



PNNL-Richland Campus Radionuclide Air Emissions Report for Calendar Year 2022

June 2023

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

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Pacific Northwest National Laboratory
Richland, Washington 99352

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 2022 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 2022, including fugitive emissions and radon, is $2.3\text{E-}05$ mrem ($2.3\text{E-}07$ 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 routine major and minor point source emissions in 2022 is $2.1\text{E-}05$ mrem ($2.1\text{E-}07$ millisievert [mSv]) EDE. The MEI dose from all PNNL-Richland Campus fugitive sources is $1.2\text{E-}06$ mrem ($1.2\text{E-}08$ mSv) EDE. The dose from radon emissions is $9.2\text{E-}09$ mrem ($9.2\text{E-}11$ mSv) EDE. No nonroutine emissions from Campus facilities occurred in 2022.

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.

CERTIFICATION of PNNL-20436-13
DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2022

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 TURNER Digitally signed by JULIE TURNER
Date: 2023.06.20 13:51:58 -07'00'

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

Date

Acronyms and Abbreviations

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

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1.0 Introduction

This report documents calendar year (CY) 2022 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 CY2022 operations.

Richland Campus onsite activities had been reduced since March 2020 due to the COVID-19 pandemic, with radiological operations generally considered at their new normal around mid-2022.

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 Richland 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 Richland 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 PNNL-Richland 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

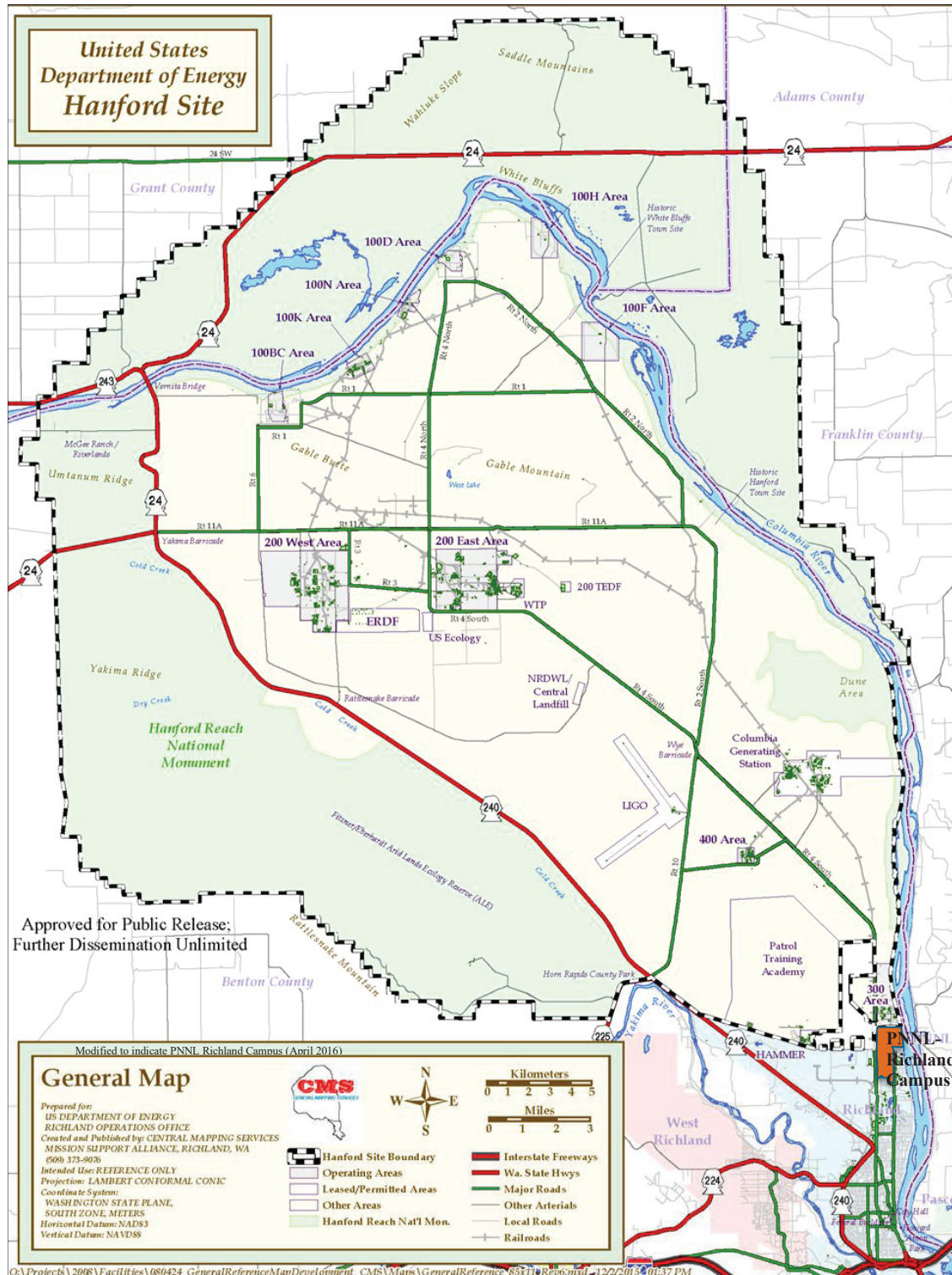


Figure 1.2. Location of the Hanford Site in Relation to the PNNL-Richland Campus

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 – 2022

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 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.

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.

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 – 2022

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

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., restaurants, 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. 2022).

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 PNNL-Richland Campus.

1.2 Point Source Descriptions

This section describes point sources that emit or have the potential to emit radionuclides at the Campus. A point source is reported in this document if it met the following two criteria during 2022:

- Required continuous sampling or periodic confirmatory measurements (including 40 CFR 61, Appendix D calculations) in accordance with 40 CFR 61, Subpart H (2002), and with WAC 246-247 (2021).
- Was described in the WDOH-issued RAEL-005 and remained a registered emission unit during 2022.

Table 1.3 lists the PNNL-Richland Campus emission units registered with the WDOH for radiological emissions. 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 103 ft (31.4 m) and was applied to all PSF major stack emissions, as a conservative assumption. Neither the J-Facilities Restoration nor J-SOIC 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	20,766 ft ³ /min (9.80 m ³ /s)	1.09E+10 ft ³ (3.09E+08 m ³)	75.0° F (23.9° C)	44 ft (13.5 m)	3.3 ft (1.0 m)	103 ft (31.4 m)	Single-stage HEPA filter
Major EP-3420-01-S	65,370 ft ³ /min (30.9 m ³ /s)	3.44E+10 ft ³ (9.74E+08 m ³)	66.5° F (19.2° C)	51 ft (15.5 m)	4.3 ft (1.3 m)	150 ft (45.7 m)	Single-stage HEPA filter
Major EP-3430-01-S	33,670 ft ³ /min (15.9 m ³ /s)	1.77E+10 ft ³ (5.01E+08 m ³)	62.0° F (16.7° C)	44 ft (13.5 m)	3.7 ft (1.1 m)	106 ft (32.2 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 Richland Campus sources:

- Table 2.1 indicates emissions from sampled point sources on the Campus in 2022.
- Minor point and fugitive source emissions are shown in two tables
 - Table 2.2 shows the emissions that resulted in 99.98% of the dose impact from minor and fugitive emission units, whereas
 - Table 2.3 shows the remaining 0.02%.

Table 2.4 summarizes the nuclide emissions from major sources and from minor, and fugitive sources that result in more than 99.98% of the total dose impact to the MEI. Appendix B lists the radioactive materials handled or potentially handled at the PNNL-Richland Campus in 2022.

Table 2.1. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2022

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total (Ci)
gross $\alpha^{(a)}$	3.68E-08	1.16E-07	2.76E-08	1.8E-07
gross $\beta^{(a)}$	2.71E-07	1.00E-06	1.90E-07	1.5E-06
H-3 ^(b)	1.20E-04	NA	NA	1.2E-04
Al-26	NA	6.73E-09	NA	6.7E-09
Co-60	ND	9.69E-08	ND	9.7E-08
Xe-131m ^(b)	NA	7.72E-09	NA	7.7E-09
Xe-133 ^(b)	NA	8.27E-09	NA	8.3E-09
Xe-133m ^(b)	NA	1.68E-09	NA	1.7E-09
Cs-137	1.91E-08	1.60E-09	1.11E-08	3.2E-08
Po-210	2.58E-08	1.04E-07	1.82E-08	1.5E-07
Th-229	4.64E-11	NA	NA	4.6E-11
U-233/234	ND	NA	2.07E-10	2.1E-10
Pu-238	ND	9.14E-09 ^(c)	4.40E-10 ^(c)	9.6E-09 ^(c)
Pu-239/240	7.06E-10	1.27E-08	1.22E-09	1.5E-08
Am-241 ^(c)	1.81E-10	7.43E-09	8.64E-10	8.5E-09 ^(c)
Am-243 ^(c)	1.71E-10	2.33E-10	2.27E-11	4.3E-10 ^(c)
Cm-243/244	5.72E-14 ^(c)	3.80E-08 ^(c)	2.45E-10	3.8E-08 ^(c)

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 99.98% of the Offsite Dose from Minor Emissions Units and Fugitive Sources – 2022^(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)	7.19E-13	NA	NA	7.2E-13
Na-24	8.11E-12	1.30E-08	1.35E-08	2.7E-08
Mn-54	8.30E-11	2.91E-10	2.75E-14	3.7E-10
Al-26 ^(c)	NA	NA	NA	NA
Co-60	2.28E-10	2.96E-10	9.93E-11	6.2E-10
Rb-83	1.44E-06	NA	NA	1.4E-06
Sr-85	1.82E-08	3.12E-10	5.21E-11	1.9E-08
Y-88	3.45E-10	5.23E-10	8.60E-11	9.5E-10
Cs-137	1.48E-10	2.40E-10	5.38E-11	4.4E-10
Pb-210	4.78E-10	8.99E-10	1.39E-10	1.5E-09
Po-210	NA	NA	NA	NA
Rn-222 ^(d)	5.40E-06	NA	NA	5.4E-06
Ra-226	NA	1.19E-09	NA	1.2E-09
Th-229	NA	NA	NA	NA
Th-232	1.38E-11	NA	NA	1.4E-11
U-232	1.29E-10	NA	NA	1.3E-10
U-233/234 ^(c)	4.94E-07	2.25E-11	1.93E-08	5.1E-07
Pu-238 ^(c)	NA	2.9E-17	NA	2.9E-17
Pu-239/240 ^(c)	NA	8.64E-16	NA	8.6E-16
Am-241	1.85E-10	1.56E-10	1.10E-10	4.5E-10
Am-243 ^(c)	NA	2.56E-15	NA	2.6E-15
Cm-243/244 ^(c)	NA	3.66E-13	NA	3.7E-13

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 99.97% of dose impact from release record and Appendix D calculated minor and fugitive sources in 2022. 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, Po-210, Th-229, U-234, Pu-238, Pu-239/240, Am-243, and Cm-244), significant nuclides (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 3.6.3.

Table 2.3. Nonsignificant (0.02% of Offsite Dose Contributors) PNNL-Richland Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2022

Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)
Ag-109m	1.9E-14	Fe-55	2.2E-13	P-32	2.2E-13	Tc-99	3.1E-12
Ag-112	2.2E-14	Fe-59	1.2E-12	Pd-109	1.9E-14	Tc-99m	2.4E-10
Am-240	5.4E-12	Hg-203	1.1E-10	Pm-149	1.9E-11	Te-123m	8.2E-11
Am-242	4.4E-19	I-131	1.6E-11	Pm-151	1.0E-11	Te-129	1.1E-14
Ar-37	3.7E-12	I-132	2.1E-10	Pr-143	8.4E-12	Te-131m	7.4E-11
Ba-133	9.9E-13	I-133	5.7E-10	Pu-241	1.5E-15	Te-132	2.0E-10
Ba-140	8.2E-11	I-135	2.8E-10	Pu-242	9.7E-19	U-235	4.3E-14
Be-10	2.5E-22	Ir-192	3.9E-14	Pu-244	3.3E-19	U-236	2.0E-16
Br-82	1.3E-08	Ir-194	1.3E-15	Rb-82	9.2E-10	U-238	9.0E-13
C-14	3.1E-10	K-40	4.0E-19	Rb-84	2.3E-09	Xe-131m	8.7E-09
Ca-47	2.7E-13	K-42	4.1E-09	Rb-86	1.7E-11	Xe-133	9.4E-09
Cd-109	1.5E-09	Kr-83m	1.0E-06	Re-188	7.4E-16	Xe-133m	2.2E-09
Ce-139	4.2E-11	Kr-85	4.1E-15	Rh-105	2.4E-11	Xe-135	1.8E-09
Ce-141	8.8E-12	La-140	8.3E-12	Ru-105	1.5E-14	Xe-135m	1.6E-11
Ce-143	4.6E-10	La-141	1.0E-10	S-35	6.1E-10	Y-90	1.5E-13
Cl-36	3.2E-12	Mn-56	1.8E-11	Sb-127	1.1E-14	Y-91m	3.1E-10
Cm-248	3.7E-13	Mo-99	2.8E-10	Sm-151	1.0E-11	Y-92	2.2E-10
Co-57	9.6E-11	Nb-97	5.5E-10	Sn-113	4.1E-10	Y-93	5.5E-10
Co-58	1.2E-13	Nb-97m	4.9E-10	Sn-121	1.3E-14	Zn-65	1.3E-10
Cr-51	1.7E-09	Nd-147	9.8E-12	Sr-82	9.2E-10	Zr-95	5.8E-16
Cs-134	1.4E-13	Ni-63	3.1E-12	Sr-89	1.6E-16	Zr-97	5.2E-10
Cu-64	7.0E-14	Np-236	7.0E-17	Sr-90	3.1E-12	-	-
Cu-67	7.6E-17	Np-237	2.0E-18	Sr-91	4.8E-10	-	-
Eu-152	5.4E-14	Os-191	3.7E-16	Tb-161	6.2E-12	-	-
Total (Ci)						1.1E-06	

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 2022

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units^(a)	Total (Ci)
gross α	1.8E-07 ^(b)	NA	1.8E-07
gross β	1.5E-06 ^(b)	NA	1.5E-06
H-3	1.2E-04 ^(c)	7.2E-13 ^(c)	1.2E-04
Na-24	NA	2.7E-08	2.7E-08
Al-26	6.7E-09	NA	6.7E-09
Mn-54	NA	3.7E-10	3.7E-10
Co-60	9.7E-08	6.2E-10	9.8E-08
Rb-83	NA	1.4E-06	1.4E-06
Sr-85	NA	1.9E-08	1.9E-08
Y-88	NA	9.5E-10	9.5E-10
Cs-137	3.2E-08	4.4E-10	3.2E-08
Pb-210	NA	1.5E-09	1.5E-09
Po-210	1.5E-07	NA	1.5E-07
Rn-222	NA	5.4E-06 ^(c)	5.4E-06
Ra-226	NA	1.2E-09	1.2E-09
Th-229	4.6E-11	NA	4.6E-11
Th-232	NA	1.4E-11	1.4E-11
U-232	NA	1.3E-10	1.3E-10
U-233/234	2.1E-10	5.1E-07	5.1E-07
Pu-238	9.6E-09	2.9E-17	9.6E-09
Pu-239/240	1.5E-08	8.6E-16	1.5E-08
Am-241	8.5E-09	4.5E-10	8.9E-09
Am-243	4.3E-10	2.6E-15	4.3E-10
Cm-243/244	3.8E-08	3.7E-13	3.8E-08
TOTAL (Ci)	1.2E-04	7.4E-06	1.2E-04

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 99.98% of the minor and fugitive dose to the MEI. See Table 2.3 for the nuclides that contribute the remaining 0.02% 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 2022 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) CY2022 meteorological data (Appendix A) to determine the 2022 MEI receptor location from Campus emissions. The receptor is presumed to produce their own food supply at the MEI location.

The CY2022 MEI location was determined to be an office building at 3200 George Washington Way.

Table 3.1. Receptor Locations for the PNNL-Richland Campus

Locale	Distance Relative to PSF (3410 Building) km (mi)
2022 PNNL-Richland Campus MEI	
Office, 3200 George Washington Way	0.63 (0.39) 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	
From major emission units ^(b) –	
Office building, 3200 George Washington Way	0.63 (0.39) SSE of 3410-01-S
From minor and fugitive emission units ^(b) –	
Office building, 3200 George Washington Way	0.69 (0.43) SSE of 3420-02-S
Richland Campus Historical MEI Doses and Locations^(c)	
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 2022 meteorology and applicable stack characteristics given in Section 1.2.1. The greatest dose impact from facility emissions is calculated for 3200 George Washington Way, SSE of the 3410 Building, where an office is located; as a result, this is the 2022 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 2022 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 2022. Appendix A tables indicate meteorological data for 2022 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 temperature data used for stability category determinations were substituted for all of 2022. 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.

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 2022 Doses

	40 CFR 61, Subpart H Campus MEI (3200 GW Way)	WAC 246-247 Campus MEI (3200 GW Way)	Offsite Maximum Air^(b) for Campus Emissions (3200 GW Way)
PNNL-Richland Campus MEI Location			
Location relative to PSF	0.63 km (0.39 mi) SSE	0.63 km (0.39 mi) SSE	0.63 km (0.39 mi) SSE
Radon Emissions			
Rn-220	NA	0 Ci	0 Ci
Rn-222			
3420-02-S	NA	5.4E-06 Ci	5.4E-06 Ci
Receptor Dose			
Dose excluding radon emissions ^(a)	2.3E-05 mrem	2.3E-05 mrem	2.3E-05 mrem
Radon	NA	9.2E-09 mrem	9.2E-09 mrem
Total	2.3E-05 mrem	2.3E-05 mrem	2.3E-05 mrem

NA = not applicable.

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 CY2022, the PNNL-Richland Campus MEI location was 0.63 km (0.39 mi) SSE of the 3410 Building. The PNNL-Richland Campus MEI dose is 2.3E-05 mrem (2.3E-07 mSv) (see Table 3.2, 40 CFR 61, Subpart H).

Table 3.3 indicates nuclide-specific doses to the CY2022 Campus MEI. The MEI dose includes routine and, as applicable, nonroutine point source emissions (see Section 3.5). The fugitive PIC-5 category doses are about 4% of the CY2022 PNNL-Richland Campus MEI dose estimate.

Table 3.3. PNNL-Richland Campus 2022 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)	1.8E-07	7.0E-06	31%
Gross β ^(c)	1.5E-06	5.7E-06	25%
H-3	1.2E-04	1.6E-08	<1%
Na-24	2.7E-08	2.8E-10	<1%
Al-26	6.7E-09	1.1E-07	<1%
Mn-54	3.7E-10	2.1E-10	<1%
Co-60	9.8E-08	2.5E-07	1%
Rb-83	1.4E-06	3.3E-07	1%
Sr-85	1.9E-08	1.6E-09	<1%
Y-88	9.5E-10	5.8E-10	<1%
Cs-137	3.2E-08	1.3E-07	1%
Pb-210	1.5E-09	2.8E-08	<1%
Po-210	1.5E-07	5.3E-07	2%
Rn-222	5.4E-06	9.2E-09	<1%
Ra-226 ^(d)	1.2E-09	7.7E-08	<1%
Th-229	4.6E-11	2.7E-09	<1%
Th-232	1.4E-11	1.8E-09	<1%
U-232	1.3E-10	6.8E-09	<1%
U-233/234	5.1E-07	5.1E-06	23%
Pu-238	9.6E-09	3.4E-07	2%
Pu-239/240	1.5E-08	5.7E-07	3%
Am-241	8.9E-09	3.3E-07	1%
Am-243	4.3E-10	1.4E-08	<1%
Cm-243/244	3.8E-08	9.3E-07	4%
Table 2.3 nuclides	1.1E-06	1.1E-09	<1%
PIC-5 emissions – VRRM	NA	9.4E-07 ^(e)	4%
PIC-5 emissions – NDRM	NA	6.6E-08 ^(e)	<1%
PIC-5 emissions – Facilities Restoration ^(e)	NA	0	0%
PIC-5 emissions – SOIC ^(e)	NA	0	0%
Total^(f)	1.3E-04 Ci	2.3E-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) Dose includes progeny isotope Rn-222.

(e) The PIC-5 emission doses are assigned based on permit value. The SOIC and Facilities Restoration emission sources were not implemented in 2022. The SOIC PIC-5 permit has been alternatively referred to as the LLS PIC-5 permit.

(f) 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 and NDRM PIC-5 permitted emissions indicate a maximum dose impact. The PIC-5 permitted emissions for J-SOIC and Facilities Restoration were not applicable for 2022 operations.

Table 3.4. Dose Contributions from Each Registered Emission Point

Facility/Building	Emission Unit	Emissions ^(a)	Campus MEI Dose (mrem EDE)	% of Total MEI Dose
PSF/3420 Building	3420-01-S	Sampled, Estimated	1.1E-05	50%
PSF/3420 Building	3420-02-S	Estimated	5.3E-06	23%
PSF/3410 Building	3410-01-S	Sampled, Estimated	2.7E-06	12%
PSF/3430 Building	3430-01-S	Sampled, Estimated	2.0E-06	9%
Campus	VRRM	PIC-5	9.4E-07 ^(b)	4%
PSF/3425 Building	J-3425	Estimated	2.1E-07	1%
PSF/3430 Building	3430-02-S	Estimated	1.2E-07	1%
Campus	NDRM	PIC-5	6.6E-08 ^(b)	<1%
Campus	Facility Restoration	PIC-5	0 ^(b)	0%
Campus	J-SOIC	PIC-5	0 ^(b)	0%

To convert mrem to mSv, multiply mrem by 0.01.

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

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

For comparison, the Subpart H PNNL-Richland Campus 2022 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 2022 MEI dose (40 CFR 61, Subpart H)	0.000023	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 PNNL-Richland Campus MEI dose was 1.8E-05 mrem/yr (1.8E-07 mSv/yr).

3.4.2 Washington Administrative Code

For PNNL-Richland Campus radionuclide air emissions, Washington State in WAC 246-247-040(1) (2021) 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 (2002), 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 2022, the WAC-246-247 dose is the 2.3E-05 mrem/yr

(2.3E-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 CY2022, the maximum modeled air concentration is the same as the MEI location, this WAC 173-480 dose is 2.3E-05 mrem/yr (2.3E-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 CY2022 were reviewed. Both the PNNL-Richland Campus and the Hanford Site (Dyekman et al. 2023) are in compliance with the 10 mrem/yr regulatory standard for CY2022 radiological emissions.

The CY2022 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 2022. The dose to both the PNNL-Richland Campus MEI and the Hanford Site MEI from the Hanford Site 300 Area emissions in 2022, 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 PNNL-Richland 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 2022 PNNL-Richland Campus Emissions	Dose from 2022 Hanford Site 300 Area Emissions
Hanford Site 2022 MEI	NA ^(a)	5.0E-02 mrem
PNNL-Richland Campus 2022 MEI	2.3E-05 mrem	3.0E-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 Nonroutine Releases of Radionuclides to the Atmosphere

No nonroutine emissions were reported in 2022.

3.6 Additional Compliance Information

3.6.1 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. 2017. There are currently five particulate ambient air sampling stations. The Campus Environmental Monitoring Plan is documented in Snyder et al. 2020.

3.6.2 Approvals to Construct or Modify

During 2022, a Notice of Construction (NOC) application for the EP-3430-01-S emission unit was submitted pursuant to the WAC 246-247 and 40 CFR 61, Subpart H, and WDOH issued a new NOC via letter number AIR 22-1002. The WDOH emission unit identification (EUID) number is 1205 and the new NOC ID is number 1675. The NOC approval included the addition of a third exhaust fan, an air blender, and larger exhaust stack diameter. An equivalency determination to use computational fluid dynamics for meeting the well-mixed location sampling site selection requirements was also approved. Construction activities will be completed in 2023.

3.6.3 Radon-220 and Radon-222 Emissions

Radon-220 was not emitted from PNNL-Richland Campus operations in 2022. Some Rn-222 was emitted. See Section 3.4 for radon emissions and dose results.

4.0 Fugitive Sources of Emissions

The Clean Air Act (i.e., 40 CFR 61, Subpart H [2002]) 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 [2021]). 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 2022. 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 2022 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 1.2E-06 mrem/yr (1.2E-08 mSv/yr) which is (5%) of the total 2.3E-05 mrem/yr (2.3E-07 mSv/yr) MEI dose for 2022.

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 2022 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. 2023).

5.0 Supplemental Information

This section provides the following supplemental information related to PNNL-Richland Campus radionuclide air emissions in 2022:

- 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 2022 was calculated using CAP88-PC Version 4.0. In prior years, regional populations were based on 2010 U.S. Census data within a 50-mile (80 km) radius of the Hanford Site 300 Area (Hamilton and Snyder 2011). Data became available in 2022 for the determination of 2020 Census-based data. The population assessment in Rose et al. (2023) was used to determine collective dose within 50 miles of the PNNL-Richland Campus. For the 50-mile region, the total population increased 40% between the two Census periods (433- to 605-thousand), including the adjustments mentioned in the previous report (Snyder et al. 2022). The greatest population changes in the latest Census were 5–10 miles from the site, reflecting growth in the cities of Pasco, West Pasco, Kennewick, and Richland. Growth in the 40–50-mile region is also observed from growth in the Walla Walla/College Place region. Due to the delayed availability of the 2020 Census information, the collective doses reported in 2020 (Snyder et al. 2021b) and 2021 (Snyder et al. 2022) emissions' years were updated (Table 5.1).

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 2022 total collective dose from radionuclide air emissions estimated from nuclides that originated from the PNNL-Richland Campus is provided in Table 5.1.

Table 5.1. Collective Doses 2020–2021 (Revised) and 2022

	Year of Emissions		
	2020 Collective Dose (person-rem)	2021 Collective Dose (person-rem)	2022 Collective Dose (person-rem)
2010-Census-based	8.9E-5	9.7E-5	n/a
2020-Census-based	1.6E-4	1.7E-4	2.5E-4
To convert person-rem to person-Sv, multiply person-rem by 0.01.			

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 pCi/m²/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 PNNL-Richland Campus were evaluated for compliance with 40 CFR 61, Subpart T (2000), “National Emissions 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 CY2022 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. The data management activities for the environmental surveillance program transitioned to a new cloud-based Environmental Information Management (EIM)³ software system. Parallel testing throughout 2022 occurred between the former Hanford Environmental Information System (HEIS) database and new EIM system.

5.3.1 Ambient Air Surveillance

A particulate air sampling network was established in 2010 to monitor radioactive particulates in ambient air near the PNNL-Richland 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 2022 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 2022, 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 2021). During 2021, environmental air surveillance continued at PNL-1 (solar), PNL-2 (solar), PNL-3, PNL-4, and PNL-5 (background location) (Figure 5.1).

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

³ Locus EIM, provided by Locus Technologies, Mountain View, California. <https://locustec.com/>.

for specific radionuclide analysis. The composite analyses reported for 2022 include gamma-emitting isotopes Co-60 and Cs-137, U-233/234,⁴ Pu-238 and Pu 239/240, Am-241, Am-243, and Cm-243/244.

Offsite events that affected the ambient sampling program in 2022 included numerous wildfires in the Pacific Northwest, which caused continuous smoky days in August and September 2022. The wildfire smoke events were particularly thick and resulted in consecutive days of unhealthy to hazardous air quality levels. 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 to the sampler was maintained. In September, two of the five particulate air sampling stations (solar-powered stations PNL-1 and PNL-2) required a weekly instead of biweekly filter change-out 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. Select composite results for the first half of 2022 missed analytical holding times due to delays in data deliverables as a result of issues encountered during parallel testing between the databases. There was no significant impact to the annual composite results or station operational frequency for CY2022, because of these events.

Air sampling results are summarized in Table 5.2. The biweekly gross alpha and gross beta results were comparable to background levels. All nuclide-specific results shown in Table 5.2 were less than the values in Table 2 of 40 CFR 61, Appendix E (2011). 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 CY2022 PNNL-Richland Campus sampling, including composite gross alpha and gross beta results.

⁴ U-234 is a naturally occurring radionuclide. It is co-reported with U-233 by the analytical laboratory because the emission peaks overlap.

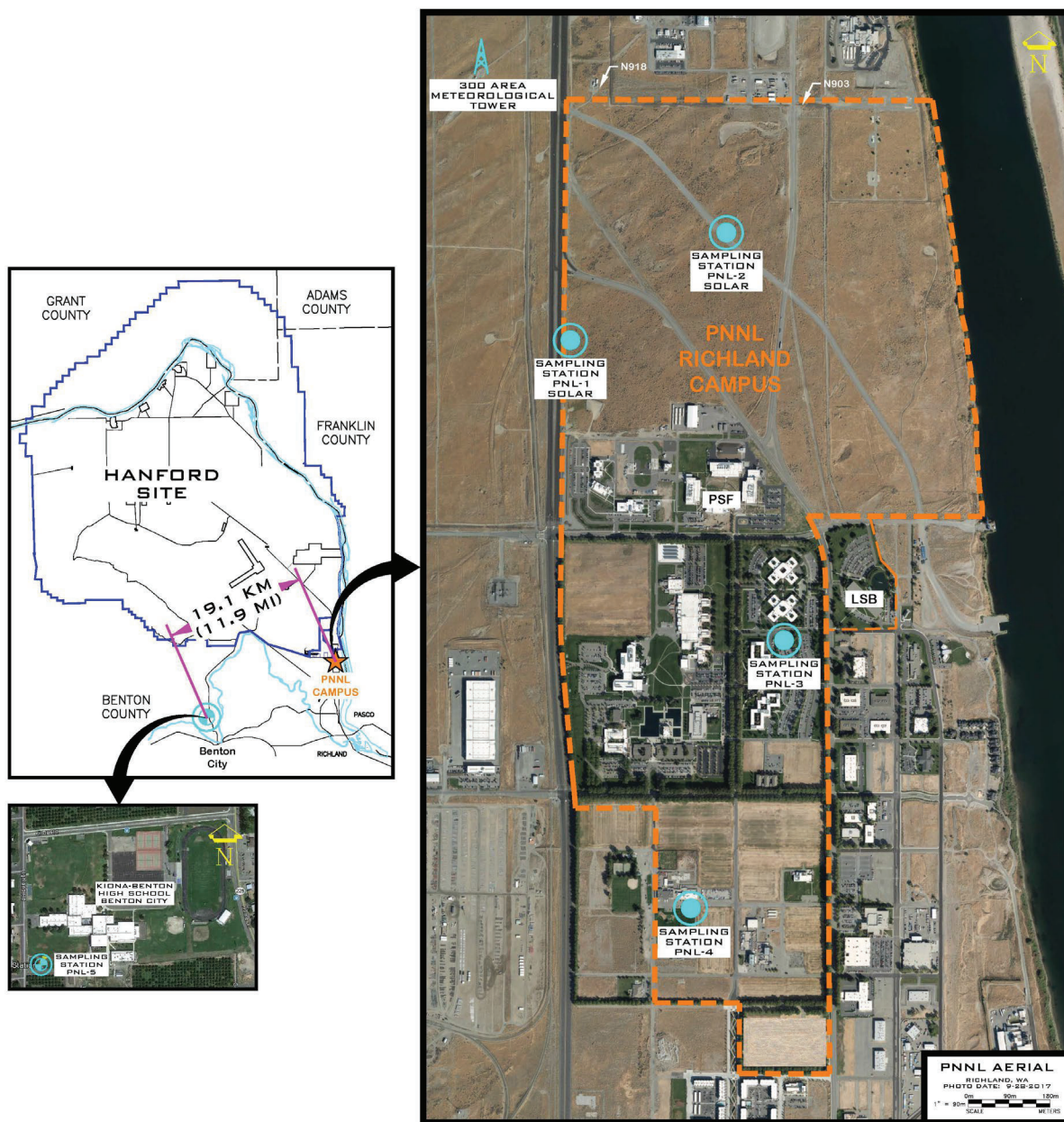


Figure 5.1. Air Surveillance Station Locations for the PNNL-Richland Campus

Table 5.2. Summary of 2022 Air Sampling Results

Nuclide	Location ^(a)	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m ³) ^(b)		
Gross Alpha	PNL-1	27	26	9.4E-04	±	2.1E-03
	PNL-2	27	26	9.6E-04	±	2.1E-03
	PNL-3	26	22	7.5E-04	±	1.6E-03
	PNL-4	26	25	7.3E-04	±	1.6E-03
	PNL-5	26	21	6.5E-04	±	1.6E-03
Gross Beta	PNL-1	27	27	2.1E-02	±	7.1E-03
	PNL-2	27	27	2.1E-02	±	7.4E-03
	PNL-3	26	26	1.9E-02	±	6.3E-03
	PNL-4	26	26	1.7E-02	±	5.7E-03
	PNL-5	26	26	1.6E-02	±	5.6E-03
Co-60 ^(c)	PNL-1	2	0	7.5E-06	±	7.5E-05
	PNL-2	2	0	-2.4E-05	±	1.2E-04
	PNL-3	2	0	2.2E-05	±	9.1E-05
	PNL-4	2	0	-1.8E-05	±	1.2E-04
	PNL-5	2	0	7.0E-06	±	9.2E-05
Cs-137 ^(c)	PNL-1	2	0	7.6E-05	±	2.0E-04
	PNL-2	2	0	1.8E-05	±	9.9E-05
	PNL-3	2	0	7.8E-06	±	8.9E-05
	PNL-4	2	0	2.3E-05	±	1.2E-04
	PNL-5	2	0	1.6E-05	±	8.3E-05
U-233/234 ^(c)	PNL-1	2	2	4.2E-05	±	2.8E-05
	PNL-2	2	2	4.1E-05	±	3.3E-05
	PNL-3	2	2	3.6E-05	±	2.8E-05
	PNL-4	2	2	3.8E-05	±	3.1E-05
	PNL-5	2	2	3.0E-05	±	2.4E-05
Pu-238 ^(c)	PNL-1	2	0	3.4E-06	±	1.1E-05
	PNL-2	2	0	5.4E-08	±	1.1E-05
	PNL-3	2	0	2.2E-06	±	1.6E-05
	PNL-4	2	0	1.7E-06	±	6.0E-06
	PNL-5	2	0	2.9E-06	±	6.9E-06
Pu-239/240 ^(c)	PNL-1	2	0	1.9E-06	±	9.5E-06
	PNL-2	2	0	3.1E-06	±	1.2E-05
	PNL-3	2	0	-1.4E-06	±	7.7E-06
	PNL-4	2	1	8.6E-06	±	1.4E-05
	PNL-5	2	0	9.6E-07	±	5.4E-06
Am-241 ^(c)	PNL-1	2	0	2.0E-06	±	8.7E-06
	PNL-2	2	0	1.7E-06	±	8.6E-06
	PNL-3	2	0	1.0E-06	±	5.8E-06
	PNL-4	2	0	3.5E-06	±	9.3E-06
	PNL-5	2	0	7.4E-07	±	3.6E-06
Am-243 ^(c)	PNL-1	2	0	6.5E-06	±	1.3E-05
	PNL-2	2	0	1.9E-06	±	8.5E-06
	PNL-3	2	0	7.3E-06	±	1.1E-05
	PNL-4	2	0	2.4E-06	±	7.8E-06
	PNL-5	2	0	2.1E-06	±	9.5E-06

Nuclide	Location ^(a)	No. of Samples Analyzed	No. of Detections	Value $\pm$ Error (pCi/m ³) ^(b)		
Cm-234/244 ^(c)	PNL-1	2	0	-1.8E-06	$\pm$	6.8E-06
	PNL-2	2	0	-8.8E-07	$\pm$	2.5E-05
	PNL-3	2	0	6.8E-07	$\pm$	9.9E-06
	PNL-4	2	0	2.0E-06	$\pm$	1.1E-05
	PNL-5	2	0	1.0E-06	$\pm$	5.5E-06

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 2022. No current PNNL-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 2022 ambient external dose monitoring results at Campus monitoring stations ranged from 31–43 mrem/yr (0.31–0.43 mSv/yr), and the background station indicated a local ambient external dose for 2022 of 37 mrem/yr (0.37 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 2022 operations (e.g., Snyder et al. 2022).

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 5.3 during CY2022. QA requirements are implemented, as appropriate, at the Campus as new facilities become operational and programmatic plans are developed.

Table 5.3. 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-1-2000, <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)

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Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

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

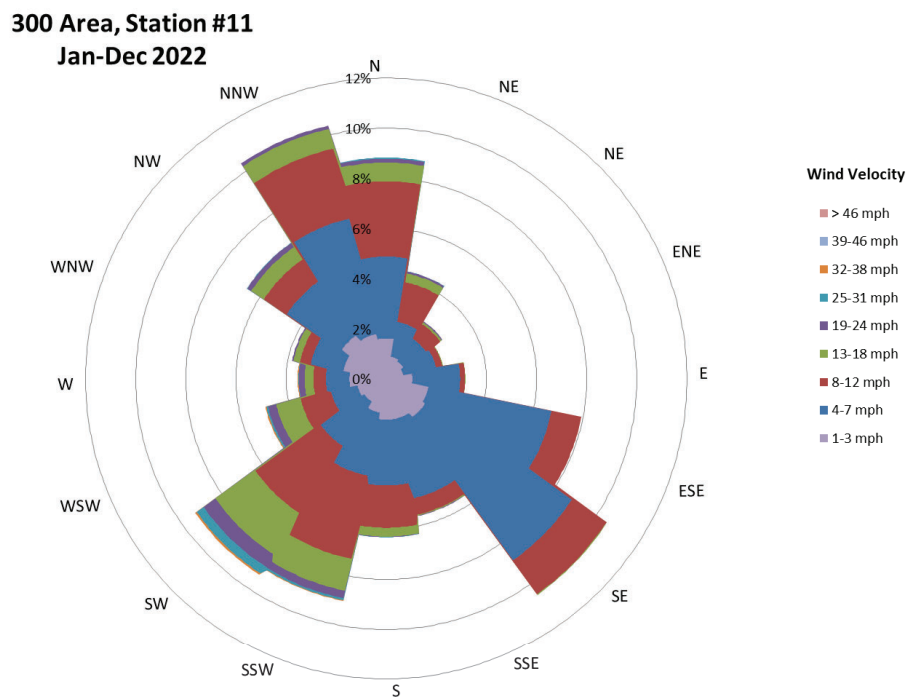


Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2022

Table A.1. Annual Average Joint Frequency during 2022 (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	0.01	0.01	0.02	0.00	0.01	0.00	0.03	0.01	0.02	0.01	0.02	0.00	0.01	0.00	0.02	0.00	0.17	
	B	0.02	0.04	0.04	0.02	0.03	0.07	0.00	0.01	0.02	0.02	0.01	0.02	0.03	0.01	0.03	0.01	0.38	
	C	0.06	0.07	0.10	0.08	0.07	0.08	0.13	0.05	0.04	0.02	0.03	0.04	0.01	0.00	0.06	0.06	0.90	
	D	0.41	0.26	0.30	0.31	0.37	0.55	0.50	0.34	0.35	0.28	0.24	0.34	0.39	0.40	0.56	0.57	6.17	
	E	0.39	0.15	0.14	0.08	0.27	0.38	0.44	0.50	0.52	0.48	0.33	0.32	0.45	0.56	0.44	0.38	5.83	
	F	0.39	0.26	0.16	0.16	0.19	0.42	0.45	0.50	0.48	0.38	0.28	0.37	0.40	0.47	0.59	0.48	5.98	
	G	0.37	0.14	0.07	0.06	0.12	0.25	0.33	0.26	0.23	0.20	0.18	0.12	0.22	0.34	0.47	0.37	3.73	
	Total	1.65	0.93	0.83	0.71	1.06	1.75	1.88	1.67	1.66	1.39	1.09	1.21	1.51	1.78	2.17	1.87	23.16	
2.65	A	0.03	0.10	0.23	0.26	0.49	0.50	0.27	0.21	0.13	0.27	0.22	0.05	0.05	0.03	0.02	0.02	2.88	
	B	0.04	0.14	0.25	0.34	0.32	0.42	0.29	0.10	0.10	0.18	0.20	0.06	0.03	0.03	0.03	0.07	2.60	
	C	0.13	0.22	0.23	0.27	0.36	0.37	0.46	0.12	0.13	0.24	0.21	0.04	0.07	0.06	0.10	0.10	3.11	
	D	0.93	0.44	0.31	0.36	0.39	1.03	1.11	0.56	0.50	0.48	0.57	0.41	0.23	0.35	0.78	1.27	9.72	
	E	1.06	0.26	0.05	0.08	0.23	0.93	1.56	0.86	0.99	0.87	0.65	0.43	0.42	0.52	0.81	1.51	11.23	
	F	0.75	0.18	0.02	0.02	0.10	1.21	2.19	1.03	0.53	0.43	0.23	0.08	0.14	0.23	0.59	1.20	8.93	
	G	0.32	0.07	0.00	0.02	0.03	0.53	1.12	0.37	0.24	0.08	0.05	0.01	0.01	0.13	0.29	0.57	3.84	
	Total	3.26	1.41	1.09	1.35	1.92	4.99	7.00	3.25	2.62	2.55	2.13	1.08	0.95	1.35	2.62	4.74	42.31	
4.70	A	0.12	0.46	0.29	0.08	0.10	0.33	0.40	0.19	0.26	0.84	0.59	0.19	0.04	0.04	0.04	0.07	4.04	
	B	0.17	0.28	0.16	0.08	0.07	0.11	0.14	0.06	0.16	0.28	0.30	0.12	0.04	0.00	0.04	0.16	2.17	
	C	0.12	0.21	0.14	0.00	0.02	0.13	0.08	0.04	0.13	0.31	0.38	0.06	0.03	0.03	0.06	0.15	1.89	
	D	0.47	0.26	0.07	0.03	0.01	0.14	0.20	0.16	0.38	0.66	0.68	0.23	0.10	0.12	0.29	0.77	4.57	
	E	0.87	0.22	0.02	0.05	0.01	0.14	0.30	0.14	0.45	0.74	0.93	0.52	0.23	0.21	0.53	0.94	6.30	
	F	0.80	0.10	0.01	0.00	0.00	0.20	0.27	0.04	0.15	0.39	0.25	0.08	0.05	0.03	0.09	0.67	3.13	
	G	0.45	0.08	0.00	0.01	0.00	0.16	0.26	0.04	0.17	0.16	0.06	0.03	0.01	0.00	0.04	0.10	1.57	
	Total	3.00	1.61	0.69	0.25	0.21	1.21	1.65	0.67	1.70	3.38	3.19	1.23	0.50	0.43	1.09	2.86	23.67	

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	0.10	0.21	0.01	0.00	0.00	0.00	0.01	0.00	0.06	0.22	0.53	0.27	0.11	0.08	0.09	0.01	1.70
	B	0.11	0.05	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.17	0.26	0.07	0.01	0.02	0.04	0.04	0.82
	C	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.20	0.21	0.03	0.03	0.02	0.01	0.04	0.66
	D	0.19	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.07	0.30	0.39	0.30	0.11	0.07	0.20	0.31	1.98
	E	0.17	0.03	0.03	0.02	0.01	0.00	0.00	0.03	0.10	0.27	0.45	0.29	0.08	0.06	0.23	0.33	2.10
	F	0.06	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.11	0.09	0.03	0.01	0.00	0.03	0.06	0.45
	G	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	Total	0.75	0.34	0.07	0.03	0.01	0.00	0.02	0.04	0.34	1.30	1.93	0.99	0.35	0.25	0.60	0.80	7.82
9.8	A	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.17	0.14	0.05	0.03	0.00	0.00	0.46
	B	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.06	0.01	0.00	0.00	0.16
	C	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.05	0.03	0.00	0.01	0.02	0.24
	D	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.07	0.08	0.06	0.06	0.00	0.07	0.07	0.54
	E	0.04	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.14	0.22	0.05	0.03	0.03	0.11	0.04	0.71
	F	0.01	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	0.00	0.02
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
	Total	0.15	0.07	0.04	0.00	0.00	0.00	0.00	0.02	0.02	0.31	0.58	0.34	0.23	0.07	0.19	0.13	2.15
12.7	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.05	0.02	0.00	0.00	0.00	0.14
	B	0.00	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	0.01
	C	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
	D	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.09	0.01	0.00	0.00	0.01	0.00	0.19
	E	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.16	0.00	0.00	0.00	0.00	0.00	0.21
	F	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
	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	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.34	0.07	0.02	0.00	0.01	0.00	0.57

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	0.04	0.03	0.00	0.00	0.00	0.07
	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	0.01	0.00	0.00	0.00	0.01
	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	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	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	0.03	0.06	0.04	0.04	0.00	0.00	0.00	0.00	0.17
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	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	0.00	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	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	A	0.26	0.81	0.55	0.34	0.60	0.83	0.71	0.41	0.47	1.38	1.60	0.74	0.31	0.18	0.17	0.10	9.46
	B	0.35	0.51	0.45	0.44	0.42	0.60	0.44	0.17	0.32	0.67	0.79	0.32	0.18	0.07	0.14	0.28	6.15
	C	0.40	0.52	0.47	0.35	0.45	0.58	0.67	0.22	0.33	0.80	0.91	0.22	0.17	0.11	0.24	0.37	6.81
	D	2.10	1.02	0.71	0.70	0.77	1.72	1.81	1.08	1.31	1.82	2.06	1.35	0.89	0.94	1.91	2.99	23.18
	E	2.54	0.67	0.27	0.23	0.52	1.45	2.30	1.53	2.07	2.57	2.79	1.61	1.21	1.38	2.12	3.20	26.46
	F	2.01	0.54	0.20	0.19	0.29	1.83	2.91	1.57	1.20	1.32	0.86	0.56	0.60	0.73	1.30	2.41	18.52
	G	1.19	0.30	0.07	0.09	0.15	0.94	1.71	0.67	0.65	0.47	0.31	0.16	0.24	0.47	0.80	1.05	9.27
	Total	8.85	4.37	2.72	2.34	3.20	7.95	10.55	5.65	6.35	9.03	9.32	4.96	3.60	3.88	6.68	10.40	99.85

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 VARIABLESHUMAN 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 PRODUCTIVITYGrass-cow-milk-man pathway (kg/m²) = 2.80 E-01Produce/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 [2022]

RR = 18.6 cm/yr (7.34 in/yr)

AVERAGE AIR TEMPERATURE [2022]

A = 12.0 degrees C (53.6 degrees F; 285.2 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 2022

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL-Richland Campus in 2022

Table B.1. Radionuclides Handled and/or Potentially Handled at the PNNL-Richland Campus in 2022

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 2022

Appendix C

Ambient Particulate Air Sampling Results for the PNNL Richland Campus Air Surveillance in 2022

Table C.1. Definitions for Air Sampling Data

Column Heading	Data Type/Format	Content
Location ID	Text	Location of monitoring station: PNNL-Richland Campus monitoring stations PNL-1, PNL-2, PNL-3, PNL-4 Background Location PNL-5
Sample Matrix	Text	Matrix of the sample at the time of sample collection (e.g., FILTER)
Field Sample ID	Number (#####)	Unique identifier assigned to a sample (typically six-digit number but characters allowed).
Start Date	Date (DD-MM-YYYY)	Date when air sampling started.
Sample Date	Date (DD-MM-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 a quality control criteria not being met. If “X”, see text in the Result Comment field regarding radio-analysis. If blank, no qualifier was needed.
Sample Comments	Text or Blank	Additional information pertaining to the sample. If blank, no comment was needed
Result Comments	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 2022

Location ID	Sample Matrix	Field Sample ID	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNNL-1	FILTER	220001	12/29/2021	01/12/2022	Gross alpha	1.37E-03	pCi/m3	4.19E-04	4.19E-04				
PNNL-1	FILTER	220006	01/12/2022	01/26/2022	Gross alpha	9.67E-04	pCi/m3	4.70E-04	4.71E-04				
PNNL-1	FILTER	220011	01/26/2022	02/09/2022	Gross alpha	5.68E-04	pCi/m3	3.13E-04	3.14E-04				
PNNL-1	FILTER	220016	02/09/2022	02/23/2022	Gross alpha	9.66E-04	pCi/m3	3.54E-04	3.55E-04	O		Method Blank Contamination RPI:1105342631	
PNNL-1	FILTER	220021	02/23/2022	03/09/2022	Gross alpha	4.63E-04	pCi/m3	3.73E-04	3.73E-04				
PNNL-1	FILTER	220026	03/09/2022	03/23/2022	Gross alpha	5.09E-04	pCi/m3	2.60E-04	2.60E-04				
PNNL-1	FILTER	220031	03/23/2022	04/06/2022	Gross alpha	4.80E-04	pCi/m3	2.90E-04	2.90E-04				
PNNL-1	FILTER	220036	04/06/2022	04/20/2022	Gross alpha	4.95E-04	pCi/m3	2.87E-04	2.88E-04				
PNNL-1	FILTER	220041	04/20/2022	05/04/2022	Gross alpha	5.57E-04	pCi/m3	2.83E-04	2.83E-04				
PNNL-1	FILTER	220046	05/04/2022	05/18/2022	Gross alpha	1.85E-04	pCi/m3	1.80E-04	1.80E-04	U			
PNNL-1	FILTER	220051	05/18/2022	06/01/2022	Gross alpha	6.73E-04	pCi/m3	3.07E-04	3.07E-04				
PNNL-1	FILTER	220056	06/01/2022	06/15/2022	Gross alpha	6.37E-04	pCi/m3	3.00E-04	3.00E-04		Air sampler #24095 expiring 06/29/22 was replaced on 05/15/22 with #22974 expires 04/21/23.		
PNNL-1	FILTER	220061	06/15/2022	06/29/2022	Gross alpha	5.38E-04	pCi/m3	3.08E-04	3.09E-04				
PNNL-1	FILTER	220099	06/29/2022	07/13/2022	Gross alpha	6.03E-04	pCi/m3	3.18E-04	3.19E-04				
PNNL-1	FILTER	220104	07/13/2022	07/27/2022	Gross alpha	5.01E-04	pCi/m3	2.54E-04	2.55E-04				
PNNL-1	FILTER	220109	07/27/2022	08/10/2022	Gross alpha	5.89E-04	pCi/m3	2.81E-04	2.81E-04		Outdoor air quality alert issued		
PNNL-1	FILTER	220114	08/10/2022	08/24/2022	Gross alpha	8.23E-04	pCi/m3	3.29E-04	3.30E-04				
PNNL-1	FILTER	220119	08/24/2022	09/07/2022	Gross alpha	4.23E-04	pCi/m3	2.72E-04	2.72E-04				
PNNL-1	FILTER	220164	09/07/2022	09/14/2022	Gross alpha	2.07E-03	pCi/m3	8.57E-04	8.58E-04		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNNL-1	FILTER	220124	09/14/2022	09/21/2022	Gross alpha	9.40E-04	pCi/m3	5.69E-04	5.69E-04		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNNL-1	FILTER	220129	09/21/2022	10/05/2022	Gross alpha	9.14E-04	pCi/m3	3.83E-04	3.83E-04				
PNNL-1	FILTER	220134	10/05/2022	10/19/2022	Gross alpha	1.68E-03	pCi/m3	4.57E-04	4.59E-04				
PNNL-1	FILTER	220139	10/19/2022	11/02/2022	Gross alpha	1.01E-03	pCi/m3	3.78E-04	3.79E-04				
PNNL-1	FILTER	220144	11/02/2022	11/16/2022	Gross alpha	1.44E-03	pCi/m3	4.33E-04	4.33E-04				
PNNL-1	FILTER	220149	11/16/2022	11/30/2022	Gross alpha	2.93E-03	pCi/m3	6.40E-04	6.43E-04		Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		
PNNL-1	FILTER	220154	11/30/2022	12/14/2022	Gross alpha	8.02E-04	pCi/m3	3.43E-04	3.43E-04		Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		

Table C.2 (contd)

Location ID	Field Sample Matrix ID	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-1	FILTER	220159	12/14/2022	12/28/2022	Gross alpha	2.18E-03	pCi/m ³	5.63E-04	5.65E-04	Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		
PNL-1	FILTER	220001	12/29/2021	01/12/2022	Gross beta	2.86E-02	pCi/m ³	1.46E-03	1.56E-03			
PNL-1	FILTER	220006	01/12/2022	01/26/2022	Gross beta	2.30E-02	pCi/m ³	1.29E-03	1.33E-03			
PNL-1	FILTER	220011	01/26/2022	02/09/2022	Gross beta	1.98E-02	pCi/m ³	1.17E-03	1.43E-03			
PNL-1	FILTER	220016	02/09/2022	02/23/2022	Gross beta	1.61E-02	pCi/m ³	1.03E-03	1.06E-03			
PNL-1	FILTER	220021	02/23/2022	03/09/2022	Gross beta	1.83E-02	pCi/m ³	1.14E-03	1.18E-03			
PNL-1	FILTER	220026	03/09/2022	03/23/2022	Gross beta	1.41E-02	pCi/m ³	1.04E-03	1.08E-03			
PNL-1	FILTER	220031	03/23/2022	04/06/2022	Gross beta	1.12E-02	pCi/m ³	9.25E-04	9.37E-04			
PNL-1	FILTER	220036	04/06/2022	04/20/2022	Gross beta	1.04E-02	pCi/m ³	8.96E-04	9.36E-04			
PNL-1	FILTER	220041	04/20/2022	05/04/2022	Gross beta	8.97E-03	pCi/m ³	8.32E-04	8.64E-04			
PNL-1	FILTER	220046	05/04/2022	05/18/2022	Gross beta	8.55E-03	pCi/m ³	7.85E-04	7.92E-04			
PNL-1	FILTER	220051	05/18/2022	06/01/2022	Gross beta	1.04E-02	pCi/m ³	8.61E-04	8.69E-04			
PNL-1	FILTER	220056	06/01/2022	06/15/2022	Gross beta	9.12E-03	pCi/m ³	8.52E-04	8.84E-04	Air sampler #24095 expiring 06/29/22 was replaced on 05/15/22 with #22974 expires 04/21/23.	Method Blank Contamination RPI:1127700262	
PNL-1	FILTER	220061	06/15/2022	06/29/2022	Gross beta	1.09E-02	pCi/m ³	9.10E-04	1.03E-03			
PNL-1	FILTER	220099	06/29/2022	07/13/2022	Gross beta	1.02E-02	pCi/m ³	8.66E-04	9.51E-04		Method Blank Contamination RPI:1132796454	
PNL-1	FILTER	220104	07/13/2022	07/27/2022	Gross beta	1.38E-02	pCi/m ³	9.76E-04	1.08E-03			
PNL-1	FILTER	220109	07/27/2022	08/10/2022	Gross beta	1.72E-02	pCi/m ³	1.08E-03	1.14E-03	Outdoor air quality alert issued		
PNL-1	FILTER	220114	08/10/2022	08/24/2022	Gross beta	2.01E-02	pCi/m ³	1.21E-03	1.32E-03		Method Blank Contamination RPI:1144522674	
PNL-1	FILTER	220119	08/24/2022	09/07/2022	Gross beta	1.75E-02	pCi/m ³	1.10E-03	1.13E-03			
PNL-1	FILTER	220164	09/07/2022	09/14/2022	Gross beta	2.80E-02	pCi/m ³	2.30E-03	2.33E-03	Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNL-1	FILTER	220124	09/14/2022	09/21/2022	Gross beta	1.94E-02	pCi/m ³	1.64E-03	1.67E-03	Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNL-1	FILTER	220129	09/21/2022	10/05/2022	Gross beta	3.50E-02	pCi/m ³	1.54E-03	1.65E-03			
PNL-1	FILTER	220134	10/05/2022	10/19/2022	Gross beta	4.74E-02	pCi/m ³	1.76E-03	2.13E-03		Method Blank Contamination RPI:1153293035	
PNL-1	FILTER	220139	10/19/2022	11/02/2022	Gross beta	2.03E-02	pCi/m ³	1.17E-03	1.22E-03		Method Blank Contamination RPI:1157265995	
PNL-1	FILTER	220144	11/02/2022	11/16/2022	Gross beta	2.78E-02	pCi/m ³	1.35E-03	1.41E-03			
PNL-1	FILTER	220149	11/16/2022	11/30/2022	Gross beta	5.25E-02	pCi/m ³	1.88E-03	2.21E-03	Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		
PNL-1	FILTER	220154	11/30/2022	12/14/2022	Gross beta	2.58E-02	pCi/m ³	1.31E-03	1.35E-03	Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-1	FILTER	220159	12/14/2022	12/28/2022	Gross beta	3.32E-02	pCi/m3	1.53E-03	1.69E-03	O	Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.	Method Blank Contamination RPI:1168678855	Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Antimony-125	4.83E-04	pCi/m3	4.85E-04	5.33E-04	XU		Results are considered a false positive due to low abundance.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Antimony-125	-3.74E-05	pCi/m3	1.55E-04	1.56E-04	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Beryllium-7	3.55E-02	pCi/m3	2.56E-03	4.12E-03	Y			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Beryllium-7	3.85E-02	pCi/m3	2.70E-03	4.61E-03	Y			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Cesium-134	8.12E-06	pCi/m3	5.74E-05	5.75E-05	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Cesium-134	1.15E-05	pCi/m3	6.83E-05	6.85E-05	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Cesium-137	2.03E-05	pCi/m3	7.47E-05	7.52E-05	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Cesium-137	1.31E-04	pCi/m3	1.88E-04	1.88E-04	UX		Results are considered a false positive due to high counting uncertainty.	Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Cobalt-60	1.50E-05	pCi/m3	5.29E-05	5.33E-05	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Cobalt-60	-4.21E-05	pCi/m3	7.23E-05	7.48E-05	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Europium-152	2.26E-05	pCi/m3	1.48E-04	1.48E-04	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Europium-152	-5.08E-07	pCi/m3	1.46E-04	1.46E-04	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Europium-154	-1.31E-04	pCi/m3	1.60E-04	1.71E-04	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Europium-154	8.32E-05	pCi/m3	2.00E-04	2.04E-04	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Europium-155	-5.30E-05	pCi/m3	1.17E-04	1.19E-04	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Europium-155	6.12E-05	pCi/m3	1.46E-04	1.49E-04	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Potassium-40	3.09E-03	pCi/m3	1.57E-03	1.60E-03	Y			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Potassium-40	2.55E-03	pCi/m3	1.45E-03	1.47E-03	Y			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Ruthenium-106	-2.24E-04	pCi/m3	4.64E-04	4.76E-04	U			Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Ruthenium-106	3.37E-04	pCi/m3	5.89E-04	6.10E-04	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Gross alpha (COMP)	1.03E-02	pCi/m3	1.63E-03	1.67E-03	X		Analytical holding time exceeded.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Gross alpha (COMP)	1.34E-02	pCi/m3	1.95E-03	2.03E-03	Y			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Gross beta (COMP)	1.43E-02	pCi/m3	9.07E-04	1.06E-03	X		Analytical holding time exceeded.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Gross beta (COMP)	2.75E-02	pCi/m3	1.32E-03	1.80E-03	Y			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Americium-241	-1.18E-05	pCi/m3	1.38E-05	1.38E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Americium-241	3.97E-06	pCi/m3	6.15E-06	6.17E-06	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Americium-243	1.23E-05	pCi/m3	1.20E-05	1.21E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Americium-243	7.36E-07	pCi/m3	5.20E-06	5.20E-06	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Curium-243/244	-2.64E-06	pCi/m3	5.17E-06	5.17E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Curium-243/244	-9.90E-07	pCi/m3	4.34E-06	4.34E-06	U			Y

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Plutonium-238	2.50E-06	pCi/m3	8.54E-06	8.55E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Plutonium-238	4.34E-06	pCi/m3	6.66E-06	6.67E-06	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Plutonium-239/240	-5.74E-07	pCi/m3	4.95E-06	4.96E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Plutonium-239/240	3.74E-06	pCi/m3	6.74E-06	6.75E-06	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Uranium-233/234	3.26E-05	pCi/m3	2.10E-05	2.15E-05	X		Analytical holding time exceeded.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Uranium-233/234	5.14E-05	pCi/m3	1.75E-05	1.84E-05	O			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Uranium-235	4.05E-06	pCi/m3	1.11E-05	1.12E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Uranium-235	4.09E-06	pCi/m3	6.82E-06	6.83E-06	U			Y
PNL-1	FILTER	220094	12/29/2021	06/29/2022	Uranium-238	2.63E-05	pCi/m3	1.75E-05	1.79E-05	X		Analytical holding time exceeded.	Y
PNL-1	FILTER	220166	06/29/2022	12/28/2022	Uranium-238	6.49E-05	pCi/m3	1.90E-05	2.02E-05				Y
PNL-2	FILTER	220002	12/29/2021	01/12/2022	Gross alpha	1.33E-03	pCi/m3	4.39E-04	4.40E-04				
PNL-2	FILTER	220007	01/12/2022	01/26/2022	Gross alpha	1.38E-03	pCi/m3	4.25E-04	4.26E-04		Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		
PNL-2	FILTER	220012	01/26/2022	02/09/2022	Gross alpha	1.21E-03	pCi/m3	4.60E-04	4.61E-04				
PNL-2	FILTER	220017	02/09/2022	02/23/2022	Gross alpha	5.49E-04	pCi/m3	2.92E-04	2.93E-04	O		Method Blank Contamination RPI:1105342631	
PNL-2	FILTER	220022	02/23/2022	03/09/2022	Gross alpha	9.88E-04	pCi/m3	3.94E-04	3.94E-04				
PNL-2	FILTER	220027	03/09/2022	03/23/2022	Gross alpha	7.30E-04	pCi/m3	3.26E-04	3.26E-04				
PNL-2	FILTER	220032	03/23/2022	04/06/2022	Gross alpha	5.35E-04	pCi/m3	2.76E-04	2.76E-04				
PNL-2	FILTER	220037	04/06/2022	04/20/2022	Gross alpha	6.48E-04	pCi/m3	3.00E-04	3.00E-04		Air sampler #22974 expiring 04/22/22 was replaced on 04/20/22 with #21711 expires 12/28/22.		
PNL-2	FILTER	220042	04/20/2022	05/04/2022	Gross alpha	3.03E-04	pCi/m3	2.10E-04	2.10E-04				
PNL-2	FILTER	220047	05/04/2022	05/18/2022	Gross alpha	1.89E-04	pCi/m3	2.17E-04	2.17E-04	U			
PNL-2	FILTER	220052	05/18/2022	06/01/2022	Gross alpha	6.04E-04	pCi/m3	3.10E-04	3.11E-04				
PNL-2	FILTER	220057	06/01/2022	06/15/2022	Gross alpha	3.74E-04	pCi/m3	2.33E-04	2.33E-04		Unit working but noisy; air sampler #21711 expiring 12/28/22 was replaced on 05/15/22 with #26472 expires 04/20/23.		
PNL-2	FILTER	220062	06/15/2022	06/29/2022	Gross alpha	3.85E-04	pCi/m3	2.62E-04	2.63E-04				
PNL-2	FILTER	220100	06/29/2022	07/13/2022	Gross alpha	4.54E-04	pCi/m3	2.41E-04	2.41E-04				
PNL-2	FILTER	220105	07/13/2022	07/27/2022	Gross alpha	6.87E-04	pCi/m3	3.04E-04	3.04E-04				
PNL-2	FILTER	220110	07/27/2022	08/10/2022	Gross alpha	7.88E-04	pCi/m3	3.21E-04	3.21E-04		Outdoor air quality alert issued		
PNL-2	FILTER	220115	08/10/2022	08/24/2022	Gross alpha	5.14E-04	pCi/m3	2.79E-04	2.80E-04				
PNL-2	FILTER	220120	08/24/2022	09/07/2022	Gross alpha	7.36E-04	pCi/m3	3.46E-04	3.47E-04				

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-2	FILTER	220165	09/07/2022	09/14/2022	Gross alpha	2.66E-03	pCi/m3	9.86E-04	9.87E-04		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNL-2	FILTER	220125	09/14/2022	09/21/2022	Gross alpha	9.83E-04	pCi/m3	5.30E-04	5.31E-04		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNL-2	FILTER	220130	09/21/2022	10/05/2022	Gross alpha	1.38E-03	pCi/m3	4.26E-04	4.30E-04				
PNL-2	FILTER	220135	10/05/2022	10/19/2022	Gross alpha	1.80E-03	pCi/m3	4.60E-04	4.61E-04				
PNL-2	FILTER	220140	10/19/2022	11/02/2022	Gross alpha	8.87E-04	pCi/m3	3.77E-04	3.78E-04				
PNL-2	FILTER	220145	11/02/2022	11/16/2022	Gross alpha	1.20E-03	pCi/m3	4.03E-04	4.04E-04				
PNL-2	FILTER	220150	11/16/2022	11/30/2022	Gross alpha	2.70E-03	pCi/m3	5.97E-04	6.07E-04				
PNL-2	FILTER	220155	11/30/2022	12/14/2022	Gross alpha	7.02E-04	pCi/m3	3.43E-04	3.44E-04				
PNL-2	FILTER	220160	12/14/2022	12/28/2022	Gross alpha	1.24E-03	pCi/m3	5.28E-04	5.28E-04				
PNL-2	FILTER	220002	12/29/2021	01/12/2022	Gross beta	2.75E-02	pCi/m3	1.38E-03	1.51E-03				
PNL-2	FILTER	220007	01/12/2022	01/26/2022	Gross beta	2.51E-02	pCi/m3	1.31E-03	1.33E-03		Display panel indicated air flow failure, sampler was running and displayed realistic monitoring data.		
PNL-2	FILTER	220012	01/26/2022	02/09/2022	Gross beta	2.10E-02	pCi/m3	1.22E-03	1.33E-03				
PNL-2	FILTER	220017	02/09/2022	02/23/2022	Gross beta	1.65E-02	pCi/m3	1.07E-03	1.37E-03				
PNL-2	FILTER	220022	02/23/2022	03/09/2022	Gross beta	1.96E-02	pCi/m3	1.13E-03	1.18E-03				
PNL-2	FILTER	220027	03/09/2022	03/23/2022	Gross beta	1.23E-02	pCi/m3	9.75E-04	1.04E-03				
PNL-2	FILTER	220032	03/23/2022	04/06/2022	Gross beta	1.07E-02	pCi/m3	9.12E-04	1.01E-03				
PNL-2	FILTER	220037	04/06/2022	04/20/2022	Gross beta	9.87E-03	pCi/m3	8.65E-04	8.76E-04		Air sampler #22974 expiring 04/22/22 was replaced on 04/20/22 with #21711 expires 12/28/22.		
PNL-2	FILTER	220042	04/20/2022	05/04/2022	Gross beta	6.83E-03	pCi/m3	6.97E-04	7.18E-04				
PNL-2	FILTER	220047	05/04/2022	05/18/2022	Gross beta	7.90E-03	pCi/m3	7.74E-04	7.84E-04				
PNL-2	FILTER	220052	05/18/2022	06/01/2022	Gross beta	1.17E-02	pCi/m3	9.09E-04	1.09E-03				
PNL-2	FILTER	220057	06/01/2022	06/15/2022	Gross beta	7.72E-03	pCi/m3	7.65E-04	7.73E-04	O	Unit working but noisy; air sampler #21711 expiring 12/28/22 was replaced on 05/15/22 with #26472 expires 04/20/23.	Method Blank Contamination RPI:1127700262	
PNL-2	FILTER	220062	06/15/2022	06/29/2022	Gross beta	1.05E-02	pCi/m3	8.98E-04	9.15E-04				
PNL-2	FILTER	220100	06/29/2022	07/13/2022	Gross beta	1.22E-02	pCi/m3	9.44E-04	9.80E-04	O		Method Blank Contamination RPI:1132796454	
PNL-2	FILTER	220105	07/13/2022	07/27/2022	Gross beta	1.50E-02	pCi/m3	1.04E-03	1.06E-03				
PNL-2	FILTER	220110	07/27/2022	08/10/2022	Gross beta	1.95E-02	pCi/m3	1.17E-03	1.20E-03		Outdoor air quality alert issued		
PNL-2	FILTER	220115	08/10/2022	08/24/2022	Gross beta	1.68E-02	pCi/m3	1.06E-03	1.14E-03	O		Method Blank Contamination RPI:1144522674	
PNL-2	FILTER	220120	08/24/2022	09/07/2022	Gross beta	1.75E-02	pCi/m3	1.10E-03	1.13E-03				
PNL-2	FILTER	220165	09/07/2022	09/14/2022	Gross beta	2.53E-02	pCi/m3	2.18E-03	2.21E-03		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		
PNL-2	FILTER	220125	09/14/2022	09/21/2022	Gross beta	1.75E-02	pCi/m3	1.56E-03	1.58E-03		Refer to Discrepancy rpt EMP22-005, one-week sample due to smoke in the air from fires in surrounding areas.		

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-2	FILTER	220130	09/21/2022	10/05/2022	Gross beta	3.38E-02	pCi/m3	1.55E-03	2.09E-03				
PNL-2	FILTER	220135	10/05/2022	10/19/2022	Gross beta	5.12E-02	pCi/m3	1.86E-03	2.14E-03	O		Method Blank Contamination RPI:1153293035	
PNL-2	FILTER	220140	10/19/2022	11/02/2022	Gross beta	2.01E-02	pCi/m3	1.17E-03	1.20E-03	O		Method Blank Contamination RPI:1157265995	
PNL-2	FILTER	220145	11/02/2022	11/16/2022	Gross beta	2.66E-02	pCi/m3	1.33E-03	1.36E-03				
PNL-2	FILTER	220150	11/16/2022	11/30/2022	Gross beta	5.24E-02	pCi/m3	1.93E-03	3.00E-03				
PNL-2	FILTER	220155	11/30/2022	12/14/2022	Gross beta	2.63E-02	pCi/m3	1.35E-03	1.39E-03				
PNL-2	FILTER	220160	12/14/2022	12/28/2022	Gross beta	3.43E-02	pCi/m3	1.55E-03	1.63E-03	O		Method Blank Contamination RPI:1168678855	
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Antimony-125	8.03E-05	pCi/m3	1.52E-04	1.57E-04	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Antimony-125	-2.90E-05	pCi/m3	1.44E-04	1.45E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Beryllium-7	4.06E-02	pCi/m3	2.89E-03	4.86E-03				Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Beryllium-7	3.76E-02	pCi/m3	3.14E-03	4.91E-03				Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Cesium-134	-6.59E-05	pCi/m3	7.32E-05	7.93E-05	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Cesium-134	1.59E-05	pCi/m3	8.06E-05	8.09E-05	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Cesium-137	3.55E-05	pCi/m3	6.77E-05	6.97E-05	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Cesium-137	-1.26E-04	pCi/m3	1.08E-04	1.23E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Cobalt-60	-7.03E-06	pCi/m3	8.67E-05	8.67E-05	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Cobalt-60	-4.06E-05	pCi/m3	8.66E-05	8.86E-05	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Europium-152	-4.28E-05	pCi/m3	1.59E-04	1.60E-04	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Europium-152	7.39E-05	pCi/m3	1.53E-04	1.57E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Europium-154	2.15E-04	pCi/m3	2.13E-04	2.35E-04	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Europium-154	-1.01E-04	pCi/m3	2.14E-04	2.19E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Europium-155	-4.04E-05	pCi/m3	1.31E-04	1.32E-04	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Europium-155	-2.06E-05	pCi/m3	1.27E-04	1.27E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Potassium-40	3.03E-03	pCi/m3	1.73E-03	1.75E-03				Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Potassium-40	2.08E-03	pCi/m3	1.96E-03	1.97E-03				Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Ruthenium-106	-1.06E-04	pCi/m3	5.84E-04	5.86E-04	U			Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Ruthenium-106	-5.16E-05	pCi/m3	5.93E-04	5.94E-04	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Gross alpha (COMP)	1.02E-02	pCi/m3	1.65E-03	1.66E-03	X		Analytical holding time exceeded.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Gross alpha (COMP)	1.75E-02	pCi/m3	2.20E-03	2.22E-03				Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Gross beta (COMP)	1.43E-02	pCi/m3	9.10E-04	9.64E-04	X		Analytical holding time exceeded.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Gross beta (COMP)	3.01E-02	pCi/m3	1.35E-03	1.43E-03				Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Americium-241	1.75E-06	pCi/m3	7.68E-06	7.68E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Americium-241	1.58E-06	pCi/m3	3.80E-06	3.80E-06	U			Y

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Americium-243	-1.48E-06	pCi/m3	1.04E-05	1.04E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Americium-243	3.72E-06	pCi/m3	6.01E-06	6.03E-06	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Curium-243/244	-1.76E-06	pCi/m3	2.47E-05	2.47E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Curium-243/244	-1.32E-13	pCi/m3	3.09E-06	3.09E-06	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Plutonium-238	1.07E-07	pCi/m3	7.94E-06	7.95E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Plutonium-238	-2.52E-06	pCi/m3	7.22E-06	7.22E-06	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Plutonium-239/240	2.13E-06	pCi/m3	9.56E-06	9.56E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Plutonium-239/240	4.06E-06	pCi/m3	7.86E-06	7.88E-06	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Uranium-233/234	4.00E-05	pCi/m3	2.77E-05	2.84E-05	X		Analytical holding time exceeded.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Uranium-233/234	4.14E-05	pCi/m3	1.69E-05	1.76E-05	O			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Uranium-235	-8.56E-07	pCi/m3	1.29E-05	1.29E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Uranium-235	4.71E-06	pCi/m3	7.85E-06	7.87E-06	U			Y
PNL-2	FILTER	220095	12/29/2021	06/29/2022	Uranium-238	5.38E-05	pCi/m3	2.81E-05	2.92E-05	X		Analytical holding time exceeded.	Y
PNL-2	FILTER	220167	06/29/2022	12/28/2022	Uranium-238	5.80E-05	pCi/m3	1.87E-05	1.98E-05				Y
PNL-3	FILTER	220003	12/29/2021	01/12/2022	Gross alpha	1.02E-03	pCi/m3	3.55E-04	3.55E-04				
PNL-3	FILTER	220008	01/12/2022	01/26/2022	Gross alpha	1.26E-03	pCi/m3	4.07E-04	4.08E-04				
PNL-3	FILTER	220013	01/26/2022	02/09/2022	Gross alpha	6.46E-04	pCi/m3	3.91E-04	3.92E-04				
PNL-3	FILTER	220018	02/09/2022	02/23/2022	Gross alpha	4.95E-04	pCi/m3	2.97E-04	2.98E-04	O		Method Blank Contamination RPI:1105342631	
PNL-3	FILTER	220023	02/23/2022	03/09/2022	Gross alpha	7.51E-04	pCi/m3	3.24E-04	3.24E-04				
PNL-3	FILTER	220028	03/09/2022	03/23/2022	Gross alpha	7.58E-04	pCi/m3	3.10E-04	3.10E-04				
PNL-3	FILTER	220033	03/23/2022	04/06/2022	Gross alpha	2.33E-04	pCi/m3	2.68E-04	2.68E-04	U			
PNL-3	FILTER	220038	04/06/2022	04/20/2022	Gross alpha	5.21E-04	pCi/m3	2.83E-04	2.83E-04				
PNL-3	FILTER	220043	04/20/2022	05/04/2022	Gross alpha	2.53E-04	pCi/m3	2.15E-04	2.15E-04	U		Totalizer #41499 expiring 05/17/22 was replaced on 05/04/22 with totalizer #42288, expires 11/09/22	
PNL-3	FILTER	220048	05/04/2022	05/18/2022	Gross alpha	2.23E-04	pCi/m3	1.94E-04	1.94E-04	U			
PNL-3	FILTER	220053	05/18/2022	06/01/2022	Gross alpha	4.99E-04	pCi/m3	2.41E-04	2.41E-04				
PNL-3	FILTER	220058	06/01/2022	06/15/2022	Gross alpha	3.58E-04	pCi/m3	2.20E-04	2.20E-04				
PNL-3	FILTER	220063	06/15/2022	06/29/2022	Gross alpha	3.17E-04	pCi/m3	2.48E-04	2.49E-04	U			
PNL-3	FILTER	220101	06/29/2022	07/13/2022	Gross alpha	7.57E-04	pCi/m3	3.26E-04	3.28E-04				
PNL-3	FILTER	220106	07/13/2022	07/27/2022	Gross alpha	5.74E-04	pCi/m3	2.96E-04	2.96E-04				

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-3	FILTER	220111	07/27/2022	08/10/2022	Gross alpha	6.71E-04	pCi/m3	2.82E-04	2.82E-04		Outdoor air quality alert issued		
PNL-3	FILTER	220116	08/10/2022	08/24/2022	Gross alpha	5.42E-04	pCi/m3	2.64E-04	2.64E-04				
PNL-3	FILTER	220121	08/24/2022	09/07/2022	Gross alpha	4.08E-04	pCi/m3	2.38E-04	2.39E-04				
PNL-3	FILTER	220126	09/07/2022	09/21/2022	Gross alpha	7.89E-04	pCi/m3	2.71E-04	2.72E-04				
PNL-3	FILTER	220131	09/21/2022	10/05/2022	Gross alpha	9.79E-04	pCi/m3	3.68E-04	3.68E-04		Totalizer recorded 6 m3; total sample volume manually calculated (899.7 m3) using sample on/off dates. Digits on display not rolling over consistently. Totalizer #42288 replaced with totalizer #43344 on 10/05/22, start volume 5830, expires 06/27/23.		
PNL-3	FILTER	220136	10/05/2022	10/19/2022	Gross alpha	1.27E-03	pCi/m3	3.82E-04	3.84E-04				
PNL-3	FILTER	220141	10/19/2022	11/02/2022	Gross alpha	9.02E-04	pCi/m3	3.26E-04	3.28E-04				
PNL-3	FILTER	220146	11/02/2022	11/16/2022	Gross alpha	1.21E-03	pCi/m3	3.94E-04	3.99E-04				
PNL-3	FILTER	220151	11/16/2022	11/30/2022	Gross alpha	1.75E-03	pCi/m3	4.53E-04	4.54E-04				
PNL-3	FILTER	220156	11/30/2022	12/14/2022	Gross alpha	6.03E-04	pCi/m3	2.94E-04	2.94E-04				
PNL-3	FILTER	220161	12/14/2022	12/28/2022	Gross alpha	1.72E-03	pCi/m3	4.53E-04	4.54E-04				
PNL-3	FILTER	220003	12/29/2021	01/12/2022	Gross beta	2.71E-02	pCi/m3	1.32E-03	1.55E-03				
PNL-3	FILTER	220008	01/12/2022	01/26/2022	Gross beta	2.27E-02	pCi/m3	1.25E-03	1.28E-03				
PNL-3	FILTER	220013	01/26/2022	02/09/2022	Gross beta	1.96E-02	pCi/m3	1.21E-03	1.24E-03				
PNL-3	FILTER	220018	02/09/2022	02/23/2022	Gross beta	1.42E-02	pCi/m3	1.01E-03	1.03E-03				
PNL-3	FILTER	220023	02/23/2022	03/09/2022	Gross beta	1.57E-02	pCi/m3	1.05E-03	1.06E-03				
PNL-3	FILTER	220028	03/09/2022	03/23/2022	Gross beta	1.38E-02	pCi/m3	9.61E-04	9.75E-04				
PNL-3	FILTER	220033	03/23/2022	04/06/2022	Gross beta	9.16E-03	pCi/m3	8.19E-04	8.30E-04				
PNL-3	FILTER	220038	04/06/2022	04/20/2022	Gross beta	9.80E-03	pCi/m3	8.21E-04	8.57E-04				
PNL-3	FILTER	220043	04/20/2022	05/04/2022	Gross beta	6.93E-03	pCi/m3	7.04E-04	7.20E-04		Totalizer #41499 expiring 05/17/22 was replaced on 05/04/22 with totalizer #42288, expires 11/09/22		
PNL-3	FILTER	220048	05/04/2022	05/18/2022	Gross beta	7.71E-03	pCi/m3	7.01E-04	7.10E-04				
PNL-3	FILTER	220053	05/18/2022	06/01/2022	Gross beta	9.75E-03	pCi/m3	7.99E-04	8.10E-04				
PNL-3	FILTER	220058	06/01/2022	06/15/2022	Gross beta	7.62E-03	pCi/m3	6.85E-04	7.04E-04	O		Method Blank Contamination RPI:1127700262	
PNL-3	FILTER	220063	06/15/2022	06/29/2022	Gross beta	1.25E-02	pCi/m3	1.10E-03	1.20E-03				
PNL-3	FILTER	220101	06/29/2022	07/13/2022	Gross beta	1.17E-02	pCi/m3	9.37E-04	1.01E-03	O		Method Blank Contamination RPI:1132796454	
PNL-3	FILTER	220106	07/13/2022	07/27/2022	Gross beta	1.30E-02	pCi/m3	1.01E-03	1.04E-03				
PNL-3	FILTER	220111	07/27/2022	08/10/2022	Gross beta	1.47E-02	pCi/m3	9.54E-04	9.93E-04		Outdoor air quality alert issued		
PNL-3	FILTER	220116	08/10/2022	08/24/2022	Gross beta	1.52E-02	pCi/m3	9.73E-04	1.01E-03	O		Method Blank Contamination RPI:1144522674	
PNL-3	FILTER	220121	08/24/2022	09/07/2022	Gross beta	1.55E-02	pCi/m3	9.54E-04	1.12E-03				
PNL-3	FILTER	220126	09/07/2022	09/21/2022	Gross beta	1.06E-02	pCi/m3	7.11E-04	7.21E-04				

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-3	FILTER	220131	09/21/2022	10/05/2022	Gross beta	3.88E-02	pCi/m3	1.71E-03	1.87E-03		Totalizer recorded 6 m3; total sample volume manually calculated (899.7 m3) using sample on/off dates. Digits on display not rolling over consistently. Totalizer #42288 replaced with totalizer #43344 on 10/05/22, start volume 5830, expires 06/27/23.		
PNL-3	FILTER	220136	10/05/2022	10/19/2022	Gross beta	4.22E-02	pCi/m3	1.57E-03	2.26E-03	O		Method Blank Contamination RPI:1153293035	
PNL-3	FILTER	220141	10/19/2022	11/02/2022	Gross beta	1.85E-02	pCi/m3	1.04E-03	1.29E-03	O		Method Blank Contamination RPI:1157265995	
PNL-3	FILTER	220146	11/02/2022	11/16/2022	Gross beta	2.53E-02	pCi/m3	1.24E-03	1.80E-03				
PNL-3	FILTER	220151	11/16/2022	11/30/2022	Gross beta	4.67E-02	pCi/m3	1.64E-03	1.74E-03				
PNL-3	FILTER	220156	11/30/2022	12/14/2022	Gross beta	2.31E-02	pCi/m3	1.18E-03	1.24E-03				
PNL-3	FILTER	220161	12/14/2022	12/28/2022	Gross beta	3.54E-02	pCi/m3	1.45E-03	1.57E-03	O		Method Blank Contamination RPI:1168678855	
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Antimony-125	6.98E-05	pCi/m3	1.45E-04	1.49E-04	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Antimony-125	-7.76E-06	pCi/m3	1.46E-04	1.46E-04	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Beryllium-7	3.37E-02	pCi/m3	2.46E-03	4.21E-03				Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Beryllium-7	3.30E-02	pCi/m3	2.27E-03	3.90E-03				Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Cesium-134	2.17E-05	pCi/m3	5.67E-05	5.76E-05	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Cesium-134	1.73E-05	pCi/m3	6.84E-05	6.89E-05	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Cesium-137	-8.79E-05	pCi/m3	8.83E-05	9.75E-05	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Cesium-137	1.56E-05	pCi/m3	6.23E-05	6.28E-05	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Cobalt-60	8.57E-07	pCi/m3	6.66E-05	6.66E-05	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Cobalt-60	4.35E-05	pCi/m3	5.87E-05	6.20E-05	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Europium-152	-3.11E-05	pCi/m3	1.46E-04	1.47E-04	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Europium-152	-1.29E-04	pCi/m3	1.43E-04	1.55E-04	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Europium-154	1.66E-05	pCi/m3	2.08E-04	2.08E-04	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Europium-154	2.38E-05	pCi/m3	1.70E-04	1.70E-04	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Europium-155	6.41E-05	pCi/m3	1.55E-04	1.58E-04	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Europium-155	1.31E-04	pCi/m3	1.23E-04	1.37E-04	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Potassium-40	2.79E-03	pCi/m3	1.80E-03	1.82E-03				Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Potassium-40	3.36E-03	pCi/m3	1.17E-03	1.22E-03				Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Ruthenium-106	-5.22E-04	pCi/m3	5.11E-04	5.66E-04	U			Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Ruthenium-106	1.83E-04	pCi/m3	4.87E-04	4.94E-04	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Gross alpha (COMP)	6.76E-03	pCi/m3	1.17E-03	1.19E-03	X		Analytical holding time exceeded.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Gross alpha (COMP)	7.26E-03	pCi/m3	1.31E-03	1.33E-03				Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Gross beta (COMP)	1.39E-02	pCi/m3	8.62E-04	8.95E-04	X		Analytical holding time exceeded.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Gross beta (COMP)	2.28E-02	pCi/m3	1.07E-03	1.44E-03				Y

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Americium-241	-6.73E-06	pCi/m3	1.52E-05	1.52E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Americium-241	2.08E-06	pCi/m3	4.08E-06	4.08E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Americium-243	1.17E-05	pCi/m3	9.89E-06	9.98E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Americium-243	2.81E-06	pCi/m3	4.77E-06	4.78E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Curium-243/244	1.35E-06	pCi/m3	7.02E-06	7.03E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Curium-243/244	-3.46E-06	pCi/m3	4.50E-06	4.50E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Plutonium-238	4.34E-06	pCi/m3	1.14E-05	1.14E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Plutonium-238	-2.22E-06	pCi/m3	4.99E-06	4.99E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Plutonium-239/240	-2.66E-06	pCi/m3	6.16E-06	6.17E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Plutonium-239/240	-1.16E-07	pCi/m3	4.53E-06	4.53E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Uranium-233/234	3.65E-05	pCi/m3	2.44E-05	2.50E-05	X		Analytical holding time exceeded.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Uranium-233/234	3.50E-05	pCi/m3	1.30E-05	1.36E-05	O			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Uranium-235	1.51E-07	pCi/m3	1.12E-05	1.12E-05	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Uranium-235	6.34E-06	pCi/m3	6.94E-06	6.97E-06	U			Y
PNL-3	FILTER	220096	12/29/2021	06/29/2022	Uranium-238	2.77E-05	pCi/m3	2.01E-05	2.05E-05	X		Analytical holding time exceeded.	Y
PNL-3	FILTER	220168	06/29/2022	12/28/2022	Uranium-238	5.45E-05	pCi/m3	1.51E-05	1.61E-05				Y
PNL-4	FILTER	220004	12/29/2021	01/12/2022	Gross alpha	9.88E-04	pCi/m3	3.23E-04	3.25E-04				
PNL-4	FILTER	220009	01/12/2022	01/26/2022	Gross alpha	5.86E-04	pCi/m3	1.98E-04	1.99E-04				
PNL-4	FILTER	220014	01/26/2022	02/09/2022	Gross alpha	3.71E-04	pCi/m3	1.58E-04	1.58E-04				
PNL-4	FILTER	220019	02/09/2022	02/23/2022	Gross alpha	3.10E-04	pCi/m3	1.57E-04	1.57E-04	O		Method Blank Contamination RPI:1105342631	
PNL-4	FILTER	220024	02/23/2022	03/09/2022	Gross alpha	6.10E-04	pCi/m3	2.25E-04	2.25E-04				
PNL-4	FILTER	220029	03/09/2022	03/23/2022	Gross alpha	3.12E-04	pCi/m3	1.64E-04	1.64E-04			Totalizer reading high. Totalizer #43554 expiring 09/01/22 was replaced on 03/23/22 with totalizer #43344, expires 06/23/22.	
PNL-4	FILTER	220034	03/23/2022	04/06/2022	Gross alpha	3.46E-04	pCi/m3	2.21E-04	2.21E-04				
PNL-4	FILTER	220039	04/06/2022	04/20/2022	Gross alpha	4.02E-04	pCi/m3	2.30E-04	2.31E-04				
PNL-4	FILTER	220044	04/20/2022	05/04/2022	Gross alpha	3.59E-04	pCi/m3	2.31E-04	2.31E-04				
PNL-4	FILTER	220049	05/04/2022	05/18/2022	Gross alpha	3.32E-04	pCi/m3	2.33E-04	2.33E-04				
PNL-4	FILTER	220054	05/18/2022	06/01/2022	Gross alpha	2.77E-04	pCi/m3	2.14E-04	2.14E-04	U			

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-4	FILTER	220059	06/01/2022	06/15/2022	Gross alpha	4.31E-04	pCi/m3	2.37E-04	2.37E-04		Totalizer #43344 expiring 06/23/22 was replaced on 06/15/22 with totalizer #41499, expires 05/27/23.		
PNL-4	FILTER	220064	06/15/2022	06/29/2022	Gross alpha	3.28E-04	pCi/m3	2.06E-04	2.06E-04				
PNL-4	FILTER	220102	06/29/2022	07/13/2022	Gross alpha	3.96E-04	pCi/m3	2.30E-04	2.31E-04				
PNL-4	FILTER	220107	07/13/2022	07/27/2022	Gross alpha	5.39E-04	pCi/m3	2.47E-04	2.47E-04				
PNL-4	FILTER	220112	07/27/2022	08/10/2022	Gross alpha	7.62E-04	pCi/m3	2.90E-04	2.91E-04		Outdoor air quality alert issued		
PNL-4	FILTER	220117	08/10/2022	08/24/2022	Gross alpha	7.01E-04	pCi/m3	2.85E-04	2.86E-04				
PNL-4	FILTER	220122	08/24/2022	09/07/2022	Gross alpha	8.66E-04	pCi/m3	3.24E-04	3.26E-04				
PNL-4	FILTER	220127	09/07/2022	09/21/2022	Gross alpha	6.68E-04	pCi/m3	2.63E-04	2.65E-04				
PNL-4	FILTER	220132	09/21/2022	10/05/2022	Gross alpha	1.43E-03	pCi/m3	5.13E-04	5.14E-04				
PNL-4	FILTER	220137	10/05/2022	10/19/2022	Gross alpha	2.00E-03	pCi/m3	4.70E-04	4.78E-04				
PNL-4	FILTER	220142	10/19/2022	11/02/2022	Gross alpha	8.78E-04	pCi/m3	3.78E-04	3.79E-04				
PNL-4	FILTER	220147	11/02/2022	11/16/2022	Gross alpha	9.42E-04	pCi/m3	3.40E-04	3.40E-04				
PNL-4	FILTER	220152	11/16/2022	11/30/2022	Gross alpha	2.20E-03	pCi/m3	5.45E-04	5.46E-04				
PNL-4	FILTER	220157	11/30/2022	12/14/2022	Gross alpha	1.05E-03	pCi/m3	3.61E-04	3.61E-04				
PNL-4	FILTER	220162	12/14/2022	12/28/2022	Gross alpha	9.43E-04	pCi/m3	3.84E-04	3.84E-04				
PNL-4	FILTER	220004	12/29/2021	01/12/2022	Gross beta	1.75E-02	pCi/m3	8.65E-04	9.18E-04				
PNL-4	FILTER	220009	01/12/2022	01/26/2022	Gross beta	1.31E-02	pCi/m3	6.83E-04	7.23E-04				
PNL-4	FILTER	220014	01/26/2022	02/09/2022	Gross beta	1.12E-02	pCi/m3	6.57E-04	7.47E-04				
PNL-4	FILTER	220019	02/09/2022	02/23/2022	Gross beta	9.22E-03	pCi/m3	6.19E-04	6.30E-04				
PNL-4	FILTER	220024	02/23/2022	03/09/2022	Gross beta	1.23E-02	pCi/m3	7.30E-04	7.63E-04		Totalizer reading high. Totalizer #43554 expiring 09/01/22 was replaced on 03/23/22 with totalizer #43344, expires 06/23/22.		
PNL-4	FILTER	220029	03/09/2022	03/23/2022	Gross beta	7.14E-03	pCi/m3	5.28E-04	5.40E-04				
PNL-4	FILTER	220034	03/23/2022	04/06/2022	Gross beta	9.91E-03	pCi/m3	8.10E-04	8.19E-04				
PNL-4	FILTER	220039	04/06/2022	04/20/2022	Gross beta	9.45E-03	pCi/m3	8.01E-04	8.25E-04				
PNL-4	FILTER	220044	04/20/2022	05/04/2022	Gross beta	8.91E-03	pCi/m3	7.90E-04	8.00E-04				
PNL-4	FILTER	220049	05/04/2022	05/18/2022	Gross beta	8.08E-03	pCi/m3	7.26E-04	7.36E-04				
PNL-4	FILTER	220054	05/18/2022	06/01/2022	Gross beta	8.92E-03	pCi/m3	7.61E-04	7.93E-04				
PNL-4	FILTER	220059	06/01/2022	06/15/2022	Gross beta	7.66E-03	pCi/m3	7.47E-04	7.61E-04	O	Totalizer #43344 expiring 06/23/22 was replaced on 06/15/22 with totalizer #41499, expires 05/27/23.	Method Blank Contamination RPI:1127700262	
PNL-4	FILTER	220064	06/15/2022	06/29/2022	Gross beta	9.19E-03	pCi/m3	7.98E-04	8.06E-04				
PNL-4	FILTER	220102	06/29/2022	07/13/2022	Gross beta	1.22E-02	pCi/m3	9.36E-04	1.04E-03	O		Method Blank Contamination RPI:1132796454	
PNL-4	FILTER	220107	07/13/2022	07/27/2022	Gross beta	1.27E-02	pCi/m3	8.90E-04	9.35E-04				
PNL-4	FILTER	220112	07/27/2022	08/10/2022	Gross beta	1.73E-02	pCi/m3	1.04E-03	1.11E-03		Outdoor air quality alert issued		
PNL-4	FILTER	220117	08/10/2022	08/24/2022	Gross beta	1.54E-02	pCi/m3	1.00E-03	1.06E-03	O		Method Blank Contamination RPI:1144522674	
PNL-4	FILTER	220122	08/24/2022	09/07/2022	Gross beta	1.66E-02	pCi/m3	1.03E-03	1.24E-03				
PNL-4	FILTER	220127	09/07/2022	09/21/2022	Gross beta	1.10E-02	pCi/m3	7.51E-04	9.41E-04				

Table C.2 (contd)

Location ID	Sample Matrix	Field ID	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-4	FILTER	220132	09/21/2022	10/05/2022	Gross beta	3.09E-02	pCi/m3	1.39E-03	1.47E-03				
PNL-4	FILTER	220137	10/05/2022	10/19/2022	Gross beta	4.58E-02	pCi/m3	1.70E-03	2.26E-03	O		Method Blank Contamination RPI:1153293035	
PNL-4	FILTER	220142	10/19/2022	11/02/2022	Gross beta	1.86E-02	pCi/m3	1.14E-03	1.23E-03	O		Method Blank Contamination RPI:1157265995	
PNL-4	FILTER	220147	11/02/2022	11/16/2022	Gross beta	2.71E-02	pCi/m3	1.32E-03	1.37E-03				
PNL-4	FILTER	220152	11/16/2022	11/30/2022	Gross beta	5.00E-02	pCi/m3	1.78E-03	1.93E-03				
PNL-4	FILTER	220157	11/30/2022	12/14/2022	Gross beta	2.45E-02	pCi/m3	1.29E-03	1.39E-03				
PNL-4	FILTER	220162	12/14/2022	12/28/2022	Gross beta	3.31E-02	pCi/m3	1.46E-03	1.49E-03	O		Method Blank Contamination RPI:1168678855	
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Antimony-125	-1.36E-06	pCi/m3	1.47E-04	1.47E-04	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Antimony-125	-2.12E-04	pCi/m3	1.77E-04	2.02E-04	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Beryllium-7	2.85E-02	pCi/m3	2.53E-03	3.58E-03				Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Beryllium-7	3.56E-02	pCi/m3	3.10E-03	4.61E-03				Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Cesium-134	1.83E-05	pCi/m3	7.85E-05	7.89E-05	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Cesium-134	-1.36E-05	pCi/m3	8.05E-05	8.07E-05	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Cesium-137	2.65E-05	pCi/m3	7.54E-05	7.64E-05	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Cesium-137	2.01E-05	pCi/m3	9.16E-05	9.20E-05	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Cobalt-60	-3.18E-05	pCi/m3	9.63E-05	9.74E-05	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Cobalt-60	-4.35E-06	pCi/m3	6.23E-05	6.23E-05	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Europium-152	-1.05E-05	pCi/m3	1.46E-04	1.46E-04	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Europium-152	-3.39E-05	pCi/m3	1.95E-04	1.96E-04	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Europium-154	-1.46E-04	pCi/m3	1.98E-04	2.09E-04	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Europium-154	8.04E-05	pCi/m3	2.56E-04	2.59E-04	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Europium-155	2.08E-05	pCi/m3	1.25E-04	1.25E-04	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Europium-155	-1.24E-05	pCi/m3	1.51E-04	1.51E-04	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Potassium-40	7.96E-04	pCi/m3	2.06E-03	2.06E-03	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Potassium-40	3.48E-03	pCi/m3	1.65E-03	1.69E-03				Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Ruthenium-106	3.95E-04	pCi/m3	5.82E-04	6.10E-04	U			Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Ruthenium-106	1.98E-05	pCi/m3	6.85E-04	6.85E-04	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Gross alpha (COMP)	7.47E-03	pCi/m3	1.19E-03	1.20E-03	X		Analytical holding time exceeded.	Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Gross alpha (COMP)	1.57E-02	pCi/m3	1.98E-03	2.00E-03				Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Gross beta (COMP)	1.16E-02	pCi/m3	7.05E-04	7.27E-04	X		Analytical holding time exceeded.	Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Gross beta (COMP)	2.51E-02	pCi/m3	1.13E-03	1.17E-03				Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Americium-241	6.98E-06	pCi/m3	7.90E-06	7.94E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-4	FILTER	220169	06/29/2022	12/28/2022	Americium-241	0.00E+00	pCi/m3	4.86E-06	4.86E-06	U			Y
PNL-4	FILTER	220097	12/29/2021	06/29/2022	Americium-243	1.05E-06	pCi/m3	6.19E-06	6.20E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y

Table C.2 (contd)

Location ID	Field Sample Matrix ID	Sample Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-4	FIL TER	220169	06/29/2022	Americium-243	3.65E-06	pCi/m3	4.78E-06	4.80E-06	U			Y
PNL-4	FIL TER	220097	12/29/2021	Curium-243/244	2.34E-06	pCi/m3	7.23E-06	7.26E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-4	FIL TER	220169	06/29/2022	Curium-243/244	1.75E-06	pCi/m3	7.67E-06	7.67E-06	U			Y
PNL-4	FIL TER	220097	12/29/2021	Plutonium-238	2.86E-06	pCi/m3	4.76E-06	4.77E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-4	FIL TER	220169	06/29/2022	Plutonium-238	5.70E-07	pCi/m3	3.57E-06	3.57E-06	U			Y
PNL-4	FIL TER	220097	12/29/2021	Plutonium-239/240	-2.35E-06	pCi/m3	6.44E-06	6.44E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-4	FIL TER	220169	06/29/2022	Plutonium-239/240	1.72E-05	pCi/m3	9.48E-06	9.62E-06				Y
PNL-4	FIL TER	220097	12/29/2021	Uranium-233/234	3.55E-05	pCi/m3	1.90E-05	1.97E-05	X		Analytical holding time exceeded.	Y
PNL-4	FIL TER	220169	06/29/2022	Uranium-233/234	4.10E-05	pCi/m3	2.32E-05	2.40E-05				Y
PNL-4	FIL TER	220097	12/29/2021	Uranium-235	-5.46E-07	pCi/m3	8.19E-06	8.20E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-4	FIL TER	220169	06/29/2022	Uranium-235	6.01E-06	pCi/m3	1.18E-05	1.19E-05	U			Y
PNL-4	FIL TER	220097	12/29/2021	Uranium-238	2.98E-05	pCi/m3	1.68E-05	1.74E-05	X		Analytical holding time exceeded.	Y
PNL-4	FIL TER	220169	06/29/2022	Uranium-238	4.43E-05	pCi/m3	2.32E-05	2.40E-05				Y
PNL-5	FIL TER	220005	12/29/2021	Gross alpha	1.39E-03	pCi/m3	5.35E-04	5.36E-04				
PNL-5	FIL TER	220010	01/12/2022	Gross alpha	1.03E-03	pCi/m3	3.85E-04	3.87E-04				
PNL-5	FIL TER	220015	01/26/2022	Gross alpha	7.39E-04	pCi/m3	3.03E-04	3.03E-04				
PNL-5	FIL TER	220020	02/09/2022	Gross alpha	3.18E-04	pCi/m3	2.15E-04	2.15E-04	O		Method Blank Contamination RPI:1105342631	
PNL-5	FIL TER	220025	02/23/2022	Gross alpha	9.21E-04	pCi/m3	3.55E-04	3.55E-04				
PNL-5	FIL TER	220030	03/09/2022	Gross alpha	2.13E-04	pCi/m3	2.20E-04	2.20E-04	U		Result not detected above the detection limit	
PNL-5	FIL TER	220035	03/23/2022	Gross alpha	3.59E-04	pCi/m3	2.96E-04	2.96E-04	U			
PNL-5	FIL TER	220040	04/06/2022	Gross alpha	6.01E-04	pCi/m3	2.84E-04	2.84E-04				
PNL-5	FIL TER	220045	04/20/2022	Gross alpha	3.22E-04	pCi/m3	2.31E-04	2.31E-04				
PNL-5	FIL TER	220050	05/04/2022	Gross alpha	3.23E-04	pCi/m3	2.24E-04	2.24E-04			Totalizer #24562 expiring 05/26/22 was replaced on 05/18/22 with totalizer #43554, expires 03/24/23.	
PNL-5	FIL TER	220055	05/18/2022	Gross alpha	3.19E-04	pCi/m3	2.53E-04	2.53E-04	U			
PNL-5	FIL TER	220060	06/01/2022	Gross alpha	4.46E-04	pCi/m3	2.18E-04	2.19E-04				
PNL-5	FIL TER	220065	06/15/2022	Gross alpha	2.50E-04	pCi/m3	3.02E-04	3.02E-04	U		Total volume low, pump running but no vacuum. Replaced pump; in order to maintain flow greater than zero, set to 1.7 cfm.	
PNL-5	FIL TER	220103	06/29/2022	Gross alpha	7.26E-05	pCi/m3	1.14E-04	1.14E-04	U		Changed diaphragm controller.	
PNL-5	FIL TER	220108	07/13/2022	Gross alpha	1.77E-04	pCi/m3	1.16E-04	1.16E-04				
PNL-5	FIL TER	220113	07/27/2022	Gross alpha	5.32E-04	pCi/m3	2.35E-04	2.35E-04			Outdoor air quality alert issued	

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-5	FILTER	220118	08/10/2022	08/24/2022	Gross alpha	4.35E-04	pCi/m3	1.79E-04	1.79E-04				
PNL-5	FILTER	220123	08/24/2022	09/07/2022	Gross alpha	3.34E-04	pCi/m3	1.62E-04	1.63E-04				
PNL-5	FILTER	220128	09/07/2022	09/21/2022	Gross alpha	7.78E-04	pCi/m3	2.38E-04	2.39E-04				
PNL-5	FILTER	220133	09/21/2022	10/05/2022	Gross alpha	5.13E-04	pCi/m3	2.07E-04	2.08E-04		Air flow regulator replaced on vacuum pump.		
PNL-5	FILTER	220138	10/05/2022	10/19/2022	Gross alpha	8.58E-04	pCi/m3	2.46E-04	2.48E-04		High total volume, unable to adjust flow to 1.6 cfm. On 10/19/22 replaced pump and totalizer #43554 replaced with #43345.		
PNL-5	FILTER	220143	10/19/2022	11/02/2022	Gross alpha	9.32E-04	pCi/m3	4.01E-04	4.02E-04				
PNL-5	FILTER	220148	11/02/2022	11/16/2022	Gross alpha	9.58E-04	pCi/m3	3.60E-04	3.60E-04				
PNL-5	FILTER	220153	11/16/2022	11/30/2022	Gross alpha	1.27E-03	pCi/m3	4.33E-04	4.35E-04				
PNL-5	FILTER	220158	11/30/2022	12/14/2022	Gross alpha	9.12E-04	pCi/m3	3.95E-04	3.96E-04				
PNL-5	FILTER	220163	12/14/2022	12/28/2022	Gross alpha	1.85E-03	pCi/m3	4.95E-04	4.97E-04				
PNL-5	FILTER	220005	12/29/2021	01/12/2022	Gross beta	2.64E-02	pCi/m3	1.40E-03	1.46E-03				
PNL-5	FILTER	220010	01/12/2022	01/26/2022	Gross beta	2.07E-02	pCi/m3	1.22E-03	1.52E-03				
PNL-5	FILTER	220015	01/26/2022	02/09/2022	Gross beta	2.12E-02	pCi/m3	1.24E-03	1.31E-03				
PNL-5	FILTER	220020	02/09/2022	02/23/2022	Gross beta	1.43E-02	pCi/m3	9.75E-04	9.92E-04				
PNL-5	FILTER	220025	02/23/2022	03/09/2022	Gross beta	1.79E-02	pCi/m3	1.13E-03	1.15E-03				
PNL-5	FILTER	220030	03/09/2022	03/23/2022	Gross beta	1.35E-02	pCi/m3	9.97E-04	1.21E-03				
PNL-5	FILTER	220035	03/23/2022	04/06/2022	Gross beta	8.69E-03	pCi/m3	7.75E-04	7.98E-04				
PNL-5	FILTER	220040	04/06/2022	04/20/2022	Gross beta	8.91E-03	pCi/m3	8.12E-04	8.82E-04				
PNL-5	FILTER	220045	04/20/2022	05/04/2022	Gross beta	7.01E-03	pCi/m3	7.16E-04	7.28E-04				
PNL-5	FILTER	220050	05/04/2022	05/18/2022	Gross beta	8.32E-03	pCi/m3	7.57E-04	7.63E-04		Totalizer #24562 expiring 05/26/22 was replaced on 05/18/22 with totalizer #43554, expires 03/24/23.		
PNL-5	FILTER	220055	05/18/2022	06/01/2022	Gross beta	1.03E-02	pCi/m3	8.43E-04	9.33E-04			Method Blank Contamination RPI:1127700262	
PNL-5	FILTER	220060	06/01/2022	06/15/2022	Gross beta	8.64E-03	pCi/m3	7.35E-04	7.60E-04	O			
PNL-5	FILTER	220065	06/15/2022	06/29/2022	Gross beta	9.06E-03	pCi/m3	9.65E-04	9.75E-04		Total volume low, pump running but no vacuum. Replaced pump; in order to maintain flow greater than zero, set to 1.7 cfm.		
PNL-5	FILTER	220103	06/29/2022	07/13/2022	Gross beta	6.75E-03	pCi/m3	5.09E-04	5.81E-04	O	Changed diaphragm controller.	Method Blank Contamination RPI:1132796454	
PNL-5	FILTER	220108	07/13/2022	07/27/2022	Gross beta	5.62E-03	pCi/m3	4.18E-04	4.79E-04				
PNL-5	FILTER	220113	07/27/2022	08/10/2022	Gross beta	1.14E-02	pCi/m3	7.33E-04	7.52E-04		Outdoor air quality alert issued		
PNL-5	FILTER	220118	08/10/2022	08/24/2022	Gross beta	9.02E-03	pCi/m3	5.91E-04	6.74E-04	O		Method Blank Contamination RPI:1144522674	
PNL-5	FILTER	220123	08/24/2022	09/07/2022	Gross beta	1.03E-02	pCi/m3	6.51E-04	7.28E-04				
PNL-5	FILTER	220128	09/07/2022	09/21/2022	Gross beta	9.50E-03	pCi/m3	6.08E-04	6.20E-04				
PNL-5	FILTER	220133	09/21/2022	10/05/2022	Gross beta	1.67E-02	pCi/m3	8.02E-04	8.14E-04		Air flow regulator replaced on vacuum pump.		

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-5	FILTER	220138	10/05/2022	10/19/2022	Gross beta	2.44E-02	pCi/m3	9.81E-04	1.32E-03	O	High total volume, unable to adjust flow to 1.6 cfm. On 10/19/22 replaced pump and totalizer #43554 replaced with #43345.	Method Blank Contamination RPI:1153293035	
PNL-5	FILTER	220143	10/19/2022	11/02/2022	Gross beta	1.57E-02	pCi/m3	1.05E-03	1.07E-03	O		Method Blank Contamination RPI:1157265995	
PNL-5	FILTER	220148	11/02/2022	11/16/2022	Gross beta	2.65E-02	pCi/m3	1.34E-03	1.38E-03				
PNL-5	FILTER	220153	11/16/2022	11/30/2022	Gross beta	4.86E-02	pCi/m3	1.80E-03	1.91E-03				
PNL-5	FILTER	220158	11/30/2022	12/14/2022	Gross beta	2.64E-02	pCi/m3	1.35E-03	1.58E-03				
PNL-5	FILTER	220163	12/14/2022	12/28/2022	Gross beta	3.66E-02	pCi/m3	1.52E-03	1.60E-03	O		Method Blank Contamination RPI:1168678855	
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Antimony-125	-1.02E-05	pCi/m3	1.80E-04	1.80E-04	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Antimony-125	-2.22E-06	pCi/m3	1.27E-04	1.27E-04	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Beryllium-7	2.81E-02	pCi/m3	2.53E-03	3.67E-03				Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Beryllium-7	2.46E-02	pCi/m3	2.28E-03	3.31E-03				Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Cesium-134	3.70E-05	pCi/m3	7.12E-05	7.33E-05	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Cesium-134	-1.86E-05	pCi/m3	5.18E-05	5.25E-05	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Cesium-137	2.73E-05	pCi/m3	6.19E-05	6.32E-05	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Cesium-137	5.43E-06	pCi/m3	5.31E-05	5.32E-05	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Cobalt-60	-5.27E-05	pCi/m3	7.27E-05	7.67E-05	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Cobalt-60	1.40E-05	pCi/m3	6.47E-05	6.50E-05	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Europium-152	-1.01E-04	pCi/m3	1.43E-04	1.51E-04	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Europium-152	1.26E-04	pCi/m3	1.34E-04	1.46E-04	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Europium-154	8.61E-06	pCi/m3	1.83E-04	1.83E-04	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Europium-154	1.20E-04	pCi/m3	1.72E-04	1.81E-04	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Europium-155	-7.34E-06	pCi/m3	1.38E-04	1.38E-04	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Europium-155	5.51E-05	pCi/m3	1.10E-04	1.13E-04	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Potassium-40	4.37E-03	pCi/m3	1.95E-03	2.01E-03				Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Potassium-40	3.64E-03	pCi/m3	1.53E-03	1.57E-03				Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Ruthenium-106	-5.26E-06	pCi/m3	5.41E-04	5.41E-04	U			Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Ruthenium-106	-1.15E-05	pCi/m3	4.70E-04	4.70E-04	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Gross alpha (COMP)	9.07E-03	pCi/m3	1.56E-03	1.60E-03	X		Analytical holding time exceeded.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Gross alpha (COMP)	1.17E-02	pCi/m3	1.45E-03	1.46E-03				Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Gross beta (COMP)	1.35E-02	pCi/m3	9.11E-04	1.09E-03	X		Analytical holding time exceeded.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Gross beta (COMP)	1.75E-02	pCi/m3	8.19E-04	8.50E-04				Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Americium-241	-2.98E-06	pCi/m3	9.24E-06	9.24E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Americium-241	1.47E-06	pCi/m3	2.55E-06	2.55E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Americium-243	1.38E-06	pCi/m3	8.98E-06	8.99E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y

Table C.2 (contd)

Location ID	Sample Matrix	Field Sample ID	Start Date	Sample Date	Parameter Name	Result	Units	Counting Error	Total Error	Lab Qualifier	Sample Comments	Result Comments	Composite
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Americium-243	2.82E-06	pCi/m3	3.19E-06	3.20E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Curium-243/244	1.50E-06	pCi/m3	5.09E-06	5.09E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Curium-243/244	4.90E-07	pCi/m3	2.15E-06	2.15E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Plutonium-238	3.15E-06	pCi/m3	5.25E-06	5.26E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Plutonium-238	2.59E-06	pCi/m3	4.48E-06	4.49E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Plutonium-239/240	6.21E-07	pCi/m3	3.90E-06	3.90E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Plutonium-239/240	1.29E-06	pCi/m3	3.69E-06	3.69E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Uranium-233/234	3.15E-05	pCi/m3	2.06E-05	2.11E-05	X		Analytical holding time exceeded.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Uranium-233/234	2.88E-05	pCi/m3	1.08E-05	1.12E-05	O			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Uranium-235	-7.96E-07	pCi/m3	6.87E-06	6.88E-06	UX		Analytical holding time exceeded. Result not detected above the detection limit.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Uranium-235	2.19E-06	pCi/m3	4.71E-06	4.71E-06	U			Y
PNL-5	FILTER	220098	12/29/2021	06/29/2022	Uranium-238	3.50E-05	pCi/m3	2.06E-05	2.11E-05	X		Analytical holding time exceeded.	Y
PNL-5	FILTER	220170	06/29/2022	12/28/2022	Uranium-238	2.67E-05	pCi/m3	9.99E-06	1.04E-05				Y

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