



Department of Energy
Office of Science
Pacific Northwest Site Office
P.O. Box 350, K9-42
Richland, Washington 99352

JUN 18, 2024

24-PNSO-0183

Ms. Crystal D. Mathey, Acting Manager
Radioactive Air Emissions Section
State of Washington Department of Health
Office of Radiation Protection
309 Bradley Blvd., Suite 201 (MSIN: B1-42)
Richland, Washington 99352

Dear Ms. Mathey:

Enclosed for your information is the *PNNL-Richland Campus Radionuclide Air Emissions Report for Calendar Year 2023* (PNNL-20436-14). This report was prepared in compliance with Title 40, Code of Federal Regulations, Part 61, Subpart H, and with Washington Administrative Code, Chapter 246-247. The Pacific Northwest National Laboratory-Richland Campus Calendar Year (CY) 2023 effective dose equivalent to the maximally exposed individual due to routine operations, including fugitive emissions and radon, was 2.1E-05 mrem and is compliant with the federal and state standard of 10 mrem/yr. This report meets the CY 2023 PNNL Richland Campus annual reporting requirement for its operations under the Radioactive Air Emissions License – 005.

If you have any questions or require additional information regarding this submittal, please contact Mr. Tom McDermott, Pacific Northwest Site Office Operations Division, at (509) 372-4675.

Sincerely,

**Julie K.
Turner**

Julie K. Turner
Manager

Digitally signed by
Julie K. Turner
Date: 2024.06.18
11:49:52 -07'00'

OPS:TMM

Enclosure

cc w/encl: (See Page 2)

cc w/encl:

A. J. Abelman, WDOH
J. M. Barnett, PNNL
S. D. Berven, WDOH
J. W. Duling, PNNL
P. J. Martell, WDOH
J. McAuley, EPA R10
K. R. McFadden, EPA R10
J. P. Rishel, PNNL
J. M. Robinson, PNNL
C. N. Sanders, WDOH
S. F. Snyder, PNNL
M. J. Stephenson, PNNL
R. J. Utley, WDOH



PNNL-20436-14

PNNL-Richland Campus Radionuclide Air Emissions Report for Calendar Year 2023

June 2024

SF Snyder
LE Bisping
SG Ramos
LN Dinh
JM Barnett

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, 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 Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from
the Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062

www.osti.gov
ph: (865) 576-8401
fox: (865) 576-5728
email: reports@osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312

ph: (800) 553-NTIS (6847)
or (703) 605-6000
email: info@ntis.gov
Online ordering: <http://www.ntis.gov>

PNNL-Richland Campus Radionuclide Air Emissions Report for Calendar Year 2023

June 2024

SF Snyder
LE Bisping
SG Ramos
LN Dinh
JM Barnett

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99354

Summary

The U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory Richland campus (PNNL-Richland campus) facilities with the largest potential for radioactive air emissions are those at the Physical Sciences Facility. Operations conform to the Washington State Department of Health-issued Radioactive Air Emissions License-005.

This report documents radionuclide air emissions that result in the 2023 highest effective dose equivalent (EDE) to an offsite member of the public, referred to as the maximally exposed individual (MEI). The report has been prepared in compliance with the Code of Federal Regulations (CFR), Title 40, Protection of the Environment, Part 61, National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" and Washington Administrative Code (WAC) Chapter 246-247, "Radiation Protection—Air Emissions."

Federal regulations in 40 CFR 61, Subpart H, require the measurement and reporting of radionuclides emitted from DOE facilities and the resulting offsite dose from those emissions. While the regulations are intended for the measurement of point source emissions, they include fugitive emissions with regard to complying with the dose standard. The regulations impose a standard of 10 mrem/yr EDE, which is not to be exceeded. Washington State adopted the 40 CFR 61 standard of 10 mrem/yr EDE in its regulations and reporting of the EDE to the MEI from both point source emissions and any fugitive source emissions of radionuclides. WAC 246-247 further requires the reporting of radionuclide emissions, including radon, from all PNNL-Richland campus sources.

The total radiological dose to the MEI from all PNNL-Richland campus radionuclide emissions in 2023, including fugitive emissions and radon, is $2.1\text{E-}05$ mrem ($2.1\text{E-}07$ mSv) EDE, or more than 100,000 times less than the federal and state standard of 10 mrem/yr, with which the PNNL-Richland campus is in compliance. The PNNL-Richland campus MEI dose from 2023 routine emissions (excluding radon) from registered sources is $2.0\text{E-}05$ mrem ($2.0\text{E-}07$ mSv) EDE. The dose from radon emissions is $4.0\text{E-}07$ mrem ($4.0\text{E-}09$ mSv) EDE. No unplanned releases from campus facilities occurred in 2023.


For further information concerning this report, contact Thomas M. McDermott, DOE Pacific Northwest Site Office, by telephone at (509) 372-4675 or by email at tom.mcdermott@science.doe.gov.

Cover photo: Pre-installation air mixer, installed in EP-3430-01-S during CY2023.

CERTIFICATION of PNNL-20436-14
DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2023

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. See 18 U.S.C. 1001. [verbatim from 40 CFR 61, Subpart H, 61.94(b)(9)]

Julie K. Turner

 Digitally signed by Julie K. Turner
Date: 2024.06.18 11:51:04 -07'00'

Julie Turner, Manager
U.S. Department of Energy
Pacific Northwest Site Office

Date

Acronyms, Abbreviations, and Terms

Bq	becquerel(s)
campus	The land area permitted by WDOH under the RAEL-005. More formally, it is the “PNNL-Richland campus” and sometimes shortened to “Richland campus.”
CAP88-PC	Clean Air Act Assessment Package 1988-Personal Computer
CFR	Code of Federal Regulations
Ci	curie(s)
CY	calendar year
DOE	U.S. Department of Energy
DOE-SC	U.S. Department of Energy, Office of Science
ED	effective dose
EDE	effective dose equivalent
EIM	Environmental Information Management
GBq	gigabecquerel [1.0×10^9 Bq = 1 GBq]
HEPA	high-efficiency particulate air (filter)
LLS	low-level sources
Major	a radionuclide emission point source having a radiological dose potential of greater than 0.1 mrem/yr EDE, based on emissions that would result if all pollution-control equipment did not exist, but facility operations were otherwise normal
MEI	Maximally Exposed Individual
Minor	a radionuclide emission point source having a radiological dose potential of less than or equal to 0.1 mrem/yr EDE, based on emissions that would result if all pollution-control equipment did not exist, but facility operations were otherwise normal
mrem	millirem [i.e., 1.0×10^{-3} rem = 1.0E-03 rem]
mSv	millisievert
NA	not applicable
ND	not detected
NDRM	non-dispersible radioactive material
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
PIC	potential impact category
PNNL	Pacific Northwest National Laboratory
PSF	Physical Sciences Facility
QA	quality assurance
RAEL	Radioactive Air Emissions License
rem	roentgen equivalent man
SIOC	sources for instrument/operational checks
VRRM	volumetrically released radioactive material
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

Contents

Summary	ii
Acronyms, Abbreviations, and Terms.....	iv
1.0 Introduction	1.1
1.1 PNNL-Richland Campus Description	1.1
1.1.1 Historical Background.....	1.1
1.1.2 PNNL-Richland Campus Facilities.....	1.4
1.1.3 Facilities Adjacent to the PNNL-Richland Campus	1.6
1.2 Point Source Descriptions.....	1.6
1.2.1 Emission Point Characteristics	1.7
1.2.2 PNNL-Richland Campus Radiological Operations	1.8
2.0 Radionuclide Air Emissions	2.1
3.0 Dose Assessment	3.1
3.1 Description of Dose Model and Receptor Evaluation	3.1
3.2 Summary of Input Parameters	3.2
3.3 Meteorological Data	3.3
3.4 Compliance Assessment.....	3.4
3.4.1 40 CFR 61, Subpart H, Regulatory Standard.....	3.4
3.4.2 Washington Administrative Code.....	3.7
3.4.3 PNNL-Richland Campus and Hanford Site Subpart H Doses	3.7
3.5 Additional Compliance Information.....	3.8
3.5.1 Applicability of Stack Emissions Data to Air Emission Permits and Licenses	3.8
3.5.2 Approvals to Construct or Modify.....	3.8
3.5.3 Radon-220 and Radon-222 Emissions	3.8
3.5.4 Unplanned Releases of Radionuclides to the Atmosphere	3.8
4.0 Fugitive Sources of Emissions.....	4.1
5.0 Supplemental Information.....	5.1
5.1 Collective Dose Estimate	5.1
5.2 Compliance Status with 40 CFR, Subparts Q and T.....	5.1
5.3 Environmental Surveillance for the PNNL-Richland Campus	5.2
5.3.1 Ambient Air Surveillance.....	5.2
5.3.2 Ambient External Dose Monitoring	5.6
5.4 Quality Assurance Program Compliance Status.....	5.6
6.0 References.....	6.1
Appendix A – Dose Modeling and Meteorological Data.....	A.1
Appendix B – List of Radioactive Materials Handled or Potentially Handled at the PNNL- Richland Campus in 2023.....	B.1

Appendix C – Ambient Particulate Air Sampling Results for PNNL-Richland Campus Air
Surveillance in 2023 C.1

Figures

Figure 1.1. DOE-SC PNNL-Richland Campus Emission Units Locations 1.2
 Figure 1.2. Location of the Hanford Site in Relation to the PNNL-Richland Campus 1.3
 Figure 1.3. PNNL-Richland Campus Physical Sciences Facility (PSF) with Buildings
 Identified 1.5
 Figure 3.1. Locations of PNNL-Richland Campus Potential Receptors and MEI 3.3
 Figure 5.1. Air Surveillance Station Locations for the PNNL-Richland Campus 5.4

Tables

Table 1.1. PNNL-Richland Campus Licensed Buildings – 2023 1.4
 Table 1.2. Types of Emission Units under the DOE PNNL-Richland Campus License
 – 2023 1.5
 Table 1.3. PNNL-Richland Campus Registered Radioactive Air Emissions Units 1.7
 Table 1.4. Characteristics of Sampled Emission Points 1.8
 Table 2.1. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in
 2023 2.1
 Table 2.2. PNNL-Richland Campus Appendix D Calculated and Release Record
 Radionuclide Emissions (Ci) Resulting in 99.8% of the Offsite Dose from
 Minor Emissions Units and Fugitive Sources – 2023 2.2
 Table 2.3. Nonsignificant (0.2% of Offsite Dose Contributors) PNNL-Richland
 Campus Radionuclide Emissions (Ci) from Minor Emission Units and
 Fugitive Sources – 2023 2.3
 Table 2.4. PNNL-Richland Campus Radionuclide Emissions (Ci) in 2023 2.4
 Table 3.1. Receptor Locations for the PNNL-Richland Campus 3.2
 Table 3.2. Summary of Reported 2023 Doses 3.4
 Table 3.3. PNNL-Richland Campus 2023 Combined Radionuclide Emissions and
 Dose Contributions by Nuclide from Major and Minor Emission Units and
 Fugitive Emissions 3.5
 Table 3.4. Subpart H Dose Contributions from Each Registered Emission Point 3.6
 Table 3.5. Subpart H Doses to PNNL-Richland Campus MEI and Hanford Site MEI 3.8
 Table 5.1. Summary of 2023 Air Sampling Results 5.5
 Table 5.2. Summary List of QA-Related Documents 5.7

1.0 Introduction

This report documents calendar year (CY) 2023 radionuclide air emissions from the U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory Richland campus (hereafter, PNNL-Richland campus or campus), and the resulting effective dose equivalent (EDE) to the maximally exposed individual (MEI) member of the public. This document complies with reporting requirements in the Code of Federal Regulations (CFR), Title 40, Protection of the Environment, Part 61, National Emission Standards for Hazardous Air Pollutants, Subpart H (2002), “National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities,” and in Washington Administrative Code (WAC) Chapter 246-247 (2019), “Radiation Protection—Air Emissions.” This report satisfies the annual reporting requirements under the DOE PNNL-Richland campus license, Radioactive Air Emissions License (RAEL)-005, for CY2023 operations.

This report is available online at <https://science.osti.gov/pnso/Resources>.

Battelle Memorial Institute (Battelle) is contracted to operate PNNL for DOE-SC. Battelle manages operations at the PNNL-Richland campus and other leased/occupied research and office areas nearby. Activities at the campus include research and development in the physical, chemical, life, and environmental sciences, and relevant environmental monitoring.

1.1 PNNL-Richland Campus Description

The PNNL-Richland campus (PNSO 2013) is located in southeastern Washington State (Figure 1.1). It is adjacent to the much larger DOE Hanford Site (Figure 1.2). The campus occupies 1.2 mi² (3.0 km²) just south of the Hanford Site 300 Area, whereas the Hanford Site occupies about 580 mi² (1,500 km²).

The campus lies about 170 mi (275 km) east-northeast of Portland, Oregon; 170 mi (270 km) southeast of Seattle, Washington; and 125 mi (200 km) southwest of Spokane, Washington. Operations are permitted under RAEL-005 to perform radiological activities with potential air emissions.

The area south and east of the PNNL-Richland campus is developed with office, laboratory, residential, and retail space. The Columbia River borders the northern campus to the east. Environmental conditions of non-operational Hanford Site areas are also characteristic of the campus. More in-depth discussions on the characteristics of the Hanford Site are available in the Hanford Site National Environmental Policy Act characterization (Duncan et al. 2007).

1.1.1 Historical Background

In December 2003, DOE assigned responsibility to the Pacific Northwest Site Office within DOE-SC to oversee the operation of PNNL, which was established in 1965. Battelle is contracted to DOE to operate PNNL (contract DE-AC06-76RL01830) and has operated PNNL since 1965. The PNNL-Richland campus (orange boundary) includes active emission units in the Physical Sciences Facility (PSF), as identified in Figure 1.1.



Figure 1.1. DOE-SC PNNL-Richland Campus Emission Units Locations

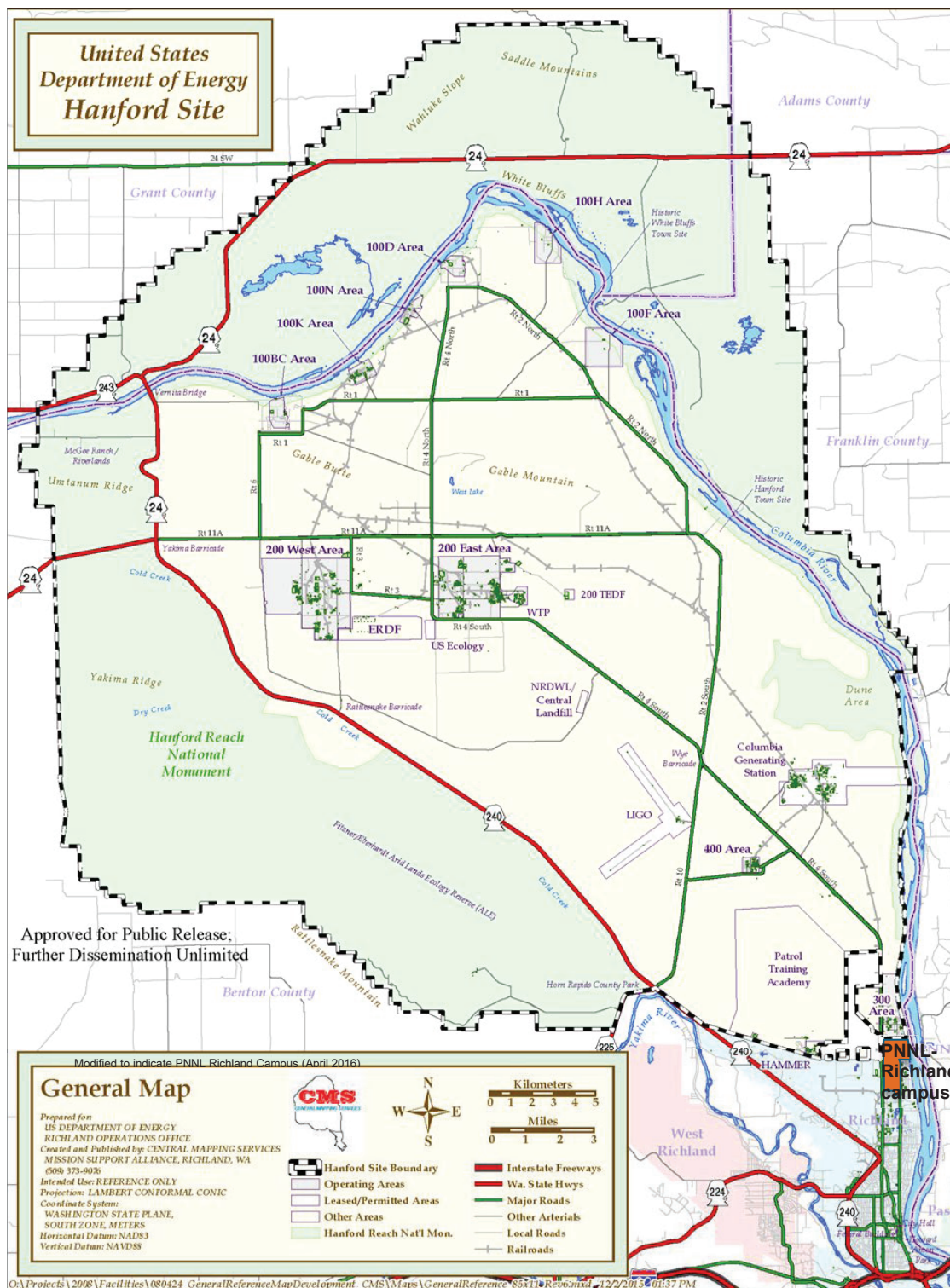


Figure 1.2. Location of the Hanford Site in Relation to the PNNL-Richland Campus

The buildings or areas with emission units subject to 40 CFR 61, Subpart H, reporting are listed in Table 1.1. As a group of research buildings, the PSF buildings host changing types of research. Section 1.2.2 provides more detailed descriptions of the buildings with emission units subject to 40 CFR 61, Subpart H (2002), reporting.

Table 1.1. PNNL-Richland Campus Licensed Buildings – 2023

Building	Start Date of DOE-SC Radiological Operations
3410 Building – Materials Sciences and Technology Laboratory	August 2010
3420 Building – Radiation Detection Laboratory	August 2010
3425 Building – Underground Laboratory	October 2010
3430 Building – Ultra-Trace Laboratory	July 2010

The Hanford Site history is briefly described here because of its location adjacent to the PNNL-Richland campus and because it is a source of radiological airborne emissions. From the mid-1940s, facilities at the Hanford Site were dedicated to producing plutonium for national defense and to managing the radioactive and chemical wastes generated from those production processes. More recently, major efforts have been underway to clean up contamination in the environment and facilities resulting from past operational practices and the research and development of new and improved waste disposal technologies. The Hanford Site 300 Area, which is closest to the PNNL-Richland campus, contains research and development laboratories and ongoing remediation operations. The two principal DOE Offices that manage programs at the Hanford Site are the Richland Operations Office and the Office of River Protection; the Pacific Northwest Site Office manages PNNL, which operates several Hanford Site 300 Area locations with radiological operations.

1.1.2 PNNL-Richland Campus Facilities

Point source emission units are identified as major or minor. Other emissions are identified as a fugitive emission. The identifier for the emission unit considers whether radiological emissions are expected to expose a member of the public to a potential dose greater or less than 0.1 millirem per year (mrem/yr). A point source is designated *major* when hypothetically, in the absence of all abatement-control equipment, its potential maximum emissions can cause a dose greater than 0.1 mrem/yr (0.001 mSv/yr) EDE¹ to the nearest member of the public not employed by DOE or its contractors associated with the PNNL-Richland campus and who lives near and/or has unrestricted access to a place of employment on the campus. A point source is *minor* when under the same conditions its potential maximum emissions in the absence of all abatement-control equipment cannot cause a dose greater than 0.1 mrem/yr EDE. A source could be characterized as a fugitive emission if a potential source of radioactive material is not actively monitored or ventilated at the point of release.² Fugitive sources of radionuclide emissions are generally those that are not actively ventilated, not sealed to prevent the escape of volatile or resuspended radioactive material to the ambient air, and not as amenable to controlled routine sampling, as is done with stacks. Potential unabated emissions from campus fugitive source locations would be expected to have an extremely small dose impact, even under worst-case release conditions.

Activity and dose information is generally reported to two significant digits. An annual dose rate of less than 1.0E-04 mrem/yr (1.0E-06 mSv/yr) is very low and may be rounded to one significant digit (e.g., 3.9E-05 mrem would be rounded to 4E-05 mrem [4E-07mSv]). More significant digits may be reported if they provide informative resolution or if the value is significantly larger than most of the other values reported with it (e.g., a 5.9723E+01 Ci K-40

¹ CAP88-PC Version 4.0, used for dose modeling, indicates dose as mrem/yr EDE in output files.

² Section 4.0 provides a more detailed discussion of fugitive emissions.

emission from one source and 2.4E-03 Ci K-40 emission from another). Reported totals may be slightly different from the sum of individual values in the text because the individual text values are rounded whereas the reported total uses additional, unreported, significant digits in the summed individual value.

Types of emission units under the license include both major and minor emission units as well as fugitive emissions. Fugitive emissions also include Potential Impact Category (PIC)-5 permits for campus-wide operations (Table 1.2; Figure 1.3 and Figure 1.1). PIC-5 emissions are very low potential-to-emit activities that are permitted under the license and conform to PNNL operational controls; emissions are conservatively reported as the permit maximum (Barnett 2018).

Table 1.2. Types of Emission Units under the DOE PNNL-Richland Campus License – 2023

Facility/Building ID	Building Name or Campus-wide Permit Name	Emission Unit Type(s)
PSF/ 3410	Materials Sciences and Technology Laboratory	Major
PSF/ 3420	Radiation Detection Laboratory	Major and Minor
PSF/ 3425	Underground Laboratory	Fugitive
PSF/ 3430	Ultra-Trace Laboratory	Major and Minor
Campus	Volumetrically Released Radioactive Material (VRRM; PIC-5)	Fugitive
	Non-dispersible Radioactive Material (NDRM; PIC-5)	Fugitive
	Facilities Restoration (PIC-5)	Fugitive
	Sources for Instrument/Operational Checks (SIOC; PIC-5) ^(a)	Fugitive

(a) Name reflects RAEL-005 nomenclature; historically referred to as Low-level Sources (LLS) PIC-5 emission unit.



Figure 1.3. PNNL-Richland Campus Physical Sciences Facility (PSF) with Buildings Identified

1.1.3 Facilities Adjacent to the PNNL-Richland Campus

Developed land adjacent to the PNNL-Richland campus is occupied by the Hanford Site (Figure 1.2), office and research facilities, and a smaller number of local businesses (e.g., restaurant, offices). Just north of the campus, the Hanford Site 300 Area hosts radiological operations. The current Hanford Site 300 Area activities include cleanup, research, and office support functions. Radiological emissions from the Hanford Site are described in the Hanford Site Radionuclide Air Emissions Report (Dyekman et al. 2024).

In addition to the Hanford Site, some privately and publicly owned facilities capable of generating airborne radionuclide emissions are located adjacent to or near the PNNL-Richland campus. These facilities include those that are on the Hanford Site but are not part of DOE operations: 1) a low-level waste burial site on the Hanford Site 200 Area plateau and 2) a commercial nuclear power reactor and associated buildings near the Columbia River, north of the Hanford Site 300 Area. In addition, nearby facilities include a tritium radiolabeling service south of the campus, a commercial nuclear reactor fuel fabrication facility, and a waste treatment business west of the campus, and a nuclear power plant commercial laundry service southwest of the campus. These facilities are discussed in this report to the extent necessary. Emissions from these facilities are not included in this report because they are regulated separately from the campus.

1.2 Point Source Descriptions

This section describes point sources that emit or have the potential to emit radionuclides at the PNNL-Richland campus. A point source is reported in this document if it met the following two criteria during 2023:

- Required continuous sampling or periodic confirmatory measurements (including 40 CFR 61, Appendix D calculations) in accordance with 40 CFR 61, Subpart H, and with WAC 246-247.
- Was described in the WDOH-issued RAEL-005 and remained a registered emission unit during 2023.

Table 1.3 lists the campus emission units registered with the WDOH for radiological emissions. During 2023, the EP-3430-01-S emission unit was modified to a three-fan system with an air blender to expand the exhaust capacity for the 3430 Building labs to accommodate ongoing and future research. Potential Impact Categories for each emission unit are provided (Barnett 2018).

Table 1.3. PNNL-Richland Campus Registered Radioactive Air Emissions Units

Building	Discharge Point ID	Discharge Point Description	Compliance Method ^(a)
3410	EP-3410-01-S	Major point source. Main stack. PIC-2.	Continuous sampling, Appendix D
3420	EP-3420-01-S	Major point source. Main stack. PIC-2.	Continuous sampling, Appendix D
	EP-3420-02-S	Minor point source. Areas not exhausted to main stack. Calculations used to determine radionuclide emissions in lieu of monitoring. PIC-4.	Appendix D
3425	J-3425	Fugitive emissions. Calculations used to determine radionuclide emissions in lieu of monitoring. PIC-4.	Appendix D
3430	EP-3430-01-S	Major point source. Main stack. PIC-2.	Continuous sampling, Appendix D
	EP-3430-02-S	Minor point source. Areas not exhausted to main stack. Calculations used to determine radionuclide emissions in lieu of monitoring. PIC-4.	Appendix D
Campus	J-VRRM	Volumetrically released radioactive material	PIC-5
	J-NDRM	Non-dispersible radioactive material	PIC-5
	J-Facilities Restoration	Facilities restoration	PIC-5
	J-SIOC	Sources for instrument/operational checks	PIC-5

(a) Appendix D means that values are calculated from in-facility material inventories and estimates and 40 CFR 61, Appendix D (1989). PIC-5 source compliance indicated per permit methods during years that the source is used.

1.2.1 Emission Point Characteristics

In general, radionuclide air emissions from point sources are discharged from stacks and vents. Table 1.4 provides the emission point characteristics for the sampled emission units. The effective discharge height of 3410-01-S used in modeling was 108 ft (32.8 m) and was applied to all PSF major stack emissions, as a conservative assumption. Neither the J-Facilities Restoration nor J-SIOC PIC-5 permits were implemented in 2022.

High-efficiency particulate air (HEPA) filters were the principal emission abatement method used at the major emission units to remove radioactive constituents from stack emissions. In general, one-stage of HEPA filtration was used as the final particulate-removal method before an air emission stream was exhausted to the atmosphere. (Table 1.4 lists the emission abatement technologies at sampled stacks.) The single-stage HEPA filter abatement technology listed in the table has a minimum acceptable test criteria rating of 99% efficient.

Table 1.4. Characteristics of Sampled Emission Points

Unit Type/ Emission Point ID	Average Flow Rate	Total Flow	Temper- ature	Physical Discharge Height	Physical Discharge Diameter	Effective Discharge Height	Abatement Technology
Major EP-3410-01-S	22,360 ft ³ /min (10.6 m ³ /s)	1.17E+10 ft ³ (3.31E+08 m ³)	77.7 °F (25.4 °C)	44 ft (13.5 m)	3.3 ft (1.0 m)	108 ft (32.8 m)	Single- stage HEPA filter
Major EP-3420-01-S	63,820 ft ³ /min (30.1 m ³ /s)	3.35E+10 ft ³ (9.49E+08 m ³)	64.1 °F (17.8 °C)	51 ft (15.5 m)	4.3 ft (1.3 m)	145 ft (44.1 m)	Single- stage HEPA filter
Major EP-3430-01-S	33,260 ft ³ /min (15.7 m ³ /s)	1.75E+10 ft ³ (4.96E+08 m ³)	59.7 °F (15.4 °C)	53 ft (16.2 m)	3.8 ft (1.2 m)	114 ft (34.8 m)	Single- stage HEPA filter

1.2.2 PNNL-Richland Campus Radiological Operations

This section describes the handling and processing of radioactive material in each facility on the PNNL-Richland campus.

Physical Sciences Facility Buildings

3410 Building – Materials Sciences and Technology Laboratory

The 3410 Building provides laboratory space and infrastructure for research associated with performance and life of materials in high-temperature, high-radiation, and corrosive environments found in next-generation technologies and applications for energy, construction, and transportation. Researchers work with metals, ceramics, polymeric materials, composites, and specialized coatings, and surface treatments to study these situations. Radioactive material emissions are discharged from this building through a major stack.

3420 Building – Radiation Detection Laboratory

The 3420 Building contains laboratories for a wide variety of radionuclide measurements. Projects support research in radionuclide measurement technologies, and capabilities used or under development include state-of-the-art analytical chemistry, radiation physics, light detection, particle detection, chromatography, scintillation materials, sorbents/“smart” materials, and field-deployable instrumentation. Applications for these capabilities range from fundamental science to applied systems. Radioactive material emissions are discharged from this building through either the major stack or the minor stack.

3425 Building – Underground Laboratory (Deep Lab)

The 3425 Building is an underground laboratory protected from background radiation to support the radiation detection capabilities in the 3420 Building. Research areas are located 40 ft (12 m) below ground. Projects support the development and advancement of radiation detection technologies. Additional activities include radiation physics experiments, development of ultra-low radioactivity materials, and other fundamental sciences studies. Radioactive material emissions from this building are fugitive emissions.

3430 Building – Ultra-Trace Laboratory

The 3430 Building provides ultra-trace radioanalytical capabilities for nuclear forensics. These capabilities include highly sensitive analytical systems such as mass spectrometers, optical microscopes, and electron microscopes to provide isotopic analyses and ultra-low-level radionuclide detection in a wide variety of sample matrices. Radioactive material emissions are discharged from this building through either the major stack or a minor stack

2.0 Radionuclide Air Emissions

This section presents information on quantities of radionuclide emissions on the PNNL-Richland campus. The sampled point sources listed are actively ventilated stacks using electrically powered exhausters and from which emissions are discharged under controlled conditions. Also included are minor and fugitive emission units.

Three tables are provided to indicate emissions from campus sources:

- Table 2.1 indicates emissions from sampled point sources on the campus in 2023.
- Minor point and fugitive source emissions are shown in two tables
 - Table 2.2 shows the emissions that resulted in 99.8% of the dose impact from minor and fugitive emission units, whereas
 - Table 2.3 shows the remaining 0.2%.

Table 2.4 summarizes the nuclide emissions from major sources and from minor, and fugitive sources that result in more than 99.8% of the total dose impact to the MEI. Appendix B lists the radioactive materials handled or potentially handled at the PNNL-Richland campus in 2023.

Table 2.1. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2023

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total (Ci)
gross $\alpha^{(a)}$	2.91E-08	7.85E-08	3.69E-08	1.4E-07
gross $\beta^{(a)}$	1.67E-07	8.38E-07	4.47E-07	1.5E-06
H-3 ^(b)	2.00E-05	NA	NA	2.0E-05
Al-26	NA	1.56E-08	NA	1.6E-08
Co-60	1.97E-08	ND	2.18E-08	4.1E-08
Xe-133 ^(b)	NA	1.65E-09	NA	1.7E-09
Xe-133m ^(b)	NA	2.47E-10	NA	2.5E-10
Xe-135 ^(b)	NA	7.24E-10	NA	7.2E-10
Ce-141	NA	2.75E-08	NA	2.8E-08
Rn-220 ^(b)	2.60E-03	NA	NA	2.6E-03
Rn-222 ^(b)	2.70E-09	NA	NA	2.7E-09
Th-229	2.18E-08	NA	NA	2.2E-08
U-233/234	2.43E-09	NA	8.67E-08 ^(c)	8.9E-08 ^(c)
Pu-238 ^(c)	1.89E-10	9.14E-09	NA	9.3E-09 ^(c)
Pu-239/240	1.22E-08	1.88E-08	1.32E-08 ^(c)	4.4E-08 ^(c)
Am-241 ^(c)	1.30E-10	6.28E-09	8.64E-10	7.3E-09 ^(c)
Am-243 ^(c)	7.81E-12	6.16E-11	NA	6.9E-11 ^(c)
Cm-243/244	2.43E-09	1.88E-08	1.39E-08	3.5E-08

NA = not applicable; ND = not detected.

To convert Ci to GBq, multiply Ci by 37.

(a) Maximum of the biweekly or composited average measurement.

(b) Value based on release records.

(c) Value based wholly or partially on calculated Appendix D methods of 40 CFR 61.

Table 2.2. PNNL-Richland Campus Appendix D Calculated and Release Record Radionuclide Emissions (Ci) Resulting in 99.8% of the Offsite Dose from Minor Emissions Units and Fugitive Sources – 2023^(a,b)

Nuclide	EP-3420-02-S 3420 Building PSF	EP-3430-02-S 3430 Building PSF	J-3425 3425 Building PSF	Total (Ci)
H-3 ^(a)	1.04E-12	4.10E-11	3.20E-13	4.2E-11
Al-26 ^(c)	NA	NA	NA	NA
Mn-54	8.30E-11	2.91E-10	NA	3.7E-10
Co-60	1.18E-10	2.10E-10	9.93E-11	4.3E-10
Zn-65	9.12E-11	4.32E-11	NA	1.3E-10
Br-82	NA	1.30E-08	NA	1.3E-08
Rb-83	5.00E-09	NA	NA	5.0E-09
Y-88	1.38E-10	3.96E-10	8.60E-11	6.2E-10
Cd-109	2.31E-10	1.17E-09	3.52E-12	1.4E-09
Cs-137	6.78E-11	1.95E-10	5.37E-11	3.2E-10
Ce-141 ^(c)	8.84E-12	NA	NA	8.8E-12
Pb-210	2.46E-10	8.89E-10	1.39E-10	1.3E-09
Rn-220 ^(d)	NA	NA	NA	NA
Rn-222 ^(d)	1.46E-07	NA	NA	1.5E-07
Th-229 ^(c)	NA	NA	NA	NA
Th-232	NA	3.00E-12	NA	3.0E-12
U-233/234	1.93E-08	6.50E-11	NA	1.9E-08
U-235 ^(c)	2.00E-15	1.68E-11	NA	1.7E-11
Pu-238 ^(c)	NA	8.84E-15	NA	8.8E-15
Pu-239/240 ^(c)	NA	8.43E-13	NA	8.4E-13
Am-241 ^(c)	4.04E-11	1.22E-10	1.08E-10	2.7E-10
Am-243 ^(c)	NA	1.18E-15	NA	1.2E-15
Cm-243/244 ^(c)	NA	NA	NA	NA

NA = not applicable.

To convert Ci to GBq, multiply Ci by 37.

- (a) Values are not from actual measurements but are calculated from in-facility material inventories and estimates (Snyder et al. 2021a; Snyder and Barnett 2016) and 40 CFR 61, Appendix D (1989). Values for gases are based on release records.
- (b) Listed nuclides account for 99.8% of dose impact from release record and Appendix D calculated minor and fugitive sources in 2023. In addition, nuclides sampled at major emission units that are also reported from listed stacks are included (see footnote c).
- (c) While not significant dose contributors, several nuclides are included for completeness. These include nuclides that are major emission unit sampled nuclides (Al-26, Ce-141, Th-229, Pu-238, Pu-239/240, Am-243, and Cm-243/244), a significant nuclide (Am-241), or gas emissions. Table 2.1 indicates major emission unit nuclides and emissions.
- (d) Radon dose to MEI; see Sections 3.4 and 3.5.3.

Table 2.3. Nonsignificant (0.2% of Offsite Dose Contributors) PNNL-Richland Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2023

Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)
Am-240	5.4E-12	Hg-203	2.7E-11	Ni-63	1.8E-12	Tb-161	3.5E-12
Ar-37	3.7E-12	I-131	1.6E-11	Os-191	3.7E-16	Tc-99	1.8E-12
Ba-133	9.9E-13	I-132	1.6E-10	P-32	1.1E-14	Tc-99m	1.6E-10
Ba-140	5.3E-11	I-133	3.8E-10	Pm-149	1.9E-11	Te-123m	7.0E-11
Ca-47	2.7E-13	I-135	1.9E-10	Pm-151	1.0E-11	Te-131m	4.2E-11
Ce-139	1.7E-11	Ir-192	3.9E-14	Pr-143	8.4E-12	Te-132	1.3E-10
Ce-143	3.0E-10	Ir-194	1.3E-15	Pu-241	1.2E-13	U-232	7.5E-13
Cl-36	1.8E-12	K-42	1.9E-12	Pu-242	4.8E-15	U-236	1.3E-12
Co-57	6.5E-11	Kr-83m	5.0E-09	Pu-244	4.6E-15	U-238	8.6E-13
Co-58	1.2E-13	Kr-85	8.6E-09	Re-188	7.4E-16	Xe-133	1.4E-07
Cr-51	1.5E-09	La-140	8.3E-12	Rh-105	2.4E-11	Xe-135	5.3E-10
Cs-134	1.1E-13	La-141	6.7E-11	Sm-151	1.6E-12	Xe-135m	1.6E-11
Cu-64	7.0E-14	Mn-56	1.8E-11	Sn-113	2.8E-10	Y-90	3.8E-14
Cu-67	7.6E-17	Mo-99	2.0E-10	Sr-85	3.7E-10	Y-91m	2.0E-10
Eu-152	5.4E-14	Nb-97	3.7E-10	Sr-89	1.6E-16	Y-92	1.4E-10
Fe-55	2.2E-13	Nb-97m	3.3E-10	Sr-90	1.8E-12	Y-93	3.5E-10
Fe-59	1.2E-12	Nd-147	9.8E-12	Sr-91	3.1E-10	Zr-97	3.5E-10
						Total (Ci)	1.6E-07

To convert Ci to GBq, multiply Ci by 37.

Values may not sum to the indicated total due to rounding of tabulated emissions.

(a) Values based on release records for gases. Other emissions are calculated from in-facility material inventories and estimates (Snyder et al. 2021a; Snyder and Barnett 2016) and 40 CFR 61, Appendix D (1989).

Table 2.4. PNNL-Richland Campus Radionuclide Emissions (Ci) in 2023

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units ^(a)	Total (Ci)
gross α	1.4E-07 ^(b)	NA	1.4E-07
gross β	1.5E-06 ^(b)	NA	1.5E-06
H-3	2.0E-05 ^(c)	4.2E-11 ^(c)	2.0E-05 ^(c)
Al-26	1.6E-08	NA	1.6E-08
Mn-54	NA	3.7E-10	3.7E-10
Co-60	4.1E-08	4.3E-10	4.2E-08
Zn-65	NA	1.3E-10	1.3E-10
Br-82	NA	1.3E-08	1.3E-08
Rb-83	NA	5.0E-09	5.0E-09
Y-88	NA	6.2E-10	6.2E-10
Cd-109	NA	1.4E-09	1.4E-09
Cs-137	NA	3.2E-10	3.2E-10
Ce-141	2.8E-08	8.8E-12	2.8E-08
Pb-210	NA	1.3E-09	1.3E-09
Rn-220	2.6E-03 ^(c)	NA	2.6E-03 ^(c)
Rn-222	2.7E-09 ^(c)	1.5E-07 ^(c)	1.5E-07 ^(c)
Th-229	2.2E-08	NA	2.2E-08
Th-232	NA	3.0E-12	3.0E-12
U-233/234	8.9E-08	1.9E-08	1.1E-07
U-235	NA	1.7E-11	1.7E-11
Pu-238	9.3E-09	8.8E-15	9.3E-09
Pu-239/240	4.4E-08	8.4E-13	4.4E-08
Am-241	7.3E-09	2.7E-10	7.5E-09
Am-243	6.9E-11	1.2E-15	6.9E-11
Cm-243/244	3.5E-08	NA	3.5E-08
TOTAL (Ci)	2.6E-03	1.9E-07	2.6E-03

NA = not applicable.

To convert Ci to GBq, multiply Ci by 37.

Total Ci may not equal the major and the minor and fugitive sum due to rounding.

- (a) Nuclides that contribute 99.8% of the minor and fugitive dose to the MEI. See Table 2.3 for the nuclides that contribute the remaining 0.2% of dose impact.
- (b) Maximum of the biweekly or semi-annual average measurement. Gross α is assumed to be Pu-239 and gross β is assumed to be Cs-137 for dose assessment.
- (c) Value based on release records.

3.0 Dose Assessment

This section presents the method for determining the MEI dose from PNNL-Richland campus radiological emissions.

3.1 Description of Dose Model and Receptor Evaluation

The dose to the MEI was calculated using the dose-modeling program Clean Air Act Assessment Package 1988-Personal Computer (CAP88-PC) Version 4.0 (EPA 2015), approved by the U.S. Environmental Protection Agency. This dose value was used to determine compliance of the PNNL-Richland campus with the dose standard of 10 mrem/yr EDE to any member of the public as required by 40 CFR 61, Subpart H (2002), and WAC 246-247 (2021).

CAP88-PC Version 4.0 is an environmental dispersion model that allows user-entered emission point characteristics, annual emissions, site-specific meteorology, and public exposure characteristics to be used to calculate the dose to an exposed individual. This model is used to determine the dose to the MEI from campus radionuclide emissions (Table 2.4).

The nearest location (e.g., dwelling, business, school, office) to the PNNL-Richland campus where a public receptor has the potential to receive the maximum exposure from RAEL-005 permitted emission units is determined. This may be a hypothetical person, but there must be some potential for continued occupancy at the location indicated. For example, the campus northwest fence-line was not considered because no individual routinely occupies this location, which is in a shrub-steppe field. In addition to the nearest location, the location with the potential for the greatest annual impact from emissions is determined. Due to the proximity of offsite businesses and the annual variability of dispersion estimates at close distances, several options for businesses at boundary locations are the likely maximally impacted locations based on past evaluations. Table 3.1 indicates the location of the 2023 MEI and provides information on these nearest receptors, including distances to the nearest farms that produce milk, meat, and vegetables.

The PNNL-Richland campus MEI is a member of the public who hypothetically receives the highest calculated radiological dose attributable to exposure to campus emissions in one calendar year. Selection of the annual MEI is contingent on an individual's place of residence or employment.

Potential MEI locations are evaluated with 1) the CAP88-PC Version 4.0 model; 2) PNNL-Richland campus facility emissions and release point characterization; and 3) CY2023 meteorological data (Appendix A) to determine the 2023 MEI receptor location from campus emissions. The receptor is presumed to produce their own food supply at the MEI location.

The CY2023 MEI location was determined to be an office building at 3170 George Washington Way.

Table 3.1. Receptor Locations for the PNNL-Richland Campus

Locale	Distance Relative to PSF (3410 Building) km (mi)
2023 PNNL-Richland Campus MEI	
Office, 3170 George Washington Way	0.74 (0.46) SSE
Offsite nearest residence, business, school	
Residence	0.97 (0.60) SE
School or preschool	1.6 (1.0) S
Business ^(a)	0.63 (0.39) SSE
Farm with potential for crops or livestock	
Nearest to PSF (east of Columbia River)	1.51 (0.93) E
Offsite MEI maximum annual air concentrations	
Office, Sigma IV Building, 3170 George Washington Way	
From major emission units ^(b)	0.74 (0.46) SSE of 3410-01-S
From minor and fugitive emission units ^(b)	0.84 (0.52) SSE of 3420-02-S
Richland Campus Historical MEI Doses and Locations^(c)	
CY2022/ 2.3E-05 mrem	0.63 (0.39) SSE
CY2021/ 1.8E-05 mrem	0.64 (0.40) SSE
CY2020 / 1.7E-05 mrem	0.55 (0.34) SSE
CY2019 / 1.5E-05 mrem	0.67 (0.42) SSE
CY2018 / 1.8E-05 mrem	0.64 (0.40) SSE
CY2017 / 2.3E-05 mrem	0.70 (0.43) SSE
CY2016 / 5.8E-04 mrem	1.86 (1.16) S
CY2015 / 2.6E-04 mrem	1.86 (1.16) S
CY2014 / 2.8E-05 mrem	0.70 (0.43) SSE
CY2013 / 1.8E-05 mrem	0.75 (0.47) SSE
CY2012 / 9.2E-06 mrem	0.55 (0.34) SSE
CY2011 / 1.7E-05 mrem	0.55 (0.34) SSE
(a) Locations with PNNL access control are considered part of the PNNL-Richland campus.	
(b) This location is 2.31 km south of the Hanford Site 300 Area. Minor and fugitive emission unit distances are relative to 3420 Building because the 3410 Building has no minor or fugitive emission points.	
(c) To convert mrem to mSv, multiply mrem by 0.01. Dose includes point, non-point, and radon emissions.	

3.2 Summary of Input Parameters

Radionuclide emissions data from the PNNL-Richland campus (Table 2.4) were used in the dose calculations. Emissions were modeled in CAP88-PC Version 4.0 with 2023 meteorology and applicable stack characteristics given in Section 1.2.1. The greatest dose impact from facility emissions is calculated for 3170 George Washington Way, SSE of the 3410 Building, where an office is located; as a result, this is the 2023 MEI location. PSF emissions reported as gross alpha or gross beta were conservatively evaluated as Pu-239 or Cs-137, respectively. Appendix A provides additional data used for dose calculations; all other radionuclide-specific parameters used were default values in CAP88-PC Version 4.0 data libraries. The entire hypothetical MEI diet was constructed using the “local” food production option in CAP88-PC for ingestion-pathway parameters. This assumption overestimates the dose to the MEI because no food is grown at the 2023 MEI location.



Figure 3.1. Locations of PNNL-Richland Campus Potential Receptors and MEI

3.3 Meteorological Data

Radionuclide air emissions disperse once they enter the atmosphere. Atmospheric dispersion models predict the degree of dilution and the magnitude of resulting air concentrations at downwind locations. Site-specific measurements of the occurrence frequencies for wind speed, wind direction, and atmospheric stability are used in the CAP88-PC model.

Radionuclide air concentrations at receptor locations are determined using the site-specific meteorological data. CAP88-PC Version 4.0 wind files were prepared from data collected at the Hanford Site 300 Area meteorological tower, just north of the PNNL-Richland campus (refer to

Figure 5.1), representing the average of hourly data recorded in 2023. Appendix A tables indicate meteorological data for 2023 as joint frequency of wind speed, wind direction, and stability category for the Hanford Site 300 Area station, 10 m instrumentation height. The proximity of the 300 Area meteorological station (less than 500 m from the campus boundary) and lack of turbulent interference allows that station data to be used to represent the PNNL-Richland campus meteorology.

Some adjustments to the 2023 meteorological data were necessary. Temperature data used for stability category determinations were substituted for all of 2023. Typically, 10 m and 61 m temperature instrumentation are used in the determinations. The 61 m results were replaced with 76 m results, as sufficient replacements. Additionally, there were several instances of wind instrumentation inoperability (0 wind speed and 0 degrees direction results). During these instances, which mainly happened during an icing event in late November, wind results from Prosser Barricade (station 1) were substituted.

3.4 Compliance Assessment

Federal and state reporting requirements for doses (summarized in Table 3.2) vary. Section 3.4.1 and Section 3.4.2 give details on doses reported under 40 CFR 61, Subpart H, and the WAC, respectively.

Table 3.2. Summary of Reported 2023 Doses

	40 CFR 61, Subpart H Campus MEI (3170 GW Way)	WAC 246-247 Campus MEI (3170 GW Way)	Offsite Maximum Air ^(b) for Campus Emissions (3170 GW Way)
PNNL-Richland Campus MEI Location			
Location relative to PSF	0.74 km (0.46 mi) SSE	0.74 km (0.46 mi) SSE	0.74 km (0.46 mi) SSE
Radon Emissions			
Rn-220			
3410-01-S	NA	2.6E-03 Ci	2.6E-03 Ci
Rn-222			
3410-01-S	NA	2.7E-09 Ci	2.7E-09 Ci
3420-02-S	NA	1.5E-07 Ci	1.5E-07 Ci
Receptor Dose			
Dose excluding radon emissions ^(a)	2.0E-05 mrem	2.0E-05 mrem	2.0E-05 mrem
Radon	- NA -	4.0E-07 mrem	4.0E-07 mrem
Total	2.0E-05 mrem	2.1E-05 mrem	2.1E-05 mrem

NA = not applicable.

Total dose may not equal the sum of parts due to rounding.

To convert Ci to GBq, multiply Ci by 37. To convert mrem to mSv, multiply mrem by 0.01.

(a) Dose from routine major and minor points' emissions, fugitive emissions, PIC-5, and nonroutine events.

(b) WAC 173-480. See Figure 5.1 for PNL-1 ambient air surveillance station location.

3.4.1 40 CFR 61, Subpart H, Regulatory Standard

The regulatory standard for a maximum dose to any member of the public is 10 mrem/yr (0.10 mSv/yr) EDE. The standard is in 40 CFR 61, Subpart H (2002), and applies to radionuclide air emissions, other than radon, from DOE facilities. For CY2023, the PNNL-Richland campus MEI location was 0.74 km (0.46 mi) SSE of the 3410 Building. The campus MEI dose is 2.0E-05 mrem (2.0E-07 mSv) (see Table 3.2, 40 CFR 61, Subpart H).

Table 3.3 indicates nuclide-specific doses to the CY2023 campus MEI. The MEI dose includes routine and, as applicable, unplanned (i.e., nonroutine) point source emissions (see Section 3.5.4). The fugitive PIC-5 category doses are about 9% of the CY2023 campus MEI dose estimate.

Table 3.3. PNNL-Richland Campus 2023 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units and Fugitive Emissions

Radionuclide ^(a)	Releases (Ci)	Campus MEI Dose (mrem EDE)	% of Total EDE
Gross α ^(b)	1.4E-07	6.3E-06	31%
Gross β ^(c)	1.5E-06	6.2E-06	30%
H-3	2.0E-05	3.9E-09	<1%
Al-26	1.6E-08	2.7E-07	1%
Mn-54	3.7E-10	1.9E-10	<1%
Co-60	4.2E-08	1.2E-07	1%
Zn-65	1.3E-10	1.8E-10	<1%
Br-82	1.3E-08	1.5E-10	<1%
Rb-83	5.9E-09	1.0E-09	<1%
Y-88	6.2E-10	3.5E-10	<1%
Cd-109	1.4E-09	1.4E-10	<1%
Cs-137	3.2E-10	4.2E-09	<1%
Ce-141	2.8E-08	1.5E-10	<1%
Pb-210	1.3E-09	2.1E-08	<1%
Rn-220	2.6E-03	4.0E-07	2%
Rn-222	1.5E-07	4.0E-10	<1%
Th-229	2.2E-08	1.4E-06	7%
Th-232	3.0E-12	3.5E-10	<1%
U-233/234	1.1E-07	4.2E-07	2%
U-235	1.7E-11	2.0E-10	<1%
Pu-238	9.3E-09	3.7E-07	2%
Pu-239/240	4.4E-08	1.9E-06	9%
Am-241	7.5E-09	3.0E-07	1%
Am-243	6.9E-11	2.6E-09	<1%
Cm-243/244	3.5E-08	9.6E-07	5%
Table 2.3 nuclides	1.6E-07	4.8E-10	<1%
PIC-5 emissions – VRRM	NA	9.4E-07 ^(d)	5%
PIC-5 emissions – NDRM	NA	6.6E-08 ^(d)	<1%
PIC-5 emissions – Facilities Restoration	NA	8.4E-07 ^(d)	4%
PIC-5 emissions – SIOC ^(d)	NA	0	0%
Total^(e)	2.6E-03 Ci	2.1E-05 mrem EDE	100%

NA = not applicable.

To convert Ci to GBq, multiply Ci by 37. To convert mrem to mSv, multiply mrem by 0.01.

(a) Release in whole or in part based on 40 CFR 61, Appendix D (1989), release records, or measurements. See Table 2.1 and Table 2.2.

(b) Gross alpha from PSF emission unit sampling assumed to be Pu-239 for dose modeling.

(c) Gross beta from PSF emission unit sampling assumed to be Cs-137 for dose modeling.

(d) The PIC-5 emission doses are assigned based on permit value. The SIOC emission sources were not implemented in 2023. The SIOC PIC-5 permit has been alternatively referred to as the LLS PIC-5 permit.

(e) Totals may not add up to value indicated due to rounding.

Table 3.4 provides the campus MEI dose attributed to each emission point. The doses assigned to the fugitive VRRM, NDRM, and Facility Restoration PIC-5 permitted emissions indicate a maximum dose impact. The PIC-5 permitted emissions for J-SIOC were not applicable for 2023 operations. All respective dose estimates were below the abated emission dose limit of each emission unit.

Table 3.4. Subpart H Dose Contributions from Each Registered Emission Point

Facility/ Building	Emission Unit ID	RAEL-005 Abated Limit ^(a)	Emissions ^(b)	Campus MEI Subpart H Dose (mrem EDE) ^(c)	% of Total MEI Dose
PSF					
3420 Building	3420-01-S	3.3E-01 mrem	Sampled, Estimated	9.2E-06	46%
3430 Building	3430-01-S	6.13E-02 mrem	Sampled, Estimated	4.8E-06	24%
3410 Building	3410-01-S	7.93E-02 mrem	Sampled, Estimated	4.1E-06	20%
3420 Building	3420-02-S	3.2E-04 mrem	Estimated	1.9E-07	1%
3430 Building	3430-02-S	3.2E-04 mrem	Estimated	3.6E-08	0.2%
3425 Building	J-3425	2.7E-04 mrem	Estimated	1.7E-08	0.1%
Campus-wide					
Campus	J-VRRM	9.4E-07 mrem	PIC-5	9.4E-07 ^(d)	5%
Campus	J-NDRM	6.6E-08 mrem	PIC-5	6.6E-08 ^(d)	<1%
Campus	J-Facilities Restoration	8.4E-07 mrem	PIC-5	8.4E-07 ^(d)	4%
Campus	J-SIOC	1.0E-06 mrem	PIC-5	0 ^(b)	0%

To convert mrem to mSv, multiply mrem by 0.01.

(a) RAEL-005 abated emission dose limit for each emission unit.

(b) Emissions “estimated” are determined by 40 CFR 61, Appendix D, and may include gas emissions from release records.

(c) Subpart H dose values do not include radon. Radon contributes an additional 4.0E-7 mrem (3410-01-S) and 4.0E-10 mrem (3420-02-S) under WAC 246-247.

(d) Dose assigned by permit determination, or for J-SIOC a dose estimate may be done.

For comparison, the Subpart H PNNL-Richland campus 2023 MEI dose and average U.S. background radiation (NCRP 2009) are shown below:

• Annual natural background radiation	310.0	mrem/yr
• Daily natural background radiation	0.85	mrem/d
• Hourly natural background radiation	0.035	mrem/hr
• Per minute natural background radiation	0.00059	mrem/min
• PNNL-Richland campus 2023 MEI dose (40 CFR 61, Subpart H)	0.000020	mrem/yr
• Per second natural background radiation	0.0000098	mrem/sec

Dose from anthropogenic sources, overwhelmingly a result of medical procedure exposures, adds another 310 mrem (3.1 mSv) to the annual average U.S. dose (HPS 2012). Last year, the campus MEI dose was 2.3E-05 mrem/yr (2.3E-07 mSv/yr).

3.4.2 Washington Administrative Code

For PNNL-Richland campus radionuclide air emissions, Washington State in WAC 246-247-040(1) has adopted the federal dose standard of 10 mrem/yr found in 40 CFR 61, Subpart H (2002). In addition to the maximum dose attributable to radionuclides emitted from point sources, WAC 246-247-040(6) requires that the dose to the MEI also include doses attributable to fugitive emissions, radon, and nonroutine events. Radon is exempt from consideration in determining compliance with the dose standard of 40 CFR 61, Subpart H, but it is encompassed by state regulations, as in WAC-246-247-040(6), which states that “[a]ll emissions of radionuclides . . . are subject to the standards of this section.”

The WAC 246-247 receptor location considers whether an individual resides or abides at the evaluated location (see Table 3.2, WAC 246-247). For 2023, the WAC-246-247 dose is the 2.1E-05 mrem/yr (2.1E-07 mSv/yr). An additional assessment was performed for the location with maximum offsite nuclide air concentrations, whether the reside/abide criterion was met or not (see Table 3.2, WAC 173-480). For CY2023, the maximum modeled air concentration is the same as the MEI location, this WAC 173-480 dose is 2.1E-05 mrem/yr (2.1E-07 mSv/yr).

3.4.3 PNNL-Richland Campus and Hanford Site Subpart H Doses

For information purposes only, the nearby Hanford Site, which is the adjacent DOE site with major emissions units, was considered for comparative evaluation. PNNL-Richland campus air compliance is a distinctly separate issue, but the dose from such nearby major radiological emitters is worth considering for total DOE-source impacts to the region. Hanford Site 300 Area emissions and the Hanford Site MEI for CY2023 were reviewed. Both the PNNL-Richland campus and the Hanford Site (Dyekman et al. 2024) are in compliance with the 10 mrem/yr regulatory standard for CY2023 radiological emissions.

The CY2023 Hanford Site MEI location is on the PNNL-Richland campus, directly south of the Hanford Site 300 Area. As a result, no dose to the Hanford Site MEI from campus emissions was estimated for 2023. The dose to both the PNNL-Richland campus MEI and the Hanford Site MEI from the Hanford Site 300 Area emissions in 2023, excluding Rn-220 and Rn-222 (see Dyekman et al. 2023), is indicated in Table 3.5. Essentially all of the dose from Hanford Site 300 Area emissions to the campus MEI (and Hanford Site MEI) is attributable to H-3 releases.

Table 3.5. Subpart H Doses to PNNL-Richland Campus MEI and Hanford Site MEI

Receptor	Dose from 2023 PNNL-Richland Campus Emissions	Dose from 2023 Hanford Site 300 Area Emissions
Hanford Site 2023 MEI	NA ^(a)	5.2E-02 mrem
PNNL-Richland campus 2023 MEI	2.0E-05 mrem	4.6E-02 mrem

NA = not applicable.
To convert mrem to mSv, multiply mrem by 0.01.
(a) Hanford Site receptor is located at the PNNL-Richland campus.

3.5 Additional Compliance Information

3.5.1 Applicability of Stack Emissions Data to Air Emission Permits and Licenses

The WDOH license (RAEL-005) requires that an environmental monitoring program be established for the PNNL-Richland campus as a condition of operation. Environmental monitoring supplements the required stack sampling and provides additional assurance that airborne radiological releases comply with federal and state standards. The requirements for site selection and sampling program optimization are documented in Snyder et al. 2024. There are currently five particulate ambient air sampling stations. The campus Environmental Monitoring Plan is documented in Snyder et al. 2020.

3.5.2 Approvals to Construct or Modify

No approvals under 40 CFR 61.96 were requested or granted in 2023.

3.5.3 Radon-220 and Radon-222 Emissions

Both radon-220 and radon-222 were emitted from PNNL-Richland campus operations in 2023. See Section 3.4 for radon emissions and dose results.

3.5.4 Unplanned Releases of Radionuclides to the Atmosphere

No unplanned releases were reported in 2023.

4.0 Fugitive Sources of Emissions

The Clean Air Act (i.e., 40 CFR 61, Subpart H) governs emissions of radionuclides from DOE facilities and the resulting radiological doses to members of the public. A dose standard of 10 mrem/yr EDE was implemented, to which compliance is expected for radionuclide emissions emanating from both point and fugitive sources. Measuring and/or modeling these emissions are fundamental to demonstrating compliance with the standard.

In general, fugitive sources of radioactive emissions are radionuclide air emissions that do not and could not reasonably pass through a stack, vent, or other functionally equivalent structure and that are not feasible to measure directly or quantify (WAC 246-247-030). Some fugitive sources can be classified as diffuse (i.e., area) sources (DOE 2022). The PNNL-Richland campus has no diffuse sources.

PNNL facility-specific fugitive sources include only J-3425 in 2023. In addition to facility-specific fugitive sources, campus-wide permits for fugitive emissions are registered with WDOH. These include the following:

- J-VRRM Volumetrically released radioactive material
- J-NDRM Non-dispersible radioactive material
- J-Facilities Restoration Facilities restoration
- J-SIOC Sources for instrument/operational checks

These four permitted fugitive emissions sources are managed such that the assigned dose (see Table 3.3) over-estimates the actual dose from respective applicable campus-wide releases. These permits include PIC-5 (Barnett 2018) levels of radionuclide emissions and cover a broad range of the nuclides, as listed in Appendix B.

The 2023 PNNL-Richland campus emissions from facility fugitive sources were estimated (see Table 2.2 for a list of dose-significant emissions) and dose was determined (see Table 3.4). Table 3.4 also indicates the relative magnitudes and the permit-assigned doses from campus-wide fugitive emission sources. Fugitive emissions from facility and permitted fugitive emissions account for 1.9E-06 mrem/yr (1.9E-08 mSv/yr), which is about 9% of the total MEI dose for 2023.

Emissions from fugitive sources mix with ambient air, which may also include emissions from point sources. Emissions from all PNNL-Richland campus sources *and* non-PNNL and background sources are monitored by five particulate air sampling stations. The air surveillance program conducted in 2023 is described in Section 5.3.

Past operations at the nearby Hanford Site created a number of fugitive sources within the landscape, whose emissions could affect the PNNL-Richland campus. The Hanford Site fugitive emissions are evaluated in detail in their Radiological Air Emissions Report (e.g., Dyekman et al. 2024).

5.0 Supplemental Information

This section provides the following supplemental information related to PNNL-Richland campus radionuclide air emissions in 2023:

- Collective dose estimate (DOE 1995)
- Compliance status with 40 CFR 61, Subparts Q (2000) and T (2000)
- Radionuclide emission estimates and periodic confirmatory measurement information related to notices of construction
- Ambient air sampling measurements
- Quality assurance (QA) program status of compliance with 40 CFR 61, Appendix B (2011), Method 114

5.1 Collective Dose Estimate

The estimated regional collective dose from PNNL-Richland campus air emissions in 2023 was calculated using CAP88-PC Version 4.0. Regional populations were based on 2020 U.S. Census data within a 50-mile (80-km) radius of the campus (Rose et al. 2023). Pathways evaluated for population exposure include inhalation, air submersion, ground shine, and food consumption. CAP88-PC Version 4.0 calculates the collective dose by considering site-specific meteorology and population distributions, and subsequently summing the individual sector doses.

The 2023 total collective dose from radionuclide air emissions estimated from nuclides that originated from the PNNL-Richland campus was $2.4E-4$ person-rem ($2.4E-6$ person-Sv). This represents a slight decrease from the 2022 estimate of $2.5E-4$ person-rem ($2.5E-6$ person-Sv) (Snyder et al. 2023).

5.2 Compliance Status with 40 CFR, Subparts Q and T

In 40 CFR 61, Subpart Q (2000), “National Emission Standards for Radon Emissions From Department of Energy Facilities,” paragraph 61.190 states that the Subpart Q provisions apply to the design and operation of all storage and disposal facilities for radium-bearing material that emits Rn-222 to the air. Paragraph 61.191(b) states that a source means any building, structure, pile, impoundment, or area used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit Rn-222 in excess of a standard of $20 \text{ pCi/m}^2/\text{s}$. No operations from the storage and disposal of radium-bearing material resulting in radon emissions are conducted on the PNNL-Richland campus.

Activities at the campus were evaluated for compliance with 40 CFR 61, Subpart T (2000), “National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings.” In paragraph 61.220, “Designation of Facilities,” owners and operators of such facilities are subject to the provisions in Subpart T: those whose sites were used for the disposal of tailings and that managed residual radioactive material or uranium byproduct materials during and following the processing of uranium ores and that are listed in or designated by the Secretary of Energy under Title I of the Uranium Mill Tailings Control Act of 1978 or regulated under Title II of

that act. No uranium milling and uranium ore processing activities are conducted on the PNNL-Richland campus.

Subparts Q and T do not apply to the PNNL-Richland campus for CY2023 operations.

5.3 Environmental Surveillance for the PNNL-Richland Campus

Environmental surveillance activities for the PNNL-Richland campus radionuclide emissions sources include ambient particulate air sampling and ambient external dose monitoring. Data for environmental surveillance sample planning, collection, tracking, and reporting are managed by the cloud-based Environmental Information Management (EIM)¹ software system.

5.3.1 Ambient Air Surveillance

Under the requirements of WDOH license (RAEL-005), the PNNL-Richland campus must operate and maintain a radiological air monitoring program. The requirements for site selection and sampling program optimization are documented in Snyder et al. 2024. A particulate air sampling network was established in 2010 to monitor radioactive particulates in ambient air near the campus. This sampling was initiated before starting radiological operations at the new PSF buildings. The first full calendar year of air surveillance was 2011. To satisfy air permit requirements, samples were collected in 2023 at four ambient air sampling stations within and along the perimeter of the PNNL-Richland campus and at a background monitoring station that was established in Benton City, Washington (Figure 5.1). In addition to campus emissions, these samplers can collect radioactive particulates released from other nearby sources. During 2023, the Hanford Site 300 Area would have contributed most of the non-PNNL particulates detected from offsite facilities.

Routine surveillance activities at the PNNL-Richland campus include air sampling for particulate radionuclides. The air surveillance program is described in Snyder et al. (2020) and attachments (Meier 2011; Bisping 2011; Snyder and Cooley 2024). During 2023, environmental air surveillance continued at PNL-1 (solar), PNL-2 (solar), PNL-3, PNL-4, and PNL-5 (background location) (Figure 5.1). Starting in 2023, the north area of the campus began to undergo development. As documented in Snyder et al. 2024, impacts to and optimization of the existing network of ambient air surveillance stations were evaluated. This will result in planned CY2024 relocations of stations PNL-2 and PNL-3 to accommodate new construction, as well as improved sampling of emission unit effluent in the ambient environment.

Unless conditions warrant otherwise, particulate air samples are routinely collected biweekly (every two weeks) and analyzed for gross alpha activity and gross beta activity. Semi-annually, filters are composited for specific radionuclide analysis. The composite analyses reported for 2023 include gamma-emitting isotopes Co-60 and Cs-137, U-233/234,² Pu-238 and Pu 239/240, Am-241, Am-243, and Cm-243/244.

Offsite events that affected the ambient sampling program in 2023 included numerous wildfires in the Pacific Northwest, which caused continuous smoky days in August and September 2023. During these periods when high levels of particulate matter were trapped beneath a local inversion layer, ambient air sampling stations were evaluated more frequently to ensure air flow

¹ Locus EIM, provided by Locus Technologies, Mountain View, California. <https://locustec.com/>.

² U-234 is a naturally occurring radionuclide. It is co-reported with U-233 by the analytical laboratory because the emission peaks overlap.

to the sampler was maintained. In August 2023, two of the five particulate air sampling stations (solar-powered stations PNL-1 and PNL-2) were collected 2 days earlier than planned as a result of the smoky conditions and also required a weekly instead of biweekly filter change-out through early September 2023 to maintain sampler air flow. On these occasions, the air filters that sampled for one week collected sufficient volume for gross alpha and gross beta analyses. Power outages were planned for PNL-4 for a day in July and a day in September 2023 to accommodate installation of a nearby electric vehicle charging station. There was no significant loss of sample during either of the PNL-4 planned outages. There was no significant impact to the annual composite results or station operational frequency for CY2023, because of these events.

Air sampling results are summarized in Table 5.1. The biweekly gross alpha and gross beta results were comparable to background levels and detectable semi-annual composite values are within the uncertainty of the PNL-5 background values. All nuclide-specific results shown in Table 5.1 were less than the values in Table 2 of 40 CFR 61, Appendix E. There was no indication that levels of monitored particulate radionuclides near the PNNL-Richland campus were above standards. The particulate ambient air sampling results are provided in Appendix C for the CY2023 campus sampling, including composite gross alpha and gross beta results.

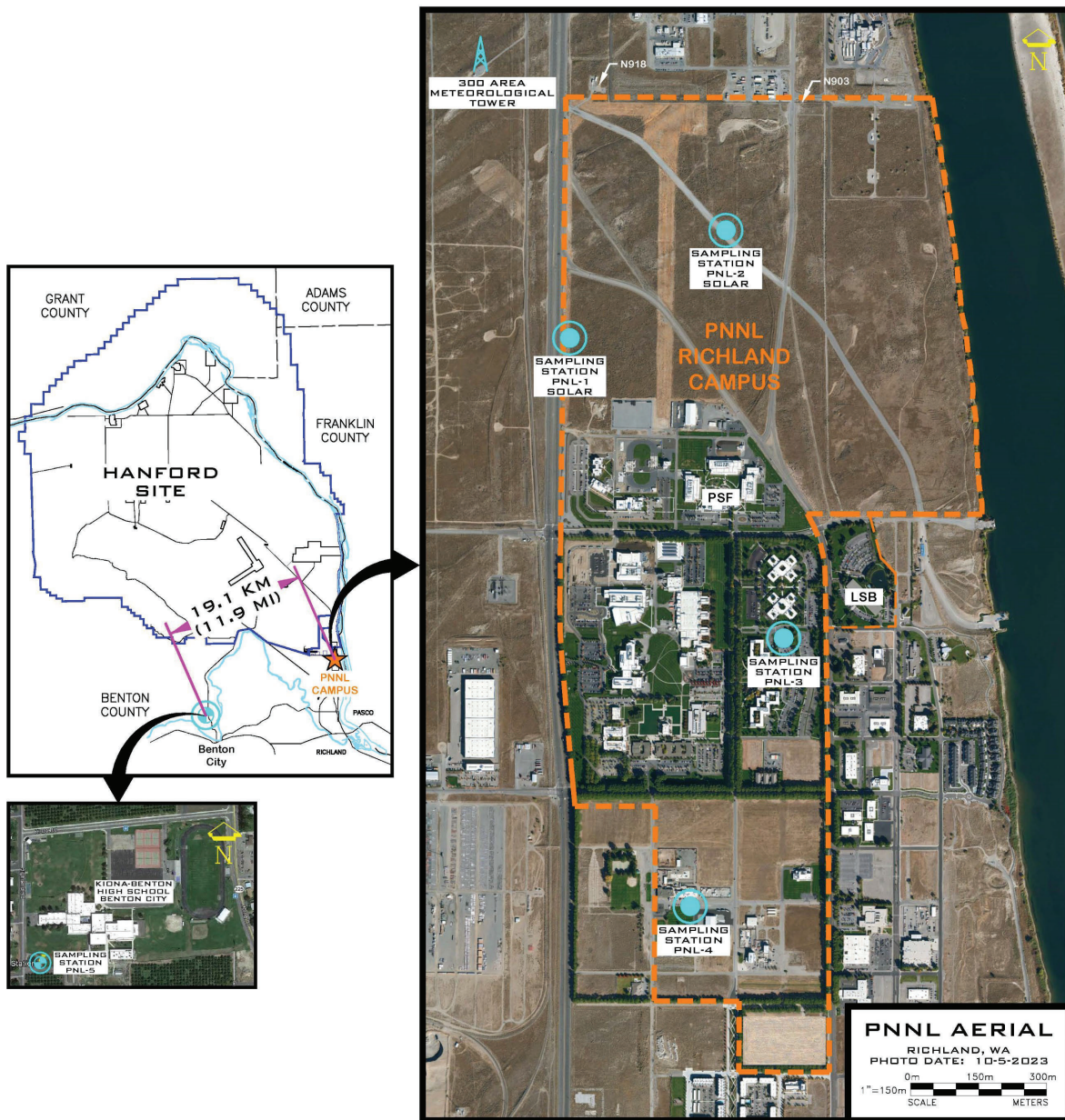


Figure 5.1. Air Surveillance Station Locations for the PNNL-Richland Campus

Table 5.1. Summary of 2023 Air Sampling Results

Nuclide	Location ^(a)	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m ³) ^(b)		
Gross Alpha	PNL-1	27	22	8.4E-04	±	2.7E-03
	PNL-2	27	21	8.9E-04	±	3.0E-03
	PNL-3	26	18	7.8E-04	±	2.3E-03
	PNL-4	26	23	8.0E-04	±	2.5E-03
	PNL-5	26	22	9.1E-04	±	2.5E-03
Gross Beta	PNL-1	27	27	1.7E-02	±	8.4E-03
	PNL-2	27	27	1.7E-02	±	8.8E-03
	PNL-3	26	26	1.6E-02	±	7.3E-03
	PNL-4	26	26	1.7E-02	±	7.9E-03
	PNL-5	26	26	1.5E-02	±	7.2E-03
Co-60 ^(c)	PNL-1	2	0	1.3E-06	±	9.0E-05
	PNL-2	2	0	3.5E-07	±	9.1E-05
	PNL-3	2	0	1.3E-05	±	1.1E-04
	PNL-4	2	0	5.3E-05	±	1.4E-04
	PNL-5	2	0	3.7E-05	±	1.0E-04
Cs-137 ^(c)	PNL-1	2	0	-3.0E-05	±	1.4E-04
	PNL-2	2	0	3.9E-05	±	1.4E-04
	PNL-3	2	0	7.2E-06	±	6.7E-05
	PNL-4	2	0	2.8E-05	±	8.7E-05
	PNL-5	2	0	3.8E-06	±	1.8E-04
U-233/234 ^(c)	PNL-1	2	2	4.2E-05	±	2.7E-05
	PNL-2	2	1	3.3E-05	±	2.6E-05
	PNL-3	2	2	5.0E-05	±	2.6E-05
	PNL-4	2	2	4.5E-05	±	2.5E-05
	PNL-5	2	2	4.1E-05	±	3.3E-05
Pu-238 ^(c)	PNL-1	2	0	7.6E-06	±	1.4E-05
	PNL-2	2	1	2.8E-05	±	2.3E-05
	PNL-3	2	1	5.1E-05	±	2.5E-05
	PNL-4	2	1	1.4E-05	±	1.8E-05
	PNL-5	2	0	1.4E-05	±	1.9E-05
Pu-239/240 ^(c)	PNL-1	2	1	9.9E-06	±	1.5E-05
	PNL-2	2	1	1.7E-05	±	2.1E-05
	PNL-3	2	1	6.1E-05	±	2.8E-05
	PNL-4	2	1	4.9E-05	±	2.8E-05
	PNL-5	2	1	2.0E-05	±	2.6E-05
Am-241 ^(c)	PNL-1	2	0	2.6E-06	±	1.9E-05
	PNL-2	2	1	1.7E-05	±	1.9E-05
	PNL-3	2	1	2.8E-05	±	2.0E-05
	PNL-4	2	1	2.2E-05	±	2.2E-05
	PNL-5	2	0	1.6E-05	±	3.2E-05
Am-243 ^(c)	PNL-1	2	0	4.2E-05	±	9.4E-05
	PNL-2	2	0	1.6E-05	±	9.4E-05
	PNL-3	2	0	3.4E-05	±	8.7E-05
	PNL-4	2	0	3.5E-06	±	1.6E-05
	PNL-5	2	0	2.5E-05	±	6.5E-05

Nuclide	Location ^(a)	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m ³) ^(b)		
Cm-243/244 ^(c)	PNL-1	2	0	7.8E-06	±	2.6E-05
	PNL-2	2	0	2.4E-06	±	2.2E-05
	PNL-3	2	0	4.5E-06	±	2.3E-05
	PNL-4	2	0	-3.1E-06	±	1.8E-05
	PNL-5	2	0	1.3E-05	±	3.4E-05

To convert pCi/m³ to Bq/m³, multiply pCi/m³ by 0.037.

(a) Refer to Figure 5.1 for PNL-1, PNL-2, PNL-3, PNL-4, and PNL-5 locations.

(b) The Value is the average of samples collected throughout the year, with no background (PNL-5) results subtracted.

(c) Semiannual composite analyses.

5.3.2 Ambient External Dose Monitoring

Ambient levels of external dose from beta, gamma, and X-ray sources were monitored quarterly at the five particulate air monitoring stations during 2023. No current PNNL-Richland campus radioactive air emissions include significant quantities of external dose contributors. The program establishes baseline ambient external dose levels at the perimeter particulate sampling stations and the background (PNL-5) station. The 2023 ambient external dose monitoring results at campus monitoring stations ranged from 26–29 mrem/yr (0.26–0.29 mSv/yr), and the background station indicated a local ambient external dose of 33 mrem/yr (0.33 mSv/yr). The reported error for the external dosimeters is 12%. Additional details regarding ambient external dose monitoring will be in the next PNNL Site Environmental Report of 2023 operations (e.g., Thompson et al. 2023).

5.4 Quality Assurance Program Compliance Status

Air emissions data reported in this document reflect the product of many QA activities concerned with the collecting, handling, analyzing, validating, and reporting of samples and the resultant analytical data. Those activities are identified in the QA plans (PNNL 2022) and in the PNNL-Richland campus Environmental Radiological Air Monitoring Plan (Snyder et al. 2020). The effluent monitoring QA elements described in PNNL (2022) were compatible with one or more of the documents shown in Table 5.2 during CY2023. QA requirements are implemented, as appropriate, at the campus as new facilities become operational and programmatic plans are developed.

Table 5.2. Summary List of QA-Related Documents

10 CFR 830 (2001), <i>Nuclear Safety Management</i>
40 CFR 61, Appendix B (2011), "Method 114 – Test Methods for Measuring Radionuclide Emissions from Stationary Sources"
ANSI/ASME NQA-1-2022, <i>Quality Assurance Requirements for Nuclear Facility Applications</i>
DOE Order 414.1D (2020a), <i>Quality Assurance</i>
ISO14001:2004 (ISO 2004), <i>International Organization for Standardization for Environmental Management Systems</i>
DOE Order 458.1 (2020b), <i>Radiation Protection of the Public and the Environment</i>
DOE-HDBK-1216-2015, <i>Environmental Radiological Effluent Monitoring and Environmental Surveillance</i> (DOE 2022)
EPA QA/R-5, <i>EPA Requirements for Quality Assurance Project Plans</i> (EPA 2001)

6.0 References

- 10 CFR 830. 2001. "Nuclear Safety Management." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix B. "Test Methods." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix D. "Methods for Estimating Radionuclide Emissions." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix E. "Compliance Procedures Methods for Determining Compliance with Subpart I." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Subpart H. "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Subpart Q. "National Emission Standards for Radon Emissions from Department of Energy Facilities." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Subpart T. "National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- ANSI/ASME NQA-1-2022. 2022. *Quality Assurance Requirements for Nuclear Facility Applications*. American Society of Mechanical Engineers, New York, New York.
- Barnett JM and SF Snyder. 2021. *Pacific Northwest National Laboratory Facility Radionuclide Emission Points and Sampling Systems*. PNNL-15992, Rev. 5, Pacific Northwest National Laboratory, Richland, Washington.
- Barnett JM. 2018. *Pacific Northwest National Laboratory Potential Impact Categories for Radiological Air Emission Monitoring*. PNNL-19904, Rev. 5, Pacific Northwest National Laboratory, Richland, Washington.
- Bisping LE. 2011. *EMP Attachment 2, DOE-SC PNNL Site, Data Management Plan*. PNNL-20919-2, Pacific Northwest National Laboratory, Richland, Washington.
- DOE – U.S. Department of Energy. 1995. Letter to E. Ramona, U.S. Environmental Protection Agency) from Raymond Berube, U.S. Department of Energy, Washington, D.C., May 16, "Memorandum of Understanding Between the U.S. Environmental Protection Agency and the U.S. Department of Energy Concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR Part 61 Including Subparts H, I, Q & T." Washington, D.C.
- DOE – U.S. Department of Energy. 2022. *Environmental Radiological Effluent Monitoring and Environmental Surveillance*. DOE-HDBK-1216-2015 CN 1, Washington, D.C.

DOE Order 414.1D. 2020a. *Quality Assurance*, Contractor Requirements Document. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE Order 458.1, Change 4. 2020b. *Radiation Protection of the Public and the Environment*. U.S. Department of Energy, Washington, D.C.

Duncan JP, KW Burk, MA Chamness, RA Fowler, BG Fritz, PL Hendrickson, EP Kennedy, GV Last, TM Poston, MR Sackschewsky, MJ Scott, SF Snyder, MD Sweeney, and PD Thorne. 2007. *Hanford Site National Environmental Policy Act (NEPA) Characterization*. PNNL-6415, Rev. 18, Pacific Northwest National Laboratory, Richland, Washington.

Dyekman DL, SF Snyder, and JE Cranna. 2024. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2023*. DOE/RL-2024-08, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA – U.S. Environmental Protection Agency. 2001. *EPA Requirements for Quality Assurance Project Plans*. QA/R-5, Washington, D.C.

EPA – U.S. Environmental Protection Agency. 2015. *CAP88-PC Version 4.0 User Guide*. Office of Radiation and Indoor Air, Washington, D.C.

HPS – Health Physics Society. 2012. *Background Radiation Fact Sheet*. Health Physics Society, McClean, VA. Last accessed April 2019 at <http://hps.org/hpspublications/radiationfactsheets.html>.

ISO – International Organization for Standardization. 2004. *International Organization for Standardization for Environmental Management Systems*. ISO14001:2004, Geneva, Switzerland.

Meier KM. 2011. *EMP Attachment 1, DOE-SC PNNL Site, Sampling and Analysis Plan*. PNNL-20919-1, Pacific Northwest National Laboratory, Richland, Washington.

NCRP – National Council on Radiation Protection and Measurements. 2009. *Ionizing Radiation Exposure of the Population of the United States*. Bethesda, Maryland.

PNNL – Pacific Northwest National Laboratory. 2022. *Pacific Northwest National Laboratory Effluent Management Quality Assurance Plan*. EM-QA-1, Rev 11, Richland, Washington.

PNSO – Pacific Northwest Site Office. 2013. *PNNL Terminology Reference Document*. PNSO-REFR-05, U.S. Department of Energy, Richland, WA.

RAEL-005 – *Radioactive Air Emissions License For The Department of Energy Office of Science Pacific Northwest National Laboratory Site, License Number: RAEL-005, Renewal 1* (Effective 2021-2026), Washington State Department of Health, Richland, Washington.

Rose SA, JD Tagestad, SF Snyder. 2023. *Pacific Northwest National Laboratory Regional Populations – 2020 Census, Richland Campus and Sequim Campus*, PNNL-25305, Rev. 1, Pacific Northwest National Laboratory, Richland, WA.

Snyder SF and JM Barnett. 2016. *PNNL Campus Dose-per-Unit-Release Factors for Calculating Radionuclide Emissions Potential-to-Emit Doses*. PNNL-17847, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF, PM Daling, and JM Barnett. 2021a. *Determining Unabated Airborne Radionuclide Emissions Monitoring Requirements Using Inventory-Based Methods*. PNNL-10855, Rev. 7, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF, KM Meier, JM Barnett, LE Bisping. 2020. *Environmental Radiological Air Monitoring Plan, PNNL Operations in Washington*. PNNL-20919, Rev.1, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF, LE Bisping, TR Hay, JM Barnett, LN Dinh, MC Klein. 2024. *Data Quality Objectives Supporting Radiological Air Emissions Monitoring for the PNNL-Richland Campus*. PNNL-19427, Rev. 3, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF and SK Cooley. 2024. *EMP Attachment 3, Dose Assessment Guidance*. PNNL-20919-3, Rev. 3, Pacific Northwest National Laboratory, Richland, Washington.

Thompson, SW, SF Snyder, JM Becker, ES Norris, JM Barnett, KD Hand, EA Raney, TW Moon, CJ Duchsherer, JL Haigh, J Su-Coker, RA Del Mar, LE Bisping, LY Renaud, MD Ellefson, JA Stephens, MA Aranda. 2023. *Pacific Northwest National Laboratory Annual Site Environmental Report for Calendar Year 2022*. PNNL-34638, Pacific Northwest National Laboratory, Richland, Washington.

WAC 173-480. "Ambient Air Quality Standards and Emission Limits for Radionuclides." Washington Administrative Code, Olympia, Washington.

WAC 246-247. "Radiation Protection – Air Emissions." Washington Administrative Code, Olympia, Washington.

Appendix A – Dose Modeling and Meteorological Data

Wind rose for Hanford Site 300 Area, station #11, indicating from which direction that the wind blows.

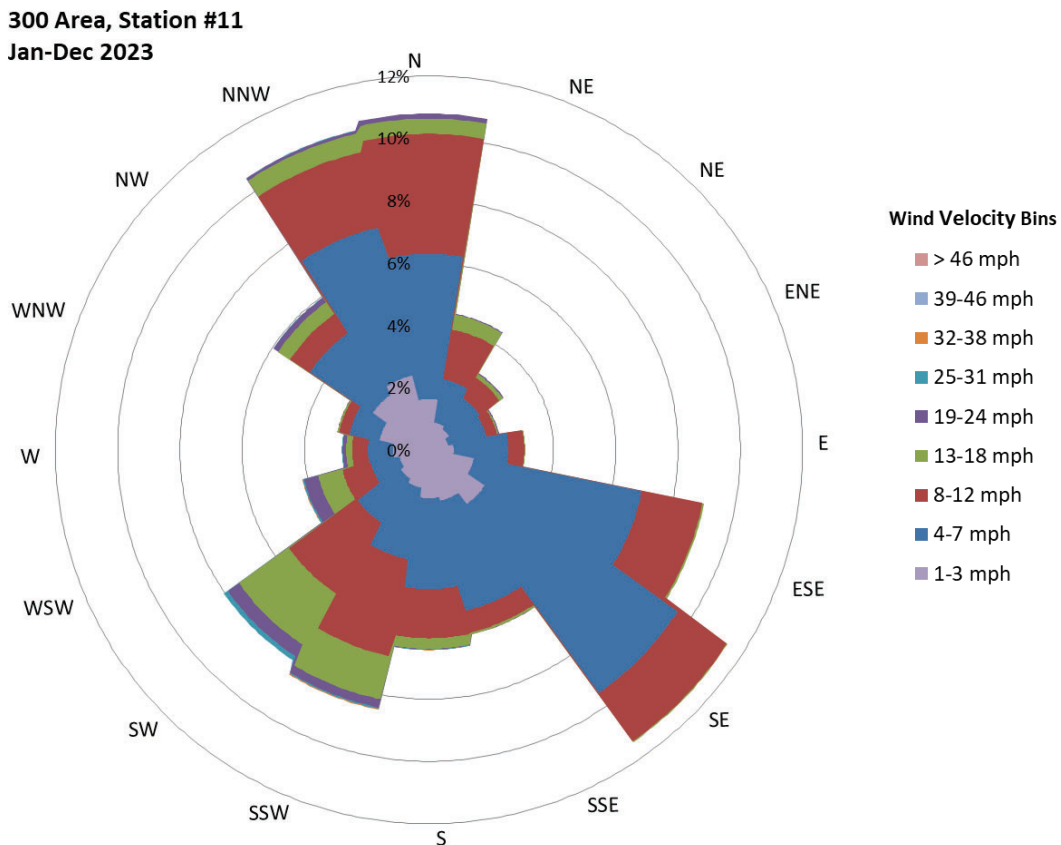


Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2023

Table A.1. Annual Average Joint Frequency during 2023 (as percent of time) of Wind Speed, Stability Class, and Direction for the Hanford Site 300 Area (Station 11) at the 10-meter Level (3 sheets).

Wind Speed (m/sec)	Stability Class	Wind Direction Toward															Total	
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE		SSE
0.89	A	0.02	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.02	0.00	0.01	0.02	0.00	0.02	0.00	0.14
	B	0.00	0.00	0.00	0.01	0.05	0.01	0.03	0.01	0.01	0.01	0.00	0.03	0.03	0.01	0.00	0.01	0.21
	C	0.04	0.04	0.04	0.04	0.01	0.09	0.05	0.08	0.07	0.03	0.02	0.00	0.02	0.00	0.02	0.04	0.59
	D	0.36	0.21	0.36	0.20	0.31	0.36	0.50	0.30	0.26	0.28	0.18	0.14	0.15	0.16	0.37	0.71	4.85
	E	0.60	0.28	0.21	0.20	0.17	0.36	0.78	0.55	0.58	0.40	0.33	0.35	0.41	0.70	0.83	0.90	7.65
	F	0.38	0.23	0.14	0.14	0.22	0.44	0.53	0.53	0.53	0.44	0.44	0.33	0.41	0.54	0.65	0.57	6.52
	G	0.28	0.15	0.05	0.05	0.05	0.19	0.29	0.23	0.12	0.10	0.15	0.13	0.14	0.23	0.31	0.25	2.72
	Total	1.68	0.91	0.80	0.64	0.81	1.49	2.18	1.70	1.58	1.28	1.12	0.99	1.18	1.64	2.20	2.48	22.68
2.65	A	0.03	0.06	0.18	0.26	0.31	0.34	0.14	0.05	0.09	0.17	0.08	0.06	0.02	0.01	0.01	0.01	1.82
	B	0.06	0.11	0.25	0.31	0.38	0.45	0.33	0.19	0.24	0.16	0.10	0.07	0.02	0.01	0.03	0.09	2.80
	C	0.22	0.16	0.28	0.25	0.31	0.39	0.41	0.25	0.23	0.25	0.28	0.07	0.04	0.00	0.05	0.11	3.30
	D	1.18	0.50	0.29	0.23	0.36	1.04	1.44	0.58	0.44	0.47	0.34	0.25	0.17	0.17	0.59	1.39	9.44
	E	1.68	0.39	0.08	0.14	0.24	1.51	1.74	1.15	1.06	0.78	0.56	0.36	0.38	0.40	0.84	1.66	12.97
	F	0.97	0.15	0.07	0.06	0.15	1.39	2.36	0.97	0.71	0.38	0.33	0.11	0.16	0.30	0.68	1.19	9.98
	G	0.52	0.05	0.04	0.01	0.02	0.38	0.98	0.42	0.15	0.11	0.02	0.02	0.02	0.10	0.21	0.44	3.49
	Total	4.66	1.42	1.19	1.26	1.77	5.50	7.40	3.61	2.92	2.32	1.71	0.94	0.81	0.99	2.41	4.89	43.80
4.70	A	0.08	0.37	0.25	0.11	0.12	0.33	0.27	0.13	0.15	0.45	0.30	0.08	0.07	0.05	0.05	0.03	2.84
	B	0.12	0.35	0.25	0.03	0.13	0.22	0.25	0.09	0.15	0.41	0.29	0.08	0.06	0.03	0.07	0.09	2.62
	C	0.26	0.24	0.14	0.07	0.09	0.19	0.15	0.09	0.13	0.25	0.35	0.05	0.03	0.01	0.05	0.14	2.24
	D	0.60	0.24	0.07	0.08	0.03	0.22	0.20	0.10	0.36	0.62	0.67	0.28	0.16	0.08	0.33	0.84	4.88
	E	1.38	0.20	0.04	0.04	0.05	0.26	0.38	0.20	0.50	0.89	0.73	0.39	0.16	0.16	0.22	0.82	6.42
	F	0.80	0.16	0.03	0.02	0.07	0.54	0.37	0.08	0.25	0.53	0.31	0.05	0.03	0.00	0.04	0.39	3.67
	G	0.61	0.06	0.00	0.00	0.01	0.23	0.27	0.03	0.04	0.03	0.04	0.00	0.00	0.01	0.00	0.18	1.51
	Total	3.85	1.62	0.78	0.35	0.50	1.99	1.89	0.72	1.58	3.18	2.69	0.93	0.51	0.34	0.76	2.49	24.18

Table A.1 (contd)

Wind Speed (m/sec)	Stability Class	Wind Direction Toward																Total	
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE		
7.15	A	0.07	0.18	0.03	0.04	0.00	0.02	0.01	0.00	0.03	0.26	0.47	0.21	0.01	0.00	0.04	0.02	1.39	
	B	0.11	0.14	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.19	0.21	0.10	0.04	0.00	0.02	0.04	0.89	
	C	0.06	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.19	0.23	0.07	0.01	0.00	0.02	0.06	0.76
	D	0.14	0.08	0.02	0.00	0.01	0.02	0.01	0.03	0.10	0.36	0.40	0.20	0.09	0.02	0.21	0.24	1.93	
	E	0.10	0.03	0.01	0.00	0.01	0.02	0.01	0.03	0.10	0.28	0.50	0.19	0.04	0.03	0.15	0.19	1.69	
	F	0.01	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.02	0.11	0.12	0.01	0.01	0.00	0.02	0.05	0.39	
	G	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.09	
	Total	0.50	0.48	0.12	0.04	0.03	0.06	0.03	0.06	0.33	1.43	1.96	0.79	0.20	0.05	0.46	0.60	7.14	
9.8	A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.07	0.10	0.00	0.00	0.00	0.00	0.27	
	B	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.07	0.03	0.01	0.00	0.01	0.20	
	C	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.09	0.11	0.01	0.00	0.03	0.00	0.27	
	D	0.09	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.08	0.12	0.16	0.06	0.00	0.12	0.08	0.76	
	E	0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.08	0.11	0.03	0.01	0.00	0.01	0.01	0.31	
	F	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
	Total	0.16	0.03	0.03	0.03	0.00	0.00	0.00	0.01	0.03	0.26	0.45	0.47	0.11	0.01	0.16	0.10	1.85	
12.7	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.04	
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.04	
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.04	
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.00	0.01	0.00	0.01	0.01	0.09	
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.01	0.00	0.00	0.00	0.10	
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.15	0.05	0.03	0.00	0.01	0.01	0.31	

Table A.1 (contd)

Wind Speed (m/sec)	Stability Class	Wind Direction Toward																Total
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
15.6	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.00	0.00
19	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	A	0.21	0.61	0.46	0.41	0.43	0.73	0.42	0.18	0.29	0.98	0.93	0.48	0.13	0.06	0.12	0.06	
	B	0.31	0.60	0.52	0.35	0.56	0.68	0.61	0.29	0.44	0.78	0.67	0.35	0.18	0.06	0.12	0.24	
	C	0.59	0.49	0.47	0.36	0.41	0.67	0.61	0.42	0.50	0.73	1.00	0.31	0.11	0.01	0.17	0.35	
	D	2.37	1.04	0.77	0.51	0.71	1.64	2.15	1.02	1.18	1.85	1.73	1.03	0.64	0.43	1.63	3.27	
	E	3.79	0.92	0.34	0.39	0.47	2.15	2.91	1.93	2.24	2.45	2.29	1.35	1.01	1.29	2.05	3.58	
	F	2.16	0.54	0.27	0.24	0.45	2.37	3.26	1.58	1.51	1.46	1.21	0.50	0.61	0.84	1.39	2.20	
	G	1.42	0.26	0.09	0.06	0.08	0.80	1.54	0.68	0.31	0.28	0.25	0.16	0.16	0.34	0.52	0.87	
	Total	10.85	4.46	2.92	2.32	3.11	9.04	11.50	6.10	6.47	8.53	8.08	4.18	2.84	3.03	6.00	10.57	

Table A.2. Exposure and Consumption Data for the PNNL-Richland Campus

FOOD SOURCE FOR THE MAXIMALLY EXPOSED INDIVIDUAL
(fraction of food produced at indicated location)

<u>Food</u>	<u>Local</u>	<u>Regional</u>	<u>Imported</u>
Vegetable	1.000	0.000	0.000
Meat	1.000	0.000	0.000
Milk	1.000	0.000	0.000

VALUES FOR RADIONUCLIDE-INDEPENDENT VARIABLES

HUMAN INHALATION RATE (cm³/hr) = 5.26 E+03

SOIL PARAMETERS

Effective surface density, kg/sq m, dry weight
(assumes 15-cm plow layer) = 2.15 E+02

BUILDUP TIMES

For activity in soil (yr) = 1.00 E+02

For radionuclides deposited on ground/water (d) = 3.65E+04

DELAY TIMES

Ingestion of pasture grass by animals (hr) = 0.00 E+00

Ingestion of stored feed by animals (hr) = 2.16 E+03

Ingestion of leafy vegetables by man (hr) = 3.36 E+02

Ingestion of produce by man (hours) = 3.36 E+02

Transport time from animal feed-milk-man (d) = 2.00 E+00

Time from slaughter to consumption (d) = 2.00 E+01

WEATHERING

Removal rate constant for physical loss (per hr) = 2.90 E-03

CROP EXPOSURE DURATION

Pasture grass (hr) = 7.20 E+02

Crops/leafy vegetables (hr) = 1.44 E+03

AGRICULTURAL PRODUCTIVITY

Grass-cow-milk-man pathway (kg/m²) = 2.80 E-01

Produce/leafy veg for human consumption (kg/m²) = 7.16 E-01

FALLOUT INTERCEPTION FRACTIONS

Vegetables = 2.00 E-01

Pasture = 5.70 E-01

GRAZING PARAMETERS

Fraction of year animals graze on pasture = 4.00 E-01

Fraction of daily feed that is pasture grass when animal grazes on pasture = 4.30 E-01

ANIMAL FEED CONSUMPTION FACTORS

Contaminated feed/forage (kg/day, dry weight) = 1.56 E+01

DAIRY PRODUCTIVITY

Milk production of cow (L/day) = 1.10 E+01

Table A.2. (contd)

MEAT ANIMAL SLAUGHTER PARAMETERS

Muscle mass of animal at slaughter (kg) = 2.00 E+02

Fraction of herd slaughtered (per day) = 3.81 E-03

DECONTAMINATION

Fraction of radioactivity retained after washing
or leafy vegetables and produce = 5.00 E-01

FRACTIONS GROWN IN GARDEN OF INTEREST

Produce ingested = 1.00 E+0

Leafy vegetables ingested = 1.00 E+00

INGESTION RATIOS:

IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA

Vegetables = 1.00 E+00

Meat = 1.00 E+00

Milk = 1.00 E+00

MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA

(Minimum fractions of food types from outside area listed below are actual fixed values.)

Vegetables = 0.00 E+00

Meat = 0.00 E+00

Milk = 0.00 E+00

HUMAN FOOD UTILIZATION FACTORS

Produce ingestion (kg/yr) = 7.62 E+01

Milk ingestion (L/yr) = 5.30 E+01

Meat ingestion (kg/yr) = 8.40 E+01

Leafy vegetable ingestion (kg/yr) = 7.79 E+00

SWIMMING PARAMETERS

Fraction of time spent swimming = 0.00 E+00

Dilution depth for water (cm) = 1.00 E+00

EXTERNAL DOSE

Ground surface contamination correction factor = 5.00 E-01

Table A.3. PNNL-Richland Campus Meteorological Data — General Information

HEIGHT OF LID

LIDAI = 1,000 m

RAINFALL RATE [2023]

RR = 15.3 cm/yr (6.02 in/yr)

AVERAGE AIR TEMPERATURE [2023]

A = 13.1 degrees C (55.5 degrees F; 286.2 K)

SURFACE ROUGHNESS LENGTH

0 = 0.010 m

VERTICAL TEMPERATURE GRADIENTS: (TG) (K/m)

STABILITY E 0.073

STABILITY F 0.109

STABILITY G 0.146

Appendix B – List of Radioactive Materials Handled or Potentially Handled at the PNNL-Richland Campus in 2023

Table B.1. Radionuclides Handled and/or Potentially Handled at the PNNL-Richland Campus in 2023

Ac-225	Au-194	Br-84	Cm-250	Eu-154	Hg-205	Ir-189	Na-24	P-33
Ac-226	Au-195	Br-84m	Co-56	Eu-154m	Hg-206	Ir-190	Na-24m	Pa-231
Ac-227	Au-195m	Br-85	Co-57	Eu-155	Ho-163	Ir-192	Nb-100	Pa-232
Ac-228	Au-196	C-11	Co-58	Eu-156	Ho-164	Ir-194	Nb-101	Pa-233
Ag-105	Au-196m	C-14	Co-58m	Eu-157	Ho-164m	K-40	Nb-103	Pa-234
Ag-106m	Au-198	C-15	Co-60	F-18	Ho-166	K-42	Nb-91	Pa-234m
Ag-108	Au-198m	Ca-41	Co-60m	Fe-55	Ho-166m	Kr-81	Nb-91m	Pb-203
Ag-108m	Au-199	Ca-45	Cr-49	Fe-59	I-122	Kr-81m	Nb-92	Pb-204m
Ag-109m	Ba-131	Ca-47	Cr-51	Fr-221	I-123	Kr-83m	Nb-92m	Pb-205
Ag-110	Ba-131m	Cd-107	Cr-55	Fr-222	I-124	Kr-85	Nb-93m	Pb-209
Ag-110m	Ba-133	Cd-109	Cs-131	Fr-223	I-125	Kr-85m	Nb-94	Pb-210
Ag-111	Ba-133m	Cd-111m	Cs-132	Ga-67	I-126	Kr-87	Nb-94m	Pb-211
Ag-111m	Ba-135m	Cd-113	Cs-134	Ga-68	I-128	Kr-88	Nb-95	Pb-212
Ag-112	Ba-137m	Cd-113m	Cs-134m	Ga-70	I-129	Kr-89	Nb-95m	Pb-214
Al-26	Ba-139	Cd-115	Cs-135	Ga-72	I-130	Kr-90	Nb-96	Pd-103
Al-28	Ba-140	Cd-115m	Cs-135m	Gd-148	I-130m	La-137	Nb-97	Pd-107
Am-240	Ba-141	Cd-117	Cs-136	Gd-149	I-131	La-138	Nb-97m	Pd-109
Am-241	Ba-142	Cd-117m	Cs-137	Gd-150	I-132	La-140	Nb-98	Pd-109m
Am-242	Ba-143	Ce-139	Cs-138	Gd-151	I-132m	La-141	Nd-144	Pd-111
Am-242m	Be-10	Ce-141	Cs-138m	Gd-152	I-133	La-142	Nd-147	Pd-112
Am-243	Be-7	Ce-142	Cs-139	Gd-153	I-133m	La-144	Ni-56	Pm-143
Am-244	Bi-207	Ce-143	Cs-140	Gd-159	I-134	Lu-177	Ni-57	Pm-144
Am-244m	Bi-208	Ce-144	Cs-141	Ge-68	I-134m	Lu-177m	Ni-59	Pm-145
Am-245	Bi-210	Cf-249	Cu-64	Ge-69	I-135	Mg-27	Ni-63	Pm-146
Am-246	Bi-210m	Cf-250	Cu-66	Ge-71	In-106	Mg-28	Ni-65	Pm-147
Ar-37	Bi-211	Cf-251	Cu-67	Ge-71m	In-111	Mn-52	Np-235	Pm-148
Ar-39	Bi-212	Cf-252	Dy-159	Ge-75	In-111m	Mn-52m	Np-236	Pm-148m
Ar-41	Bi-212m	Cl-36	Dy-165	Ge-77	In-112	Mn-53	Np-236m	Pm-149
Ar-42	Bi-212n	Cl-38	Dy-169	Ge-77m	In-112m	Mn-54	Np-237	Pm-150
As-73	Bi-213	Cm-241	Er-169	H-3	In-113m	Mn-56	Np-238	Pm-151
As-74	Bi-214	Cm-242	Er-171	Hf-175	In-114	Mo-93	Np-239	Po-208
As-76	Bk-247	Cm-243	ES-253	Hf-177m	In-114m	Mo-93m	Np-240	Po-209
As-77	Bk-248m	Cm-244	Es-254	Hf-178m	In-115	Mo-99	Np-240m	Po-210
At-211	Bk-249	Cm-245	Eu-150	Hf-179m	In-115m	Mo-103	O-15	Po-211
At-217	Bk-250	Cm-246	Eu-150m	Hf-180m	In-116	Mo-104	O-19	Po-212
At-218	Br-82	Cm-247	Eu-152	Hf-181	In-116m	Mo-105	Os-185	Po-212m
Au-193	Br-82m	Cm-248	Eu-152m	Hf-182	In-117	N-13	Os-191	Po-213
Au-193m	Br-83	Cm-249	Eu-152n	Hg-203	In-117m	Na-22	P-32	Po-214

Table B.1 (cont'd)

Po-215	Pu-246	Rh-102	Sb-128	Sn-121	Tc-96	Th-229	U-236	Y-89m
Po-216	Ra-223	Rh-102m	Sb-128m	Sn-121m	Tc-96m	Th-230	U-237	Y-90
Po-218	Ra-224	Rh-103m	Sb-129	Sn-123	Tc-97	Th-231	U-238	Y-90m
Pr-142	Ra-225	Rh-104	Sc-44	Sn-123m	Tc-97m	Th-232	U-239	Y-91
Pr-142m	Ra-226	Rh-104m	Sc-44m	Sn-125	Tc-98	Th-233	U-240	Y-91m
Pr-143	Ra-227	Rh-105	Sc-46	Sn-125m	Tc-99	Th-234	V-48	Y-92
Pr-144	Ra-228	Rh-105m	Sc-47	Sn-126	Tc-99m	Ti-44	V-49	Y-93
Pr-144m	Rb-81	Rh-106	Sc-48	Sr-82	Tc-101	Ti-45	W-181	Yb-164
Pt-191	Rb-81m	Rn-218	Se-75	Sr-83	Tc-103	Ti-51	W-185	Yb-165
Pt-193	Rb-82	Rn-219	Se-77m	Sr-85	Tc-106	Tl-200	W-185m	Yb-166
Pt-193m	Rb-82m	Rn-220	Se-79	Sr-85m	Te-121	Tl-201	W-187	Yb-167
Pt-195m	Rb-83	Rn-222	Se-79m	Sr-87m	Te-121m	Tl-202	W-188	Yb-169
Pt-197	Rb-84	Rn-224	Si-31	Sr-89	Te-123	Tl-204	Xe-122	Yb-175
Pt-197m	Rb-84m	Ru-103	Si-32	Sr-90	Te-123m	Tl-206	Xe-123	Yb-177
Pt-199	Rb-86	Ru-105	Sm-145	Sr-91	Te-125m	Tl-206m	Xe-125	Zn-65
Pt-199m	Rb-86m	Ru-106	Sm-146	Sr-92	Te-127	Tl-207	Xe-127	Zn-69
Pu-234	Rb-87	Ru-97	Sm-147	Ta-179	Te-127m	Tl-208	Xe-127m	Zn-69m
Pu-235	Rb-88	S-35	Sm-148	Ta-180	Te-129	Tl-209	Xe-129m	Zr-88
Pu-236	Rb-89	Sb-122	Sm-151	Ta-182	Te-129m	Tl-210	Xe-131m	Zr-89
Pu-237	Rb-90	Sb-122m	Sm-153	Ta-182m	Te-131	Tm-168	Xe-133	Zr-89m
Pu-238	Rb-90m	Sb-124	Sm-155	Ta-183	Te-131m	Tm-170	Xe-133m	Zr-93
Pu-239	Re-186	Sb-124m	Sm-156	Tb-157	Te-132	Tm-171	Xe-135	Zr-95
Pu-240	Re-186m	Sb-124n	Sm-157	Tb-158	Te-133	U-232	Xe-135m	Zr-97
Pu-241	Re-187	Sb-125	Sn-113	Tb-160	Te-133m	U-233	Xe-137	Zr-98
Pu-242	Re-188	Sb-126	Sn-113m	Tb-161	Te-134	U-234	Xe-138	Zr-99
Pu-243	Rh-101	Sb-126m	Sn-117m	Tc-95	Th-227	U-235	Xe-139	Zr-100
Pu-244	Rh-101m	Sb-127	Sn-119m	Tc-95m	Th-228	U-235m	Y-88	-

Appendix C – Ambient Particulate Air Sampling Results for PNNL-Richland Campus Air Surveillance in 2023

Table C.1. Definitions for Air Sampling Data

Column Heading	Data Type/Format	Content
Location ID	Text	Location of monitoring station: <u>PNNL-Richland campus monitoring stations</u> <u>Background Location</u> PNL-1, PNL-2, PNL-3, PNL-4 PNL-5
Field Sample ID	Number (#####)	Unique identifier assigned to a sample (typically six-digit number but characters allowed).
Sample Matrix	Text	Matrix of the sample at the time of sample collection (e.g., FILTER)
Start Date	Date (DD-MMM-YYYY)	Date when air sampling started.
Sample Date	Date (DD-MMM-YYYY)	Date when air sampling ended.
Parameter Name	Text	Code assigned to analytical parameter (e.g., Gross alpha, Cesium-137, Plutonium-238). Note: The sum of Uranium-233 and Uranium-234 is reported as either isotope and used for Uranium-233 reporting.
Result	Number (usually scientific notation)	Result reported by the analytical laboratory.
Units	Text	Picocuries per cubic meter. Units associated with the values shown in the Result, Counting Error, and Total Error columns.
Counting Error	Number (usually scientific notation)	The 2-sigma counting error for the radioanalytical results only.
Total Error	Number (usually scientific notation)	The 2-sigma total analytical error for the radioanalytical results only.
Lab Qualifier	Text or Blank	If "U", the Result was not detected above limiting criteria, which may include any of the following: Result < 0, or < Counting Error, or < Total Error, or <= Contract method detection limit/instrument detection limit/minimum detectable activity/practical quantitation limit. . If "O", the case narrative contains additional information regarding quality control criteria not being met.
Sample Comment	Text or Blank	Additional information pertaining to the sample. If blank, no comment was needed
Result Comment	Text or Blank	Additional information pertaining to the analytical result. If blank, no comment was needed.
Composite	Y or Blank	Composite of two or more samples. If "Y", several samples from the same monitoring station were composited and the composite measured for radioactivity. If blank, a single sample was measured.
Further details on each PNNL-Richland campus sample event (e.g., sample volume, lab method) can be obtained from the project Environmental Information Management (EIM) software system provided by Locus Technologies.		

Table C.2. Air Sampling Results for the PNNL-Richland Campus for Calendar Year 2023

Location ID	Field Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-1	230039	FILTER	12/28/2022	01/11/2023	Gross alpha	3.66E-04	pCi/m3	2.49E-04	2.50E-04				
PNL-1	230044	FILTER	01/11/2023	01/25/2023	Gross alpha	9.69E-04	pCi/m3	5.07E-04	5.07E-04				
PNL-1	230049	FILTER	01/25/2023	02/08/2023	Gross alpha	1.42E-03	pCi/m3	6.44E-04	6.44E-04				
PNL-1	230054	FILTER	02/08/2023	02/22/2023	Gross alpha	5.37E-04	pCi/m3	3.79E-04	3.80E-04				
PNL-1	230059	FILTER	02/22/2023	03/08/2023	Gross alpha	8.89E-04	pCi/m3	4.76E-04	4.76E-04				
PNL-1	230064	FILTER	03/08/2023	03/22/2023	Gross alpha	8.97E-04	pCi/m3	5.14E-04	5.15E-04				
PNL-1	230069	FILTER	03/22/2023	04/05/2023	Gross alpha	6.89E-04	pCi/m3	4.52E-04	4.52E-04				
PNL-1	230074	FILTER	04/05/2023	04/19/2023	Gross alpha	1.01E-03	pCi/m3	5.51E-04	5.51E-04				
PNL-1	230079	FILTER	04/19/2023	05/03/2023	Gross alpha	4.24E-04	pCi/m3	3.48E-04	3.48E-04	U			
PNL-1	230084	FILTER	05/03/2023	05/17/2023	Gross alpha	7.49E-04	pCi/m3	4.47E-04	4.47E-04				
PNL-1	230089	FILTER	05/17/2023	05/31/2023	Gross alpha	3.72E-04	pCi/m3	3.26E-04	3.26E-04	U			
PNL-1	230094	FILTER	05/31/2023	06/14/2023	Gross alpha	9.25E-04	pCi/m3	4.99E-04	4.99E-04		Issues stabilizing air flow; air sampler #24094 expiring 10/3/23 was replaced on 6/14/23 with #21710 expires 4/10/24.		
PNL-1	230099	FILTER	06/14/2023	06/28/2023	Gross alpha	6.41E-04	pCi/m3	4.28E-04	4.28E-04				
PNL-1	230104	FILTER	06/28/2023	07/12/2023	Gross alpha	5.50E-04	pCi/m3	4.35E-04	4.35E-04				
PNL-1	230109	FILTER	07/12/2023	07/26/2023	Gross alpha	6.10E-04	pCi/m3	4.38E-04	4.38E-04				
PNL-1	230114	FILTER	07/26/2023	08/09/2023	Gross alpha	9.19E-04	pCi/m3	4.75E-04	4.75E-04				
PNL-1	230119	FILTER	08/09/2023	08/21/2023	Gross alpha	1.13E-03	pCi/m3	6.74E-04	6.74E-04		Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	
PNL-1	230174	FILTER	08/21/2023	08/29/2023	Gross alpha	1.18E-03	pCi/m3	9.20E-04	9.20E-04		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-1	230124	FILTER	08/29/2023	09/06/2023	Gross alpha	2.13E-04	pCi/m3	4.14E-04	4.14E-04	U	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-1	230129	FILTER	09/06/2023	09/20/2023	Gross alpha	4.16E-04	pCi/m3	3.55E-04	3.55E-04	U			
PNL-1	230134	FILTER	09/20/2023	10/04/2023	Gross alpha	6.03E-04	pCi/m3	4.35E-04	4.35E-04				

Field		Sample		Sample	Parameter	Counting		Total	Lab	Sample Comment	Result Comment	Com- posite
Location ID	ID	Matrix	Start Date	Date	Name	Result	Units	Error	Error			
PNL-1	230139	FILTER	10/04/2023	10/18/2023	Gross alpha	8.40E-04	pCi/m3	4.95E-04	4.95E-04			
PNL-1	230144	FILTER	10/18/2023	11/01/2023	Gross alpha	1.76E-03	pCi/m3	7.21E-04	7.21E-04			
PNL-1	230149	FILTER	11/01/2023	11/15/2023	Gross alpha	1.80E-03	pCi/m3	6.84E-04	6.84E-04			
PNL-1	230154	FILTER	11/15/2023	11/29/2023	Gross alpha	3.26E-04	pCi/m3	3.48E-04	3.48E-04	U		
PNL-1	230159	FILTER	11/29/2023	12/13/2023	Gross alpha	8.09E-04	pCi/m3	4.80E-04	4.80E-04			
PNL-1	230164	FILTER	12/13/2023	12/27/2023	Gross alpha	1.58E-03	pCi/m3	6.72E-04	6.72E-04			
PNL-1	230039	FILTER	12/28/2022	01/11/2023	Gross beta	1.56E-02	pCi/m3	1.03E-03	1.14E-03			
PNL-1	230044	FILTER	01/11/2023	01/25/2023	Gross beta	1.66E-02	pCi/m3	1.53E-03	1.53E-03			
PNL-1	230049	FILTER	01/25/2023	02/08/2023	Gross beta	2.65E-02	pCi/m3	1.90E-03	1.91E-03			
PNL-1	230054	FILTER	02/08/2023	02/22/2023	Gross beta	9.82E-03	pCi/m3	1.21E-03	1.21E-03	O	Method Blank Contamination RPI:1177656161	
PNL-1	230059	FILTER	02/22/2023	03/08/2023	Gross beta	1.68E-02	pCi/m3	1.55E-03	1.55E-03			
PNL-1	230064	FILTER	03/08/2023	03/22/2023	Gross beta	1.71E-02	pCi/m3	1.54E-03	1.54E-03			
PNL-1	230069	FILTER	03/22/2023	04/05/2023	Gross beta	1.13E-02	pCi/m3	1.26E-03	1.27E-03			
PNL-1	230074	FILTER	04/05/2023	04/19/2023	Gross beta	1.01E-02	pCi/m3	1.21E-03	1.21E-03			
PNL-1	230079	FILTER	04/19/2023	05/03/2023	Gross beta	1.21E-02	pCi/m3	1.33E-03	1.34E-03			
PNL-1	230084	FILTER	05/03/2023	05/17/2023	Gross beta	1.20E-02	pCi/m3	1.30E-03	1.30E-03			
PNL-1	230089	FILTER	05/17/2023	05/31/2023	Gross beta	1.63E-02	pCi/m3	1.53E-03	1.53E-03			
PNL-1	230094	FILTER	05/31/2023	06/14/2023	Gross beta	1.28E-02	pCi/m3	1.35E-03	1.35E-03		Issues stabilizing air flow; air sampler #24094 expiring 10/3/23 was replaced on 6/14/23 with #21710 expires 4/10/24.	
PNL-1	230099	FILTER	06/14/2023	06/28/2023	Gross beta	9.41E-03	pCi/m3	1.17E-03	1.19E-03			
PNL-1	230104	FILTER	06/28/2023	07/12/2023	Gross beta	1.34E-02	pCi/m3	1.38E-03	1.39E-03			
PNL-1	230109	FILTER	07/12/2023	07/26/2023	Gross beta	1.28E-02	pCi/m3	1.36E-03	1.36E-03			
PNL-1	230114	FILTER	07/26/2023	08/09/2023	Gross beta	1.39E-02	pCi/m3	1.42E-03	1.42E-03			
PNL-1	230119	FILTER	08/09/2023	08/21/2023	Gross beta	1.51E-02	pCi/m3	1.66E-03	1.67E-03	Refer to Discrepancy Report EMP23-003, collected sample two days earlier than	Refer to Discrepancy Report EMP23-003, collected sample two days earlier than due to wildfire smoke in the area.	

Field Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
											planned due to wildfire smoke in the area.		
PNL-1	230174	FILTER	08/21/2023	08/29/2023	Gross beta	2.25E-02	pCi/m3	2.57E-03	2.57E-03		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-1	230124	FILTER	08/29/2023	09/06/2023	Gross beta	1.31E-02	pCi/m3	1.92E-03	1.92E-03		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-1	230129	FILTER	09/06/2023	09/20/2023	Gross beta	1.81E-02	pCi/m3	1.57E-03	1.57E-03				
PNL-1	230134	FILTER	09/20/2023	10/04/2023	Gross beta	1.15E-02	pCi/m3	1.28E-03	1.29E-03				
PNL-1	230139	FILTER	10/04/2023	10/18/2023	Gross beta	1.54E-02	pCi/m3	1.50E-03	1.50E-03				
PNL-1	230144	FILTER	10/18/2023	11/01/2023	Gross beta	3.08E-02	pCi/m3	2.06E-03	2.07E-03				
PNL-1	230149	FILTER	11/01/2023	11/15/2023	Gross beta	2.30E-02	pCi/m3	1.76E-03	1.77E-03				
PNL-1	230154	FILTER	11/15/2023	11/29/2023	Gross beta	2.30E-02	pCi/m3	1.80E-03	1.81E-03				
PNL-1	230159	FILTER	11/29/2023	12/13/2023	Gross beta	2.11E-02	pCi/m3	1.69E-03	1.69E-03				
PNL-1	230164	FILTER	12/13/2023	12/27/2023	Gross beta	4.02E-02	pCi/m3	2.32E-03	2.34E-03				
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Antimony-125	2.05E-05	pCi/m3	1.36E-04	1.36E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Antimony-125	1.34E-04	pCi/m3	1.46E-04	1.59E-04	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Beryllium-7	4.45E-02	pCi/m3	2.90E-03	5.90E-03				Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Beryllium-7	2.87E-02	pCi/m3	2.07E-03	3.67E-03				Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Cesium-134	2.72E-05	pCi/m3	6.45E-05	6.57E-05	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Cesium-134	5.44E-05	pCi/m3	5.98E-05	6.48E-05	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Cesium-137	-5.41E-05	pCi/m3	1.18E-04	1.21E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Cesium-137	-5.26E-06	pCi/m3	7.97E-05	7.97E-05	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Cobalt-60	-1.85E-05	pCi/m3	5.96E-05	6.02E-05	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Cobalt-60	2.52E-06	pCi/m3	6.37E-05	6.37E-05	U			Y

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Europium-152	6.69E-05	pCi/m3	1.52E-04	1.55E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Europium-152	1.13E-04	pCi/m3	1.47E-04	1.56E-04	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Europium-154	-1.03E-04	pCi/m3	2.01E-04	2.07E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Europium-154	2.41E-05	pCi/m3	1.96E-04	1.96E-04	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Europium-155	5.03E-05	pCi/m3	1.38E-04	1.40E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Europium-155	8.05E-05	pCi/m3	1.30E-04	1.36E-04	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Potassium-40	3.30E-03	pCi/m3	1.49E-03	1.52E-03				Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Potassium-40	3.69E-03	pCi/m3	1.94E-03	1.98E-03				Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Ruthenium-106	6.59E-04	pCi/m3	5.38E-04	6.19E-04	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Ruthenium-106	3.78E-04	pCi/m3	5.42E-04	5.69E-04	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Gross alpha (Comp)	5.26E-03	pCi/m3	1.16E-03	1.17E-03			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Gross alpha (Comp)	1.78E-03	pCi/m3	6.69E-04	6.80E-04	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Gross beta (Comp)	1.63E-02	pCi/m3	9.72E-04	1.10E-03	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Gross beta (Comp)	2.13E-02	pCi/m3	1.11E-03	1.29E-03				Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Americium-241	5.24E-06	pCi/m3	1.33E-05	1.33E-05	UO		Result not detected above the detection limit	Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Americium-241	-2.68E-06	pCi/m3	5.25E-06	5.25E-06	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Americium-243	7.84E-05	pCi/m3	9.22E-05	9.26E-05	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Americium-243	5.51E-06	pCi/m3	1.32E-05	1.32E-05	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Curium-243/244	1.56E-05	pCi/m3	2.53E-05	2.53E-05	U			Y

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Curium-243/244	0.00E+00	pCi/m3	7.37E-06	7.37E-06	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Plutonium-238	1.02E-05	pCi/m3	1.16E-05	1.16E-05	U			Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Plutonium-238	4.91E-06	pCi/m3	7.61E-06	7.62E-06	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Plutonium-239/240	1.36E-05	pCi/m3	1.16E-05	1.16E-05				Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Plutonium-239/240	6.13E-06	pCi/m3	9.91E-06	9.92E-06	U			Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Uranium-233/234	3.87E-05	pCi/m3	1.88E-05	1.92E-05				Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Uranium-233/234	4.58E-05	pCi/m3	1.88E-05	1.94E-05				Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Uranium-235	1.77E-06	pCi/m3	7.74E-06	7.75E-06	UO		Result not detected above the detection limit	Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Uranium-235	1.04E-05	pCi/m3	9.60E-06	9.65E-06				Y
PNL-1	230169	FILTER	12/28/2022	06/28/2023	Uranium-238	4.72E-05	pCi/m3	1.66E-05	1.71E-05				Y
PNL-1	230204	FILTER	06/28/2023	12/27/2023	Uranium-238	5.89E-05	pCi/m3	1.86E-05	1.94E-05				Y
PNL-2	230040	FILTER	12/28/2022	01/11/2023	Gross alpha	3.05E-04	pCi/m3	2.45E-04	2.46E-04	U			
PNL-2	230045	FILTER	01/11/2023	01/25/2023	Gross alpha	6.31E-04	pCi/m3	4.41E-04	4.41E-04				
PNL-2	230050	FILTER	01/25/2023	02/08/2023	Gross alpha	9.02E-04	pCi/m3	4.74E-04	4.74E-04				
PNL-2	230055	FILTER	02/08/2023	02/22/2023	Gross alpha	4.21E-04	pCi/m3	3.89E-04	3.89E-04	U			
PNL-2	230060	FILTER	02/22/2023	03/08/2023	Gross alpha	4.73E-04	pCi/m3	3.92E-04	3.92E-04				
PNL-2	230065	FILTER	03/08/2023	03/22/2023	Gross alpha	1.62E-03	pCi/m3	6.18E-04	6.18E-04				
PNL-2	230070	FILTER	03/22/2023	04/05/2023	Gross alpha	3.73E-04	pCi/m3	3.23E-04	3.23E-04	U			
PNL-2	230075	FILTER	04/05/2023	04/19/2023	Gross alpha	6.03E-04	pCi/m3	4.15E-04	4.15E-04				
PNL-2	230080	FILTER	04/19/2023	05/03/2023	Gross alpha	1.17E-03	pCi/m3	5.90E-04	5.91E-04				
PNL-2	230085	FILTER	05/03/2023	05/17/2023	Gross alpha	5.57E-04	pCi/m3	4.09E-04	4.09E-04				
PNL-2	230090	FILTER	05/17/2023	05/31/2023	Gross alpha	1.59E-03	pCi/m3	6.78E-04	6.78E-04				
PNL-2	230095	FILTER	05/31/2023	06/14/2023	Gross alpha	1.07E-03	pCi/m3	5.64E-04	5.64E-04				
PNL-2	230100	FILTER	06/14/2023	06/28/2023	Gross alpha	1.61E-04	pCi/m3	2.23E-04	2.23E-04	U			
PNL-2	230105	FILTER	06/28/2023	07/12/2023	Gross alpha	5.58E-04	pCi/m3	3.81E-04	3.81E-04				
PNL-2	230110	FILTER	07/12/2023	07/26/2023	Gross alpha	6.77E-04	pCi/m3	4.53E-04	4.53E-04				

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-2	230115	FILTER	07/26/2023	08/09/2023	Gross alpha	5.80E-04	pCi/m3	4.39E-04	4.39E-04				
PNL-2	230120	FILTER	08/09/2023	08/21/2023	Gross alpha	1.23E-03	pCi/m3	6.25E-04	6.25E-04		Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	
PNL-2	230175	FILTER	08/21/2023	08/29/2023	Gross alpha	2.68E-03	pCi/m3	1.66E-03	1.66E-03		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area. Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	
PNL-2	230125	FILTER	08/29/2023	09/06/2023	Gross alpha	3.04E-04	pCi/m3	5.56E-04	5.56E-04	U	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-2	230130	FILTER	09/06/2023	09/20/2023	Gross alpha	8.29E-04	pCi/m3	4.94E-04	4.94E-04				
PNL-2	230135	FILTER	09/20/2023	10/04/2023	Gross alpha	3.61E-04	pCi/m3	3.30E-04	3.30E-04	U			
PNL-2	230140	FILTER	10/04/2023	10/18/2023	Gross alpha	9.79E-04	pCi/m3	4.87E-04	4.87E-04				
PNL-2	230145	FILTER	10/18/2023	11/01/2023	Gross alpha	1.19E-03	pCi/m3	5.63E-04	5.63E-04				
PNL-2	230150	FILTER	11/01/2023	11/15/2023	Gross alpha	1.05E-03	pCi/m3	5.48E-04	5.48E-04				
PNL-2	230155	FILTER	11/15/2023	11/29/2023	Gross alpha	1.02E-03	pCi/m3	6.16E-04	6.16E-04		Sampler not running. Air sampler #22974 replaced 11/29/23 with #21711, expires 7/25/24. Display panel readings recovered (Total Flow 636 m3, Elapsed Time 250.8 Hr).		
PNL-2	230160	FILTER	11/29/2023	12/13/2023	Gross alpha	1.27E-03	pCi/m3	6.23E-04	6.24E-04		Display Panel indicated air flow failure, sampler was running, acceptable volume and flow recorded.		
PNL-2	230165	FILTER	12/13/2023	12/27/2023	Gross alpha	1.36E-03	pCi/m3	5.74E-04	5.74E-04				

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-2	230040	FILTER	12/28/2022	01/11/2023	Gross beta	1.54E-02	pCi/m3	1.03E-03	1.17E-03				
PNL-2	230045	FILTER	01/11/2023	01/25/2023	Gross beta	1.51E-02	pCi/m3	1.46E-03	1.47E-03				
PNL-2	230050	FILTER	01/25/2023	02/08/2023	Gross beta	2.38E-02	pCi/m3	1.82E-03	1.83E-03				
PNL-2	230055	FILTER	02/08/2023	02/22/2023	Gross beta	9.75E-03	pCi/m3	1.19E-03	1.19E-03	O		Method Blank Contamination RPI:1177656161	
PNL-2	230060	FILTER	02/22/2023	03/08/2023	Gross beta	1.61E-02	pCi/m3	1.50E-03	1.51E-03				
PNL-2	230065	FILTER	03/08/2023	03/22/2023	Gross beta	1.73E-02	pCi/m3	1.57E-03	1.57E-03				
PNL-2	230070	FILTER	03/22/2023	04/05/2023	Gross beta	1.11E-02	pCi/m3	1.27E-03	1.28E-03				
PNL-2	230075	FILTER	04/05/2023	04/19/2023	Gross beta	9.10E-03	pCi/m3	1.15E-03	1.15E-03				
PNL-2	230080	FILTER	04/19/2023	05/03/2023	Gross beta	1.15E-02	pCi/m3	1.29E-03	1.29E-03				
PNL-2	230085	FILTER	05/03/2023	05/17/2023	Gross beta	1.28E-02	pCi/m3	1.34E-03	1.35E-03				
PNL-2	230090	FILTER	05/17/2023	05/31/2023	Gross beta	1.46E-02	pCi/m3	1.45E-03	1.46E-03				
PNL-2	230095	FILTER	05/31/2023	06/14/2023	Gross beta	1.23E-02	pCi/m3	1.33E-03	1.33E-03				
PNL-2	230100	FILTER	06/14/2023	06/28/2023	Gross beta	1.04E-02	pCi/m3	1.21E-03	1.21E-03				
PNL-2	230105	FILTER	06/28/2023	07/12/2023	Gross beta	1.57E-02	pCi/m3	1.50E-03	1.50E-03				
PNL-2	230110	FILTER	07/12/2023	07/26/2023	Gross beta	1.23E-02	pCi/m3	1.32E-03	1.32E-03				
PNL-2	230115	FILTER	07/26/2023	08/09/2023	Gross beta	1.48E-02	pCi/m3	1.45E-03	1.46E-03				
PNL-2	230120	FILTER	08/09/2023	08/21/2023	Gross beta	1.45E-02	pCi/m3	1.63E-03	1.63E-03		Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, collected sample two days earlier than planned due to wildfire smoke in the area.	
PNL-2	230175	FILTER	08/21/2023	08/29/2023	Gross beta	2.19E-02	pCi/m3	3.56E-03	3.56E-03		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-2	230125	FILTER	08/29/2023	09/06/2023	Gross beta	1.43E-02	pCi/m3	1.96E-03	1.97E-03		Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	Refer to Discrepancy Report EMP23-003, one-week sample due to wildfire smoke in the area.	
PNL-2	230130	FILTER	09/06/2023	09/20/2023	Gross beta	1.65E-02	pCi/m3	1.52E-03	1.52E-03				

Field	Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
	PNL-2	230135	FILTER	09/20/2023	10/04/2023	Gross beta	1.20E-02	pCi/m3	1.30E-03	1.30E-03				
	PNL-2	230140	FILTER	10/04/2023	10/18/2023	Gross beta	1.70E-02	pCi/m3	1.55E-03	1.56E-03				
	PNL-2	230145	FILTER	10/18/2023	11/01/2023	Gross beta	2.99E-02	pCi/m3	2.00E-03	2.01E-03				
	PNL-2	230150	FILTER	11/01/2023	11/15/2023	Gross beta	2.37E-02	pCi/m3	1.80E-03	1.81E-03				
	PNL-2	230155	FILTER	11/15/2023	11/29/2023	Gross beta	2.07E-02	pCi/m3	2.06E-03	2.07E-03		Sampler not running. Air sampler #22974 replaced 11/29/23 with #21711, expires 7/25/24. Display panel readings recovered (Total Flow 636 m3, Elapsed Time 250.8 Hr).		
	PNL-2	230160	FILTER	11/29/2023	12/13/2023	Gross beta	2.31E-02	pCi/m3	1.82E-03	1.83E-03		Display Panel indicated air flow failure, sampler was running, acceptable volume and flow recorded.		
	PNL-2	230165	FILTER	12/13/2023	12/27/2023	Gross beta	3.81E-02	pCi/m3	2.28E-03	2.30E-03				
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Antimony-125	-1.47E-04	pCi/m3	1.50E-04	1.64E-04	U			Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Antimony-125	6.42E-05	pCi/m3	1.36E-04	1.39E-04	U			Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Beryllium-7	4.44E-02	pCi/m3	2.59E-03	4.82E-03				Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Beryllium-7	2.66E-02	pCi/m3	1.98E-03	3.55E-03				Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Cesium-134	6.55E-05	pCi/m3	1.36E-04	1.36E-04	U			Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Cesium-134	1.03E-05	pCi/m3	6.18E-05	6.20E-05	U			Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Cesium-137	1.32E-05	pCi/m3	1.25E-04	1.25E-04	U			Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Cesium-137	6.44E-05	pCi/m3	6.23E-05	6.89E-05	U			Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Cobalt-60	-2.91E-07	pCi/m3	7.96E-05	7.96E-05	U			Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Cobalt-60	7.04E-07	pCi/m3	6.41E-05	6.41E-05	U			Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Europium-152	1.03E-04	pCi/m3	1.62E-04	1.69E-04	U			Y
	PNL-2	230205	FILTER	06/28/2023	12/27/2023	Europium-152	-1.59E-04	pCi/m3	1.44E-04	1.62E-04	U			Y
	PNL-2	230170	FILTER	12/28/2022	06/28/2023	Europium-154	5.79E-05	pCi/m3	2.15E-04	2.16E-04	U			Y

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Europium-154	-7.87E-05	pCi/m3	1.76E-04	1.80E-04	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Europium-155	8.57E-05	pCi/m3	1.45E-04	1.50E-04	U			Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Europium-155	-6.63E-05	pCi/m3	1.31E-04	1.35E-04	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Potassium-40	2.94E-03	pCi/m3	1.95E-03	1.97E-03				Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Potassium-40	4.08E-03	pCi/m3	1.44E-03	1.51E-03				Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Ruthenium-106	-2.20E-04	pCi/m3	5.59E-04	5.68E-04	U			Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Ruthenium-106	1.55E-04	pCi/m3	4.62E-04	4.67E-04	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Gross alpha (Comp)	2.86E-03	pCi/m3	8.66E-04	8.71E-04			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Gross alpha (Comp)	3.45E-03	pCi/m3	9.00E-04	9.10E-04	O		LCS/LCSD RER not met but spike recoveries were met. Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Gross beta (Comp)	1.43E-02	pCi/m3	8.42E-04	1.04E-03	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Gross beta (Comp)	2.35E-02	pCi/m3	1.20E-03	1.35E-03				Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Americium-241	2.68E-05	pCi/m3	1.60E-05	1.63E-05	O		Method Blank Contamination RPI:1224784291	Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Americium-241	6.31E-06	pCi/m3	9.59E-06	9.61E-06	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Americium-243	1.43E-05	pCi/m3	9.32E-05	9.33E-05	U			Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Americium-243	1.69E-05	pCi/m3	1.46E-05	1.47E-05	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Curium-243/244	4.70E-06	pCi/m3	1.54E-05	1.54E-05	U			Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Curium-243/244	-6.27E-06	pCi/m3	8.15E-06	8.15E-06	U			Y

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Plutonium-238	4.89E-05	pCi/m3	2.11E-05	2.15E-05				Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Plutonium-238	6.10E-06	pCi/m3	7.18E-06	7.19E-06	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Plutonium-239/240	3.13E-05	pCi/m3	1.93E-05	1.95E-05				Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Plutonium-239/240	2.44E-06	pCi/m3	6.76E-06	6.76E-06	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Uranium-233/234	3.89E-05	pCi/m3	1.77E-05	1.82E-05				Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Uranium-233/234	2.66E-05	pCi/m3	1.90E-05	1.92E-05	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Uranium-235	5.17E-06	pCi/m3	7.55E-06	7.56E-06	UO		Result not detected above the detection limit	Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Uranium-235	3.38E-06	pCi/m3	9.38E-06	9.38E-06	U			Y
PNL-2	230170	FILTER	12/28/2022	06/28/2023	Uranium-238	4.74E-05	pCi/m3	1.77E-05	1.82E-05				Y
PNL-2	230205	FILTER	06/28/2023	12/27/2023	Uranium-238	5.06E-05	pCi/m3	1.67E-05	1.74E-05				Y
PNL-3	230041	FILTER	12/28/2022	01/11/2023	Gross alpha	2.96E-04	pCi/m3	2.61E-04	2.61E-04	U			
PNL-3	230046	FILTER	01/11/2023	01/25/2023	Gross alpha	6.96E-04	pCi/m3	3.91E-04	3.91E-04				
PNL-3	230051	FILTER	01/25/2023	02/08/2023	Gross alpha	7.11E-04	pCi/m3	4.45E-04	4.45E-04				
PNL-3	230056	FILTER	02/08/2023	02/22/2023	Gross alpha	6.62E-04	pCi/m3	4.01E-04	4.01E-04				
PNL-3	230061	FILTER	02/22/2023	03/08/2023	Gross alpha	1.07E-03	pCi/m3	4.99E-04	5.00E-04				
PNL-3	230066	FILTER	03/08/2023	03/22/2023	Gross alpha	1.76E-03	pCi/m3	6.63E-04	6.63E-04				
PNL-3	230071	FILTER	03/22/2023	04/05/2023	Gross alpha	4.12E-04	pCi/m3	3.45E-04	3.45E-04	U			
PNL-3	230076	FILTER	04/05/2023	04/19/2023	Gross alpha	4.36E-04	pCi/m3	3.52E-04	3.52E-04				
PNL-3	230081	FILTER	04/19/2023	05/03/2023	Gross alpha	4.85E-04	pCi/m3	3.50E-04	3.50E-04				
PNL-3	230086	FILTER	05/03/2023	05/17/2023	Gross alpha	2.34E-05	pCi/m3	1.47E-04	1.47E-04	U			
PNL-3	230091	FILTER	05/17/2023	05/31/2023	Gross alpha	3.77E-04	pCi/m3	3.18E-04	3.18E-04	U	Totalizer #43344 expiring 06/27/23 was replaced on 05/31/23 with totalizer #44483, expires 03/09/24.		
PNL-3	230096	FILTER	05/31/2023	06/14/2023	Gross alpha	3.77E-04	pCi/m3	3.18E-04	3.18E-04	U			
PNL-3	230101	FILTER	06/14/2023	06/28/2023	Gross alpha	5.52E-04	pCi/m3	3.61E-04	3.61E-04				
PNL-3	230106	FILTER	06/28/2023	07/12/2023	Gross alpha	7.40E-04	pCi/m3	4.65E-04	4.65E-04				

Field	Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
	PNL-3	230111	FILTER	07/12/2023	07/26/2023	Gross alpha	8.64E-04	pCi/m3	5.06E-04	5.06E-04				
	PNL-3	230116	FILTER	07/26/2023	08/09/2023	Gross alpha	6.94E-04	pCi/m3	4.35E-04	4.35E-04				
	PNL-3	230121	FILTER	08/09/2023	08/23/2023	Gross alpha	1.11E-03	pCi/m3	5.55E-04	5.55E-04				
	PNL-3	230126	FILTER	08/23/2023	09/06/2023	Gross alpha	1.00E-03	pCi/m3	5.11E-04	5.11E-04				
	PNL-3	230131	FILTER	09/06/2023	09/20/2023	Gross alpha	3.70E-04	pCi/m3	3.12E-04	3.12E-04	U			
	PNL-3	230136	FILTER	09/20/2023	10/04/2023	Gross alpha	6.27E-04	pCi/m3	4.51E-04	4.51E-04				
	PNL-3	230141	FILTER	10/04/2023	10/18/2023	Gross alpha	3.55E-04	pCi/m3	3.58E-04	3.58E-04	U			
	PNL-3	230146	FILTER	10/18/2023	11/01/2023	Gross alpha	2.45E-03	pCi/m3	8.15E-04	8.15E-04				
	PNL-3	230151	FILTER	11/01/2023	11/15/2023	Gross alpha	9.13E-04	pCi/m3	4.66E-04	4.66E-04				
	PNL-3	230156	FILTER	11/15/2023	11/29/2023	Gross alpha	4.07E-04	pCi/m3	3.75E-04	3.75E-04	U			
	PNL-3	230161	FILTER	11/29/2023	12/13/2023	Gross alpha	8.90E-04	pCi/m3	4.68E-04	4.68E-04				
	PNL-3	230166	FILTER	12/13/2023	12/27/2023	Gross alpha	2.13E-03	pCi/m3	7.62E-04	7.63E-04				
	PNL-3	230041	FILTER	12/28/2022	01/11/2023	Gross beta	1.74E-02	pCi/m3	1.06E-03	1.09E-03				
	PNL-3	230046	FILTER	01/11/2023	01/25/2023	Gross beta	1.67E-02	pCi/m3	1.47E-03	1.47E-03				
	PNL-3	230051	FILTER	01/25/2023	02/08/2023	Gross beta	2.18E-02	pCi/m3	1.63E-03	1.64E-03				
	PNL-3	230056	FILTER	02/08/2023	02/22/2023	Gross beta	8.78E-03	pCi/m3	1.06E-03	1.06E-03	O		Method Blank Contamination RPI:1177656161	
	PNL-3	230061	FILTER	02/22/2023	03/08/2023	Gross beta	1.36E-02	pCi/m3	1.28E-03	1.29E-03				
	PNL-3	230066	FILTER	03/08/2023	03/22/2023	Gross beta	1.66E-02	pCi/m3	1.42E-03	1.43E-03				
	PNL-3	230071	FILTER	03/22/2023	04/05/2023	Gross beta	9.34E-03	pCi/m3	1.05E-03	1.05E-03				
	PNL-3	230076	FILTER	04/05/2023	04/19/2023	Gross beta	8.55E-03	pCi/m3	1.03E-03	1.03E-03				
	PNL-3	230081	FILTER	04/19/2023	05/03/2023	Gross beta	1.05E-02	pCi/m3	1.14E-03	1.14E-03				
	PNL-3	230086	FILTER	05/03/2023	05/17/2023	Gross beta	1.03E-02	pCi/m3	1.16E-03	1.16E-03				
	PNL-3	230091	FILTER	05/17/2023	05/31/2023	Gross beta	1.25E-02	pCi/m3	1.26E-03	1.26E-03		Totalizer #43344 expiring 06/27/23 was replaced on 05/31/23 with totalizer #44483, expires 03/09/24.		
	PNL-3	230096	FILTER	05/31/2023	06/14/2023	Gross beta	1.22E-02	pCi/m3	1.27E-03	1.28E-03				
	PNL-3	230101	FILTER	06/14/2023	06/28/2023	Gross beta	9.13E-03	pCi/m3	1.12E-03	1.15E-03				
	PNL-3	230106	FILTER	06/28/2023	07/12/2023	Gross beta	1.32E-02	pCi/m3	1.32E-03	1.33E-03				
	PNL-3	230111	FILTER	07/12/2023	07/26/2023	Gross beta	1.10E-02	pCi/m3	1.23E-03	1.24E-03				

Field	Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
	PNL-3	230116	FILTER	07/26/2023	08/09/2023	Gross beta	1.25E-02	pCi/m3	1.30E-03	1.30E-03				
	PNL-3	230121	FILTER	08/09/2023	08/23/2023	Gross beta	1.22E-02	pCi/m3	1.27E-03	1.27E-03				
	PNL-3	230126	FILTER	08/23/2023	09/06/2023	Gross beta	1.46E-02	pCi/m3	1.40E-03	1.40E-03				
	PNL-3	230131	FILTER	09/06/2023	09/20/2023	Gross beta	1.61E-02	pCi/m3	1.48E-03	1.48E-03				
	PNL-3	230136	FILTER	09/20/2023	10/04/2023	Gross beta	1.21E-02	pCi/m3	1.31E-03	1.32E-03				
	PNL-3	230141	FILTER	10/04/2023	10/18/2023	Gross beta	1.54E-02	pCi/m3	1.46E-03	1.47E-03				
	PNL-3	230146	FILTER	10/18/2023	11/01/2023	Gross beta	3.26E-02	pCi/m3	2.06E-03	2.07E-03				
	PNL-3	230151	FILTER	11/01/2023	11/15/2023	Gross beta	2.33E-02	pCi/m3	1.69E-03	1.70E-03				
	PNL-3	230156	FILTER	11/15/2023	11/29/2023	Gross beta	2.69E-02	pCi/m3	1.88E-03	1.89E-03				
	PNL-3	230161	FILTER	11/29/2023	12/13/2023	Gross beta	2.20E-02	pCi/m3	1.71E-03	1.72E-03				
	PNL-3	230166	FILTER	12/13/2023	12/27/2023	Gross beta	3.86E-02	pCi/m3	2.23E-03	2.24E-03				
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Antimony-125	-3.06E-05	pCi/m3	1.24E-04	1.25E-04	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Antimony-125	1.64E-05	pCi/m3	9.28E-05	9.31E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Beryllium-7	3.90E-02	pCi/m3	2.38E-03	4.63E-03				Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Beryllium-7	2.33E-02	pCi/m3	1.97E-03	3.25E-03				Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Cesium-134	4.33E-05	pCi/m3	5.88E-05	6.21E-05	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Cesium-134	1.71E-06	pCi/m3	4.17E-05	4.17E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Cesium-137	9.50E-06	pCi/m3	5.25E-05	5.27E-05	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Cesium-137	4.93E-06	pCi/m3	4.16E-05	4.17E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Cobalt-60	2.66E-05	pCi/m3	7.36E-05	7.46E-05	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Cobalt-60	-1.69E-05	pCi/m3	4.41E-05	4.48E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Europium-152	-1.14E-05	pCi/m3	1.29E-04	1.29E-04	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Europium-152	-6.30E-05	pCi/m3	1.01E-04	1.05E-04	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Europium-154	3.44E-06	pCi/m3	1.61E-04	1.61E-04	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Europium-154	-1.11E-04	pCi/m3	1.44E-04	1.53E-04	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Europium-155	-1.93E-05	pCi/m3	1.19E-04	1.19E-04	U			Y

Field	Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Europium-155	2.31E-05	pCi/m3	9.34E-05	9.41E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Potassium-40	2.18E-03	pCi/m3	1.41E-03	1.43E-03				Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Potassium-40	2.89E-03	pCi/m3	1.15E-03	1.19E-03				Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Ruthenium-106	-1.53E-04	pCi/m3	5.21E-04	5.26E-04	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Ruthenium-106	-1.52E-05	pCi/m3	3.47E-04	3.47E-04	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Gross alpha (Comp)	2.54E-03	pCi/m3	7.72E-04	7.73E-04			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Gross alpha (Comp)	3.54E-03	pCi/m3	8.75E-04	8.89E-04	O		LCS/LCSD RER not met but spike recoveries were met. Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Gross beta (Comp)	1.21E-02	pCi/m3	7.79E-04	8.00E-04	O		LCS/LCSD RER not met but spike recoveries were met.	Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Gross beta (Comp)	2.29E-02	pCi/m3	1.10E-03	1.20E-03				Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Americium-241	5.32E-05	pCi/m3	1.74E-05	1.84E-05	O		Method Blank Contamination RPI:1224784291	Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Americium-241	3.39E-06	pCi/m3	8.57E-06	8.58E-06	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Americium-243	6.17E-05	pCi/m3	8.55E-05	8.57E-05	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Americium-243	7.08E-06	pCi/m3	1.24E-05	1.24E-05	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Curium-243/244	9.03E-06	pCi/m3	1.66E-05	1.66E-05	U			Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Curium-243/244	-3.36E-06	pCi/m3	6.59E-06	6.59E-06	U			Y
	PNL-3	230171	FILTER	12/28/2022	06/28/2023	Plutonium-238	9.84E-05	pCi/m3	2.32E-05	2.46E-05				Y
	PNL-3	230206	FILTER	06/28/2023	12/27/2023	Plutonium-238	3.45E-06	pCi/m3	5.96E-06	5.96E-06	U			Y

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-3	230171	FILTER	12/28/2022	06/28/2023	Plutonium-239/240	1.18E-04	pCi/m3	2.56E-05	2.73E-05				Y
PNL-3	230206	FILTER	06/28/2023	12/27/2023	Plutonium-239/240	4.59E-06	pCi/m3	7.79E-06	7.79E-06	U			Y
PNL-3	230171	FILTER	12/28/2022	06/28/2023	Uranium-233/234	5.17E-05	pCi/m3	1.76E-05	1.83E-05				Y
PNL-3	230206	FILTER	06/28/2023	12/27/2023	Uranium-233/234	4.79E-05	pCi/m3	1.84E-05	1.91E-05				Y
PNL-3	230171	FILTER	12/28/2022	06/28/2023	Uranium-235	2.99E-06	pCi/m3	1.01E-05	1.01E-05	UO		Result not detected above the detection limit	Y
PNL-3	230206	FILTER	06/28/2023	12/27/2023	Uranium-235	6.16E-06	pCi/m3	8.54E-06	8.55E-06	U			Y
PNL-3	230171	FILTER	12/28/2022	06/28/2023	Uranium-238	4.83E-05	pCi/m3	1.67E-05	1.73E-05				Y
PNL-3	230206	FILTER	06/28/2023	12/27/2023	Uranium-238	4.98E-05	pCi/m3	1.83E-05	1.88E-05				Y
PNL-4	230042	FILTER	12/28/2022	01/11/2023	Gross alpha	4.95E-04	pCi/m3	2.77E-04	2.77E-04				
PNL-4	230047	FILTER	01/11/2023	01/25/2023	Gross alpha	9.37E-04	pCi/m3	5.20E-04	5.20E-04				
PNL-4	230052	FILTER	01/25/2023	02/08/2023	Gross alpha	9.10E-04	pCi/m3	4.86E-04	4.86E-04				
PNL-4	230057	FILTER	02/08/2023	02/22/2023	Gross alpha	1.08E-04	pCi/m3	2.37E-04	2.37E-04	U			
PNL-4	230062	FILTER	02/22/2023	03/08/2023	Gross alpha	5.82E-04	pCi/m3	4.34E-04	4.34E-04				
PNL-4	230067	FILTER	03/08/2023	03/22/2023	Gross alpha	1.01E-03	pCi/m3	5.44E-04	5.44E-04				
PNL-4	230072	FILTER	03/22/2023	04/05/2023	Gross alpha	1.72E-04	pCi/m3	2.51E-04	2.51E-04	U			
PNL-4	230077	FILTER	04/05/2023	04/19/2023	Gross alpha	4.55E-04	pCi/m3	3.47E-04	3.47E-04				
PNL-4	230082	FILTER	04/19/2023	05/03/2023	Gross alpha	6.59E-04	pCi/m3	4.41E-04	4.41E-04				
PNL-4	230087	FILTER	05/03/2023	05/17/2023	Gross alpha	6.86E-04	pCi/m3	4.35E-04	4.35E-04		Totalizer #41499 expiring 05/27/23 was replaced on 05/17/23 with totalizer #42288, expires 11/04/23.		
PNL-4	230092	FILTER	05/17/2023	05/31/2023	Gross alpha	1.65E-03	pCi/m3	1.03E-03	1.03E-03		Low volume (438 m3). Totalizer #42288 expiring 11/04/23 was replaced on 05/31/23 with totalizer #44485, expires 03/09/24.		
PNL-4	230097	FILTER	05/31/2023	06/14/2023	Gross alpha	6.68E-04	pCi/m3	4.29E-04	4.29E-04				
PNL-4	230102	FILTER	06/14/2023	06/28/2023	Gross alpha	4.79E-04	pCi/m3	3.32E-04	3.32E-04				

Field Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-4	230107	FILTER	06/28/2023	07/12/2023	Gross alpha	6.07E-04	pCi/m3	3.85E-04	3.85E-04		Planned power outage on 7/12/23 (7 hours) to accommodate nearby EV installation; no impact to sample volume.		
PNL-4	230112	FILTER	07/12/2023	07/26/2023	Gross alpha	7.84E-04	pCi/m3	4.27E-04	4.27E-04				
PNL-4	230117	FILTER	07/26/2023	08/09/2023	Gross alpha	4.35E-04	pCi/m3	3.54E-04	3.54E-04				
PNL-4	230122	FILTER	08/09/2023	08/23/2023	Gross alpha	1.95E-03	pCi/m3	6.47E-04	6.47E-04				
PNL-4	230127	FILTER	08/23/2023	09/06/2023	Gross alpha	8.46E-04	pCi/m3	4.94E-04	4.94E-04				
PNL-4	230132	FILTER	09/06/2023	09/20/2023	Gross alpha	6.05E-04	pCi/m3	4.01E-04	4.01E-04				
PNL-4	230137	FILTER	09/20/2023	10/04/2023	Gross alpha	6.36E-04	pCi/m3	4.05E-04	4.05E-04		Planned power outage on 9/26/23 (5-hours) to accommodate nearby EV installation; no impact to sample volume.		
PNL-4	230142	FILTER	10/04/2023	10/18/2023	Gross alpha	4.55E-04	pCi/m3	3.77E-04	3.77E-04	U			
PNL-4	230147	FILTER	10/18/2023	11/01/2023	Gross alpha	1.02E-03	pCi/m3	4.92E-04	4.92E-04				
PNL-4	230152	FILTER	11/01/2023	11/15/2023	Gross alpha	1.12E-03	pCi/m3	5.66E-04	5.66E-04				
PNL-4	230157	FILTER	11/15/2023	11/29/2023	Gross alpha	7.69E-04	pCi/m3	4.51E-04	4.51E-04				
PNL-4	230162	FILTER	11/29/2023	12/13/2023	Gross alpha	7.31E-04	pCi/m3	4.82E-04	4.82E-04				
PNL-4	230167	FILTER	12/13/2023	12/27/2023	Gross alpha	2.00E-03	pCi/m3	7.22E-04	7.22E-04				
PNL-4	230042	FILTER	12/28/2022	01/11/2023	Gross beta	1.55E-02	pCi/m3	1.01E-03	1.05E-03				
PNL-4	230047	FILTER	01/11/2023	01/25/2023	Gross beta	1.75E-02	pCi/m3	1.54E-03	1.55E-03				
PNL-4	230052	FILTER	01/25/2023	02/08/2023	Gross beta	2.32E-02	pCi/m3	1.74E-03	1.75E-03				
PNL-4	230057	FILTER	02/08/2023	02/22/2023	Gross beta	8.86E-03	pCi/m3	1.13E-03	1.13E-03	O		Method Blank Contamination RPI:1177656161	
PNL-4	230062	FILTER	02/22/2023	03/08/2023	Gross beta	1.55E-02	pCi/m3	1.47E-03	1.47E-03				
PNL-4	230067	FILTER	03/08/2023	03/22/2023	Gross beta	1.80E-02	pCi/m3	1.62E-03	1.62E-03				
PNL-4	230072	FILTER	03/22/2023	04/05/2023	Gross beta	2.96E-03	pCi/m3	7.25E-04	7.26E-04				
PNL-4	230077	FILTER	04/05/2023	04/19/2023	Gross beta	8.85E-03	pCi/m3	1.12E-03	1.13E-03				
PNL-4	230082	FILTER	04/19/2023	05/03/2023	Gross beta	9.46E-03	pCi/m3	1.16E-03	1.16E-03				

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-4	230087	FILTER	05/03/2023	05/17/2023	Gross beta	1.11E-02	pCi/m3	1.20E-03	1.20E-03		Totalizer #41499 expiring 05/27/23 was replaced on 05/17/23 with totalizer #42288, expires 11/04/23.		
PNL-4	230092	FILTER	05/17/2023	05/31/2023	Gross beta	3.19E-02	pCi/m3	3.07E-03	3.08E-03		Low volume (438 m3). Totalizer #42288 expiring 11/04/23 was replaced on 05/31/23 with totalizer #44485, expires 03/09/24.		
PNL-4	230097	FILTER	05/31/2023	06/14/2023	Gross beta	1.37E-02	pCi/m3	1.36E-03	1.36E-03				
PNL-4	230102	FILTER	06/14/2023	06/28/2023	Gross beta	9.29E-03	pCi/m3	1.11E-03	1.13E-03				
PNL-4	230107	FILTER	06/28/2023	07/12/2023	Gross beta	1.46E-02	pCi/m3	1.34E-03	1.34E-03		Planned power outage on 7/12/23 (7 hours) to accommodate nearby EV installation; no impact to sample volume.		
PNL-4	230112	FILTER	07/12/2023	07/26/2023	Gross beta	1.17E-02	pCi/m3	1.26E-03	1.26E-03				
PNL-4	230117	FILTER	07/26/2023	08/09/2023	Gross beta	1.21E-02	pCi/m3	1.25E-03	1.26E-03				
PNL-4	230122	FILTER	08/09/2023	08/23/2023	Gross beta	1.33E-02	pCi/m3	1.25E-03	1.26E-03				
PNL-4	230127	FILTER	08/23/2023	09/06/2023	Gross beta	1.53E-02	pCi/m3	1.41E-03	1.42E-03				
PNL-4	230132	FILTER	09/06/2023	09/20/2023	Gross beta	1.56E-02	pCi/m3	1.35E-03	1.36E-03				
PNL-4	230137	FILTER	09/20/2023	10/04/2023	Gross beta	1.18E-02	pCi/m3	1.33E-03	1.34E-03		Planned power outage on 9/26/23 (5-hours) to accommodate nearby EV installation; no impact to sample volume.		
PNL-4	230142	FILTER	10/04/2023	10/18/2023	Gross beta	1.48E-02	pCi/m3	1.43E-03	1.43E-03				
PNL-4	230147	FILTER	10/18/2023	11/01/2023	Gross beta	2.89E-02	pCi/m3	1.92E-03	1.93E-03				
PNL-4	230152	FILTER	11/01/2023	11/15/2023	Gross beta	2.17E-02	pCi/m3	1.68E-03	1.69E-03				
PNL-4	230157	FILTER	11/15/2023	11/29/2023	Gross beta	2.67E-02	pCi/m3	1.79E-03	1.80E-03				
PNL-4	230162	FILTER	11/29/2023	12/13/2023	Gross beta	2.09E-02	pCi/m3	1.71E-03	1.72E-03				
PNL-4	230167	FILTER	12/13/2023	12/27/2023	Gross beta	3.71E-02	pCi/m3	2.23E-03	2.24E-03				

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Antimony-125	-5.15E-05	pCi/m3	1.82E-04	1.84E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Antimony-125	5.93E-05	pCi/m3	1.49E-04	1.51E-04	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Beryllium-7	4.64E-02	pCi/m3	3.42E-03	5.86E-03				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Beryllium-7	2.72E-02	pCi/m3	2.00E-03	3.65E-03				Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Cesium-134	1.28E-05	pCi/m3	8.43E-05	8.45E-05	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Cesium-134	-7.47E-06	pCi/m3	5.43E-05	5.44E-05	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Cesium-137	-7.04E-05	pCi/m3	9.79E-05	1.03E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Cesium-137	5.68E-05	pCi/m3	5.54E-05	6.12E-05	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Cobalt-60	2.65E-05	pCi/m3	8.41E-05	8.50E-05	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Cobalt-60	7.95E-05	pCi/m3	1.11E-04	1.17E-04	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Europium-152	-1.08E-04	pCi/m3	2.00E-04	2.06E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Europium-152	9.43E-05	pCi/m3	1.25E-04	1.32E-04	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Europium-154	2.04E-05	pCi/m3	2.02E-04	2.03E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Europium-154	-1.33E-05	pCi/m3	1.90E-04	1.90E-04	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Europium-155	6.53E-05	pCi/m3	1.84E-04	1.86E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Europium-155	-1.71E-05	pCi/m3	9.94E-05	9.97E-05	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Potassium-40	1.95E-03	pCi/m3	1.70E-03	1.70E-03				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Potassium-40	4.30E-03	pCi/m3	1.45E-03	1.52E-03				Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Ruthenium-106	1.42E-04	pCi/m3	6.12E-04	6.16E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Ruthenium-106	-2.27E-04	pCi/m3	5.68E-04	5.78E-04	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Gross alpha (Comp)	5.18E-03	pCi/m3	1.12E-03	1.12E-03			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Gross alpha (Comp)	2.62E-03	pCi/m3	7.57E-04	7.64E-04	O		LCS/LCSD RER not met but spike recoveries were	Y

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
												met. Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Gross beta (Comp)	1.38E-02	pCi/m3	8.91E-04	9.14E-04	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Gross beta (Comp)	2.19E-02	pCi/m3	1.08E-03	1.16E-03				Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Americium-241	4.25E-05	pCi/m3	2.03E-05	2.08E-05	O		Method Blank Contamination RPI:1224784291	Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Americium-241	1.30E-06	pCi/m3	8.42E-06	8.43E-06	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Americium-243	-5.28E-05	pCi/m3	1.27E-04	1.27E-04	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Americium-243	6.93E-06	pCi/m3	1.15E-05	1.16E-05	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Curium-243/244	-4.88E-06	pCi/m3	1.72E-05	1.72E-05	U			Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Curium-243/244	-1.29E-06	pCi/m3	6.67E-06	6.67E-06	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Plutonium-238	2.45E-05	pCi/m3	1.66E-05	1.67E-05				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Plutonium-238	3.50E-06	pCi/m3	6.85E-06	6.86E-06	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Plutonium-239/240	8.79E-05	pCi/m3	2.55E-05	2.65E-05				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Plutonium-239/240	1.05E-05	pCi/m3	8.84E-06	8.87E-06	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Uranium-233/234	3.80E-05	pCi/m3	1.69E-05	1.74E-05				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Uranium-233/234	5.29E-05	pCi/m3	1.74E-05	1.83E-05				Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Uranium-235	-1.69E-06	pCi/m3	7.40E-06	7.40E-06	UO		Result not detected above the detection limit	Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Uranium-235	-3.21E-06	pCi/m3	7.70E-06	7.70E-06	U			Y
PNL-4	230172	FILTER	12/28/2022	06/28/2023	Uranium-238	4.78E-05	pCi/m3	1.67E-05	1.73E-05				Y
PNL-4	230207	FILTER	06/28/2023	12/27/2023	Uranium-238	3.89E-05	pCi/m3	1.69E-05	1.73E-05				Y

Field Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Com- posite
PNL-5	230043	FILTER	12/28/2022	01/11/2023	Gross alpha	4.12E-04	pCi/m3	2.35E-04	2.35E-04				
PNL-5	230048	FILTER	01/11/2023	01/25/2023	Gross alpha	6.57E-04	pCi/m3	4.05E-04	4.05E-04				
PNL-5	230053	FILTER	01/25/2023	02/08/2023	Gross alpha	1.01E-03	pCi/m3	5.29E-04	5.29E-04				
PNL-5	230058	FILTER	02/08/2023	02/22/2023	Gross alpha	4.95E-04	pCi/m3	3.74E-04	3.74E-04				
PNL-5	230063	FILTER	02/22/2023	03/08/2023	Gross alpha	5.04E-04	pCi/m3	3.86E-04	3.86E-04				
PNL-5	230068	FILTER	03/08/2023	03/22/2023	Gross alpha	1.71E-03	pCi/m3	7.04E-04	7.04E-04				
PNL-5	230073	FILTER	03/22/2023	04/05/2023	Gross alpha	3.15E-04	pCi/m3	3.04E-04	3.04E-04	U	Filter paper off-centered resulting in lower than normal dust loading.		
PNL-5	230078	FILTER	04/05/2023	04/19/2023	Gross alpha	1.01E-03	pCi/m3	5.12E-04	5.12E-04				
PNL-5	230083	FILTER	04/19/2023	05/03/2023	Gross alpha	2.65E-04	pCi/m3	2.66E-04	2.66E-04	U			
PNL-5	230088	FILTER	05/03/2023	05/17/2023	Gross alpha	8.77E-04	pCi/m3	4.47E-04	4.47E-04		Totalizer #41499 expiring 05/27/23 was replaced on 05/17/23 with totalizer #42288, expires 11/04/23.		
PNL-5	230093	FILTER	05/17/2023	05/31/2023	Gross alpha	4.71E-04	pCi/m3	3.28E-04	3.28E-04				
PNL-5	230098	FILTER	05/31/2023	06/14/2023	Gross alpha	8.76E-04	pCi/m3	4.73E-04	4.73E-04		Totalizer #43345 expiring 6/27/23 was replaced on /14/23 with totalizer #41499 expires 5/30/24.		
PNL-5	230103	FILTER	06/14/2023	06/28/2023	Gross alpha	3.30E-04	pCi/m3	2.79E-04	2.79E-04				
PNL-5	230108	FILTER	06/28/2023	07/12/2023	Gross alpha	3.56E-04	pCi/m3	3.39E-04	3.39E-04	U			
PNL-5	230113	FILTER	07/12/2023	07/26/2023	Gross alpha	4.71E-04	pCi/m3	3.63E-04	3.63E-04				
PNL-5	230118	FILTER	07/26/2023	08/09/2023	Gross alpha	9.12E-04	pCi/m3	4.42E-04	4.42E-04				
PNL-5	230123	FILTER	08/09/2023	08/23/2023	Gross alpha	2.04E-03	pCi/m3	6.92E-04	6.92E-04				
PNL-5	230128	FILTER	08/23/2023	09/06/2023	Gross alpha	5.68E-04	pCi/m3	3.87E-04	3.87E-04				
PNL-5	230133	FILTER	09/06/2023	09/20/2023	Gross alpha	1.97E-04	pCi/m3	2.47E-04	2.47E-04	U			
PNL-5	230138	FILTER	09/20/2023	10/04/2023	Gross alpha	1.17E-03	pCi/m3	5.71E-04	5.71E-04				
PNL-5	230143	FILTER	10/04/2023	10/18/2023	Gross alpha	1.07E-03	pCi/m3	5.42E-04	5.42E-04				
PNL-5	230148	FILTER	10/18/2023	11/01/2023	Gross alpha	1.48E-03	pCi/m3	6.50E-04	6.50E-04				
PNL-5	230153	FILTER	11/01/2023	11/15/2023	Gross alpha	1.52E-03	pCi/m3	6.10E-04	6.10E-04				
PNL-5	230158	FILTER	11/15/2023	11/29/2023	Gross alpha	1.69E-03	pCi/m3	6.65E-04	6.65E-04				

Field Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-5	230163	FILTER	11/29/2023	12/13/2023	Gross alpha	5.25E-04	pCi/m3	3.88E-04	3.88E-04				
PNL-5	230168	FILTER	12/13/2023	12/27/2023	Gross alpha	2.78E-03	pCi/m3	8.47E-04	8.47E-04			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	
PNL-5	230043	FILTER	12/28/2022	01/11/2023	Gross beta	1.57E-02	pCi/m3	1.02E-03	1.08E-03				
PNL-5	230048	FILTER	01/11/2023	01/25/2023	Gross beta	1.43E-02	pCi/m3	1.36E-03	1.37E-03				
PNL-5	230053	FILTER	01/25/2023	02/08/2023	Gross beta	2.12E-02	pCi/m3	1.65E-03	1.66E-03				
PNL-5	230058	FILTER	02/08/2023	02/22/2023	Gross beta	8.92E-03	pCi/m3	1.18E-03	1.18E-03	O		Method Blank Contamination RPI:1177656161	
PNL-5	230063	FILTER	02/22/2023	03/08/2023	Gross beta	1.55E-02	pCi/m3	1.53E-03	1.54E-03				
PNL-5	230068	FILTER	03/08/2023	03/22/2023	Gross beta	1.63E-02	pCi/m3	1.53E-03	1.53E-03				
PNL-5	230073	FILTER	03/22/2023	04/05/2023	Gross beta	2.53E-03	pCi/m3	6.41E-04	6.41E-04		Filter paper off-centered resulting in lower than normal dust loading.		
PNL-5	230078	FILTER	04/05/2023	04/19/2023	Gross beta	8.51E-03	pCi/m3	1.04E-03	1.04E-03				
PNL-5	230083	FILTER	04/19/2023	05/03/2023	Gross beta	1.23E-02	pCi/m3	1.24E-03	1.24E-03				
PNL-5	230088	FILTER	05/03/2023	05/17/2023	Gross beta	1.04E-02	pCi/m3	1.13E-03	1.14E-03		Totalizer #41499 expiring 05/27/23 was replaced on 05/17/23 with totalizer #42288, expires 11/04/23.		
PNL-5	230093	FILTER	05/17/2023	05/31/2023	Gross beta	1.49E-02	pCi/m3	1.35E-03	1.35E-03				
PNL-5	230098	FILTER	05/31/2023	06/14/2023	Gross beta	1.26E-02	pCi/m3	1.30E-03	1.30E-03		Totalizer #43345 expiring 6/27/23 was replaced on /14/23 with totalizer #41499 expires 5/30/24.		
PNL-5	230103	FILTER	06/14/2023	06/28/2023	Gross beta	7.55E-03	pCi/m3	9.89E-04	1.03E-03				
PNL-5	230108	FILTER	06/28/2023	07/12/2023	Gross beta	1.34E-02	pCi/m3	1.28E-03	1.28E-03				
PNL-5	230113	FILTER	07/12/2023	07/26/2023	Gross beta	1.12E-02	pCi/m3	1.19E-03	1.19E-03				
PNL-5	230118	FILTER	07/26/2023	08/09/2023	Gross beta	1.29E-02	pCi/m3	1.28E-03	1.29E-03				
PNL-5	230123	FILTER	08/09/2023	08/23/2023	Gross beta	1.06E-02	pCi/m3	1.12E-03	1.12E-03				
PNL-5	230128	FILTER	08/23/2023	09/06/2023	Gross beta	1.60E-02	pCi/m3	1.50E-03	1.50E-03				
PNL-5	230133	FILTER	09/06/2023	09/20/2023	Gross beta	1.59E-02	pCi/m3	1.38E-03	1.38E-03				

Field	Location ID	Sample ID	Sample Matrix	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
	PNL-5	230138	FILTER	09/20/2023	10/04/2023	Gross beta	1.14E-02	pCi/m3	1.25E-03	1.25E-03				
	PNL-5	230143	FILTER	10/04/2023	10/18/2023	Gross beta	1.44E-02	pCi/m3	1.41E-03	1.42E-03				
	PNL-5	230148	FILTER	10/18/2023	11/01/2023	Gross beta	2.82E-02	pCi/m3	1.93E-03	1.94E-03				
	PNL-5	230153	FILTER	11/01/2023	11/15/2023	Gross beta	2.08E-02	pCi/m3	1.62E-03	1.63E-03				
	PNL-5	230158	FILTER	11/15/2023	11/29/2023	Gross beta	2.67E-02	pCi/m3	1.82E-03	1.83E-03				
	PNL-5	230163	FILTER	11/29/2023	12/13/2023	Gross beta	2.01E-02	pCi/m3	1.60E-03	1.60E-03				
	PNL-5	230168	FILTER	12/13/2023	12/27/2023	Gross beta	3.56E-02	pCi/m3	2.12E-03	2.13E-03				
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Antimony-125	-3.41E-05	pCi/m3	1.39E-04	1.40E-04	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Antimony-125	2.71E-05	pCi/m3	1.32E-04	1.33E-04	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Beryllium-7	4.20E-02	pCi/m3	2.87E-03	5.11E-03				Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Beryllium-7	2.73E-02	pCi/m3	2.10E-03	3.79E-03				Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Cesium-134	1.91E-05	pCi/m3	6.20E-05	6.26E-05	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Cesium-134	3.90E-06	pCi/m3	7.38E-05	7.39E-05	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Cesium-137	-1.60E-04	pCi/m3	8.71E-05	1.15E-04	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Cesium-137	7.53E-06	pCi/m3	1.28E-04	1.28E-04	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Cobalt-60	6.09E-05	pCi/m3	6.72E-05	7.28E-05	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Cobalt-60	1.30E-05	pCi/m3	6.86E-05	6.89E-05	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Europium-152	4.85E-05	pCi/m3	1.35E-04	1.36E-04	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Europium-152	-2.11E-06	pCi/m3	1.46E-04	1.46E-04	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Europium-154	1.40E-05	pCi/m3	1.66E-04	1.66E-04	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Europium-154	5.41E-05	pCi/m3	1.89E-04	1.91E-04	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Europium-155	-6.84E-05	pCi/m3	1.21E-04	1.25E-04	U			Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Europium-155	-4.49E-06	pCi/m3	1.42E-04	1.42E-04	U			Y
	PNL-5	230173	FILTER	12/28/2022	06/28/2023	Potassium-40	2.60E-03	pCi/m3	1.47E-03	1.50E-03				Y
	PNL-5	230208	FILTER	06/28/2023	12/27/2023	Potassium-40	9.46E-04	pCi/m3	1.47E-03	1.54E-03	U			Y

Field Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Ruthenium-106	4.65E-05	pCi/m3	4.98E-04	4.99E-04	U			Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Ruthenium-106	-6.20E-05	pCi/m3	5.89E-04	5.90E-04	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Gross alpha (Comp)	3.58E-03	pCi/m3	8.83E-04	8.88E-04			Lab Result exceeded Project Control Limit (0.0025 pCi/m3).	Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Gross alpha (Comp)	1.56E-03	pCi/m3	5.94E-04	5.96E-04	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Gross beta (Comp)	1.30E-02	pCi/m3	8.37E-04	8.50E-04	O		LCS/LCSD RER not met but spike recoveries were met.	Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Gross beta (Comp)	1.16E-02	pCi/m3	7.79E-04	8.10E-04				Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Americium-241	2.52E-05	pCi/m3	3.08E-05	3.10E-05	UO		Result not detected above the detection limit	Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Americium-241	6.59E-06	pCi/m3	7.46E-06	7.49E-06	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Americium-243	4.13E-05	pCi/m3	6.41E-05	6.43E-05	U			Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Americium-243	8.44E-06	pCi/m3	1.21E-05	1.21E-05	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Curium-243/244	2.51E-05	pCi/m3	3.37E-05	3.39E-05	U			Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Curium-243/244	1.09E-06	pCi/m3	4.78E-06	4.78E-06	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Plutonium-238	2.16E-05	pCi/m3	1.70E-05	1.71E-05	U			Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Plutonium-238	5.57E-06	pCi/m3	7.24E-06	7.25E-06	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Plutonium-239/240	3.99E-05	pCi/m3	1.78E-05	1.82E-05				Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Plutonium-239/240	-1.11E-06	pCi/m3	7.23E-06	7.23E-06	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Uranium-233/234	3.72E-05	pCi/m3	2.45E-05	2.49E-05				Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Uranium-233/234	4.57E-05	pCi/m3	2.04E-05	2.09E-05				Y

Field													
Location ID	Sample ID	Sample Matrix	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comment	Result Comment	Composite
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Uranium-235	9.54E-06	pCi/m3	1.32E-05	1.33E-05	UO		Result not detected above the detection limit	Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Uranium-235	5.74E-06	pCi/m3	9.93E-06	9.94E-06	U			Y
PNL-5	230173	FILTER	12/28/2022	06/28/2023	Uranium-238	3.28E-05	pCi/m3	2.17E-05	2.20E-05				Y
PNL-5	230208	FILTER	06/28/2023	12/27/2023	Uranium-238	4.03E-05	pCi/m3	1.72E-05	1.76E-05				Y

- | | |
|---|---|
| <p>4 U.S. Department of Energy-
Headquarters
1000 Independence Avenue SW
Washington, D.C. 20585-0001</p> <p>JM Blaikie (PDF)¹
RT Carver (PDF)
C Lobos (PDF)
M Stewart (PDF)</p> <p>1 U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
P.O. Box 5400
Albuquerque, NM 87185-5400</p> <p>D Bytwerk (PDF)</p> <p>3 U.S. Environmental Protection Agency
Region 10
Stationary Source Unit
Office of Air and Waste
1200 Sixth Avenue, Suite 900, AWT-150
Seattle, WA 98101</p> <p>JM McAuley (PDF)
KD Pepple (PDF)
D Bray (PDF)</p> <p>3 U.S. Environmental Protection Agency
William Jefferson Clinton West Building
1200 Pennsylvania Avenue NW
Washington, D.C. 20460</p> <p>RT Peake (PDF)
DJ Schultheisz (PDF)
JP Walsh (PDF)</p> <p>1 Washington State Department of
Ecology
Eastern Regional Office
4601 N. Monroe Street
Spokane, WA 99205-1295</p> <p>B. Beeler (PDF)</p> | <p>1 Washington State Department of
Ecology Hanford Project Office
3100 Port of Benton Boulevard
Richland, WA 99354-1670</p> <p>M Williams (PDF)</p> <p>7 Washington State Department of Health
Radioactive Air Emissions Section
309 Bradley Boulevard, Suite 201
Richland, WA 99352-4524</p> <p>CD Mathey, Acting Manager (2) B1-42
AJ Ableman (PDF)
SD Berven (PDF)
CA Kennedy (PDF)
TA Rogers (PDF)
CN Sanders (PDF)
RJ Utley (PDF)</p> <p>1 Confederated Tribes of the Colville
Reservation
21 Colville St
Nespelem, WA 99155</p> <p>K Condon, Chairperson (PDF)</p> <p>1 Confederated Tribes of the Umatilla
Indian Reservation
46411 Ti'mine Way
Pendleton, OR 97801-9467</p> <p>G Burke, Board of Trustees Chair(PDF)</p> <p>1 Nez Perce Tribe
P.O. Box 365
Lapwai, ID 83540-0365</p> <p>SF Wheeler, Chairperson (PDF)</p> <p>1 Yakama Nation
P.O. Box 151
Toppenish, WA 98948-0632</p> <p>G Lewis, Chairperson (PDF)</p> |
|---|---|

¹ (PDF) = electronic distribution only as a PDF file.

1 Wanapum Band
29082 WA-243
Mattawa, WA 99349

C Buck (PDF)

LIBRARIES

1 Richland Public Library
955 Northgate Drive
Richland, WA 99352-3505

1 Mid-Columbia Libraries
Director
405 S Dayton Street
Kennewick, WA 99336-5660

K Cox, Director (PDF)

ON SITE

6 U.S. Department of Energy
Pacific Northwest Site Office

CL Arm (PDF)
DM Thrasher (PDF)
JL Carlson (PDF)
AS Friedman (PDF)
FB Hidden (PDF)
TM McDermott (2) K9-42

1 U.S. Department of Energy
Office of River Protection

BR Trimberger (PDF)

2 U.S. Department of Energy
Richland Operations Office

DOE-RL Public Reading Room H2-53
M Kamal (PDF)

2 Hanford Mission Integration Solutions

DL Dyekman (PDF)
AL Johnson (PDF)

1 Central Plateau Cleanup Company

BJ Zelen (PDF)

31 Pacific Northwest National Laboratory
Laboratory

EJ Antonio (PDF)
JM Barnett (3) J2-25
LE Bisping K7-68
TW Buckendorf (PDF)
EG Damberg (PDF)
TR Daves (PDF)
LN Dinh (PDF)
CA Duberstein (PDF)
WL Duffy (PDF)
JW Duling (PDF)
DL Edwards (PDF)
SU Fies (PDF)
TR Hay (PDF)
JR Holland (PDF)
MC Klein (PDF)
AK McDowell (PDF)
AL Miracle (PDF)
HL Newsome (PDF)
SG Ramos (PDF)
JP Rishel (PDF)
JM Robinson (PDF)
EA Rosso (PDF)
AM Sachs (PDF)
SK Sanan (PDF)
SF Snyder (2) K7-68
MJ Stephenson J2-25
DM Storms (PDF)
DJ Warren (PDF)
GM Wellsfry (PDF)
PNNL Reference Library (PDF)
E-Record Case 1830-08-10 (PDF)

Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354

1-888-375-PNNL (7665)

www.pnnl.gov