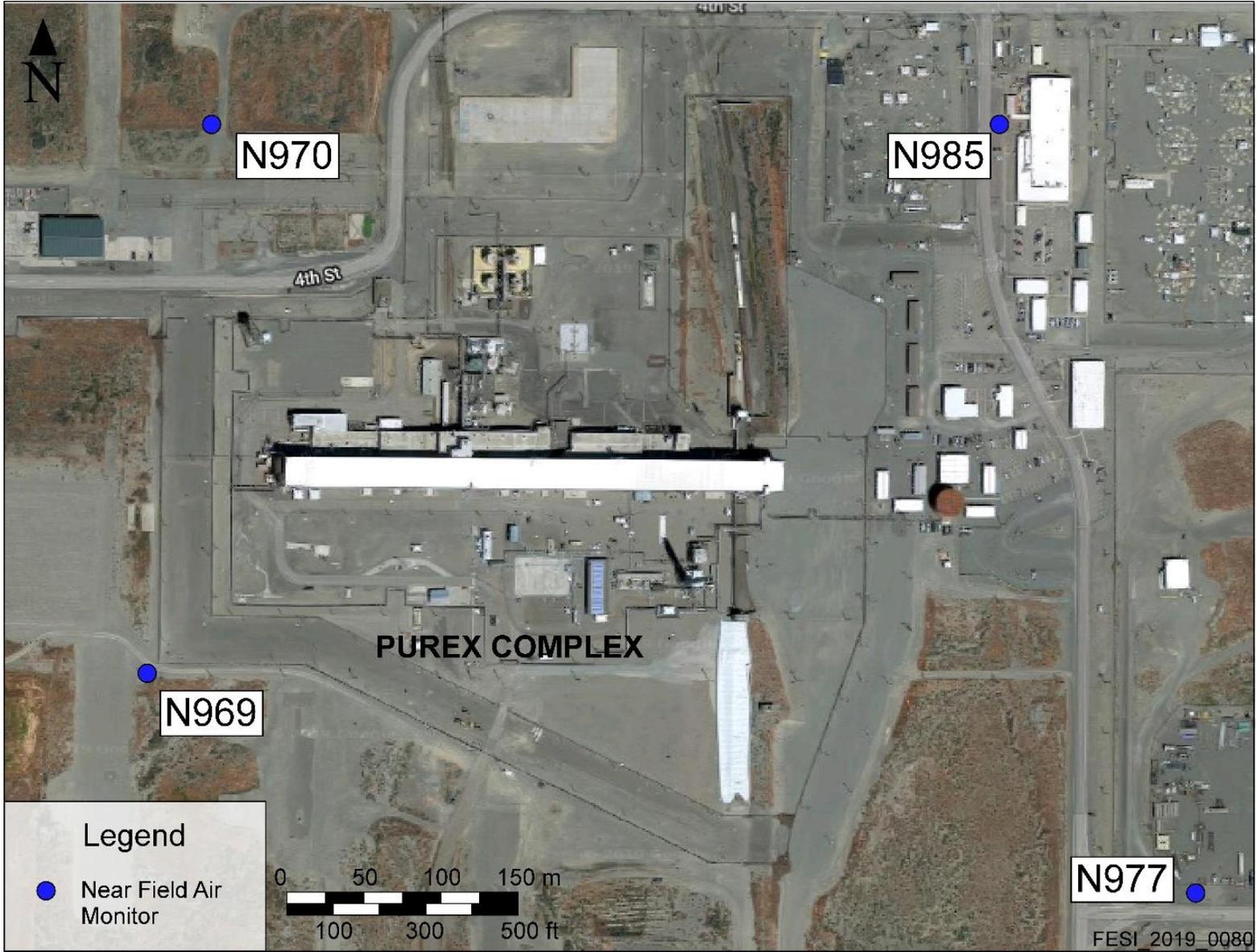


Figure 9. Near-Facility Air Monitoring Stations for the PUREX Complex

### 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 PUREX Complex removal action. The assumptions and inputs are derived from site features, physical parameters, sample results, and historical data.

#### 3.1.1 Assumptions

This section contains the following assumptions used in the calculations:

1. Emissions from removal activities in the 202A Canyon, including demo prep of the 202A East and West Annexes, are assumed to be point source emissions through the 291A001 stack. No credit is taken for any abatement by the ventilation system filters.
2. Emissions from the demolition of the 202A East and West Annexes are assumed to be diffuse and fugitive.
3. Emissions from the PUREX Complex S&M activities for buildings other than 202A are diffuse and fugitive and assumed to be negligible in comparison to the demolition of the 202A Annexes.

#### 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 202A Building, decayed to January 1, 2018, that was obtained from the PUREX safety analysis (CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis*). Due to the intrusive nature of the removal activities in the 202A Building, the inventory used for calculating the 291A001 stack point source emissions will be the total inventory identified in Table 2. This total inventory will conservatively bound the removal activities in the 202A Building, either currently identified in the PUREX RAWP (DOE/RL-2020-04) or in future removal actions.

**Table 2. 202A Building Inventory, Decayed to January 2018**

Isotope	Mass (g)	Curies (Ci)
Pu-238	9.00E+00	1.55E+02
Pu-239	1.20E+04	7.43E+02
Pu-240	1.87E+03	4.27E+02
Pu-241	3.30E+01	3.36E+03
Pu-242	3.90E+01	0.00E+00
Am-241	3.57E+02	1.23E+03
Sr-90	4.60E+01	6.35E+03
Cs-137	9.10E+01	7.90E+03
<b>Total</b>	<b>1.44E+04</b>	<b>2.02E+04</b>

Reference: Tables C-6 and C-8 in CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis*.

2. A project duration of 5 years is assumed for the removal activities performed inside the 202A Building.
3. The 291A001 stack rises 60.96 m (200 ft) abovegrade with a diameter of 2.13 m (7 ft) (AIR 17-1006, “Final Approval of Monitoring Requirements for EU 369”).
4. The average operating flow rate of the 291A001 stack in 2018 is 13.42 m<sup>3</sup>/s (28,434 ft<sup>3</sup>/min) as reported in Table 2-1 of DOE/RL-2019-09, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2018*. Dividing the stack flow rate by the stack area determines the stack exit velocity:

$$V = \frac{13.42 \frac{m^3}{s}}{\pi \left(\frac{2.13 m}{2}\right)^2} = 3.77 \frac{m}{s} = 12.37 \frac{ft}{s}$$

### 3.1.2.2 Diffuse and Fugitive

1. There are some contamination areas posted within the 202A Annexes. The available inventory for the unventilated 202A Annexes is calculated using the structure floor areas and the upper limit for a contamination area (2,000 dpm/100cm<sup>2</sup> alpha and 100,000 dpm/100cm<sup>2</sup> 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 3).

**Table 3. 202A East and West Annexes – Calculate Area**

Annex	Floor	Column No.	Drawing No. <sup>a</sup>	Length (ft) <sup>b</sup>	Width (ft) <sup>b</sup>	Area (ft <sup>2</sup> )
East	Basement	35-38	H-2-52027	70.75	56.00	3,962
	First	28-35	H-2-52019	165.83	56.29	9,335
		35-38	H-2-52028	72.50	56.71	4,111
	Second	29-35	H-2-52019	145.00	57.00	8,265
West	Basement	9-10	H-2-52005	20.00	56.29	1,126
		17-20	H-2-52010	60.00	56.29	3,377
	First	4-9	H-2-52002	101.17	57.00	5,767
		9-17	H-2-52005	160.00	57.00	9,120
		17-20	H-2-52010	60.00	57.00	3,420
		20-27.2	H-2-52015	174.00	57.00	9,918
	Second	9-17	H-2-52005	160.00	57.00	9,120
		17-20	H-2-52010	60.00	57.00	3,420
	Third	17-20	H-2-52011	60.00	57.00	3,420
	Fourth	18-19	H-2-52011	21.00	18.42	387
		19-20	H-2-52011	20.00	38.33	767
	<b>Total Annex Area (ft<sup>2</sup>) =</b>					
<b>Total Annex Area (m<sup>2</sup>)<sup>c</sup> =</b>						<b>7,016</b>

a. Complete reference citations for drawings are included in Chapter 5.

b. Length is measured east to west. Width is measured north to south.

c. Conversion factor: 1 m<sup>2</sup> = 10.76391 ft<sup>2</sup>

Using the total floor area (in m<sup>2</sup>) from Table 3, the 202A Annexes inventory is calculated using Equation 1:

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

Equation 1 yields an inventory for the 202A Annex of 6.32E-04 Ci of alpha and 3.16E-02 Ci of beta/gamma. The same isotopic mix from the point source is applied to the diffuse and fugitive inventory.

2. A project duration of 1 year is assumed for the demolition of the 202A East and West Annexes.

The diffuse and fugitive area source is based on the footprint of the 202A East and West Annexes, as calculated in Table 4.

**Table 4. 202A East and West Annexes – Calculate Footprint**

Annex	Floor	Column No.	Drawing No. <sup>a</sup>	Length (ft) <sup>b</sup>	Width (ft) <sup>b</sup>	Area (ft <sup>2</sup> )
East	First	28-35	H-2-52019	165.83	68.50	11,359
		35-38	H-2-52028	72.50	68.50	4,966
West	First	4-9	H-2-52002	101.17	68.50	6,930
		9-17	H-2-52005	160.00	68.50	10,960
		17-20	H-2-52010	60.00	68.50	4,110
		20-27.2	H-2-52015	174.67	68.50	11,965
<b>Total Annex Footprint Area (ft<sup>2</sup>) =</b>						<b>50,291</b>
<b>Total Annex Footprint Area (m<sup>2</sup>)<sup>c</sup> =</b>						<b>4,672</b>

a. Complete reference citations for drawings are included in Chapter 5.

b. Length is measured east to west. Width is measured north to south.

c. Conversion factor: 1 m<sup>2</sup> = 10.76391 ft<sup>2</sup>.

### 3.2 Methodology

Building radiological reports and process knowledge are used to estimate annual possession quantity (APQ), which is the assumed annual 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 PUREX Complex removal action. The PTE is used to determine the TEDE to the offsite MEI.

### 3.2.1 Annual Possession Quantity

The APQ is measured as total annual activity in curies. The point source bounding inventory (i.e., building activity) is specified in Section 3.1.2.1, Item 1, and the diffuse and fugitive bounding inventory is specified in Section 3.1.2.2, Item 1. The point source project duration is specified in Section 3.1.2.1, Item 2, and the diffuse and fugitive project duration is specific in Section 3.1.2.2, Item 2. The bounding inventory divided by the project duration is equal to the APQ, as shown in Equation 2.

$$\text{APQ} \left( \frac{Ci}{yr} \right) = \frac{\text{Activity } (Ci)}{\text{Duration } (yr)} \quad (\text{Eq. 2})$$

where:

APQ = annual possession quantity  
 activity = building activity  
 duration = project duration.

### 3.2.2 Potential-to-Emit

The PTE is calculated using the APQ and a release fraction, in accordance with and 40 CFR 61, “National Emission Standards for Hazardous Air Pollutants” (NESHAP), Appendix D, “Methods for Estimating Radionuclide Emissions.” 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,” and NESHAP (40 CFR 61), Appendix D. Equation 3 shows this process:

$$\text{PTE} \left( \frac{Ci}{yr} \right) = \text{APQ} \left( \frac{Ci}{yr} \right) \times 1.0\text{E-}03 \quad (\text{Eq. 3})$$

where PTE is potential-to-emit.

### 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 #6 in the 200 East Area at the 10 m (32.8 ft) level (a13200E10.wnd).

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

The distances that are used in the CAP88-PC model run are shown in Appendix B 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, taking into account all exposure pathways by the radioactive emissions. For the purposes of this calculation, and for each source term being considered, 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. Exception to this is where the Columbia River defines the site boundary. The site boundary is the west bank of the Columbia River; however, as shown on the map in Appendix B, the east bank is chosen as the closest habitable location. Also, as agreed upon between the U.S. Department of Energy (DOE) and the Washington Department of Health (WDOH) (AIR 00-1012, "New Onsite MEI"), the Laser Interferometer Gravitational-Wave Observatory (LIGO), and Energy Northwest Columbia Generating Station 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 map shown in Appendix B reflects land transferred to the Tri-City Development Council on September 30, 2015, from DOE.

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 Columbia Generating Station). However, CAP88-PC automatically calculates the "individual effective dose equivalent" for each distance in all directions (see CAP88-PC model runs in Appendices C through F of this ECF). By default, CAP88-PC will take the maximum "individual effective dose equivalent" regardless of direction or distance and use it as the basis for the dose to the MEI and report it as the "effective dose equivalent" in the nuclide-specific dose equivalent summary. This results in the maximum "individual effective dose equivalent" selected from the matrix of individual effective dose equivalents at a location that is not on the site boundary or other non-DOE-related business location. To determine the maximum effective dose equivalent at the site boundary or non-DOE-related business location, a review of the CAP88-PC Summary Reports (Appendices C through F) 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 effective dose equivalent."

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 caused primarily by the heating of the earth's surface by solar radiation, followed by heat transfer through turbulent mixing and convection. The height of lid (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 (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 was 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 was 12.2°C (53.9°F), as reported in Table 1-1 of DOE/RL-2019-33.

- The CAP88-PC default value for humidity of  $8 \text{ g/m}^3$  was used. This value 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*.
- The diffuse and fugitive area source equals an area of  $4,672 \text{ m}^2$  ( $50,291 \text{ ft}^2$ ) (Table 4). As discussed in Trinity, 2014, *CAP88-PC Version 4.0 User Guide*, the ratio of distance to the receptor/source diameter is greater than 2.5; therefore, CAP88-PC automatically models the area source as a point source. CAP88-PC automatically assumes the source is a circular area and calculates a source diameter as follows:

$$4,672 \text{ m}^2 = (\text{diameter}/2)^2 (\pi)$$

The source diameter is calculated as 77.1 m (253 ft), which is far less than the distance to the MEI determined to be 22,384 m (73,438 ft) away at the Hanford Site boundary. Thus, the CAP88-PC code assumes the source to be a point source.

### 3.3 Software Applications

CAP88-PC, Version 4.0.1.17, was used to calculate the effective dose equivalent 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*.

### 3.4 Calculations

Table 5 provides the APQ and PTE calculation for potential point source air emissions from the 291A001 stack for the PUREX Complex radiological constituents of concern. Table 6 provides the APQ and PTE calculation for potential diffuse and fugitive air emissions from demolition of the 202A Annexes for the PUREX Complex radiological constituents of concern. The calculations use the assumptions and inputs stated in Section 3.1 and follow the methodology described in Section 3.2.

### 3.5 Radiological Air Emission Results

Potential radionuclide air emission estimates were calculated for the PUREX Complex removal action described in the PUREX RAWP (DOE/RL-2020-04) and potential future removal actions.

#### 3.5.1 Total Effective Dose Equivalent to the Maximally Exposed Individual Summation

Potential radionuclide air emission estimates were calculated by CAP88-PC for the PUREX Complex removal action described in the PUREX RAWP (DOE/RL-2020-04). Table 7 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% high-efficiency particulate air [HEPA] filter efficiency).

**Table 5. PTE Calculations for PUREX Complex (Point Source – 291A001 Stack)**

A	B	C	D
Isotopes	Inventory <sup>a</sup> (Ci)	APQ <sup>b</sup> (Ci/yr)	Unabated PTE <sup>c</sup> (Ci/yr)
Pu-238	1.55E+02	3.10E+01	3.10E-02
Pu-239	7.43E+02	1.49E+02	1.49E-01
Pu-240	4.27E+02	8.54E+01	8.54E-02
Pu-241	3.36E+03	6.71E+02	6.71E-01
Am-241	1.23E+03	2.45E+02	2.45E-01
Sr-90	6.35E+03	1.27E+03	1.27E+00
Cs-137	7.90E+03	1.58E+03	1.58E+00
<b>Total</b>			<b>4.03E+00</b>

a. Bounding inventory for the 202A Building from Table C-6 of CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis* (as specified in Section 3.1.2.1, Item 1).

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

- Duration = 5 year (as specified in Section 3.1.2.1, Item 2)

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

- Release fraction = 1.0E-03 (as specified in Section 3.2.2)

APQ = annual possession quantity

PTE = potential-to-emit

**Table 6. PTE Calculation for PUREX Complex (Diffuse and Fugitive)**

A	B	C	D	E	F	G
Isotopes (Ray Type)	Inventory <sup>a</sup> (Ci)	Percent of Inventory <sup>b</sup>	Percent of Inventory <sup>c</sup>		APQ <sup>d</sup> (Ci/yr)	Unabated PTE <sup>e</sup> (Ci/yr)
			α	β/γ		
Pu-238 (α)	1.55E+02	0.77%	2.62%		1.66E-05	1.66E-08
Pu-239 (α)	7.43E+02	3.69%	12.58%		7.95E-05	7.95E-08
Pu-240 (α)	4.27E+02	2.12%	7.23%		4.57E-05	4.57E-08
Pu-241 (α)	3.36E+03	16.65%	56.82%		3.59E-04	3.59E-07
Am-241 (α)	1.23E+03	6.08%	20.74%		1.31E-04	1.31E-07
Sr-90 (β/γ)	6.35E+03	31.51%		44.57%	1.41E-02	1.41E-05
Cs-137 (β/γ)	7.90E+03	39.19%		55.43%	1.75E-02	1.75E-05
<b>Totals</b>	<b>2.02E+04</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>3.22E-02</b>	<b>3.22E-05</b>

a. Bounding inventory for the 202A Building from Table C-6 of CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis* (as specified in Section 3.1.2.1, Item 1).

b. Percent of inventory is calculated: **Column C = Column B / Sum of Column B**

c. Percent of α or β/γ inventory is calculated:

- Percent of α inventory = **Column C(α) / Sum of Column C** (α = 29.3%)
- Percent of β/γ inventory = **Column C(β/γ) / Sum of Column C** (β/γ = 70.7%)

d. APQ is calculated: **Column F (APQ) = {Column D(α) or Column E(β/γ) × Inventory} / Duration**

- Inventory = 6.32E-04 Ci (α) or 3.16E-02 Ci (β/γ) (as specified in Section 3.1.2.2, Item 1)
- Duration = 1 year (as specified in Section 3.1.2.2, Item 2)

e. PTE is calculated: **Column G (PTE) = Column F (APQ) × Release Fraction**

- Release fraction = 1.0E-03 (as specified in Section 3.2.2)

APQ = annual possession quantity

PTE = potential-to-emit

**Table 7. Total Effective Dose Equivalent to the Maximally Exposed Individual**

Emission Type	Unabated TEDE (mrem/yr)		Abated TEDE <sup>a</sup> (mrem/yr)	
	Offsite MEI	Onsite MEI <sup>b</sup>	Offsite MEI	Onsite MEI <sup>b</sup>
Point Source - 291A001 Stack	5.53E-01 <sup>c</sup>	1.21E+00 <sup>d</sup>	5.53E-03	1.21E-02
Diffuse and Fugitive - 202A Annexes	5.80E-06 <sup>e</sup>	9.47E-06 <sup>f</sup>	5.80E-08	9.47E-08
<b>Totals</b>	<b>5.53E-01</b>	<b>1.21E+00</b>	<b>5.53E-03</b>	<b>1.21E-02</b>

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: abated TEDE = unabated TEDE × 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 Onsite MEI").

c. See Appendix C for CAP88-PC synopsis and summary reports. The offsite MEI is located at the Hanford Site boundary 22,384 m (73,438 ft) east-southeast of the PUREX Complex.

d. See Appendix D for CAP88-PC synopsis and summary reports. The onsite MEI is located at LIGO 9,242 m (30,321 ft) southeast of the PUREX Complex.

e. See Appendix E for CAP88-PC synopsis and summary reports. The offsite MEI is located at the Hanford Site boundary 22,384 m (73,438 ft) east-southeast of the PUREX Complex.

f. See Appendix F for CAP88-PC synopsis and summary reports. The onsite MEI is located at the LIGO 9,242 m (30,321 ft) southeast of the PUREX Complex.

DOE-RL = U.S. Department of Energy, Richland Operations Office

EPA = U.S. Environmental Protection Agency

HEPA = high-efficiency particulate air

LIGO = Laser Interferometer Gravitational-Wave Observatory

MEI = maximally exposed individual

PUREX = Plutonium Uranium Extraction

TEDE = total effective dose equivalent

WDOH = Washington Department of Health

TEDE to the onsite MEI is provided in accordance with the agreement reached between U.S. Department of Energy, Richland Operations Office (DOE-RL); the U.S. Environmental Protection Agency (EPA); and WDOH (AIR 00-1012).

As determined by CAP88-PC, the unabated TEDE to the MEIs for the PUREX Complex are above the 0.1 mrem/yr limit in WAC 246-247-075, "Monitoring, Testing, and Quality Assurance," that requires continuous monitoring of radionuclide emissions, but 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"). They are also in compliance with WAC 246-221-060, "Radiation Protection Standards," "Dose Limits for Individual Members of the Public," which requires that the Hanford Site operations not result in a dose to an individual member of the public in excess of 10 mrem/yr.

### 3.5.2 Point Source Emissions Evaluation

To facilitate working in the building, an exhauster may be used to provide building ventilation for worker comfort as well as to control radon buildup. As a point source, controls to reduce (abate) radiological emissions using HEPA filtration would be implemented. To estimate the portion of the overall PTE an exhauster would address, a supplemental calculation was performed. Exhauster emissions were modeled

using CAP88-PC assuming an upstream value of 1 derived air concentration or less would be maintained on average for worker safety with an exhauster flow rate of 9.44 m<sup>3</sup>/sec (20,000 ft<sup>3</sup>/min) (model inputs are captured in Appendix G). The calculations discussed below provide values with and without abatement technology.

Using these inputs, the unabated offsite TEDE to the MEI is 2.00E+00 mrem/yr (Appendix H) while the unabated onsite TEDE to the MEI associated with the operation of the exhauster is 3.33E+00 mrem/yr (Appendix I). Assuming a conservative 99% HEPA filter efficiency, the abated offsite TEDE to the MEI is 2.00E-02 mrem/yr and the abated onsite TEDE to the MEI is 3.33E-02 mrem/yr.

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

#### 4 Criteria/Toxic Air Determination

This chapter documents the determination of criteria/toxic air emissions resulting from the removal action at the PUREX Complex. This determination supports the PUREX RAWP (DOE/RL-2020-04) 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/toxic emissions are expected.

To support separation operations at the PUREX Complex, various chemicals were added at different stages in the process. Table 8 provides the bounding chemical contaminants of concern for the PUREX Complex. These chemicals are identified through review of the PUREX process 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 8 were compared to WAC 173-460-150, “Table of ASIL, SQER and de Minimis Emission Values,” to identify regulated contaminants. Table 9 includes those chemicals from Table 8 that are regulated and their de minimis emission values.

**Table 8. Chemical Contaminants of Concern**

Ammonia	Corrosives (acids and caustics), including:	
Anions (chloride, fluoride, nitrate, nitrite, phosphate, and sulfate)	<ul style="list-style-type: none"> <li>• 1,1-dichloroethane</li> <li>• 1,2-dichloroethane</li> </ul>	<ul style="list-style-type: none"> <li>• Methylene chloride</li> <li>• n-Butyl alcohol</li> </ul>
Asbestos and asbestos-containing material	<ul style="list-style-type: none"> <li>• 1,1,1-trichloroethane</li> <li>• Acetone</li> <li>• Benzene</li> </ul>	<ul style="list-style-type: none"> <li>• n-Butyl benzene</li> <li>• Phenol</li> <li>• Polychlorinated biphenyls</li> </ul>
Cyanide	<ul style="list-style-type: none"> <li>• Carbon tetrachloride</li> </ul>	<ul style="list-style-type: none"> <li>• Tetrachloroethylene</li> </ul>
Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc)	<ul style="list-style-type: none"> <li>• Cis/trans-1,2-dichloroethane</li> <li>• Chlorobenzene</li> <li>• Chloroform</li> <li>• Ethylbenzene</li> <li>• Methyl ethyl ketone (2-butanone)</li> </ul>	<ul style="list-style-type: none"> <li>• Toluene</li> <li>• Total petroleum hydrocarbons</li> <li>• Tributyl phosphate and derivatives (mono, di)</li> <li>• Trichloroethylene</li> </ul>
Oil and Grease		<ul style="list-style-type: none"> <li>• Xylene</li> </ul>

Reference: DOE/RL-2020-05, *Sampling and Analysis Plan for the PUREX Complex*.

**Table 9. De Minimis Emission Values for PUREX Complex Chemicals**

Name	CAS Number	De Minimis Emission *
1,1-dichloroethane	75-34-3	5.1E+00 lb/yr
1,2-dichloroethane	107-06-2	3.1E-01 lb/yr
1,1,1-trichloroethane	71-55-6	1.9E+01 lb/day
Ammonia	7664-41-7	1.9E+00 lb/day
Arsenic and inorganic arsenic compounds, NOS	--	2.5E-03 lb/yr
Asbestos	1332-21-4	3.5E-05 fibers/cm <sup>3</sup> /yr
Benzene	71-43-2	1.0E+00 lb/yr
Beryllium and compounds, NOS	--	3.4E-03 lb/yr
Cadmium and compounds, NOS	--	1.9E-03 lb/yr
Carbon tetrachloride	56-23-5	1.4E+00 lb/yr
Chlorobenzene	108-90-7	3.7E+00 lb/day
Chromium (III), insoluble particulates, NOS	--	1.9E-02 lb/day
Chromium (III), soluble particulates, NOS	--	3.7E-04 lb/day
Chromium (VI) and compounds, NOS	--	3.3E-05 lb/yr
Copper and compounds	--	9.3E-03 lb/hr
Fluorides (fluoride containing chemicals), NOS	--	4.8E-02 lb/day
Lead and compounds, NOS	--	1.0E+01 lb/yr
Mercury, elemental	7439-97-6	1.1E-04 lb/day
Methyl ethyl ketone	78-93-3	1.9E+01 lb/day
Nickel and compounds, NOS	--	3.1E-02 lb/yr
Phenol	108-95-2	7.4E-01 lb/day
Polychlorinated biphenyls, NOS	1336-36-3	1.4E-02 lb/yr
Selenium and compounds (other than hydrogen selenide)	--	7.4E-02 lb/day
Toluene	108-88-3	1.9E+01 lb/day
Trichloroethylene	79-01-6	1.7E+00 lb/yr
Xylene (mixture), including m-xylene, o-xylene, p-xylene	1330-20-7	8.2E-01 lb/day

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

CAS = Chemical Abstracts Service

NOS = not otherwise specified

It is recognized that several process chemicals, arsenic, beryllium, cadmium, chromium, lead, and nickel 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]). This 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. The following chemicals 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:

- 1,1-dichloroethane
- 1,2-dichloroethane
- 1,1,1-trichloroethane
- Ammonia
- Benzene
- Carbon tetrachloride
- Chlorobenzene
- Methyl ethyl ketone
- Toluene
- Trichloroethylene
- Xylene

However, as stated in Section 2.1, tanks and piping in the 202A Building were rinsed and repeatedly flushed during deactivation activities in the 1990s. 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/piping in secondary containment). For chemicals having vapor pressures greater than 1 mmHg at ambient temperature, emissions exceeding the de minimis values in WAC 173-460-150 are not anticipated from the 202A Building due to the reduced chemical inventory combined with standard work practices.

Polychlorinated biphenyls are associated with painted surfaces and electrical equipment (i.e., 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 PUREX Complex will be addressed in accordance with applicable NESHAP 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

40 CFR 61, “National Emission Standards for Hazardous Air Pollutants,” *Code of Federal Regulations*. Available at: <http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol8/xml/CFR-2010-title40-vol8-part61.xml>.

Appendix D, “Methods for Estimating Radionuclide Emissions.”

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

AIR 00-1012, 2000, “New Onsite MEI” (letter to S.H. Wiseness, U.S. Department of Energy, Richland Operations Office, from A.W. Conklin), Washington State Department of Health, Olympia, Washington. October 18, 2000. Available at: <https://pdw.hanford.gov/document/AR-03321>.

AIR 17-1006, 2017, “Final Approval of Monitoring Requirements for EU 369” (letter to D. Shoop, U.S. Department of Energy, Richland Operations Office, from J. Martell), Washington State Department of Health, Olympia, Washington. October 17.

*Asbestos Hazard Emergency Response Act of 1986*, 15 USC 2614-2656, et seq. Available at: <https://www.gpo.gov/fdsys/pkg/USCODE-2009-title15/html/USCODE-2009-title15-chap53-subchapII.htm>.

- CHPRC-03392, 2018, *Clean Air Act Assessment Package-1988 – Combined Software Management Plan*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
- CP-14977, 2019, *Plutonium Uranium Extraction Facility Documented Safety Analysis*, Rev. 11, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: <https://pdw.hanford.gov/document/AR-03981>.
- DOE/RL-91-50, 2015, *Hanford Site Environmental Monitoring Plan*, Rev. 7, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: <http://www.hanford.gov/files.cfm/DOE-RL-91-50-Rev-7.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, Washington.
- DOE/RL-2016-53, 2020, *Action Memorandum for the PUREX Complex*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2019-09, 2019, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2018*, Rev. 0, 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.
- DOE/RL-2020-04, 2020, *Removal Action Work Plan for the PUREX Complex*, Draft, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2020-05, 2020, *Sampling and Analysis Plan for the PUREX Complex*, Draft, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- H-2-52002 (drawing), 1953, *Arch. Plans at 1<sup>st</sup> Floor & Roof Eleva. 712'-0", 725'-4<sup>7</sup>/<sub>8</sub>" Service Area, Cols. 1-9*, Rev. 2, General Electric Company and Vitro Corporation of America, Richland, Washington.
- H-2-52005 (drawing), 1982, *Arch. Plans at 1<sup>st</sup> Floor, 2<sup>nd</sup> Floor & Cable Room – Elevs. 712'-0" 725'-6" 701'-0" Service Area – Cols. 9-17*, Rev. 6, General Electric Company and Vitro Corporation of America, Richland, Washington.
- H-2-52010 (drawing), 1961, *Arch. Plans at Storage & Sample Galleries, 1<sup>st</sup> Floor, 2<sup>nd</sup> Floor, Elevs. 673'-4" 700'-3" 712'-0" 726'-0" Aqueous Makeup, Service Areas – Cols. 17-20*, Rev. 3, General Electric Company and Vitro Corporation of America, Richland, Washington.
- H-2-52011 (drawing), 1982, *Arch. Plans at 3<sup>rd</sup> Floor, 4<sup>th</sup> Floor & Roof, Elevs. 738'-3" 752'-9" 770'-1"*, *Aqueous Makeup, Service Areas, Cols. 17-20*, Rev. 3, General Electric Company and Vitro Corporation of America, Richland, Washington.
- H-2-52015 (drawing), 1982, *Arch. Plans at 1<sup>st</sup> Floor & Roof, Elevs. 712'-0" 730'-11<sup>7</sup>/<sub>8</sub>" 738'-0" Service Areas, Cols. 20-25*, Rev. 4, General Electric Company and Vitro Corporation of America, Richland, Washington.
- H-2-52019 (drawing), 1967, *Arch. Plans at 1<sup>st</sup> & 2<sup>nd</sup> Floors, Elevs. 712'-0" & 725'-6" Service Areas, Cols. 28-35*, Rev. 6, General Electric Company and Vitro Corporation of America, Richland, Washington.

H-2-52027 (drawing), 1953, *Arch. Plans at Storage & Sample Galleries, Service Area Cols. 35-41*, Rev. 1, General Electric Company and Vitro Corporation of America, Richland, Washington.

H-2-52028 (drawing), 1982, *Arch. Plans at 1<sup>st</sup> Floor & Roof, Elevs. 712'-0" & 724'-11" Service Area Cols. 35 to 41*, Rev. 3, General Electric Company and Vitro Corporation of America, Richland, Washington

Holzworth, G.C., 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, AP-101, (NTIS Accession No. PB 207103), U.S. Environmental Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina. Available at: <https://www.nrc.gov/docs/ML1408/ML14084A177.pdf>.

PRC-PRO-EP-40205, 2018, "CHPRC Environmental Calculation Preparation and Issue," Rev. 1, Change 6, CH2M HILL Plateau Remediation Company, Richland, Washington.

*Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: <https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf>.

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: <http://apps.leg.wa.gov/WAC/default.aspx?cite=173-400>.

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: <http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460>.

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

WAC 246-221-060, "Radiation Protection Standards," "Dose Limits for Individual Members of the Public," *Washington Administrative Code*, Olympia, Washington. Available at: <http://apps.leg.wa.gov/WAC/default.aspx?cite=246-221-060>.

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>.

247-030, "Definitions."

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

## **Appendix A**

### **Hanford Site Wind Files**

This page intentionally left blank.

**200 Area Hanford Site 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 East Area (Station #6) at the 10 m (32.8 ft) Level  
for 2004 – 2013 (A13200E10.WND)**

0.000  
0.037 0.054 0.060 0.045 0.035 0.025 0.026 0.033 0.039 0.046 0.122 0.207 0.114 0.078 0.049 0.031  
1.96 2.20 2.17 2.01 1.80 1.57 1.85 2.24 2.17 2.20 3.92 3.88 3.23 4.33 2.90 2.00  
1.94 2.08 2.28 1.86 1.56 1.42 1.47 1.79 1.94 1.94 2.76 3.07 2.77 3.53 2.68 1.86  
2.03 2.04 2.01 1.71 1.46 1.28 1.26 1.47 1.67 1.93 2.95 2.77 2.63 3.41 2.96 1.99  
1.87 1.92 1.83 1.48 1.31 1.15 1.18 1.41 1.46 1.64 2.50 3.06 2.72 3.39 2.83 2.09  
1.85 1.91 1.71 1.46 1.26 1.12 1.23 1.50 1.50 1.46 2.58 3.52 2.79 2.74 2.52 1.97  
1.58 1.78 1.50 1.19 1.09 1.04 1.00 1.16 1.20 1.25 1.91 2.67 2.32 1.90 1.50 1.39  
1.49 1.71 1.41 1.15 1.04 0.96 0.89 0.89 0.98 1.05 1.69 2.72 2.35 2.05 1.48 1.34  
3.01 3.08 2.92 2.65 2.54 2.23 3.01 3.33 3.18 3.12 5.92 5.83 5.23 6.23 4.70 2.92  
3.03 2.98 2.99 2.49 2.21 1.99 2.21 2.70 2.73 2.67 4.45 4.83 4.41 5.67 4.34 2.91  
3.06 3.05 2.82 2.52 2.09 1.75 1.91 2.25 2.48 2.68 4.70 4.55 4.64 5.59 4.91 3.10  
3.23 2.91 2.64 2.17 1.85 1.63 1.86 2.55 2.42 2.46 4.22 4.92 4.61 6.04 5.57 3.98  
3.34 2.97 2.57 2.15 1.74 1.56 2.35 3.02 2.64 2.25 4.21 4.94 4.17 4.74 4.96 3.89  
2.35 2.52 2.14 1.59 1.42 1.34 1.26 1.77 1.90 1.82 2.72 3.48 3.18 2.79 2.25 2.00  
2.14 2.50 2.00 1.56 1.27 1.09 0.89 0.89 1.14 1.30 2.51 3.53 3.14 2.92 2.11 1.86  
0.0650 0.0407 0.0352 0.1680 0.3144 0.2791 0.0976  
0.0739 0.0444 0.0499 0.1922 0.2643 0.2662 0.1091  
0.1321 0.0602 0.0702 0.2492 0.2258 0.1789 0.0836  
0.1689 0.1000 0.0978 0.2689 0.1867 0.1244 0.0533  
0.1792 0.1069 0.1127 0.2803 0.1821 0.0983 0.0405  
0.1693 0.1220 0.1142 0.3031 0.1614 0.0945 0.0354  
0.2115 0.1231 0.1115 0.3038 0.1500 0.0769 0.0231  
0.2669 0.1135 0.1043 0.3006 0.1411 0.0583 0.0153  
0.2073 0.1114 0.1140 0.3342 0.1425 0.0725 0.0181  
0.1507 0.0873 0.0939 0.3603 0.1900 0.0895 0.0284  
0.1285 0.0466 0.0548 0.2823 0.3020 0.1440 0.0417  
0.0571 0.0189 0.0213 0.1518 0.4221 0.2427 0.0861  
0.0607 0.0264 0.0273 0.1294 0.3662 0.2923 0.0977  
0.1250 0.0477 0.0451 0.1843 0.3131 0.2088 0.0760  
0.1049 0.0453 0.0556 0.1975 0.3354 0.1975 0.0638  
0.0714 0.0455 0.0390 0.1818 0.3409 0.2435 0.0779

extended data

StationName=Hanford 200E AREA (Station 6) - 10m - Pasquill A - G (2004-13)

State=WA

Latitude=46.55614

Longitude=-119.52147

TimeZone=8

RecordPeriod=2004,2005,2006,2007,2008,2009,2010,2011,2012,2013

AveragePeriodTemperature=12.01

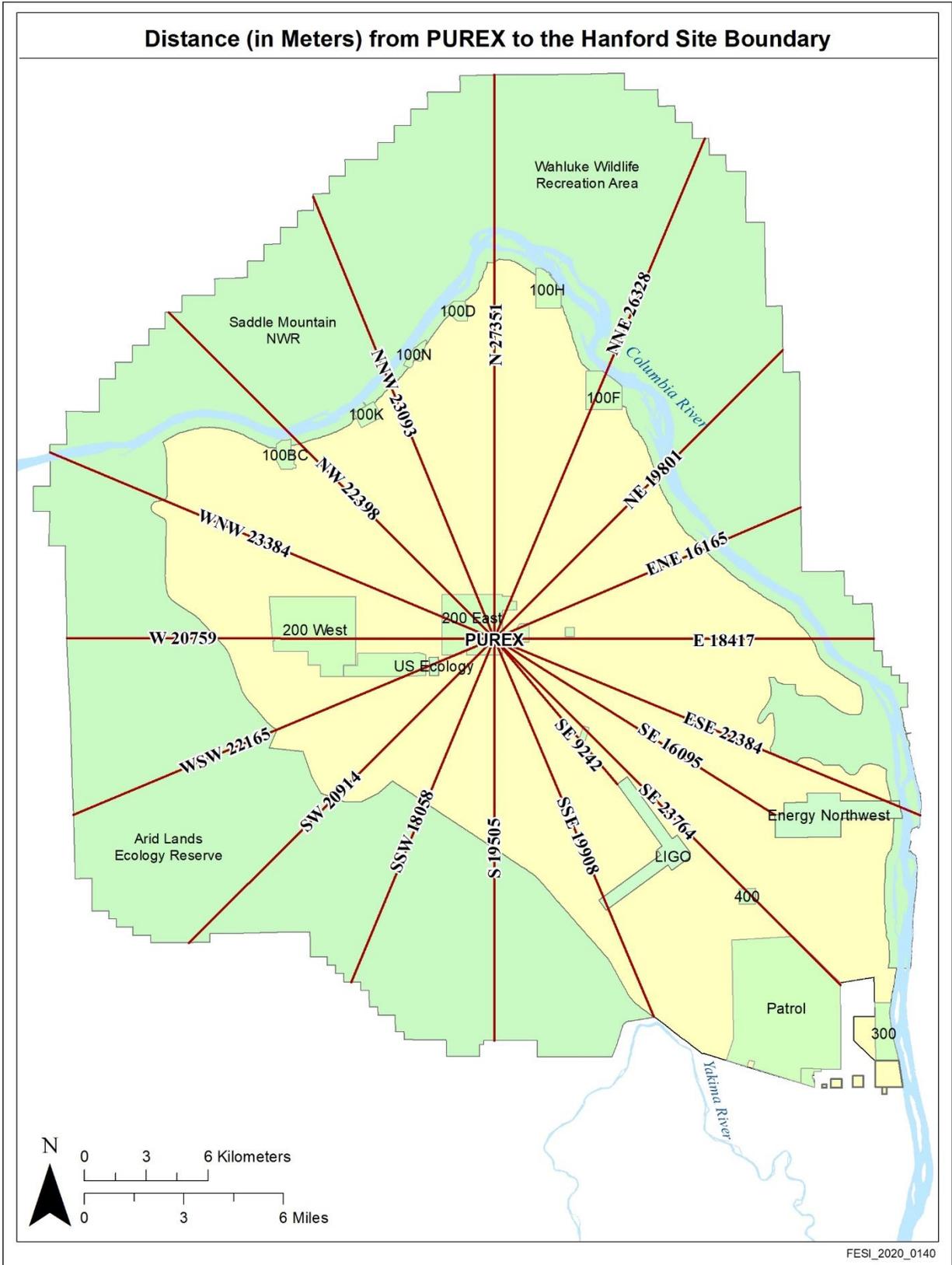
Comments=Formatted 10/21/14 SFS, Created 07/24/14 KWB; Windspeed Classes (m/s): .89 2.65 4.7

7.15 9.8 12.7 15.6 19.0

## **Appendix B**

### **Map Showing Distance to the Maximally Exposed Individual from the Plutonium Uranium Extraction Complex**

This page intentionally left blank.



This page intentionally left blank.

## **Appendix C**

### **CAP88-PC Synopsis and Summary Reports for the 291A001 Stack – Offsite Maximally Exposed Individual**

This page intentionally left blank.

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 Jul 30 13:42:00 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Point source (stack) emissions - Offsite

Committed Effective Dose Equivalent  
(mrem)

---

5.53E-01

---

At This Location: 22384 Meters East Southeast

Dataset Name: 202A\_StackOffsit  
Dataset Date: Jul 30, 2020 01:41 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\al3200HMS61.wnd

Thu Jul 30 13:42:00 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 22384 Meters East Southeast  
 Lifetime Fatal Cancer Risk: 6.05E-08

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

Organ	Dose Equivalent (mrem)
Adrenal	1.35E-01
UB_Wall	1.42E-01
Bone_Sur	1.41E+01
Brain	1.28E-01
Breasts	1.31E-01
St_Wall	1.36E-01
SI_Wall	1.38E-01
ULI_Wall	1.52E-01
LLI_Wall	2.03E-01
Kidneys	1.73E-01
Liver	1.89E+00
Muscle	1.39E-01
Ovaries	3.28E-01
Pancreas	1.35E-01
R_Marrow	1.06E+00
Skin	1.11E+00
Spleen	1.36E-01
Testes	3.29E-01
Thymus	1.34E-01
Thyroid	1.39E-01
GB_Wall	1.34E-01
Ht_Wall	1.36E-01
Uterus	1.38E-01
ET_Reg	1.69E-01
Lung_66	3.31E-01
Effectiv	5.53E-01

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	3.1E-02	3.1E-02
Pu-239	M	1.000	1.5E-01	1.5E-01
Pu-240	M	1.000	8.5E-02	8.5E-02
Pu-241	M	1.000	6.7E-01	6.7E-01
Am-241	M	1.000	2.5E-01	2.5E-01
Sr-90	M	1.000	1.3E+00	1.3E+00
Cs-137	F	1.000	1.6E+00	1.6E+00

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, 22384 meters

Thu Jul 30 13:42:00 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1  


---

Stack Height (m): 60.96  
Diameter (m): 2.13  
  
Plume Rise  
Momentum (m/s): 3.77  
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
	<hr/>	<hr/>	<hr/>
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

16165	18058	18417	19505	19801	19908	20759
20914	22165	22384	22398	23093	23384	23764
26328	27351					

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 Jul 30 13:42:00 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Point source (stack) emissions - Offsite

Dataset Name: 202A\_StackOffsit  
Dataset Date: Jul 30, 2020 01:41 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\al3200HMS61.wnd

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	1.35E-01
UB_Wall	1.42E-01
Bone_Sur	1.41E+01
Brain	1.28E-01
Breasts	1.31E-01
St_Wall	1.36E-01
SI_Wall	1.38E-01
ULI_Wall	1.52E-01
LLI_Wall	2.03E-01
Kidneys	1.73E-01
Liver	1.89E+00
Muscle	1.39E-01
Ovaries	3.28E-01
Pancreas	1.35E-01
R_Marrow	1.06E+00
Skin	1.11E+00
Spleen	1.36E-01
Testes	3.29E-01
Thymus	1.34E-01
Thyroid	1.39E-01
GB_Wall	1.34E-01
Ht_Wall	1.36E-01
Uterus	1.38E-01
ET_Reg	1.69E-01
Lung_66	3.31E-01
Effectiv	5.53E-01

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	1.37E-01
INHALATION	3.51E-01
AIR IMMERSION	3.67E-06
GROUND SURFACE	6.48E-02
INTERNAL	4.88E-01
EXTERNAL	6.48E-02
TOTAL	5.53E-01

Thu Jul 30 13:42:00 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	2.15E-02
U-234	9.36E-11
Th-230	1.47E-14
Ra-226	7.95E-16
Rn-222	4.42E-17
Pu-239	1.13E-01
U-235m	0.00E+00
U-235	4.49E-11
Th-231	4.58E-12
Pa-231	3.36E-15
Pu-240	6.47E-02
U-236	2.52E-12
Th-232	1.76E-21
Ra-228	1.78E-21
Ac-228	2.03E-18
Pu-241	9.29E-03
Am-241	1.54E-01
U-237	8.91E-08
Np-237	4.04E-09
Pa-233	3.33E-08
U-233	5.00E-15
Th-229	9.09E-16
Sr-90	6.58E-02
Y-90	8.78E-03
Cs-137	6.08E-02
Ba-137m	5.51E-02
TOTAL	5.53E-01

Thu Jul 30 13:42:00 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	2.93E-09
INHALATION	2.65E-08
AIR IMMERSION	1.99E-12
GROUND SURFACE	3.12E-08
INTERNAL	2.94E-08
EXTERNAL	3.12E-08
TOTAL	6.05E-08

Thu Jul 30 13:42:00 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	1.85E-09
U-234	3.23E-17
Th-230	6.24E-21
Ra-226	4.32E-22
Rn-222	2.41E-23
Pu-239	8.33E-09
U-235m	0.00E+00
U-235	2.43E-17
Th-231	2.09E-18
Pa-231	1.75E-21
Pu-240	5.06E-09
U-236	8.26E-19
Th-232	6.89E-28
Ra-228	5.40E-28
Ac-228	1.08E-24
Pu-241	4.03E-10
Am-241	1.16E-08
U-237	4.72E-14
Np-237	1.99E-15
Pa-233	1.80E-14
U-233	2.06E-21
Th-229	4.81E-22
Sr-90	1.42E-09
Y-90	1.05E-09
Cs-137	1.01E-09
Ba-137m	2.98E-08
TOTAL	6.05E-08

Thu Jul 30 13:42:00 2020

SUMMARY  
Page 5

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

Direction	Distance (m)						
	16165	18058	18417	19505	19801	19908	20759
N	2.2E-01	1.9E-01	1.9E-01	1.7E-01	1.7E-01	1.7E-01	1.6E-01
NNW	2.5E-01	2.2E-01	2.2E-01	2.0E-01	2.0E-01	2.0E-01	1.9E-01
NW	3.3E-01	2.9E-01	2.8E-01	2.6E-01	2.6E-01	2.6E-01	2.4E-01
WNW	2.6E-01	2.3E-01	2.3E-01	2.1E-01	2.0E-01	2.0E-01	1.9E-01
W	2.5E-01	2.1E-01	2.1E-01	1.9E-01	1.9E-01	1.9E-01	<u>1.8E-01</u>
WSW	2.1E-01	1.8E-01	1.8E-01	1.6E-01	1.6E-01	1.6E-01	1.5E-01
SW	2.4E-01	2.1E-01	2.0E-01	1.9E-01	1.8E-01	1.8E-01	1.7E-01
SSW	2.7E-01	<u>2.3E-01</u>	2.3E-01	2.1E-01	2.1E-01	2.1E-01	2.0E-01
S	3.1E-01	2.7E-01	2.6E-01	<u>2.5E-01</u>	2.4E-01	2.4E-01	2.3E-01
SSE	3.9E-01	3.4E-01	3.3E-01	3.1E-01	3.0E-01	<u>3.0E-01</u>	2.8E-01
SE	6.5E-01	5.7E-01	5.6E-01	5.2E-01	5.1E-01	5.1E-01	4.8E-01
ESE	7.9E-01	7.0E-01	6.9E-01	6.5E-01	6.3E-01	6.3E-01	6.0E-01
E	5.0E-01	4.4E-01	<u>4.3E-01</u>	4.1E-01	4.0E-01	4.0E-01	3.8E-01
ENE	<u>3.8E-01</u>	3.4E-01	3.3E-01	3.1E-01	3.0E-01	3.0E-01	2.9E-01
NE	3.0E-01	2.7E-01	2.6E-01	2.4E-01	<u>2.4E-01</u>	2.4E-01	2.3E-01
NNE	2.1E-01	1.9E-01	1.8E-01	1.7E-01	1.7E-01	1.7E-01	1.6E-01

Direction	Distance (m)						
	20914	22165	22384	22398	23093	23384	23764
N	1.6E-01	1.5E-01	1.5E-01	1.5E-01	1.4E-01	1.4E-01	1.4E-01
NNW	1.9E-01	1.7E-01	1.7E-01	1.7E-01	<u>1.7E-01</u>	1.6E-01	1.6E-01
NW	2.4E-01	2.2E-01	2.2E-01	<u>2.2E-01</u>	2.1E-01	2.1E-01	2.0E-01
WNW	1.9E-01	1.8E-01	1.7E-01	1.7E-01	1.7E-01	<u>1.7E-01</u>	1.6E-01
W	1.8E-01	1.6E-01	1.6E-01	1.6E-01	1.6E-01	1.5E-01	1.5E-01
WSW	1.5E-01	<u>1.4E-01</u>	1.4E-01	1.4E-01	1.3E-01	1.3E-01	1.3E-01
SW	<u>1.7E-01</u>	1.6E-01	1.6E-01	1.6E-01	1.5E-01	1.5E-01	1.4E-01
SSW	1.9E-01	1.8E-01	1.8E-01	1.8E-01	1.7E-01	1.7E-01	1.6E-01
S	2.2E-01	2.1E-01	2.1E-01	2.1E-01	2.0E-01	1.9E-01	1.9E-01
SSE	2.8E-01	2.6E-01	2.6E-01	2.6E-01	2.5E-01	2.5E-01	2.4E-01
SE	4.8E-01	4.5E-01	4.4E-01	4.4E-01	4.3E-01	4.2E-01	<u>4.1E-01</u>
ESE	6.0E-01	5.6E-01	<u>5.5E-01</u>	5.5E-01	5.3E-01	5.3E-01	5.2E-01
E	3.8E-01	3.5E-01	3.5E-01	3.5E-01	3.4E-01	3.3E-01	3.2E-01
ENE	2.9E-01	2.7E-01	2.7E-01	2.7E-01	2.6E-01	2.5E-01	2.5E-01
NE	2.2E-01	2.1E-01	2.1E-01	2.1E-01	2.0E-01	2.0E-01	1.9E-01
NNE	1.6E-01	1.5E-01	1.5E-01	1.5E-01	1.4E-01	1.4E-01	1.4E-01

Thu Jul 30 13:42:00 2020

SUMMARY  
Page 6

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

---

Distance (m)

---

Direction	26328	27351
N	1.2E-01	<u>1.2E-01</u>
NNW	1.4E-01	1.3E-01
NW	1.8E-01	1.7E-01
WNW	1.4E-01	1.4E-01
W	1.3E-01	1.3E-01
WSW	1.1E-01	1.1E-01
SW	1.3E-01	1.2E-01
SSW	1.4E-01	1.4E-01
S	1.7E-01	1.6E-01
SSE	2.1E-01	2.0E-01
SSE	3.7E-01	3.5E-01
ESE	4.6E-01	4.4E-01
E	2.9E-01	2.8E-01
ENE	2.2E-01	2.1E-01
NE	1.7E-01	1.6E-01
NNE	<u>1.2E-01</u>	1.1E-01

- 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.

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

---

	Distance (m)						
Direction	16165	18058	18417	19505	19801	19908	20759
N	2.4E-08	2.1E-08	2.0E-08	1.9E-08	1.9E-08	1.9E-08	1.8E-08
NNW	2.8E-08	2.5E-08	2.4E-08	2.2E-08	2.2E-08	2.2E-08	2.1E-08
NW	3.6E-08	3.2E-08	3.1E-08	2.9E-08	2.8E-08	2.8E-08	2.7E-08
WNW	2.9E-08	2.5E-08	2.5E-08	2.3E-08	2.3E-08	2.3E-08	2.1E-08
W	2.7E-08	2.4E-08	2.3E-08	2.1E-08	2.1E-08	2.1E-08	2.0E-08
WSW	2.3E-08	2.0E-08	2.0E-08	1.8E-08	1.8E-08	1.8E-08	1.7E-08
SW	2.7E-08	2.3E-08	2.2E-08	2.1E-08	2.0E-08	2.0E-08	1.9E-08
SSW	3.0E-08	2.6E-08	2.5E-08	2.3E-08	2.3E-08	2.3E-08	2.2E-08
S	3.4E-08	3.0E-08	2.9E-08	2.7E-08	2.7E-08	2.6E-08	2.5E-08
SSE	4.3E-08	3.7E-08	3.6E-08	3.4E-08	3.3E-08	3.3E-08	3.1E-08
SE	7.1E-08	6.3E-08	6.1E-08	5.7E-08	5.6E-08	5.6E-08	5.3E-08
ESE	8.7E-08	7.7E-08	7.5E-08	7.1E-08	6.9E-08	6.9E-08	6.6E-08
E	5.5E-08	4.8E-08	4.7E-08	4.4E-08	4.4E-08	4.3E-08	4.1E-08
ENE	4.2E-08	3.7E-08	3.6E-08	3.4E-08	3.3E-08	3.3E-08	3.2E-08
NE	3.3E-08	2.9E-08	2.9E-08	2.7E-08	2.6E-08	2.6E-08	2.5E-08
NNE	2.3E-08	2.1E-08	2.0E-08	1.9E-08	1.8E-08	1.8E-08	1.8E-08

---

	Distance (m)						
Direction	20914	22165	22384	22398	23093	23384	23764
N	1.8E-08	1.6E-08	1.6E-08	1.6E-08	1.6E-08	1.5E-08	1.5E-08
NNW	2.1E-08	1.9E-08	1.9E-08	1.9E-08	1.8E-08	1.8E-08	1.8E-08
NW	2.7E-08	2.5E-08	2.4E-08	2.4E-08	2.3E-08	2.3E-08	2.3E-08
WNW	2.1E-08	2.0E-08	1.9E-08	1.9E-08	1.9E-08	1.8E-08	1.8E-08
W	2.0E-08	1.8E-08	1.8E-08	1.8E-08	1.7E-08	1.7E-08	1.7E-08
WSW	1.7E-08	1.5E-08	1.5E-08	1.5E-08	1.5E-08	1.4E-08	1.4E-08
SW	1.9E-08	1.8E-08	1.7E-08	1.7E-08	1.7E-08	1.6E-08	1.6E-08
SSW	2.1E-08	2.0E-08	2.0E-08	2.0E-08	1.9E-08	1.9E-08	1.8E-08
S	2.5E-08	2.3E-08	2.3E-08	2.3E-08	2.2E-08	2.2E-08	2.1E-08
SSE	3.1E-08	2.9E-08	2.9E-08	2.9E-08	2.7E-08	2.7E-08	2.7E-08
SE	5.3E-08	4.9E-08	4.9E-08	4.9E-08	4.7E-08	4.6E-08	4.5E-08
ESE	6.5E-08	6.1E-08	6.1E-08	6.0E-08	5.8E-08	5.8E-08	5.7E-08
E	4.1E-08	3.8E-08	3.8E-08	3.8E-08	3.7E-08	3.6E-08	3.6E-08
ENE	3.1E-08	3.0E-08	2.9E-08	2.9E-08	2.8E-08	2.8E-08	2.7E-08
NE	2.5E-08	2.3E-08	2.3E-08	2.3E-08	2.2E-08	2.2E-08	2.1E-08
NNE	1.7E-08	1.6E-08	1.6E-08	1.6E-08	1.5E-08	1.5E-08	1.5E-08

---

Thu Jul 30 13:42:00 2020

SUMMARY

Page 8

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

---

	Distance (m)	
Direction	26328	27351
N	1.3E-08	1.3E-08
NNW	1.6E-08	1.5E-08
NW	2.0E-08	1.9E-08
WNW	1.6E-08	1.5E-08
W	1.5E-08	1.4E-08
WSW	1.2E-08	1.2E-08
SW	1.4E-08	1.3E-08
SSW	1.6E-08	1.5E-08
S	1.8E-08	1.8E-08
SSE	2.3E-08	2.2E-08
SE	4.0E-08	3.9E-08
ESE	5.0E-08	4.8E-08
E	3.2E-08	3.0E-08
ENE	2.5E-08	2.4E-08
NE	1.9E-08	1.8E-08
NNE	1.3E-08	1.3E-08

---

This page intentionally left blank.

## **Appendix D**

### **CAP88-PC Synopsis and Summary Reports for the 291A001 Stack – Onsite Maximally Exposed Individual**

This page intentionally left blank.

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 Jul 30 13:53:38 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Point source (stack) emissions - Onsite

Committed Effective Dose Equivalent  
(mrem)

---

1.21E+00

---

At This Location: 9242 Meters Southeast

Dataset Name: 202A\_StackOnsite  
Dataset Date: Jul 30, 2020 01:53 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\al3200HMS61.wnd

Thu Jul 30 13:53:38 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 9242 Meters Southeast  
 Lifetime Fatal Cancer Risk: 1.33E-07

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

Organ	Dose Equivalent (mrem)
Adrenal	2.96E-01
UB_Wall	3.13E-01
Bone_Sur	3.08E+01
Brain	2.81E-01
Breasts	2.89E-01
St_Wall	2.98E-01
SI_Wall	3.03E-01
ULI_Wall	3.35E-01
LLI_Wall	4.47E-01
Kidneys	3.81E-01
Liver	4.13E+00
Muscle	3.05E-01
Ovaries	7.19E-01
Pancreas	2.98E-01
R_Marrow	2.34E+00
Skin	2.44E+00
Spleen	2.99E-01
Testes	7.21E-01
Thymus	2.94E-01
Thyroid	3.06E-01
GB_Wall	2.96E-01
Ht_Wall	3.00E-01
Uterus	3.03E-01
ET_Reg	3.70E-01
Lung_66	7.26E-01
Effectiv	1.21E+00

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	3.1E-02	3.1E-02
Pu-239	M	1.000	1.5E-01	1.5E-01
Pu-240	M	1.000	8.5E-02	8.5E-02
Pu-241	M	1.000	6.7E-01	6.7E-01
Am-241	M	1.000	2.5E-01	2.5E-01
Sr-90	M	1.000	1.3E+00	1.3E+00
Cs-137	F	1.000	1.6E+00	1.6E+00

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): SE, 9242 meters

Thu Jul 30 13:53:38 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1  


---

Stack Height (m): 60.96  
Diameter (m): 2.13  
  
Plume Rise  
Momentum (m/s): 3.77  
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
	<hr/>	<hr/>	<hr/>
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

9242 16095

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 Jul 30 13:53:38 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Point source (stack) emissions - Onsite

Dataset Name: 202A\_StackOnsite  
Dataset Date: Jul 30, 2020 01:53 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\al3200HMS61.wnd

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	2.96E-01
UB_Wall	3.13E-01
Bone_Sur	3.08E+01
Brain	2.81E-01
Breasts	2.89E-01
St_Wall	2.98E-01
SI_Wall	3.03E-01
ULI_Wall	3.35E-01
LLI_Wall	4.47E-01
Kidneys	3.81E-01
Liver	4.13E+00
Muscle	3.05E-01
Ovaries	7.19E-01
Pancreas	2.98E-01
R_Marrow	2.34E+00
Skin	2.44E+00
Spleen	2.99E-01
Testes	7.21E-01
Thymus	2.94E-01
Thyroid	3.06E-01
GB_Wall	2.96E-01
Ht_Wall	3.00E-01
Uterus	3.03E-01
ET_Reg	3.70E-01
Lung_66	7.26E-01
Effectiv	1.21E+00

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	3.01E-01
INHALATION	7.68E-01
AIR IMMERSION	8.03E-06
GROUND SURFACE	1.43E-01
INTERNAL	1.07E+00
EXTERNAL	1.43E-01
TOTAL	1.21E+00

Thu Jul 30 13:53:38 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	4.71E-02
U-234	2.05E-10
Th-230	3.24E-14
Ra-226	1.75E-15
Rn-222	9.74E-17
Pu-239	2.47E-01
U-235m	0.00E+00
U-235	9.89E-11
Th-231	1.01E-11
Pa-231	7.40E-15
Pu-240	1.41E-01
U-236	5.53E-12
Th-232	3.88E-21
Ra-228	3.91E-21
Ac-228	4.47E-18
Pu-241	2.03E-02
Am-241	3.36E-01
U-237	1.96E-07
Np-237	8.90E-09
Pa-233	7.32E-08
U-233	1.10E-14
Th-229	2.00E-15
Sr-90	1.45E-01
Y-90	1.93E-02
Cs-137	1.34E-01
Ba-137m	1.21E-01
TOTAL	1.21E+00

Thu Jul 30 13:53:38 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	6.46E-09
INHALATION	5.79E-08
AIR IMMERSION	4.36E-12
GROUND SURFACE	6.86E-08
INTERNAL	6.43E-08
EXTERNAL	6.86E-08
TOTAL	1.33E-07

Thu Jul 30 13:53:38 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	4.04E-09
U-234	7.08E-17
Th-230	1.37E-20
Ra-226	9.51E-22
Rn-222	5.31E-23
Pu-239	1.82E-08
U-235m	0.00E+00
U-235	5.36E-17
Th-231	4.60E-18
Pa-231	3.86E-21
Pu-240	1.11E-08
U-236	1.81E-18
Th-232	1.52E-27
Ra-228	1.19E-27
Ac-228	2.38E-24
Pu-241	8.82E-10
Am-241	2.55E-08
U-237	1.04E-13
Np-237	4.37E-15
Pa-233	3.95E-14
U-233	4.53E-21
Th-229	1.06E-21
Sr-90	3.12E-09
Y-90	2.30E-09
Cs-137	2.23E-09
Ba-137m	6.56E-08
TOTAL	1.33E-07

Thu Jul 30 13:53:38 2020

SUMMARY  
Page 5

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

---

Distance (m)

---

Direction	9242	16095
N	4.1E-01	2.2E-01
NNW	4.8E-01	2.6E-01
NW	6.3E-01	3.3E-01
WNW	5.2E-01	2.7E-01
W	4.8E-01	2.5E-01
WSW	4.1E-01	2.1E-01
SW	4.8E-01	2.4E-01
SSW	5.3E-01	2.7E-01
S	6.1E-01	3.1E-01
SSE	7.4E-01	3.9E-01
SE	<u>1.2E+00</u>	<u>6.5E-01</u>
ESE	1.5E+00	8.0E-01
E	9.1E-01	5.0E-01
ENE	6.8E-01	3.8E-01
NE	5.6E-01	3.0E-01
NNE	4.0E-01	2.1E-01

---

- 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.

Thu Jul 30 13:53:38 2020

SUMMARY  
Page 6

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

---

	Distance (m)	
Direction	9242	16095
N	4.5E-08	2.4E-08
NNW	5.3E-08	2.8E-08
NW	7.0E-08	3.7E-08
WNW	5.7E-08	2.9E-08
W	5.3E-08	2.7E-08
WSW	4.6E-08	2.3E-08
SW	5.3E-08	2.7E-08
SSW	5.9E-08	3.0E-08
S	6.7E-08	3.5E-08
SSE	8.2E-08	4.3E-08
SE	1.3E-07	7.1E-08
ESE	1.6E-07	8.7E-08
E	9.9E-08	5.5E-08
ENE	7.5E-08	4.2E-08
NE	6.2E-08	3.3E-08
NNE	4.4E-08	2.4E-08

---

This page intentionally left blank.

## **Appendix E**

### **CAP88-PC Synopsis and Summary Reports for the 202A Annexes – Offsite Maximally Exposed Individual**

This page intentionally left blank.

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 Aug 13 08:32:15 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Diffuse (annex demo) emissions - Offsite

Committed Effective Dose Equivalent  
(mrem)

---

5.80E-06

---

At This Location: 22384 Meters East Southeast

Dataset Name: 202A\_AnnexOffsit  
Dataset Date: Aug 13, 2020 08:32 AM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200E10.WND

Thu Aug 13 08:32:15 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 22384 Meters East Southeast  
 Lifetime Fatal Cancer Risk: 9.59E-13

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

Organ	Dose Equivalent (mrem)
Adrenal	3.13E-06
UB_Wall	3.33E-06
Bone_Sur	4.97E-05
Brain	2.93E-06
Breasts	3.02E-06
St_Wall	3.15E-06
SI_Wall	3.20E-06
ULI_Wall	3.58E-06
LLI_Wall	4.95E-06
Kidneys	3.21E-06
Liver	5.75E-06
Muscle	3.23E-06
Ovaries	3.54E-06
Pancreas	3.14E-06
R_Marrow	1.56E-05
Skin	3.00E-05
Spleen	3.15E-06
Testes	3.54E-06
Thymus	3.09E-06
Thyroid	3.24E-06
GB_Wall	3.12E-06
Ht_Wall	3.17E-06
Uterus	3.21E-06
ET_Reg	3.04E-06
Lung_66	3.53E-06
Effectiv	5.80E-06

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	1.7E-08	1.7E-08
Pu-239	M	1.000	7.9E-08	7.9E-08
Pu-240	M	1.000	4.6E-08	4.6E-08
Pu-241	M	1.000	3.6E-07	3.6E-07
Am-241	M	1.000	1.3E-07	1.3E-07
Sr-90	M	1.000	1.4E-05	1.4E-05
Cs-137	F	1.000	1.8E-05	1.8E-05

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, 22384 meters

Thu Aug 13 08:32:15 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00  
Area (sq m): 4672.00

Plume Rise							
Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m):	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

16165	18058	18417	19505	19801	19908	20759
20914	22165	22384	22398	23093	23384	23764
26328	27351					

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 Aug 13 08:32:15 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Diffuse (annex demo) emissions - Offsite

Dataset Name: 202A\_AnnexOffsit  
Dataset Date: Aug 13, 2020 08:32 AM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\a13200E10.WND

Thu Aug 13 08:32:15 2020

SUMMARY  
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	3.13E-06
UB_Wall	3.33E-06
Bone_Sur	4.97E-05
Brain	2.93E-06
Breasts	3.02E-06
St_Wall	3.15E-06
SI_Wall	3.20E-06
ULI_Wall	3.58E-06
LLI_Wall	4.95E-06
Kidneys	3.21E-06
Liver	5.75E-06
Muscle	3.23E-06
Ovaries	3.54E-06
Pancreas	3.14E-06
R_Marrow	1.56E-05
Skin	3.00E-05
Spleen	3.15E-06
Testes	3.54E-06
Thymus	3.09E-06
Thyroid	3.24E-06
GB_Wall	3.12E-06
Ht_Wall	3.17E-06
Uterus	3.21E-06
ET_Reg	3.04E-06
Lung_66	3.53E-06
Effectiv	5.80E-06

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	3.48E-06
INHALATION	5.44E-07
AIR IMMERSION	1.13E-10
GROUND SURFACE	1.78E-06
INTERNAL	4.03E-06
EXTERNAL	1.78E-06
TOTAL	5.80E-06

Thu Aug 13 08:32:15 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	3.20E-08
U-234	1.25E-16
Th-230	1.96E-20
Ra-226	1.06E-21
Rn-222	5.90E-23
Pu-239	1.67E-07
U-235m	0.00E+00
U-235	5.97E-17
Th-231	6.09E-18
Pa-231	4.47E-21
Pu-240	9.60E-08
U-236	3.37E-18
Th-232	2.31E-27
Ra-228	2.33E-27
Ac-228	2.66E-24
Pu-241	1.38E-08
Am-241	2.28E-07
U-237	1.19E-13
Np-237	5.39E-15
Pa-233	4.43E-14
U-233	6.66E-21
Th-229	1.21E-21
Sr-90	1.82E-06
Y-90	2.43E-07
Cs-137	1.68E-06
Ba-137m	1.52E-06
TOTAL	5.80E-06

Thu Aug 13 08:32:15 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	5.97E-14
INHALATION	4.65E-14
AIR IMMERSION	6.13E-17
GROUND SURFACE	8.53E-13
INTERNAL	1.06E-13
EXTERNAL	8.53E-13
TOTAL	9.59E-13

Thu Aug 13 08:32:15 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	2.74E-15
U-234	4.33E-23
Th-230	8.33E-27
Ra-226	5.77E-28
Rn-222	3.22E-29
Pu-239	1.24E-14
U-235m	0.00E+00
U-235	3.23E-23
Th-231	2.78E-24
Pa-231	2.33E-27
Pu-240	7.48E-15
U-236	1.11E-24
Th-232	9.03E-34
Ra-228	7.07E-34
Ac-228	1.41E-30
Pu-241	5.99E-16
Am-241	1.72E-14
U-237	6.30E-20
Np-237	2.65E-21
Pa-233	2.39E-20
U-233	2.74E-27
Th-229	6.41E-28
Sr-90	3.99E-14
Y-90	2.89E-14
Cs-137	2.80E-14
Ba-137m	8.22E-13
TOTAL	9.59E-13

Thu Aug 13 08:32:15 2020

SUMMARY  
Page 5

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

Direction	Distance (m)						
	16165	18058	18417	19505	19801	19908	20759
N	2.2E-06	1.9E-06	1.9E-06	1.7E-06	1.7E-06	1.7E-06	1.6E-06
NNW	3.1E-06	2.7E-06	2.6E-06	2.4E-06	2.3E-06	2.3E-06	2.2E-06
NW	3.0E-06	2.6E-06	2.5E-06	2.3E-06	2.2E-06	2.2E-06	2.1E-06
WNW	2.0E-06	1.7E-06	1.7E-06	1.5E-06	1.5E-06	1.5E-06	1.4E-06
W	1.5E-06	1.3E-06	1.3E-06	1.2E-06	1.1E-06	1.1E-06	<u>1.1E-06</u>
WSW	1.1E-06	9.5E-07	9.2E-07	8.4E-07	8.3E-07	8.2E-07	7.7E-07
SW	1.0E-06	8.9E-07	8.6E-07	7.9E-07	7.7E-07	7.7E-07	7.2E-07
SSW	1.1E-06	<u>9.3E-07</u>	9.1E-07	8.3E-07	8.1E-07	8.1E-07	7.6E-07
S	1.4E-06	<u>1.2E-06</u>	1.1E-06	<u>1.0E-06</u>	1.0E-06	1.0E-06	9.5E-07
SSE	1.8E-06	1.5E-06	1.5E-06	1.4E-06	1.4E-06	<u>1.3E-06</u>	1.3E-06
SE	4.6E-06	4.0E-06	3.9E-06	3.6E-06	3.5E-06	3.5E-06	3.3E-06
ESE	8.9E-06	7.7E-06	7.5E-06	7.0E-06	6.9E-06	6.8E-06	6.5E-06
E	5.8E-06	5.0E-06	<u>4.9E-06</u>	4.5E-06	4.4E-06	4.4E-06	4.2E-06
ENE	<u>3.4E-06</u>	2.9E-06	2.8E-06	2.6E-06	2.6E-06	2.6E-06	2.4E-06
NE	2.2E-06	1.9E-06	1.9E-06	1.7E-06	<u>1.7E-06</u>	1.7E-06	1.6E-06
NNE	1.7E-06	1.5E-06	1.5E-06	1.3E-06	1.3E-06	1.3E-06	1.2E-06

Direction	Distance (m)						
	20914	22165	22384	22398	23093	23384	23764
N	1.6E-06	1.4E-06	1.4E-06	1.4E-06	1.3E-06	1.3E-06	1.2E-06
NNW	2.2E-06	2.0E-06	1.9E-06	1.9E-06	<u>1.8E-06</u>	1.8E-06	1.7E-06
NW	2.1E-06	1.9E-06	1.8E-06	<u>1.8E-06</u>	1.7E-06	1.7E-06	1.6E-06
WNW	1.4E-06	1.2E-06	1.2E-06	1.2E-06	1.2E-06	<u>1.1E-06</u>	1.1E-06
W	1.0E-06	9.4E-07	9.3E-07	9.3E-07	8.8E-07	8.6E-07	8.3E-07
WSW	7.6E-07	<u>6.9E-07</u>	6.8E-07	6.8E-07	6.4E-07	6.3E-07	6.1E-07
SW	<u>7.1E-07</u>	6.5E-07	6.4E-07	6.3E-07	6.0E-07	5.9E-07	5.7E-07
SSW	<u>7.5E-07</u>	6.9E-07	6.8E-07	6.8E-07	6.4E-07	6.3E-07	6.1E-07
S	9.4E-07	8.6E-07	8.5E-07	8.4E-07	8.0E-07	7.8E-07	7.6E-07
SSE	1.2E-06	1.1E-06	1.1E-06	1.1E-06	1.1E-06	1.0E-06	1.0E-06
SE	3.2E-06	3.0E-06	2.9E-06	2.9E-06	2.8E-06	2.7E-06	<u>2.6E-06</u>
ESE	6.4E-06	5.9E-06	<u>5.8E-06</u>	5.8E-06	5.5E-06	5.4E-06	<u>5.3E-06</u>
E	4.1E-06	3.8E-06	<u>3.7E-06</u>	3.7E-06	3.6E-06	3.5E-06	3.4E-06
ENE	2.4E-06	2.2E-06	2.2E-06	2.2E-06	2.0E-06	2.0E-06	1.9E-06
NE	1.6E-06	1.4E-06	1.4E-06	1.4E-06	1.3E-06	1.3E-06	1.3E-06
NNE	1.2E-06	1.1E-06	1.1E-06	1.1E-06	1.0E-06	1.0E-06	9.7E-07

Thu Aug 13 08:32:15 2020

SUMMARY  
Page 6

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

---

Distance (m)

---

Direction	26328	27351
N	9.6E-07	<u>9.2E-07</u>
NNW	1.3E-06	1.3E-06
NW	1.3E-06	1.2E-06
WNW	8.6E-07	8.2E-07
W	6.7E-07	6.3E-07
WSW	4.9E-07	4.7E-07
SW	4.7E-07	4.5E-07
SSW	5.1E-07	4.9E-07
S	6.3E-07	6.0E-07
SSE	8.2E-07	7.8E-07
SE	2.2E-06	2.1E-06
ESE	4.3E-06	4.1E-06
E	2.7E-06	2.6E-06
ENE	1.5E-06	1.5E-06
NE	1.0E-06	9.5E-07
NNE	<u>7.6E-07</u>	7.2E-07

---

- 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.

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

Direction	Distance (m)						
	16165	18058	18417	19505	19801	19908	20759
N	3.7E-13	3.2E-13	3.1E-13	2.9E-13	2.8E-13	2.8E-13	2.6E-13
NNW	5.1E-13	4.4E-13	4.3E-13	4.0E-13	3.9E-13	3.8E-13	3.6E-13
NW	4.9E-13	4.2E-13	4.1E-13	3.8E-13	3.7E-13	3.7E-13	3.5E-13
WNW	3.3E-13	2.8E-13	2.7E-13	2.5E-13	2.5E-13	2.4E-13	2.3E-13
W	2.5E-13	2.2E-13	2.1E-13	1.9E-13	1.9E-13	1.9E-13	1.7E-13
WSW	1.8E-13	1.6E-13	1.5E-13	1.4E-13	1.4E-13	1.4E-13	1.3E-13
SW	1.7E-13	1.5E-13	1.4E-13	1.3E-13	1.3E-13	1.3E-13	1.2E-13
SSW	1.8E-13	1.5E-13	1.5E-13	1.4E-13	1.4E-13	1.3E-13	1.3E-13
S	2.3E-13	1.9E-13	1.9E-13	1.7E-13	1.7E-13	1.7E-13	1.6E-13
SSE	3.0E-13	2.6E-13	2.5E-13	2.3E-13	2.2E-13	2.2E-13	2.1E-13
SE	7.6E-13	6.5E-13	6.4E-13	5.9E-13	5.8E-13	5.7E-13	5.4E-13
ESE	1.5E-12	1.3E-12	1.2E-12	1.2E-12	1.1E-12	1.1E-12	1.1E-12
E	9.5E-13	8.3E-13	8.1E-13	7.5E-13	7.4E-13	7.3E-13	6.9E-13
ENE	5.6E-13	4.8E-13	4.7E-13	4.4E-13	4.3E-13	4.2E-13	4.0E-13
NE	3.7E-13	3.2E-13	3.1E-13	2.9E-13	2.8E-13	2.8E-13	2.6E-13
NNE	2.9E-13	2.5E-13	2.4E-13	2.2E-13	2.2E-13	2.2E-13	2.0E-13

Direction	Distance (m)						
	20914	22165	22384	22398	23093	23384	23764
N	2.6E-13	2.3E-13	2.3E-13	2.3E-13	2.2E-13	2.1E-13	2.1E-13
NNW	3.6E-13	3.3E-13	3.2E-13	3.2E-13	3.0E-13	3.0E-13	2.9E-13
NW	3.4E-13	3.1E-13	3.1E-13	3.1E-13	2.9E-13	2.8E-13	2.7E-13
WNW	2.3E-13	2.1E-13	2.0E-13	2.0E-13	1.9E-13	1.9E-13	1.8E-13
W	1.7E-13	1.6E-13	1.5E-13	1.5E-13	1.5E-13	1.4E-13	1.4E-13
WSW	1.3E-13	1.1E-13	1.1E-13	1.1E-13	1.1E-13	1.0E-13	1.0E-13
SW	1.2E-13	1.1E-13	1.1E-13	1.1E-13	1.0E-13	9.8E-14	9.5E-14
SSW	1.2E-13	1.1E-13	1.1E-13	1.1E-13	1.1E-13	1.0E-13	1.0E-13
S	1.6E-13	1.4E-13	1.4E-13	1.4E-13	1.3E-13	1.3E-13	1.3E-13
SSE	2.1E-13	1.9E-13	1.9E-13	1.9E-13	1.8E-13	1.7E-13	1.7E-13
SE	5.3E-13	4.9E-13	4.8E-13	4.8E-13	4.6E-13	4.5E-13	4.4E-13
ESE	1.1E-12	9.7E-13	9.6E-13	9.6E-13	9.1E-13	9.0E-13	8.7E-13
E	6.8E-13	6.3E-13	6.2E-13	6.2E-13	5.9E-13	5.7E-13	5.6E-13
ENE	4.0E-13	3.6E-13	3.6E-13	3.6E-13	3.4E-13	3.3E-13	3.2E-13
NE	2.6E-13	2.4E-13	2.3E-13	2.3E-13	2.2E-13	2.2E-13	2.1E-13
NNE	2.0E-13	1.8E-13	1.8E-13	1.8E-13	1.7E-13	1.7E-13	1.6E-13

Thu Aug 13 08:32:15 2020

SUMMARY

Page 8

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

---

	Distance (m)	
Direction	26328	27351
N	1.6E-13	1.5E-13
NNW	2.2E-13	2.1E-13
NW	2.1E-13	2.0E-13
WNW	1.4E-13	1.4E-13
W	1.1E-13	1.1E-13
WSW	8.1E-14	7.7E-14
SW	7.8E-14	7.4E-14
SSW	8.5E-14	8.1E-14
S	1.0E-13	1.0E-13
SSE	1.4E-13	1.3E-13
SE	3.6E-13	3.4E-13
ESE	7.1E-13	6.8E-13
E	4.5E-13	4.3E-13
ENE	2.6E-13	2.4E-13
NE	1.7E-13	1.6E-13
NNE	1.3E-13	1.2E-13

---

This page intentionally left blank.

## **Appendix F**

### **CAP88-PC Synopsis and Summary Reports for the 202A Annexes – Onsite Maximally Exposed Individual**

This page intentionally left blank.

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 Aug 13 07:54:15 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Diffuse (annex demo) emissions - Onsite

Committed Effective Dose Equivalent  
(mrem)

---

9.47E-06

---

At This Location: 9242 Meters Southeast

Dataset Name: 202A\_AnnexOnsite  
Dataset Date: Aug 13, 2020 07:54 AM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200E10.WND

Thu Aug 13 07:54:15 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 9242 Meters Southeast  
 Lifetime Fatal Cancer Risk: 1.57E-12

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

Organ	Dose Equivalent (mrem)
Adrenal	5.11E-06
UB_Wall	5.45E-06
Bone_Sur	8.09E-05
Brain	4.79E-06
Breasts	4.94E-06
St_Wall	5.14E-06
SI_Wall	5.24E-06
ULI_Wall	5.86E-06
LLI_Wall	8.09E-06
Kidneys	5.25E-06
Liver	9.35E-06
Muscle	5.28E-06
Ovaries	5.79E-06
Pancreas	5.13E-06
R_Marrow	2.55E-05
Skin	4.91E-05
Spleen	5.15E-06
Testes	5.79E-06
Thymus	5.05E-06
Thyroid	5.30E-06
GB_Wall	5.09E-06
Ht_Wall	5.17E-06
Uterus	5.25E-06
ET_Reg	4.98E-06
Lung_66	5.76E-06
Effectiv	9.47E-06

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	1.7E-08	1.7E-08
Pu-239	M	1.000	7.9E-08	7.9E-08
Pu-240	M	1.000	4.6E-08	4.6E-08
Pu-241	M	1.000	3.6E-07	3.6E-07
Am-241	M	1.000	1.3E-07	1.3E-07
Sr-90	M	1.000	1.4E-05	1.4E-05
Cs-137	F	1.000	1.8E-05	1.8E-05

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): SE, 9242 meters

Thu Aug 13 07:54:15 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00  
Area (sq m): 4672.00

Plume Rise							
Pasquill Cat:	A	B	C	D	E	F	G
Fixed (m):	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

9242 16095

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 Aug 13 07:54:15 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Diffuse (annex demo) emissions - Onsite

Dataset Name: 202A\_AnnexOnsite  
Dataset Date: Aug 13, 2020 07:54 AM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\a13200E10.WND

Thu Aug 13 07:54:15 2020

SUMMARY  
Page 1

## ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	5.11E-06
UB_Wall	5.45E-06
Bone_Sur	8.09E-05
Brain	4.79E-06
Breasts	4.94E-06
St_Wall	5.14E-06
SI_Wall	5.24E-06
ULI_Wall	5.86E-06
LLI_Wall	8.09E-06
Kidneys	5.25E-06
Liver	9.35E-06
Muscle	5.28E-06
Ovaries	5.79E-06
Pancreas	5.13E-06
R_Marrow	2.55E-05
Skin	4.91E-05
Spleen	5.15E-06
Testes	5.79E-06
Thymus	5.05E-06
Thyroid	5.30E-06
GB_Wall	5.09E-06
Ht_Wall	5.17E-06
Uterus	5.25E-06
ET_Reg	4.98E-06
Lung_66	5.76E-06
Effectiv	9.47E-06

## PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	5.69E-06
INHALATION	8.78E-07
AIR IMMERSION	1.82E-10
GROUND SURFACE	2.90E-06
INTERNAL	6.57E-06
EXTERNAL	2.90E-06
TOTAL	9.47E-06

Thu Aug 13 07:54:15 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	5.16E-08
U-234	2.04E-16
Th-230	3.21E-20
Ra-226	1.73E-21
Rn-222	9.65E-23
Pu-239	2.69E-07
U-235m	0.00E+00
U-235	9.76E-17
Th-231	9.96E-18
Pa-231	7.31E-21
Pu-240	1.55E-07
U-236	5.49E-18
Th-232	3.84E-27
Ra-228	3.84E-27
Ac-228	4.39E-24
Pu-241	2.22E-08
Am-241	3.68E-07
U-237	1.94E-13
Np-237	8.81E-15
Pa-233	7.25E-14
U-233	1.09E-20
Th-229	1.98E-21
Sr-90	2.98E-06
Y-90	3.97E-07
Cs-137	2.74E-06
Ba-137m	2.49E-06
TOTAL	9.47E-06

Thu Aug 13 07:54:15 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	9.77E-14
INHALATION	7.50E-14
AIR IMMERSION	9.88E-17
GROUND SURFACE	1.39E-12
INTERNAL	1.73E-13
EXTERNAL	1.39E-12
TOTAL	1.57E-12

Thu Aug 13 07:54:15 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	4.42E-15
U-234	7.04E-23
Th-230	1.36E-26
Ra-226	9.43E-28
Rn-222	5.27E-29
Pu-239	2.00E-14
U-235m	0.00E+00
U-235	5.29E-23
Th-231	4.55E-24
Pa-231	3.81E-27
Pu-240	1.21E-14
U-236	1.80E-24
Th-232	1.50E-33
Ra-228	1.17E-33
Ac-228	2.33E-30
Pu-241	9.67E-16
Am-241	2.78E-14
U-237	1.03E-19
Np-237	4.33E-21
Pa-233	3.91E-20
U-233	4.48E-27
Th-229	1.05E-27
Sr-90	6.51E-14
Y-90	4.73E-14
Cs-137	4.57E-14
Ba-137m	1.34E-12
TOTAL	1.57E-12

Thu Aug 13 07:54:15 2020

SUMMARY  
Page 5

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

---

Distance (m)

---

Direction	9242	16095
N	4.7E-06	2.2E-06
NNW	6.4E-06	3.1E-06
NW	6.3E-06	3.0E-06
WNW	4.3E-06	2.0E-06
W	3.3E-06	1.5E-06
WSW	2.4E-06	1.1E-06
SW	2.3E-06	1.0E-06
SSW	2.3E-06	1.1E-06
S	2.9E-06	1.4E-06
SSE	3.9E-06	1.8E-06
SE	<u>9.5E-06</u>	<u>4.6E-06</u>
ESE	1.8E-05	8.9E-06
E	1.2E-05	5.8E-06
ENE	6.9E-06	3.4E-06
NE	4.7E-06	2.3E-06
NNE	3.7E-06	1.8E-06

---

- 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.

Thu Aug 13 07:54:15 2020

SUMMARY  
Page 6

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

---

	Distance (m)	
Direction	9242	16095
N	7.7E-13	3.7E-13
NNW	1.1E-12	5.1E-13
NW	1.0E-12	4.9E-13
WNW	7.1E-13	3.3E-13
W	5.4E-13	2.5E-13
WSW	4.0E-13	1.9E-13
SW	3.7E-13	1.7E-13
SSW	3.9E-13	1.8E-13
S	4.9E-13	2.3E-13
SSE	6.5E-13	3.0E-13
SE	1.6E-12	7.6E-13
ESE	3.0E-12	1.5E-12
E	1.9E-12	9.6E-13
ENE	1.1E-12	5.6E-13
NE	7.7E-13	3.7E-13
NNE	6.1E-13	2.9E-13

---

This page intentionally left blank.

## **Appendix G**

### **CAP88-PC Inputs for the 202A Building Exhauster**

This page intentionally left blank.

## G1 Introduction

This appendix identifies the following inputs to the CAP88-PC<sup>1</sup> models for the 202A Building exhauster scenario (Section 3.5.2 in the main text of this environmental calculation file [ECF]):

1. Wind data from the 200 East Area Weather Station #6 (10 m [33 ft]), for 2004 through 2013 (a13200E10.wnd; Appendix A in this ECF).
2. Lid height of 1,000 m (3,281 ft), which 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 (Holzworth, 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*).
3. The average annual precipitation for the Hanford Site from 1945 to 2018 was 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*.
4. The average annual temperature for the Hanford Site from 1945 to 2018 was 12.2°C (53.9°F), as reported in Table 1-1 of DOE/RL-2019-33.
5. The CAP88-PC default value for humidity of 8 g/m<sup>3</sup> was used. This value compares well to Hanford Site-specific historical data.
6. Radionuclide decay chains were limited to five (a CAP88-PC default).
7. Buildup time was set to 50 years 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*.
8. Distances to the maximum exposed individual at the Laser Interferometer Gravitational-Wave Observatory and Energy Northwest Columbia Generating Station (onsite) and at the Hanford Site boundary (offsite) from Appendix B in this ECF.
9. Exhauster model is assumed to be equivalent to the model recently used at the Plutonium Finishing Plant. The following exhauster specifications were taken from REG-0957, *PFM Exhauster Agreement*.
  - a. Height to the centerline of the horizontal exhaust duct is 3.71 m (146.25 in.).
  - b. Diameter of exhaust duct is 0.91 m (36 in.).
  - c. Maximum airflow of 9.44 m<sup>3</sup>/sec (20,000 ft<sup>3</sup>/min).
10. Exit velocity for the exhauster is calculated by dividing the exhauster airflow by the area of the exhaust duct and converting units:

$$V = \frac{20,000 \frac{ft^3}{min}}{60 \frac{sec}{min} \times \frac{\pi}{4} (3 ft)^2} = 47.16 \frac{ft}{sec} \times 0.3048 \frac{m}{ft} = 14.37 \frac{m}{sec}$$

---

<sup>1</sup> The CAP-88 (which stands for *Clean Air Act Assessment Package-1988*) computer model is a set of computer programs, databases, and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP-88 is a regulatory compliance tool under 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants." CAP88-PC (Version 4.0) allows modeling on a personal computer and is a recent version of the code.

11. The potential-to-emit (PTE) is calculated (Table G-1) assuming a 1 derived air concentration value upstream of the exhauster, airflow of 9.44 m<sup>3</sup>/sec (20,000 ft<sup>3</sup>/min) over 1 year, and isotopic percentages based on the 202A Building inventory in CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis*. The PTE values from Column G in the Table G-1 are the source inputs for the CAP88-PC models (Appendices H and I in this ECF).

**Table G-1. Potential-to-Emit Calculation for the 202A Building Exhauster**

A	B	C	D	E	F	G
Isotopes	Inventory <sup>a</sup> (Ci)	Percent of Inventory <sup>b</sup>	Isotopic DAC Value <sup>c</sup> (μCi/mL)	Inventory Percentage of Isotopic DAC Value at 1 DAC Uniformly Dispersed <sup>d</sup> (Ci/mL)	Exhauster Air Volume <sup>e</sup> (mL/yr)	PTE at 1 DAC and 20,000 ft <sup>3</sup> /min <sup>f</sup> (Ci/yr)
Pu-238	1.55E+02	0.77%	5.00E-11	3.84E-19	2.98E+14	1.14E-04
Pu-239	7.43E+02	3.69%	6.00E-11	2.21E-18	2.98E+14	6.58E-04
Pu-240	4.27E+02	2.12%	6.00E-11	1.27E-18	2.98E+14	3.78E-04
Pu-241	3.36E+03	16.65%	2.00E-09	3.33E-16	2.98E+14	9.91E-02
Am-241	1.23E+03	6.08%	5.00E-12	3.04E-19	2.98E+14	9.04E-05
Sr-90	6.35E+03	31.51%	1.00E-08	3.15E-15	2.98E+14	9.38E-01
Cs-137	7.90E+03	39.19%	8.00E-08	3.14E-14	2.98E+14	9.33E+00
<b>Totals</b>	<b>2.02E+04</b>	<b>100.0%</b>				<b>1.04E+01</b>

a. Inventory for 202A Building from Table C-6 of CP-14977, *Plutonium Uranium Extraction Facility Documented Safety Analysis*.

b. Percent of inventory is calculated: **Column C = Column B / Sum of Column B**

c. Highest isotopic DAC value from 10 CFR 835, "Occupational Radiation Protection," Appendix A, "Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities."

d. Inventory percentage of isotopic DAC value is calculated and units converted:

**Column E = Column C × Column D × CF1**

- CF1: 1 Ci = 1E+06 μCi

e. Exhauster air volume is calculated, and units converted: **Column F = Flow Rate × CF2 × CF3**

- Flow rate: 20,000 ft<sup>3</sup>/min (assumed exhauster flow rate)
- CF2: 1 year = 525,600 min (assumes 24/7 operation)
- CF3: 1 ft<sup>3</sup> = 28,316.85 mL

f. PTE at 1 DAC and 9.44 m<sup>3</sup>/sec (20,000 ft<sup>3</sup>/min) is calculated: **Column G = Column E × Column F**

DAC = derived air concentration

PTE = potential-to-emit

## G2 References

- 10 CFR 835, "Occupational Radiation Protection," Appendix A, "Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities," *Code of Federal Regulations*. Available at: <http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part835-appA.xml>.
- CP-14977, 2019, *Plutonium Uranium Extraction Facility Documented Safety Analysis*, Rev. 11, CH2M HILL Plateau Remediation Company, Richland, Washington.
- 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, 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.
- Holzworth, G.C., 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, AP-101, (NTIS Accession No. PB 207103), U.S. Environmental Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina. Available at: <https://www.nrc.gov/docs/ML1408/ML14084A177.pdf>.
- REG-0957, 2018, *PPF Exhauster Agreement*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

This page intentionally left blank.

## **Appendix H**

### **CAP88-PC Synopsis and Summary Reports for the 202A Building Exhauster – Offsite Maximally Exposed Individual**

This page intentionally left blank.

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 Jul 30 14:36:13 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Exhauster (1 DAC @ 20,000 cfm) emissions - Offsite

Committed Effective Dose Equivalent  
(mrem)

---

2.00E+00

---

At This Location: 22384 Meters East Southeast

Dataset Name: 202A\_ExhOffsite.  
Dataset Date: Jul 30, 2020 02:36 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200E10.wnd

Thu Jul 30 14:36:13 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 22384 Meters East Southeast  
 Lifetime Fatal Cancer Risk: 4.96E-07

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

Organ	Dose Equivalent (mrem)
Adrenal	1.76E+00
UB_Wall	1.85E+00
Bone_Sur	4.38E+00
Brain	1.64E+00
Breasts	1.70E+00
St_Wall	1.76E+00
SI_Wall	1.79E+00
ULI_Wall	1.85E+00
LLI_Wall	2.11E+00
Kidneys	1.78E+00
Liver	1.82E+00
Muscle	1.81E+00
Ovaries	1.84E+00
Pancreas	1.77E+00
R_Marrow	2.65E+00
Skin	5.42E+00
Spleen	1.77E+00
Testes	1.84E+00
Thymus	1.74E+00
Thyroid	1.82E+00
GB_Wall	1.75E+00
Ht_Wall	1.78E+00
Uterus	1.81E+00
ET_Reg	1.68E+00
Lung_66	1.77E+00
Effectiv	2.00E+00

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	1.1E-04	1.1E-04
Pu-239	M	1.000	6.6E-04	6.6E-04
Pu-240	M	1.000	3.8E-04	3.8E-04
Pu-241	M	1.000	9.9E-02	9.9E-02
Am-241	M	1.000	9.0E-05	9.0E-05
Sr-90	M	1.000	9.4E-01	9.4E-01
Cs-137	F	1.000	9.3E+00	9.3E+00

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, 22384 meters

Thu Jul 30 14:36:13 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1  


---

Stack Height (m): 3.71  
Diameter (m): 0.91  
  
Plume Rise  
Momentum (m/s): 14.37  
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
	<hr/>	<hr/>	<hr/>
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

16165	18058	18417	19505	19801	19908	20759
20914	22165	22384	22398	23093	23384	23764
26328	27351					

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 Jul 30 14:36:13 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Exhauster (1 DAC @ 20,000 cfm) emissions - Offsite

Dataset Name: 202A\_ExhOffsite.  
Dataset Date: Jul 30, 2020 02:36 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\a13200E10.wnd

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	1.76E+00
UB_Wall	1.85E+00
Bone_Sur	4.38E+00
Brain	1.64E+00
Breasts	1.70E+00
St_Wall	1.76E+00
SI_Wall	1.79E+00
ULI_Wall	1.85E+00
LLI_Wall	2.11E+00
Kidneys	1.78E+00
Liver	1.82E+00
Muscle	1.81E+00
Ovaries	1.84E+00
Pancreas	1.77E+00
R_Marrow	2.65E+00
Skin	5.42E+00
Spleen	1.77E+00
Testes	1.84E+00
Thymus	1.74E+00
Thyroid	1.82E+00
GB_Wall	1.75E+00
Ht_Wall	1.78E+00
Uterus	1.81E+00
ET_Reg	1.68E+00
Lung_66	1.77E+00
Effectiv	2.00E+00

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	1.09E+00
INHALATION	9.85E-03
AIR IMMERSION	6.49E-05
GROUND SURFACE	9.00E-01
INTERNAL	1.10E+00
EXTERNAL	9.00E-01
TOTAL	2.00E+00

Thu Jul 30 14:36:13 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	2.38E-04
U-234	9.32E-13
Th-230	1.46E-16
Ra-226	7.89E-18
Rn-222	4.39E-19
Pu-239	1.50E-03
U-235m	0.00E+00
U-235	5.35E-13
Th-231	5.45E-14
Pa-231	4.00E-17
Pu-240	8.60E-04
U-236	3.02E-14
Th-232	2.10E-23
Ra-228	2.12E-23
Ac-228	2.42E-20
Pu-241	4.12E-03
Am-241	1.81E-04
U-237	3.55E-08
Np-237	6.78E-11
Pa-233	5.58E-10
U-233	4.97E-18
Th-229	9.04E-19
Sr-90	1.31E-01
Y-90	1.75E-02
Cs-137	9.68E-01
Ba-137m	8.77E-01
TOTAL	2.00E+00

Thu Jul 30 14:36:13 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	1.74E-08
INHALATION	1.28E-09
AIR IMMERSION	3.54E-11
GROUND SURFACE	4.77E-07
INTERNAL	1.87E-08
EXTERNAL	4.77E-07
TOTAL	4.96E-07

Thu Jul 30 14:36:13 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	2.04E-11
U-234	3.21E-19
Th-230	6.19E-23
Ra-226	4.28E-24
Rn-222	2.39E-25
Pu-239	1.11E-10
U-235m	0.00E+00
U-235	2.90E-19
Th-231	2.49E-20
Pa-231	2.09E-23
Pu-240	6.71E-11
U-236	9.90E-21
Th-232	8.22E-30
Ra-228	6.44E-30
Ac-228	1.29E-26
Pu-241	1.79E-10
Am-241	1.79E-11
U-237	1.88E-14
Np-237	3.33E-17
Pa-233	3.01E-16
U-233	2.05E-24
Th-229	4.78E-25
Sr-90	2.87E-09
Y-90	2.08E-09
Cs-137	1.61E-08
Ba-137m	4.74E-07
TOTAL	4.96E-07

Thu Jul 30 14:36:13 2020

SUMMARY  
Page 5

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

---

	Distance (m)						
Direction	16165	18058	18417	19505	19801	19908	20759
N	8.5E-01	7.3E-01	7.1E-01	6.6E-01	6.4E-01	6.4E-01	6.0E-01
NNW	1.2E+00	1.0E+00	9.7E-01	9.0E-01	8.8E-01	8.7E-01	8.2E-01
NW	1.1E+00	9.9E-01	9.6E-01	8.9E-01	8.7E-01	8.6E-01	8.1E-01
WNW	7.8E-01	6.7E-01	6.5E-01	6.0E-01	5.8E-01	5.8E-01	5.4E-01
W	5.9E-01	5.0E-01	4.9E-01	4.5E-01	4.4E-01	4.4E-01	<u>4.1E-01</u>
WSW	4.3E-01	3.7E-01	3.6E-01	3.3E-01	3.2E-01	3.2E-01	3.0E-01
SW	3.9E-01	3.3E-01	3.2E-01	3.0E-01	2.9E-01	2.9E-01	2.7E-01
SSW	3.9E-01	<u>3.4E-01</u>	3.3E-01	3.0E-01	2.9E-01	2.9E-01	2.7E-01
S	5.0E-01	4.3E-01	4.2E-01	<u>3.8E-01</u>	3.8E-01	3.7E-01	3.5E-01
SSE	6.7E-01	5.8E-01	5.6E-01	<u>5.2E-01</u>	5.1E-01	<u>5.0E-01</u>	4.7E-01
SE	1.6E+00	1.4E+00	1.4E+00	1.3E+00	1.2E+00	1.2E+00	1.2E+00
ESE	3.1E+00	2.7E+00	2.6E+00	2.4E+00	2.4E+00	2.4E+00	2.2E+00
E	2.0E+00	1.8E+00	<u>1.7E+00</u>	1.6E+00	1.6E+00	1.6E+00	1.5E+00
ENE	<u>1.2E+00</u>	1.1E+00	1.0E+00	9.5E-01	9.3E-01	9.2E-01	8.7E-01
NE	8.4E-01	7.3E-01	7.1E-01	6.6E-01	<u>6.4E-01</u>	6.4E-01	6.0E-01
NNE	6.7E-01	5.8E-01	5.7E-01	5.2E-01	5.1E-01	5.1E-01	4.8E-01

---

	Distance (m)						
Direction	20914	22165	22384	22398	23093	23384	23764
N	5.9E-01	5.4E-01	5.3E-01	5.3E-01	5.0E-01	4.9E-01	4.7E-01
NNW	8.1E-01	7.4E-01	7.3E-01	7.3E-01	<u>6.9E-01</u>	6.7E-01	6.5E-01
NW	8.0E-01	7.3E-01	7.1E-01	<u>7.1E-01</u>	6.7E-01	6.6E-01	6.4E-01
WNW	5.4E-01	4.9E-01	4.8E-01	4.8E-01	4.5E-01	<u>4.4E-01</u>	4.3E-01
W	4.0E-01	3.7E-01	3.6E-01	3.6E-01	3.4E-01	3.3E-01	3.2E-01
WSW	3.0E-01	<u>2.7E-01</u>	2.6E-01	2.6E-01	2.5E-01	2.4E-01	2.4E-01
SW	<u>2.7E-01</u>	2.4E-01	2.4E-01	2.4E-01	2.3E-01	2.2E-01	2.2E-01
SSW	2.7E-01	2.5E-01	2.5E-01	2.4E-01	2.3E-01	2.3E-01	2.2E-01
S	3.5E-01	3.2E-01	3.1E-01	3.1E-01	3.0E-01	2.9E-01	2.8E-01
SSE	4.7E-01	4.3E-01	4.2E-01	4.2E-01	4.0E-01	3.9E-01	3.8E-01
SE	1.2E+00	1.1E+00	1.0E+00	1.0E+00	9.9E-01	9.7E-01	<u>9.4E-01</u>
ESE	2.2E+00	2.0E+00	<u>2.0E+00</u>	2.0E+00	1.9E+00	1.9E+00	1.8E+00
E	1.5E+00	1.3E+00	1.3E+00	1.3E+00	1.3E+00	1.2E+00	1.2E+00
ENE	8.6E-01	7.9E-01	7.8E-01	7.8E-01	7.4E-01	7.2E-01	7.0E-01
NE	5.9E-01	5.4E-01	5.3E-01	5.3E-01	5.0E-01	4.9E-01	4.8E-01
NNE	4.7E-01	4.3E-01	4.2E-01	4.2E-01	4.0E-01	3.9E-01	3.7E-01

---

Thu Jul 30 14:36:13 2020

SUMMARY  
Page 6

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

---

Distance (m)

---

Direction	26328	27351
N	3.7E-01	<u>3.6E-01</u>
NNW	5.1E-01	4.9E-01
NW	5.0E-01	4.8E-01
WNW	3.4E-01	3.3E-01
W	2.7E-01	2.5E-01
WSW	2.0E-01	1.9E-01
SW	1.8E-01	1.7E-01
SSW	1.9E-01	1.8E-01
S	2.4E-01	2.2E-01
SSE	3.1E-01	3.0E-01
SE	7.7E-01	7.4E-01
ESE	1.5E+00	1.4E+00
E	9.7E-01	9.2E-01
ENE	5.6E-01	5.4E-01
NE	3.8E-01	3.6E-01
NNE	<u>3.0E-01</u>	2.8E-01

- 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.

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

---

	Distance (m)						
Direction	16165	18058	18417	19505	19801	19908	20759
N	2.1E-07	1.8E-07	1.8E-07	1.6E-07	1.6E-07	1.6E-07	1.5E-07
NNW	2.9E-07	2.5E-07	2.4E-07	2.2E-07	2.2E-07	2.2E-07	2.0E-07
NW	2.8E-07	2.4E-07	2.4E-07	2.2E-07	2.1E-07	2.1E-07	2.0E-07
WNW	1.9E-07	1.7E-07	1.6E-07	1.5E-07	1.4E-07	1.4E-07	1.3E-07
W	1.5E-07	1.2E-07	1.2E-07	1.1E-07	1.1E-07	1.1E-07	1.0E-07
WSW	1.1E-07	9.1E-08	8.9E-08	8.1E-08	8.0E-08	7.9E-08	7.4E-08
SW	9.6E-08	8.2E-08	8.0E-08	7.3E-08	7.2E-08	7.1E-08	6.7E-08
SSW	9.7E-08	8.3E-08	8.1E-08	7.5E-08	7.3E-08	7.2E-08	6.8E-08
S	1.2E-07	1.1E-07	1.0E-07	9.5E-08	9.3E-08	9.2E-08	8.7E-08
SSE	1.7E-07	1.4E-07	1.4E-07	1.3E-07	1.3E-07	1.2E-07	1.2E-07
SE	4.0E-07	3.5E-07	3.4E-07	3.2E-07	3.1E-07	3.1E-07	2.9E-07
ESE	7.6E-07	6.6E-07	6.4E-07	6.0E-07	5.9E-07	5.8E-07	5.5E-07
E	5.0E-07	4.4E-07	4.3E-07	4.0E-07	3.9E-07	3.9E-07	3.6E-07
ENE	3.0E-07	2.6E-07	2.5E-07	2.3E-07	2.3E-07	2.3E-07	2.2E-07
NE	2.1E-07	1.8E-07	1.8E-07	1.6E-07	1.6E-07	1.6E-07	1.5E-07
NNE	1.7E-07	1.4E-07	1.4E-07	1.3E-07	1.3E-07	1.3E-07	1.2E-07

---

	Distance (m)						
Direction	20914	22165	22384	22398	23093	23384	23764
N	1.5E-07	1.3E-07	1.3E-07	1.3E-07	1.2E-07	1.2E-07	1.2E-07
NNW	2.0E-07	1.8E-07	1.8E-07	1.8E-07	1.7E-07	1.7E-07	1.6E-07
NW	2.0E-07	1.8E-07	1.8E-07	1.8E-07	1.7E-07	1.6E-07	1.6E-07
WNW	1.3E-07	1.2E-07	1.2E-07	1.2E-07	1.1E-07	1.1E-07	1.1E-07
W	1.0E-07	9.1E-08	9.0E-08	9.0E-08	8.5E-08	8.3E-08	8.0E-08
WSW	7.3E-08	6.7E-08	6.5E-08	6.5E-08	6.2E-08	6.0E-08	5.9E-08
SW	6.6E-08	6.0E-08	5.9E-08	5.9E-08	5.6E-08	5.5E-08	5.3E-08
SSW	6.7E-08	6.2E-08	6.1E-08	6.1E-08	5.8E-08	5.7E-08	5.5E-08
S	8.6E-08	7.8E-08	7.7E-08	7.7E-08	7.3E-08	7.2E-08	6.9E-08
SSE	1.2E-07	1.1E-07	1.0E-07	1.0E-07	9.8E-08	9.6E-08	9.3E-08
SE	2.9E-07	2.6E-07	2.6E-07	2.6E-07	2.5E-07	2.4E-07	2.3E-07
ESE	5.5E-07	5.0E-07	5.0E-07	5.0E-07	4.7E-07	4.6E-07	4.5E-07
E	3.6E-07	3.3E-07	3.3E-07	3.3E-07	3.1E-07	3.0E-07	3.0E-07
ENE	2.1E-07	2.0E-07	1.9E-07	1.9E-07	1.8E-07	1.8E-07	1.7E-07
NE	1.5E-07	1.3E-07	1.3E-07	1.3E-07	1.2E-07	1.2E-07	1.2E-07
NNE	1.2E-07	1.1E-07	1.0E-07	1.0E-07	9.8E-08	9.6E-08	9.2E-08

---

Thu Jul 30 14:36:13 2020

SUMMARY

Page 8

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

---

	Distance (m)	
Direction	26328	27351
N	9.3E-08	8.9E-08
NNW	1.3E-07	1.2E-07
NW	1.2E-07	1.2E-07
WNW	8.5E-08	8.1E-08
W	6.6E-08	6.3E-08
WSW	4.9E-08	4.6E-08
SW	4.5E-08	4.3E-08
SSW	4.7E-08	4.5E-08
S	5.8E-08	5.6E-08
SSE	7.7E-08	7.4E-08
SE	1.9E-07	1.8E-07
ESE	3.7E-07	3.5E-07
E	2.4E-07	2.3E-07
ENE	1.4E-07	1.3E-07
NE	9.4E-08	9.0E-08
NNE	7.4E-08	7.0E-08

---

This page intentionally left blank.

## **Appendix I**

### **CAP88-PC Synopsis and Summary Reports for the 202A Building Exhauster – Onsite Maximally Exposed Individual**

This page intentionally left blank.

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 Jul 30 14:20:29 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Exhauster (1 DAC @ 20,000 cfm) emissions - Onsite

Committed Effective Dose Equivalent  
(mrem)

---

3.33E+00

---

At This Location: 9242 Meters Southeast

Dataset Name: 202A\_ExhOnsite.  
Dataset Date: Jul 30, 2020 02:20 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind Files\a13200E10.wnd

Thu Jul 30 14:20:29 2020

SYNOPSIS

Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 9242 Meters Southeast  
 Lifetime Fatal Cancer Risk: 8.25E-07

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

Organ	Dose Equivalent (mrem)
Adrenal	2.92E+00
UB_Wall	3.08E+00
Bone_Sur	7.29E+00
Brain	2.74E+00
Breasts	2.82E+00
St_Wall	2.93E+00
SI_Wall	2.97E+00
ULI_Wall	3.08E+00
LLI_Wall	3.50E+00
Kidneys	2.95E+00
Liver	3.03E+00
Muscle	3.02E+00
Ovaries	3.06E+00
Pancreas	2.94E+00
R_Marrow	4.40E+00
Skin	9.02E+00
Spleen	2.95E+00
Testes	3.06E+00
Thymus	2.89E+00
Thyroid	3.03E+00
GB_Wall	2.91E+00
Ht_Wall	2.96E+00
Uterus	3.01E+00
ET_Reg	2.79E+00
Lung_66	2.94E+00
Effectiv	3.33E+00

ECF-HANFORD-20-0003, REV. 0

RADIONUCLIDE EMISSIONS DURING THE YEAR 2020

Nuclide	Type	Size	Source	
			#1 Ci/y	TOTAL Ci/y
Pu-238	M	1.000	1.1E-04	1.1E-04
Pu-239	M	1.000	6.6E-04	6.6E-04
Pu-240	M	1.000	3.8E-04	3.8E-04
Pu-241	M	1.000	9.9E-02	9.9E-02
Am-241	M	1.000	9.0E-05	9.0E-05
Sr-90	M	1.000	9.4E-01	9.4E-01
Cs-137	F	1.000	9.3E+00	9.3E+00

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): SE, 9242 meters

Thu Jul 30 14:20:29 2020

SYNOPSIS  
Page 2

SOURCE INFORMATION

Source Number: 1  


---

Stack Height (m): 3.71  
Diameter (m): 0.91  
  
Plume Rise  
Momentum (m/s): 14.37  
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
	<hr/>	<hr/>	<hr/>
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

9242 16095

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 Jul 30 14:20:29 2020

Facility: PUREX Complex (202A)  
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-2020-04  
Exhauster (1 DAC @ 20,000 cfm) emissions - Onsite

Dataset Name: 202A\_ExhOnsite.  
Dataset Date: Jul 30, 2020 02:20 PM  
Wind File: C:\Users\h0017518\Documents\CAP88\Wind  
Files\a13200E10.wnd

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenal	2.92E+00
UB_Wall	3.08E+00
Bone_Sur	7.29E+00
Brain	2.74E+00
Breasts	2.82E+00
St_Wall	2.93E+00
SI_Wall	2.97E+00
ULI_Wall	3.08E+00
LLI_Wall	3.50E+00
Kidneys	2.95E+00
Liver	3.03E+00
Muscle	3.02E+00
Ovaries	3.06E+00
Pancreas	2.94E+00
R_Marrow	4.40E+00
Skin	9.02E+00
Spleen	2.95E+00
Testes	3.06E+00
Thymus	2.89E+00
Thyroid	3.03E+00
GB_Wall	2.91E+00
Ht_Wall	2.96E+00
Uterus	3.01E+00
ET_Reg	2.79E+00
Lung_66	2.94E+00
Effectiv	3.33E+00

PATHWAY COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	1.82E+00
INHALATION	1.62E-02
AIR IMMERSION	1.07E-04
GROUND SURFACE	1.50E+00
INTERNAL	1.83E+00
EXTERNAL	1.50E+00
TOTAL	3.33E+00

Thu Jul 30 14:20:29 2020

SUMMARY

Page 2

## NUCLIDE COMMITTED EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
Pu-238	3.91E-04
U-234	1.54E-12
Th-230	2.43E-16
Ra-226	1.31E-17
Rn-222	7.30E-19
Pu-239	2.46E-03
U-235m	0.00E+00
U-235	8.90E-13
Th-231	9.08E-14
Pa-231	6.66E-17
Pu-240	1.41E-03
U-236	5.00E-14
Th-232	3.50E-23
Ra-228	3.53E-23
Ac-228	4.03E-20
Pu-241	6.78E-03
Am-241	2.97E-04
U-237	5.90E-08
Np-237	1.13E-10
Pa-233	9.28E-10
U-233	8.27E-18
Th-229	1.50E-18
Sr-90	2.18E-01
Y-90	2.91E-02
Cs-137	1.61E+00
Ba-137m	1.46E+00
TOTAL	3.33E+00

Thu Jul 30 14:20:29 2020

SUMMARY  
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
-----	-----
INGESTION	2.90E-08
INHALATION	2.11E-09
AIR IMMERSION	5.81E-11
GROUND SURFACE	7.93E-07
INTERNAL	3.11E-08
EXTERNAL	7.93E-07
TOTAL	8.25E-07

Thu Jul 30 14:20:29 2020

SUMMARY  
Page 4

## NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Pu-238	3.35E-11
U-234	5.32E-19
Th-230	1.03E-22
Ra-226	7.13E-24
Rn-222	3.98E-25
Pu-239	1.82E-10
U-235m	0.00E+00
U-235	4.82E-19
Th-231	4.14E-20
Pa-231	3.47E-23
Pu-240	1.10E-10
U-236	1.64E-20
Th-232	1.37E-29
Ra-228	1.07E-29
Ac-228	2.14E-26
Pu-241	2.95E-10
Am-241	2.95E-11
U-237	3.13E-14
Np-237	5.55E-17
Pa-233	5.01E-16
U-233	3.41E-24
Th-229	7.96E-25
Sr-90	4.77E-09
Y-90	3.46E-09
Cs-137	2.68E-08
Ba-137m	7.89E-07
TOTAL	8.25E-07

Thu Jul 30 14:20:29 2020

SUMMARY  
Page 5

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

---

Distance (m)

---

Direction	9242	16095
N	1.7E+00	8.5E-01
NNW	2.4E+00	1.2E+00
NW	2.4E+00	1.2E+00
WNW	1.6E+00	7.8E-01
W	1.2E+00	5.9E-01
WSW	9.1E-01	4.3E-01
SW	8.2E-01	3.9E-01
SSW	8.2E-01	3.9E-01
S	1.1E+00	5.0E-01
SSE	1.4E+00	6.8E-01
SE	<u>3.3E+00</u>	<u>1.6E+00</u>
ESE	6.1E+00	3.1E+00
E	4.1E+00	2.0E+00
ENE	2.4E+00	1.2E+00
NE	1.7E+00	8.5E-01
NNE	1.4E+00	6.8E-01

- 
- 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.

Thu Jul 30 14:20:29 2020

SUMMARY  
Page 6

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

---

	Distance (m)	
Direction	9242	16095
N	4.3E-07	2.1E-07
NNW	5.8E-07	2.9E-07
NW	5.8E-07	2.9E-07
WNW	4.0E-07	1.9E-07
W	3.0E-07	1.5E-07
WSW	2.2E-07	1.1E-07
SW	2.0E-07	9.6E-08
SSW	2.0E-07	9.7E-08
S	2.6E-07	1.2E-07
SSE	3.5E-07	1.7E-07
SE	8.2E-07	4.1E-07
ESE	1.5E-06	7.6E-07
E	1.0E-06	5.1E-07
ENE	6.0E-07	3.0E-07
NE	4.2E-07	2.1E-07
NNE	3.4E-07	1.7E-07

---

This page intentionally left blank.