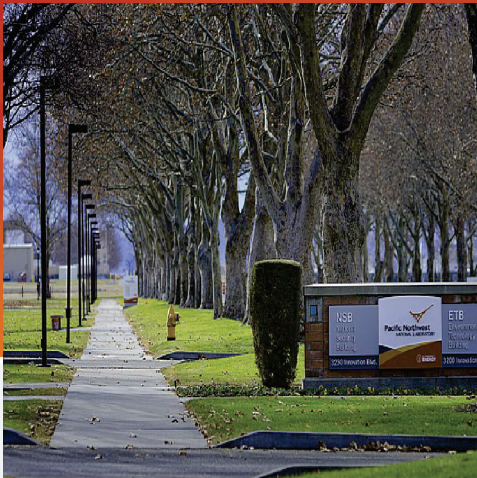




PNNL Richland Campus Radionuclide Air Emissions Report for Calendar Year 2020

June 2021

SF Snyder
JM Barnett
LE Bisping



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 (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 2020 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 PNNL Richland Campus MEI dose from routine major and minor point source emissions in 2020 is $1.5\text{E-}05$ mrem ($1.5\text{E-}07$ millisievert [mSv]) EDE. The MEI dose from all PNNL Richland Campus fugitive sources is $2.0\text{E-}06$ mrem ($2.0\text{E-}08$ mSv) EDE. The dose from radon emissions is $9.3\text{E-}09$ mrem ($9.3\text{E-}11$ mSv) EDE. No nonroutine emissions from Campus facilities occurred in 2020. The total radiological dose to the MEI from all PNNL Richland Campus radionuclide emissions in 2020, including fugitive emissions and radon, is $1.7\text{E-}05$ mrem ($1.7\text{E-}07$ 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.

Additionally, updated information is provided for one 3420 Building emission unit due to an error identified in last year’s reporting. The correction did not impact the reported 2019 MEI dose from all site emissions sources, remaining at $1.5\text{E-}05$ mrem ($1.5\text{E-}07$ mSv).

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

CERTIFICATION of PNNL-20436-11
DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2020

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)]

Roger E. Snyder

 Digitally signed by Roger E. Snyder
Date: 2021.06.23 11:43:57 -07'00'

Roger E. Snyder, 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
ED	effective dose
EDE	effective dose equivalent
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
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
SC	DOE Office of Science
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) 2020 radionuclide air emissions from the U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory (PNNL) 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 CY2020 operations.

Richland Campus on-site activities were reduced in March 2020 due to the COVID-19 pandemic. This pandemic response resulted in emissions from sampled stacks that were of slightly reduced activity and dose compared to the prior year. In contrast, the emissions from minor and fugitive sources (unsampled emissions sources) had a slight increase in activity emissions and resulting dose contribution compared to the prior year. This resulted in a change in the MEI location for CY2020 reporting, as discussed in Section 3.1.

This report is available online at <https://science.energy.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.

Additionally, due to an error identified in last year’s reporting, updated information for the 3420-01-S stack is provided in Section 6.0. The correction did not impact the reported 2019 MEI dose from all site emissions sources, remaining at $1.5\text{E-}05$ mrem ($1.5\text{E-}07$ mSv). This information was previously communicated to the Washington State Department of Health (WDOH) and is formally reported herein.

1.1 PNNL Richland Campus Description

The PNNL Richland Campus (PNSO 2013) is located in southeastern Washington State and encompasses the DOE PNNL Site (Figure 1.1; orange boundary and yellow boundary, respectively). It is adjacent to the much larger DOE Hanford Site (Figure 1.2). The Richland Campus occupies 1.2 mi^2 (3.0 km^2) just south of the Hanford Site 300 Area, whereas the Hanford Site occupies about 580 mi^2 ($1,500\text{ km}^2$). The PNNL Site occupies an area of 0.86 mi^2 (2.2 km^2), an increase of about 20% over last year due to Campus land transfers between Battelle and DOE.

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. The prior year report indicated both the formal PNNL Site boundary and the additional PNNL Richland Campus boundary. Because all CY2020 permitted emission units are within both boundaries, only the PNNL Richland Campus boundary is identified in Figure 1.1.



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

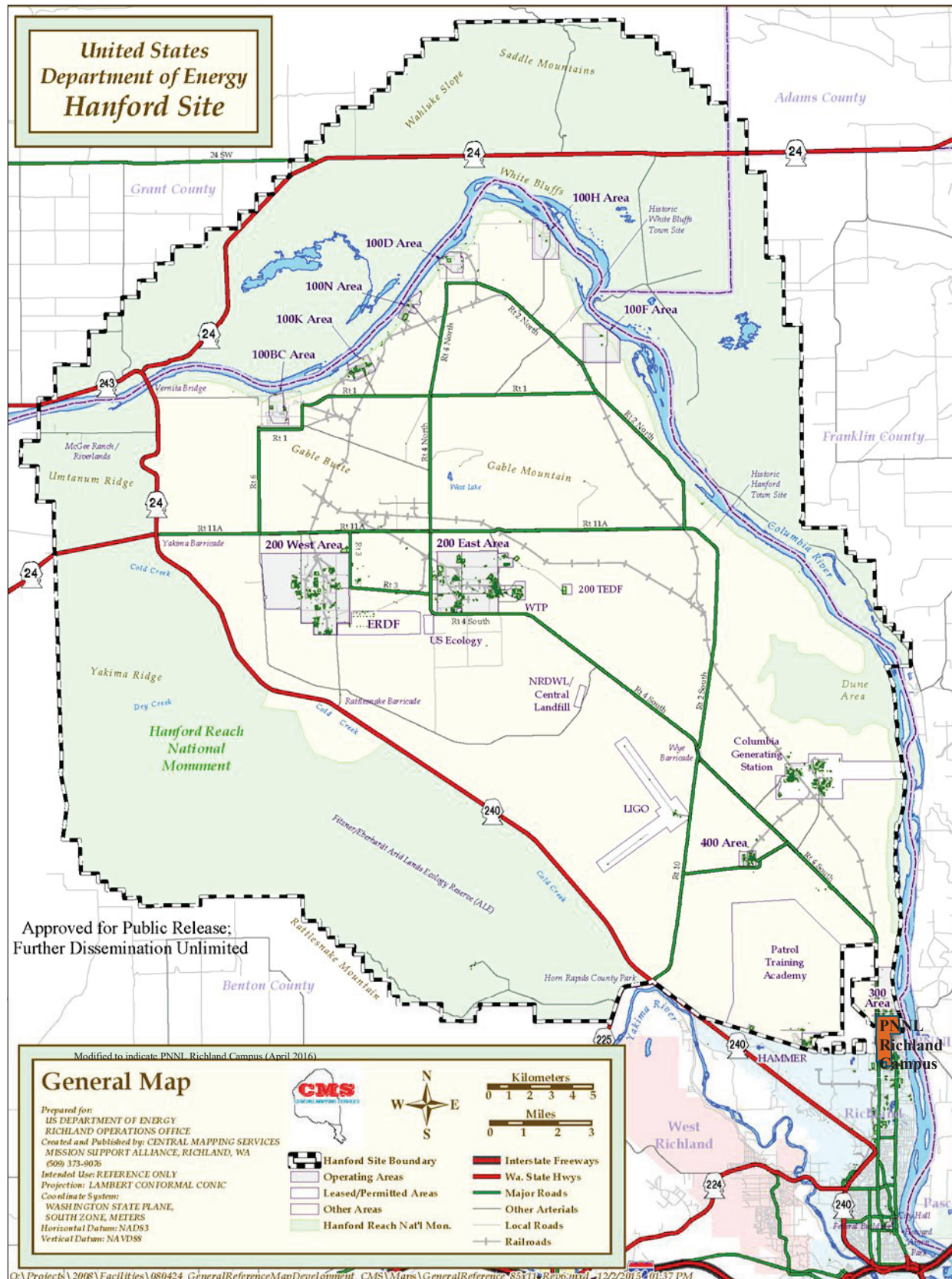


Figure 1.2. Location of the Hanford Site in Relation to the PNNL Richland Campus

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.

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 that could affect the Campus. 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.

Table 1.1. PNNL Richland Campus Licensed Buildings – 2020

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

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

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.

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.

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 – 2020

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; this is the same emission unit identified as Low-level Sources (LLS) in prior reporting (Snyder et al. 2020).



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 (Dyckman et al. 2021).

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 2020:

- 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 (2019)
- Was described in the WDOH-issued RAEL-005 and remained a registered emission unit during 2020. RAEL-005 was subject to renewal in 2020.

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 stack configuration of EP-3420-01-S was changed later in 2020 to increase flow rates. The effective discharge height indicated in Table 1.4 is that prior to reconfiguration, which would conservatively result in less dispersion if used in emissions modeling. The effective discharge height used in modeling was 102 ft (31.2 m) applied to all PSF major stack emissions, as a conservative assumption. Neither the J-Facilities Restoration nor J-SOIC PIC-5 sources were implemented in 2020.

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	20,825 ft ³ /min (9.83 m ³ /s)	1.09E+10 ft ³ (3.10E+08 m ³)	69.5° F (20.8° C)	44 ft (13.5 m)	3.3 ft (1.0 m)	102 ft (31.2 m)	Single-stage HEPA filter
Major EP-3420-01-S	52,461 ft ³ /min (24.8 m ³ /s)	2.76E+10 ft ³ (7.81E+08 m ³)	64.5° F (18.1° C)	51 ft (15.5 m)	4.3 ft (1.3 m)	141 ft (43.1 m)	Single-stage HEPA filter
Major EP-3430-01-S	34,794 ft ³ /min (16.4 m ³ /s)	1.83E+10 ft ³ (5.18E+08 m ³)	59.8° F (15.4° C)	44 ft (13.5 m)	3.7 ft (1.1 m)	109 ft (33.1 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 2020.
- Minor point and fugitive source emissions are shown in two tables
 - Table 2.2 shows the emissions that resulted in 99.9% of the dose impact from minor and fugitive emission units, whereas
 - Table 2.3 shows the remaining 0.1%.

Table 2.4 summarizes the nuclide emissions from major sources and from minor, and fugitive sources that result in more than 99.9% of the total dose impact to the MEI. Appendix B lists the radioactive materials handled or potentially handled at the PNNL Richland Campus in 2020.

Table 2.1. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2020

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total (Ci)
gross $\alpha^{(a)}$	2.04E-08	6.35E-08	3.33E-08	1.2E-07
gross $\beta^{(a)}$	2.02E-07	6.61E-07	1.88E-07	1.1E-06
H-3 ^(b)	1.20E-04	NA	NA	1.2E-04
Al-26	NA	3.52E-08	NA	3.5E-08
Ar-37 ^(b)	NA	NA	5.00E-09	5.0E-09
Ar-39 ^(b)	NA	NA	1.00E-13	1.0E-13
Co-60	6.65E-09	8.21E-10	ND	7.5E-09
Sr-90	9.62E-08	NA	NA	9.6E-08
I-125	1.03E-08	NA	NA	1.0E-08
Xe-127 ^(b)	NA	1.50E-07	NA	1.5E-07
Xe-131m ^(b)	NA	1.00E-06	NA	1.0E-06
Xe-133 ^(b)	NA	1.00E-06	NA	1.0E-06
Cs-137	1.60E-09	5.14E-09	1.12E-08	1.8E-08
U-233/234	3.78E-10	NA	3.36E-10	7.1E-10
Pu-238	ND	8.82E-09 ^(c)	4.33E-10 ^(c)	9.3E-09 ^(c)
Pu-239/240	7.07E-10	1.36E-08 ^(c)	1.08E-09	1.5E-08
Am-241 ^(c)	3.56E-10	2.60E-09	8.64E-10	3.8E-09
Am-243 ^(c)	1.22E-10	3.33E-10	2.27E-11	4.8E-10
Cm-243/244	ND	1.63E-10	9.05E-10 ^(c)	1.1E-09 ^(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 99.9% of the Offsite Dose from Minor Emissions Units and Fugitive Sources – 2020^(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
Mn-54	6.40E-09	NA	6.40E-09	1.3E-08
Co-60	5.83E-10	1.30E-10	1.06E-10	8.2E-10
Zn-65	7.10E-09	NA	7.10E-09	1.4E-08
Rb-83	1.40E-06	NA	NA	1.4E-06
Sr-85	2.30E-08	1.14E-10	4.46E-09	2.8E-08
Y-88	8.13E-09	1.91E-10	7.30E-09	1.6E-08
Cd-109	1.88E-08	3.99E-10	1.87E-08	3.8E-08
Xe-127 ^(a)	5.00E-09	NA	NA	5.0E-09
Xe-131m ^(c)	NA	NA	NA	NA
Xe-133 ^(c)	6.00E-05	NA	1.82E-10	6.0E-05
Cs-137	3.47E-09	9.63E-11	3.16E-09	6.7E-09
Pb-210	2.32E-08	1.38E-11	1.97E-08	4.3E-08
Po-210	3.22E-09	NA	NA	3.2E-09
Rn-222 ^(a,d)	5.01E-06	NA	NA	5.0E-06
Ra-226	7.48E-09	1.19E-09	NA	8.7E-09
U-232	1.29E-10	NA	NA	1.3E-10
U-233	4.94E-07	NA	1.93E-08	5.1E-07
U-234	4.45E-11	2.25E-11	4.46E-11	1.1E-10
Pu-238 ^(c)	NA	2.85E-17	NA	2.8E-17
Pu-239/240	NA	8.64E-16	NA	8.6E-16
Am-241 ^(c)	2.25E-09	6.70E-11	2.14E-09	4.5E-09
Am-243 ^(c)	NA	2.56E-15	NA	2.6E-15
Cm-244 ^(b,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 (Barnett et al. 2018; Snyder and Barnett 2016) and 40 CFR 61, Appendix D (1989). Values for gases are based on release records.
- (b) Listed nuclides account for 99.9% of dose impact from release record and Appendix D calculated minor and fugitive sources in 2020. In addition, nuclides sampled at major emission units that are also emitted from listed stacks are included (see footnote c).
- (c) Included for completeness because it is a major emission unit sampled nuclide (Pu-238, Pu-240, Am-241, Am-243, and Cm-244) or major emission unit gas emission. 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 (0.1% of Offsite Dose Contributors) PNNL Richland Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2020

Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)	Nuclide	Release ^(a) (Ci)
Ag-109m	1.9E-14	Cu-67	7.6E-17	Np-237	2.0E-18	Sn-113	7.6E-09
Ag-112	2.2E-14	Eu-152	2.7E-14	Os-191	1.1E-15	Sn-121	1.3E-14
Am-240	1.1E-11	Fe-55	2.1E-13	P-32	4.3E-13	Sr-82	9.2E-10
Am-242	4.4E-19	Fe-59	1.0E-12	Pb-214	7.5E-09	Sr-89	1.6E-16
Ar-37 ^(a)	5.2E-09 ^(b)	Hg-203	3.0E-10	Pd-109	1.9E-14	Sr-91	1.7E-09
Ar-39 ^(a)	1.0E-13 ^(b)	I-131	1.6E-10	Pm-149	1.9E-10	Tb-161	8.1E-13
Ba-133	9.9E-13	I-132	7.4E-10	Pm-151	1.0E-11	Tc-99	8.6E-13
Ba-140	3.0E-10	I-133	2.3E-09	Po-214	7.5E-09	Tc-99m	9.6E-10
Be-10	4.9E-22	I-135	1.1E-09	Po-218	7.5E-09	Te-123m	2.2E-09
Bi-210	3.3E-09	Ir-192	1.2E-13	Pr-143	8.4E-12	Te-129	1.1E-14
Bi-214	7.5E-09	Ir-194	3.8E-15	Pu-241	1.5E-15	Te-131m	7.4E-11
Br-82	1.3E-08	K-40	7.9E-19	Pu-242	9.7E-19	Te-132	7.1E-10
C-14	3.1E-10	K-42	8.2E-09	Pu-244	3.3E-19	U-235	3.0E-12
Ca-47	2.7E-13	Kr-83m	1.0E-06	Rb-82	9.2E-10	U-236	2.9E-13
Ce-139	1.1E-10	Kr-85	4.1E-15	Rb-84	2.3E-09	U-238	5.1E-13
Ce-141	8.8E-12	La-140	8.2E-12	Rb-86	1.8E-11	Xe-127	1.6E-07 ^(b)
Ce-143	1.7E-09	La-141	3.7E-10	Rb-88	7.0E-36	Xe-131m	1.0E-06 ^(b)
Cl-36	8.7E-14	Mn-56	1.8E-11	Re-188	2.2E-15	Xe-135	3.1E-09
Cm-248	3.7E-13	Mo-99	1.1E-09	Rh-105	2.4E-10	Xe-135m	1.7E-10
Co-57	1.7E-09	Na-24	4.0E-08	Ru-105	1.5E-14	Y-91m	1.1E-09
Co-58	5.0E-14	Nb-97	2.2E-09	S-35	1.2E-09	Y-92	7.8E-10
Cr-51	5.2E-10	Nb-97m	1.9E-09	Sb-127	1.1E-14	Y-93	2.0E-09
Cs-134	2.7E-14	Nd-147	9.8E-12	Sm-147	6.8E-14	Zr-95	1.2E-15
Cu-64	7.0E-14	Np-236	7.0E-17	Sm-153	7.9E-13	Zr-97	2.0E-09
						Total (Ci)	2.3E-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 (Barnett et al. 2018; Snyder and Barnett 2016) and 40 CFR 61, Appendix D (1989).

(b) Total also includes the major emission unit releases for these gases; used for dose contribution determinations.

Table 2.4. PNNL Richland Campus Radionuclide Emissions (Ci) in 2020

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units^(a)	Total (Ci)
gross α	1.2E-07 ^(b)	NA	1.2E-07
gross β	1.1E-06 ^(b)	NA	1.1E-06
H-3	1.2E-04 ^(c)	7.2E-13 ^(c)	1.2E-04
Al-26	3.5E-08	NA	3.5E-08
Mn-54	NA	1.3E-08	1.3E-08
Co-60	7.5E-09	8.2E-10	8.3E-10
Zn-65	NA	1.4E-08	1.4E-08
Rb-83	NA	1.4E-06	1.4E-06
Sr-85	NA	2.8E-08	2.8E-08
Sr-90	9.6E-08	NA	9.6E-08
Y-88	NA	1.6E-08	1.6E-08
Cd-109	NA	3.8E-08	3.8E-08
I-125	1.0E-08	NA	1.0E-08
Xe-133	1.0E-06 ^(c)	6.0E-05 ^(c)	6.1E-05
Cs-137	1.8E-08	6.7E-09	2.5E-08
Pb-210	NA	4.3E-08	4.3E-08
Po-210	NA	3.2E-09	3.2E-09
Rn-222	NA	5.0E-06 ^(c)	5.0E-06
Ra-226	NA	8.7E-09	8.7E-09
U-232	NA	1.3E-10	1.3E-10
U-233/234	7.1E-10	5.1E-07	5.1E-07
Pu-238	9.3E-09	2.8E-17	9.3E-09
Pu-239/240	1.5E-08	8.6E-16	1.5E-08
Am-241	3.8E-09	4.5E-09	8.3E-09
Am-243	4.8E-10	2.6E-15	4.8E-10
Cm-243/244	1.1E-09	3.7E-13	1.1E-09
TOTAL (Ci)	1.2E-04	6.7E-05	1.9E-04

NA = not applicable.

To convert Ci to GBq, multiply Ci by 37.

- (a) Nuclides that contribute 99.9% of the minor and fugitive dose to the MEI. See Table 2.3 for the nuclides that contribute the remaining 0.1% 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 (2019).

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 2020 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) CY2020 meteorological data (Appendix A) to determine the 2020 MEI receptor location from Campus emissions. The receptor is presumed to produce their own food supply at the MEI location.

The CY2020 MEI location was determined to be a restaurant at 3280 George Washington Way. Due to coronavirus measures, the majority of employees working at both PNNL and other north Richland businesses was severely reduced in March 2020. This impacted business at the restaurant to such an extent that it closed its doors from the end of March through the end of the calendar year. As a conservative assumption, this reduced occupancy was not accounted for in the reported MEI doses. In contrast to most years, the CY2020 MEI dose was predominantly from minor and fugitive source emissions, rather than resulting from the major stack emissions. The reduced emissions from the major stacks might also be considered a consequence of coronavirus restrictions of onsite work.

Table 3.1. Receptor Locations for the PNNL Richland Campus

Locale	Distance Relative to PSF km (mi)
2020 PNNL Richland Campus MEI	
Business, 3280 George Washington Way	0.55 (0.34) SSE
Offsite nearest residence, business, school	
Residence ^(a)	0.97 (0.60) SE
School or preschool	1.6 (1.0) S
Business ^(a)	0.55 (0.34) SSE
Farm with potential for crops or livestock	
Nearest to PSF (east of Columbia River)	1.51 (0.93) E
Offsite maximum annual air concentrations	
From major emission units ^(b) –	
Business, 3190 George Washington Way	0.725 (0.45) SSE
From minor and fugitive emission units ^(c) –	
Business, 3280 George Washington Way	0.55 (0.34) SSE
Richland Campus Historical MEI Doses and Locations^(d)	
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 / 2.9E-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
CY2010 / 8E-06 mrem	0.48 (0.30) SSE

(a) Residence and business may vary for each reference location. Locations with PNNL access control are considered part of the PNNL Richland Campus.

(b) This location is 2.47 km south of the Hanford Site 300 Area.

(c) This location is 2.31 km south of the Hanford Site 300 Area.

(d) 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 2020 meteorology and applicable stack characteristics given in Section 1.2.1. The greatest dose impact from facility emissions is calculated for 3280 George Washington Way, SSE of the 3410 Building, where a restaurant is located; as a result, this is the 2020 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 2020 MEI location.



Figure 3.1. Locations of PNNL Richland Campus Potential Receptors

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), and represent the average of hourly data recorded in 2020. Appendix A tables indicate meteorological data for 2020 as joint frequency of wind speed, wind direction, and stability category for the Hanford Site 300 Area station. 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.

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 2020 Doses

	40 CFR 61, Subpart H Campus MEI (3280 GW Way)	WAC 246-247 Campus MEI (3280 GW Way)	Offsite Maximum Air^(b) for Campus Emissions (PNL-1 station)
PNNL Richland Campus MEI Location			
Location relative to PSF	0.55 km (0.34 mi) SSE	0.55 km (0.34 mi) SSE	0.72 km (0.45 mi) NW
Radon Emissions			
Rn-220	NA	0 Ci	0 Ci
Rn-222			
3420-02-S	NA	5.0E-06 Ci	5.0E-06 Ci
Receptor Dose			
Dose excluding radon emissions ^(a)	1.7E-05 mrem	1.7E-05 mrem	2.1E-05 mrem
Radon	<u>NA</u>	<u>1.3E-08 mrem</u>	<u>5.6E-08 mrem</u>
Total	1.7E-05 mrem	1.7E-05 mrem	2.1E-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 CY2020, the PNNL Richland Campus MEI location was 0.55 km

(0.34 mi) SSE of the PSF (3410 Building). The PNNL Richland Campus MEI dose is 1.7E-05 mrem (1.7E-07 mSv) (see Table 3.2, 40 CFR 61, Subpart H).

Table 3.3 indicates nuclide-specific doses to the CY2020 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 6% of the CY2020 PNNL Richland Campus MEI dose estimate.

Table 3.3. PNNL Richland Campus 2020 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
H-3	1.2E-04	1.1E-08	<1%
Al-26	3.5E-08	3.7E-07	2%
Mn-54	1.3E-08	8.0E-09	<1%
Co-60	8.3E-09	2.0E-08	<1%
Zn-65	1.4E-08	2.3E-08	<1%
Rb-83	1.4E-06	3.6E-07	2%
Sr-85	2.8E-08	2.6E-09	<1%
Sr-90	9.6E-08	1.9E-07	1%
Y-88	1.6E-08	1.1E-08	<1%
Cd-109	3.8E-08	4.4E-09	<1%
I-125	1.0E-08	3.1E-08	<1%
Xe-133	6.1E-05	1.8E-09	<1%
Cs-137 ^(b)	1.1E-06	2.8E-06	17%
Pb-210	4.3E-08	8.7E-07	5%
Po-210	3.2E-09	5.1E-08	<1%
Rn-222	5.0E-06	1.3E-08	<1%
Ra-226 ^(c)	8.7E-09	6.2E-07	4%
U-232	1.3E-10	7.5E-09	<1%
U-233/234	5.1E-07	5.7E-06	34%
Pu-238	9.3E-09	2.2E-07	1%
Pu-239/240 ^(d)	1.3E-07	3.5E-06	21%
Am-241	8.3E-09	7.6E-07	5%
Am-243	4.8E-10	1.1E-08	<1%
Cm-243/244	1.1E-09	1.8E-08	<1%
Table 2.3 nuclides	2.3E-06	8.5E-09	<1%
PIC-5 emissions – VRRM	NA	9.4E-07 ^(e)	6%
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)	1.9E-04 Ci	1.7E-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 based on 40 CFR 61, Appendix D (1989), release records, or measurements. See Table 2.1 and Table 2.2.

(b) Gross beta from PSF emission unit sampling assumed to be Cs-137. Also, calculated Cs-137 release based on 40 CFR 61, Appendix D (1989) methods.

(c) Dose includes progeny isotope Rn-222.

(d) Gross alpha from PSF emission unit sampling assumed to be Pu-239. Also includes Pu-239 and Pu-240 based on 40 CFR 61, Appendix D (1989) methods.

(e) The PIC-5 emission doses are assigned based on permit value. The SOIC and Facilities Restoration emission sources were not implemented in 2020. 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 SOIC and Facilities Restoration were not applicable for 2020 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	3420-02-S	Estimated	7.4E-06	44%
PSF/3420 Building	3420-01-S	Sampled, Estimated	4.3E-06	26%
PSF/3430 Building	3430-01-S	Sampled, Estimated	1.4E-06	9%
PSF/3410 Building	3410-01-S	Sampled, Estimated	1.3E-06	8%
PSF/3425 Building	J-3425	Estimated	1.0E-06	6%
Campus	VRRM	PIC-5	9.4E-07 ^(b)	6%
PSF/3430 Building	3430-02-S	Estimated	9.9E-08	0.6%
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.

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

For comparison, the Subpart H PNNL Richland Campus 2020 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 2020 MEI dose (40 CFR 61, Subpart H)	0.000017	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 1.5E-05 mrem/yr (1.5E-07 mSv/yr).

3.4.2 Washington Administrative Code

For PNNL Richland Campus radionuclide air emissions, Washington State in WAC 246-247-040(1) (2019) 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 2020, the WAC-246-247 dose is the $1.7\text{E-}05$ mrem/yr ($1.7\text{E-}07$ 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 CY2020, the maximum modeled air concentration is at the PNL-1 ambient sampling station, on the western PNNL Richland Campus boundary; this WAC 173-480 dose is $2.1\text{E-}05$ mrem/yr ($2.1\text{E-}07$ 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 CY2020 were reviewed. Both the PNNL Richland Campus and the Hanford Site (Dyckman et al. 2021) are in compliance with the 10 mrem/yr regulatory standard for CY2020 radiological emissions.

The CY2020 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 2020. The dose to the PNNL Richland Campus MEI from the Hanford Site 300 Area emissions, excluding Rn-220 and Rn-222 (see Dyckman et al. 2021), is indicated in Table 3.5. Essentially all of the dose from Hanford Site 300 Area emissions to the PNNL Richland Campus MEI is attributable to H-3 releases. The table also indicates the dose to the 2020 Hanford Site MEI for emissions from the Hanford Site 300 Area sources.

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

Receptor	Dose from 2020 PNNL Richland Campus Emissions	Dose from 2020 Hanford Site 300 Area Emissions
Hanford Site 2020 MEI	NA ^(a)	$3.5\text{E-}02$ mrem
PNNL Richland Campus 2020 MEI	$1.7\text{E-}05$ mrem	$2.2\text{E-}02$ 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 2020.

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 Construction Projects and Modifications Exempted from 40 CFR 61.96

No exemptions to the approval process under 40 CFR 61.96 were requested or granted in 2020.

3.6.3 Radon-220 and Radon-222 Emissions

Radon-220 was not emitted from PNNL Richland Campus operations in 2020. 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 [2019]). Some fugitive sources can be classified as diffuse (i.e., area) sources (DOE 2015). The PNNL Richland Campus has no diffuse sources.

PNNL facility-specific fugitive sources include only J-3425 in 2020. 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 2020 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 2.0E-06 mrem/yr (2.0E-08 mSv/yr) (12%) of the total 1.7E-05 mrem/yr (1.7E-07 mSv/yr) MEI dose for 2020.

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 2020 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. 2021).

5.0 Supplemental Information

This section provides the following supplemental information related to PNNL Richland Campus radionuclide air emissions in 2020:

- 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 2020 was calculated using CAP88-PC Version 4.0. The population consists of approximately 432,700 residents within a 50-mi (80-km) radius of the Hanford Site 300 Area (Hamilton and Snyder 2011), with one adjustment to add 640 residents in the 1-2 mi S sector to account for the two phases of apartment units just south of the Campus. The proximity of the Hanford Site 300 Area and relatively rural region within 50 mi of the Campus permits the Hanford Site 300 Area 50-mi population estimate to be applicable. Pathways evaluated for population exposure include inhalation, air submersion, ground-shine, and food consumption.

The 2020 total collective dose from radionuclide air emissions estimated from nuclides that originated from the PNNL Richland Campus was $9.0\text{E-}05$ person-rem ($9.0\text{E-}07$ person-Sv). CAP88-PC Version 4.0 calculates the collective dose by considering site-specific meteorology and population distributions and subsequently summing the individual sector doses. This represents a slight increase from the 2019 estimate of $8.4\text{E-}05$ person-rem ($8.4\text{E-}07$ person-Sv) (Snyder et al. 2020).

5.2 Compliance Status with 40 CFR, Subparts Q and T

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

Activities at the 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 CY2020 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.

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 2020 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 2020, 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 2019). During 2020, 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 for specific radionuclide analysis. The composite analyses reported for 2020 include gamma-emitting isotopes Co-60 and Cs-137, U-233/234,³ Pu-238 and Pu-239/240, Am-241, Am-243, and Cm-243/244. Also, the Hanford Site has several nearby community sampling locations within a 30-mi (48-km) radius of the Campus as well as a background location in Yakima (MSA 2020).

Off-site events affected the ambient sampling program in 2020. Numerous wildfires in the Pacific Northwest caused continuous smoky days in September 2020. 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. On two occasions in September, two of the five particulate air sampling stations required a weekly instead of biweekly filter change-out to maintain sampler air flow. On one of these occasions, two air filters that operated for one-week collected insufficient volume for gross alpha, gross beta analyses. In addition, PNL-5 had a scheduled maintenance outage early in the sample year; therefore, reducing the planned sampling events from 26 to 25. There was no impact to the annual composite results or station operational frequency for CY2020, because of these events.

³ U-234 is a naturally occurring radionuclide. It is co-reported with U-233 by the analytical laboratory because the emission peaks overlap.

The particulate ambient air sampling results are provided in Appendix C for the CY2020 PNNL Richland Campus sampling. Air sampling results are summarized in Table 5.1. The gross alpha and gross beta results were comparable to background levels. All nuclide-specific results shown in Table 5.1 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.

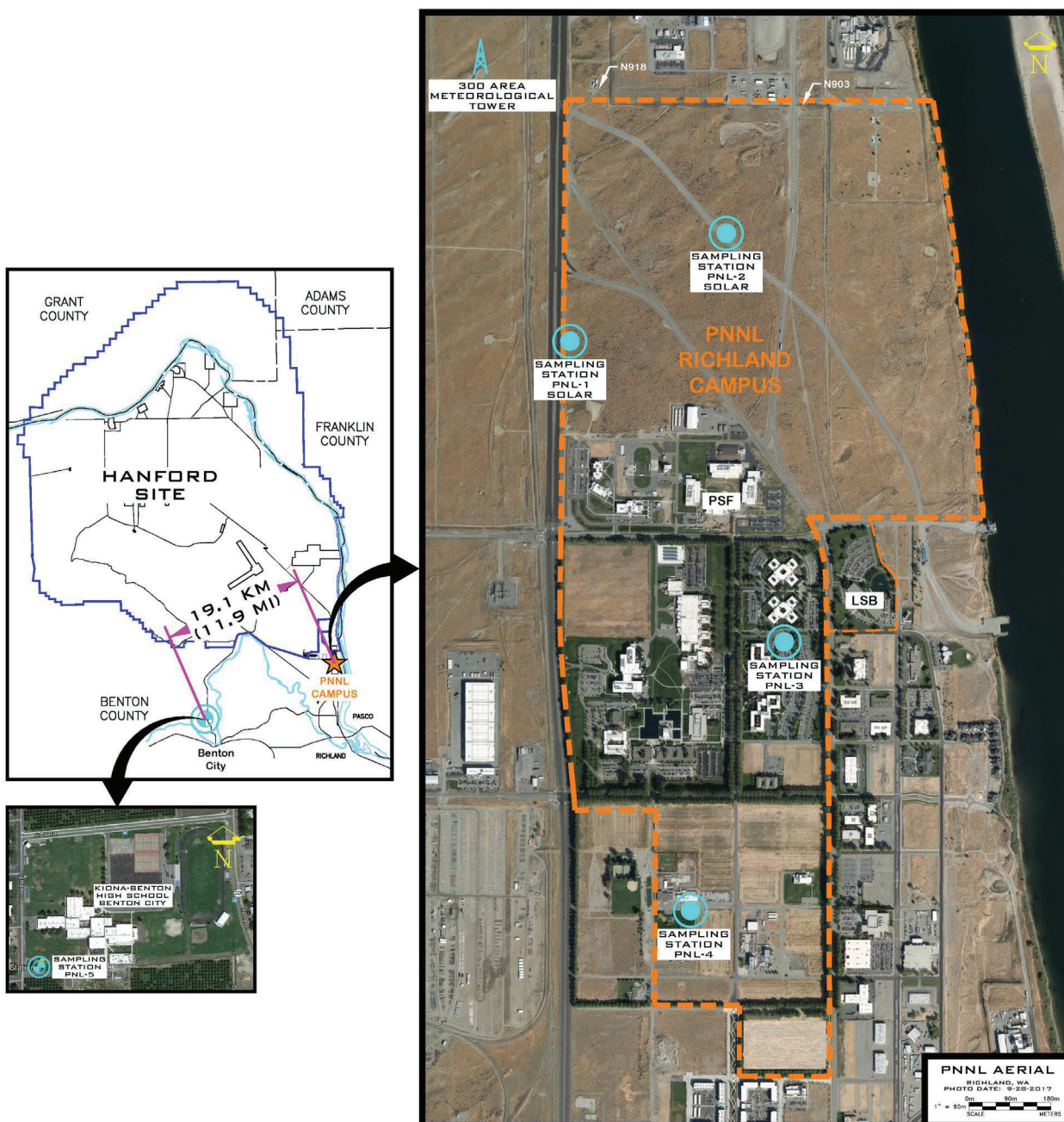


Figure 5.1. Air Surveillance Station Locations for the PNNL Richland Campus

Table 5.1. Summary of 2020 Air Sampling Results

Nuclide	Location ^(a)	No. of Samples Analyzed	No. of Detections	Value $\pm$ Error (pCi/m ³) ^(b)		
Gross Alpha	PNL-1	26	25	9.8E-04	$\pm$	2.5E-03
	PNL-2	26	20	7.6E-04	$\pm$	2.1E-03
	PNL-3	26	24	6.7E-04	$\pm$	1.8E-03
	PNL-4	26	22	6.5E-04	$\pm$	1.7E-03
	PNL-5	25	22	6.3E-04	$\pm$	1.5E-03
Gross Beta	PNL-1	26	26	1.6E-02	$\pm$	6.2E-03
	PNL-2	26	26	1.5E-02	$\pm$	5.8E-03
	PNL-3	26	26	1.5E-02	$\pm$	6.1E-03
	PNL-4	26	26	1.4E-02	$\pm$	5.6E-03
	PNL-5	25	25	1.3E-02	$\pm$	5.0E-03
Co-60	PNL-1	2	0	8.4E-06	$\pm$	1.1E-04
	PNL-2	2	0	1.6E-05	$\pm$	1.1E-04
	PNL-3	2	0	3.9E-05	$\pm$	1.1E-04
	PNL-4	2	0	7.5E-06	$\pm$	1.0E-04
	PNL-5	2	0	2.3E-05	$\pm$	1.0E-04
Cs-137	PNL-1	2	0	4.0E-06	$\pm$	1.1E-04
	PNL-2	2	0	2.0E-05	$\pm$	8.9E-05
	PNL-3	2	0	4.0E-05	$\pm$	9.8E-05
	PNL-4	2	0	1.4E-05	$\pm$	8.6E-05
	PNL-5	2	0	5.3E-06	$\pm$	1.0E-04
U-233/234	PNL-1	2	1	3.0E-05	$\pm$	3.2E-05
	PNL-2	2	2	5.8E-05	$\pm$	3.2E-05
	PNL-3	2	2	5.1E-05	$\pm$	2.8E-05
	PNL-4	2	2	5.8E-05	$\pm$	3.0E-05
	PNL-5	2	2	5.1E-05	$\pm$	3.2E-05
Pu-238	PNL-1	2	0	3.2E-06	$\pm$	1.3E-05
	PNL-2	2	0	3.8E-07	$\pm$	1.2E-05
	PNL-3	2	0	2.8E-06	$\pm$	7.1E-06
	PNL-4	2	0	4.5E-06	$\pm$	1.2E-05
	PNL-5	2	0	4.8E-07	$\pm$	8.5E-06
Pu-239/240	PNL-1	2	0	3.5E-07	$\pm$	1.0E-05
	PNL-2	2	0	1.2E-06	$\pm$	1.1E-05
	PNL-3	2	0	3.9E-07	$\pm$	6.5E-06
	PNL-4	2	0	-3.0E-06	$\pm$	7.4E-06
	PNL-5	2	0	-1.8E-06	$\pm$	7.3E-06
Am-241	PNL-1	2	0	-9.7E-07	$\pm$	2.5E-05
	PNL-2	2	0	7.9E-06	$\pm$	2.1E-05
	PNL-3	2	0	8.2E-06	$\pm$	1.9E-05
	PNL-4	2	0	1.1E-05	$\pm$	2.2E-05
	PNL-5	2	0	4.6E-06	$\pm$	1.2E-05
Am-243	PNL-1	2	0	1.1E-05	$\pm$	3.6E-05
	PNL-2	2	0	1.8E-06	$\pm$	4.3E-05
	PNL-3	2	0	3.6E-06	$\pm$	3.5E-05
	PNL-4	2	0	-3.5E-06	$\pm$	2.7E-05
	PNL-5	2	0	2.0E-05	$\pm$	2.9E-05
Cm-243/244	PNL-1	2	0	-4.3E-06	$\pm$	1.8E-05
	PNL-2	2	0	5.0E-06	$\pm$	1.7E-05
	PNL-3	2	0	2.5E-06	$\pm$	2.1E-05
	PNL-4	2	0	-3.4E-06	$\pm$	2.4E-05
	PNL-5	2	0	6.6E-07	$\pm$	1.1E-05

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

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

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

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 2020. 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 2020 ambient background was relatively low at 32 mrem/yr (28–35 mrem/yr range with uncertainty). The ambient external dose monitoring results at Campus monitoring stations were all less than the background station with the exception of PNL-3 (38 mrem/yr). For comparison, the 2019 background station ambient external dose was 40 mrem/yr (0.40 mSv/yr). Additional details regarding ambient external dose monitoring will be in the next PNNL Site Environmental Report of 2020 operations (e.g., Duncan et al. 2020).

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 2016) and in the PNNL Richland Campus Environmental Radiological Air Monitoring Plan (Snyder et al. 2020). The effluent monitoring QA elements described in PNNL 2016 were compatible with one or more of the documents shown in Table 5.2 during CY2020. QA requirements are implemented, as appropriate, at the Campus as new facilities become operational and programmatic plans are developed.

Table 5.2. Summary List of QA-Related Documents

10 CFR 830 (2001), <i>Nuclear Safety Management</i>
40 CFR 61, Appendix B (2011), “Method 114 – Test Methods for Measuring Radionuclide Emissions from Stationary Sources”
ANSI/ASME NQA-1-2000, <i>Quality Assurance Requirements for Nuclear Facilities</i>
DOE Order 414.1D (2011), <i>Quality Assurance</i>
ISO14001:2004 (ISO 2004), <i>International Organization for Standardization for Environmental Management Systems</i>
DOE Order 458.1 (2020), <i>Radiation Protection of the Public and the Environment</i>
DOE-HDBK-1216-2015, <i>Environmental Radiological Effluent Monitoring and Environmental Surveillance</i> (DOE 2015)
EPA QA/R-5, <i>EPA Requirements for Quality Assurance Project Plans</i> (EPA 2001)

6.0 Corrigendum for CY2019 Reporting

Snyder et al. 2020 reported compliance for PNNL Richland Campus operations in CY2019. An error in EP-3420-01-S flow rates was identified during a quality assurance review. This section summarizes the necessary corrections to Snyder et al. (2020). WDOH was previously notified of the identified errors. The corrections do not impact the reported PNNL Richland Campus CY2019 MEI total dose. Corrections to emissions from one emission unit impacted several radionuclide emission rates and their estimated MEI dose impact.

Section 1 of Snyder et al 2020 indicated stack flow rates and radionuclide emissions rates. The corrected EP-3420-01-S average and total flow rate corrections are indicated in Table 6.1.

Table 6.1. Characteristics of CY2019 Sampled Emission Points-Corrected

Unit Type/ Emission Point ID	Average Flow Rate	Total Flow	Temper- ature	Physical Discharge Height	Physical Discharge Diameter	Effective Discharge Height	Abatement Technology
Original Data							
Major EP-3420-01-S	50,126 ft ³ /min (23.7 m ³ /s)	2.63E+10 ft ³ (7.46E+08 m ³)	74° F (23.4° C)	51 ft (15.5 m)	4.3 ft (1.3 m)	145 ft (44.3 m)	Single-stage HEPA filter
Corrected Data							
Major EP-3420-01-S	51,898 ft ³ /min (24.5 m ³ /s)	2.73E+10 ft ³ (7.72E+08 m ³)	74° F (23.4° C)	51 ft (15.5 m)	4.3 ft (1.3 m)	145 ft (44.3 m)	Single-stage HEPA filter

Section 2 of Snyder et al 2020 indicated radionuclide emissions rates. Flow rate corrections resulted in updates to the gross alpha, gross beta, Co-60, and Cs-137 emissions rates of the major emission unit 3420-01-S (see Table 6.2 and Table 6.3). Some data values remain unchanged because corrections did not impact the significant digits displayed. Impacted yet unchanged results are not presented unless they may be informative.

Table 6.2. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in CY2019-Corrected

Nuclide	EP-3420-01-S 3420 Building	Total (Ci)	EP-3420-01-S 3420 Building	Total (Ci)
Original Data			Corrected Data	
gross $\alpha^{(a)}$	6.55E-08	1.1E-07	6.57E-08	1.1E-07
gross $\beta^{(a)}$	6.31E-07	1.2E-06	6.57E-07	1.2E-06
Co-60	2.96E-08	5.8E-08	3.08E-08	5.9E-08
Cs-137	1.28E-08	1.9E-08	1.35E-08	2.0E-08
Pu-239/240	2.98E-09	6.4E-09	2.98E-09	6.4E-09

To convert Ci to GBq, multiply Ci by 37.

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

Table 6.3. PNNL Richland Campus Radionuclide Emissions (Ci) in CY2019-Corrected

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units	Total (Ci)
Original Data			
gross α	1.1E-07 ^(a)	NA	1.1E-07
gross β	1.2E-06 ^(a)	NA	1.2E-06
Co-60	5.8E-08	6.2E-10	5.9E-08
Cs-137	1.9E-08	4.4E-10	1.9E-08
Pu-239/240	6.4E-09	1.6E-16	6.4E-09
Corrected Data			
gross α	1.1E-07 ^(a)	NA	1.1E-07
gross β	1.2E-06 ^(a)	NA	1.2E-06
Co-60	5.9E-08	6.2E-10	6.0E-08
Cs-137	2.0E-08	4.4E-10	2.0E-08
Pu-239/240	6.4E-09	1.6E-16	6.4E-09

NA = not applicable.
 To convert Ci to GBq, multiply Ci by 37.
 (a) 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.

Section 3 of Snyder et al. 2020 indicates dose assessment results. The corrected CY2019 emissions rates flow down to corrections in reported dose and associated numerical information (see Table 6.4 and Table 6.5). Some data values remain unchanged because corrections did not impact the significant digits displayed. Potentially impacted yet unchanged results are presented only if they may be informative.

Table 6.4. CY2019 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units and Fugitive Emissions-Corrected

Radionuclide ^(a)	CY2019 Releases (Ci)	CY2019 Campus MEI Dose (mrem EDE)	% of Total EDE
Original Data			
Co-60	5.9E-08	1.9E-07	1%
Cs-137 ^(a)	1.2E-06	5.7E-06	37%
Pu-239/240 ^(b)	1.2E-07	5.6E-06	36%
Total	4.4E-01 Ci	1.5E-05 mrem EDE	100%
Corrected Data			
Co-60	6.0E-08	1.9E-07	1%
Cs-137 ^(a)	1.2E-06	5.8E-06	37%
Pu-239/240 ^(b)	1.2E-07	5.6E-06	36%
Total	4.4E-01 Ci	1.5E-05 mrem EDE	100%

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

(a) Gross beta from PSF emission unit sampling assumed to be Cs-137. Also, calculated Cs-137 release based on 40 CFR 61, Appendix D (1989) methods.

(b) Gross alpha from PSF emission unit sampling assumed to be Pu-239. Also includes Pu-239 and Pu-240 based on 40 CFR 61, Appendix D (1989) methods.

Table 6.5. CY2019 Dose Contributions from Registered Emission Points-Corrected

Facility/Building	Emission Unit	Emissions ^(a)	CY 2019 Campus MEI Dose (mrem EDE)	% of Total CY2019 MEI Dose
Original Data				
PSF/3420 Building	3420-01-S	Sampled, Estimated	6.9E-06	45.3%
PSF/3410 Building	3410-01-S	Sampled, Estimated	2.8E-06	18.4%
PSF/3430 Building	3430-01-S	Sampled, Estimated	2.8E-06	18.0%
PSF/3420 Building	3420-02-S	Estimated	1.4E-06	9.3%
Corrected Data				
PSF/3420 Building	3420-01-S	Sampled, Estimated	7.1E-06	45.8%
PSF/3410 Building	3410-01-S	Sampled, Estimated	2.8E-06	18.2%
PSF/3430 Building	3430-01-S	Sampled, Estimated	2.8E-06	17.8%
PSF/3420 Building	3420-02-S	Estimated	1.4E-06	9.2%

To convert mrem to mSv, multiply mrem by 0.01.

(a) Emissions “estimated” are determined by 40 CFR 61, Appendix D.

7.0 References

- 10 CFR 830. 2001. "Nuclear Safety Management." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix B. 2011. "Test Methods." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix D. 1989. "Methods for Estimating Radionuclide Emissions." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Appendix E. 2011. "Compliance Procedures Methods for Determining Compliance with Subpart I." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
- 40 CFR 61, Subpart H. 2002. "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.
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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.

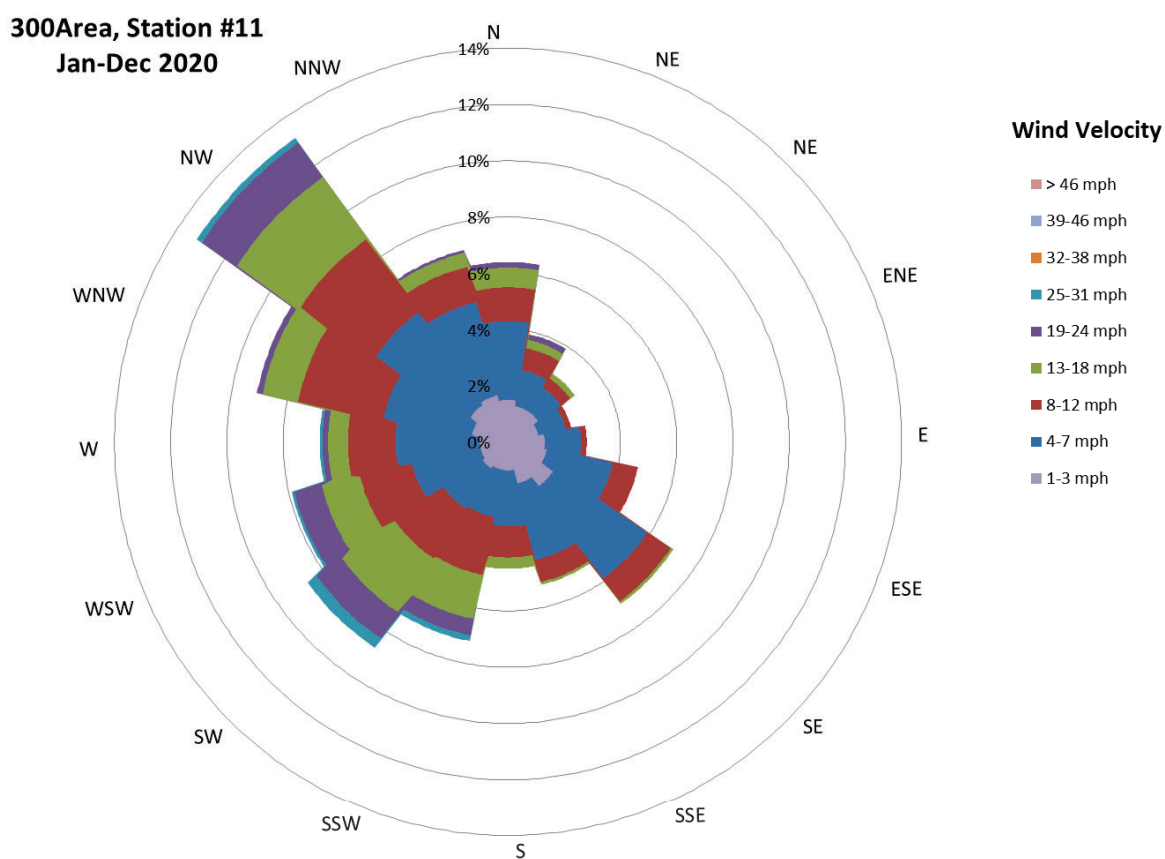


Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2020

Table A.1. Annual Average Joint Frequency during 2020 (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	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.06
	B	0.00	0.01	0.02	0.02	0.00	0.01	0.03	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.16
	C	0.02	0.06	0.08	0.07	0.07	0.06	0.07	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.01	0.01	0.53
	D	0.31	0.24	0.22	0.31	0.32	0.33	0.41	0.39	0.23	0.24	0.14	0.14	0.20	0.20	0.29	0.37	4.34
	E	0.32	0.14	0.14	0.15	0.19	0.47	0.51	0.42	0.41	0.36	0.52	0.30	0.29	0.49	0.43	0.43	5.57
	F	0.31	0.24	0.20	0.15	0.18	0.30	0.52	0.66	0.51	0.30	0.32	0.28	0.32	0.41	0.80	0.62	6.12
	G	0.23	0.13	0.09	0.08	0.10	0.13	0.28	0.22	0.12	0.09	0.12	0.05	0.11	0.27	0.38	0.26	2.66
	Total	1.20	0.82	0.76	0.78	0.86	1.30	1.82	1.73	1.31	1.01	1.11	0.79	0.97	1.38	1.91	1.69	19.44
2.65	A	0.03	0.08	0.02	0.06	0.04	0.12	0.09	0.09	0.09	0.05	0.15	0.03	0.02	0.02	0.01	0.02	0.92
	B	0.09	0.14	0.18	0.21	0.40	0.48	0.35	0.18	0.14	0.15	0.10	0.08	0.02	0.01	0.03	0.02	2.58
	C	0.09	0.17	0.23	0.30	0.38	0.37	0.49	0.20	0.25	0.24	0.19	0.09	0.03	0.03	0.03	0.04	3.13
	D	0.67	0.33	0.34	0.38	0.51	1.39	1.49	0.76	0.37	0.37	0.39	0.16	0.12	0.18	0.47	0.75	8.68
	E	1.10	0.15	0.09	0.07	0.26	1.28	2.02	0.98	1.04	0.75	0.54	0.39	0.48	0.44	0.84	1.33	11.76
	F	0.83	0.10	0.01	0.01	0.08	1.05	2.50	1.01	0.57	0.32	0.20	0.14	0.12	0.07	0.43	0.99	8.43
	G	0.34	0.10	0.04	0.00	0.02	0.29	1.11	0.39	0.17	0.05	0.02	0.04	0.04	0.12	0.27	0.44	3.44
	Total	3.15	1.07	0.91	1.03	1.69	4.98	8.05	3.61	2.63	1.93	1.59	0.93	0.83	0.87	2.08	3.59	38.94
4.70	A	0.03	0.21	0.12	0.01	0.06	0.11	0.08	0.09	0.17	0.32	0.36	0.11	0.02	0.03	0.07	0.05	1.84
	B	0.06	0.34	0.11	0.03	0.11	0.49	0.23	0.19	0.19	0.38	0.28	0.07	0.00	0.01	0.01	0.02	2.52
	C	0.11	0.19	0.05	0.05	0.09	0.31	0.27	0.16	0.10	0.35	0.25	0.13	0.03	0.02	0.01	0.04	2.16
	D	0.42	0.18	0.08	0.03	0.04	0.28	0.40	0.16	0.57	0.91	0.55	0.27	0.08	0.09	0.32	0.46	4.84
	E	1.06	0.18	0.00	0.03	0.03	0.37	0.46	0.30	0.81	1.35	1.11	0.49	0.24	0.27	0.54	0.72	7.96
	F	0.53	0.12	0.03	0.01	0.00	0.44	0.31	0.10	0.21	0.45	0.29	0.18	0.05	0.04	0.06	0.25	3.07
	G	0.20	0.05	0.00	0.01	0.00	0.29	0.34	0.03	0.10	0.19	0.12	0.06	0.00	0.01	0.06	0.19	1.65
	Total	2.41	1.27	0.39	0.17	0.33	2.29	2.09	1.03	2.15	3.95	2.96	1.31	0.42	0.47	1.07	1.73	24.04

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	0.19	0.16	0.02	0.00	0.00	0.01	0.01	0.01	0.04	0.26	0.51	0.19	0.03	0.06	0.08	0.02	1.59	
	B	0.03	0.05	0.00	0.00	0.00	0.00	0.03	0.01	0.04	0.27	0.30	0.13	0.03	0.02	0.03	0.03	0.97	
	C	0.07	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.06	0.16	0.28	0.08	0.02	0.00	0.04	0.05	0.82	
	D	0.24	0.14	0.00	0.00	0.00	0.01	0.04	0.01	0.15	0.71	0.76	0.35	0.19	0.13	0.39	0.21	3.33	
	E	0.27	0.10	0.11	0.03	0.00	0.01	0.04	0.03	0.24	0.75	1.09	0.41	0.14	0.07	0.40	0.41	4.10	
	F	0.05	0.00	0.05	0.02	0.00	0.00	0.00	0.01	0.01	0.19	0.27	0.09	0.01	0.01	0.02	0.04	0.77	
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.08	0.00	0.00	0.00	0.02	0.00	0.27	
Total		0.85	0.50	0.18	0.05	0.00	0.04	0.12	0.07	0.57	2.48	3.29	1.25	0.42	0.29	0.98	0.76	11.85	
9.8	A	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.19	0.31	0.01	0.00	0.02	0.00	0.78	
	B	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.12	0.04	0.00	0.03	0.01	0.35	
	C	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.09	0.06	0.02	0.01	0.02	0.01	0.24	
	D	0.06	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.36	0.23	0.12	0.01	0.24	0.11	1.44	
	E	0.02	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.06	0.28	0.56	0.22	0.01	0.01	0.29	0.08	1.58	
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.01	0.01	0.00	0.01	0.00	0.11	
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.03	
Total		0.21	0.17	0.04	0.01	0.00	0.00	0.00	0.00	0.06	0.69	1.34	0.95	0.21	0.03	0.61	0.21	4.53	
12.7	A	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.04	0.00	0.00	0.00	0.10	
	B	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.02	0.06	
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.03	
	D	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.06	0.03	0.03	0.00	0.08	0.00	0.28	
	E	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.28	0.01	0.01	0.00	0.08	0.00	0.52	
	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		0.03	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.39	0.06	0.10	0.00	0.17	0.02	0.99	

Table A.1 (contd)

Wind Speed (m/sec)	Stability Class	Wind Direction Toward													Total		
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
15.6	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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	0.02	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	0.02	0.02	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	0.01	0.00	0.00	0.00	0.00	0.00
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.00	0.00	0.00
	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.36	0.52	0.17	0.07	0.10	0.24	0.18	0.21	0.31	0.73	1.24	0.65	0.13	0.11	0.18	0.09
	B	0.22	0.57	0.31	0.26	0.51	0.98	0.64	0.39	0.39	0.84	0.76	0.41	0.13	0.05	0.10	0.10
	C	0.30	0.48	0.36	0.42	0.54	0.75	0.83	0.37	0.42	0.77	0.82	0.40	0.16	0.06	0.12	0.15
	D	1.71	0.95	0.65	0.72	0.87	2.01	2.34	1.32	1.32	2.54	2.27	1.18	0.74	0.61	1.79	1.90
Total	E	2.77	0.62	0.38	0.29	0.48	2.13	3.03	1.73	2.56	3.58	4.10	1.82	1.17	1.28	2.58	2.97
	F	1.72	0.46	0.29	0.19	0.26	1.79	3.33	1.78	1.30	1.28	1.14	0.70	0.51	0.53	1.32	1.90
	G	0.77	0.28	0.13	0.09	0.12	0.71	1.73	0.64	0.42	0.48	0.36	0.15	0.15	0.40	0.73	0.89
	Total	7.85	3.88	2.29	2.04	2.88	8.61	12.08	6.44	6.72	10.22	10.69	5.31	2.99	3.04	6.82	8.00
																	99.86

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 (cm^3/hr) = $5.26 \text{ E}+03$ **SOIL PARAMETERS**Effective surface density, $\text{kg}/\text{sq m}$, dry weight
(assumes 15-cm plow layer) = $2.15 \text{ E}+02$ **BUILDUP TIMES**For activity in soil (yr) = $1.00 \text{ E}+02$ For radionuclides deposited on ground/water (d) = $3.65\text{E}+04$ **DELAY TIMES**Ingestion of pasture grass by animals (hr) = $0.00 \text{ E}+00$ Ingestion of stored feed by animals (hr) = $2.16 \text{ E}+03$ Ingestion of leafy vegetables by man (hr) = $3.36 \text{ E}+02$ Ingestion of produce by man (hours) = $3.36 \text{ E}+02$ Transport time from animal feed-milk-man (d) = $2.00 \text{ E}+00$ Time from slaughter to consumption (d) = $2.00 \text{ E}+01$ **WEATHERING**Removal rate constant for physical loss (per hr) = $2.90 \text{ E}-03$ **CROP EXPOSURE DURATION**Pasture grass (hr) = $7.20 \text{ E}+02$ Crops/leafy vegetables (hr) = $1.44 \text{ E}+03$ **AGRICULTURAL PRODUCTIVITY**Grass-cow-milk-man pathway (kg/m^2) = $2.80 \text{ E}-01$ Produce/leafy veg for human consumption (kg/m^2) = $7.16 \text{ E}-01$ **FALLOUT INTERCEPTION FRACTIONS**Vegetables = $2.00 \text{ E}-01$ Pasture = $5.70 \text{ E}-01$ **GRAZING PARAMETERS**Fraction of year animals graze on pasture = $4.00 \text{ E}-01$ Fraction of daily feed that is pasture grass when animal grazes on pasture = $4.30 \text{ E}-01$ **ANIMAL FEED CONSUMPTION FACTORS**Contaminated feed/forage (kg/day , dry weight) = $1.56 \text{ E}+01$ **DAIRY PRODUCTIVITY**Milk production of cow (L/day) = $1.10 \text{ E}+01$

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

DECONTAMINATIONFraction 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 [2020]

RR = 10.34 cm/yr (4.07 in/yr)

AVERAGE AIR TEMPERATURE [2020]

A = 13.22 degrees C (55.8 degrees F; 286.4 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 2020

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Richland Campus in 2020

Table B.1. Radionuclides Handled and/or Potentially Handled at the PNNL Richland Campus in 2020

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 (contd)

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 2020

Appendix C

Ambient Particulate Air Sampling Results for the PNNL Richland Campus Air Surveillance in 2020

Table C.1. Definitions for Air Sampling Data

Column Heading	Data Type/Format	Content
SAMP SITE NAME	text	Location of monitoring station: PNNL Richland Campus monitoring stations PNL-1, PNL-2, PNL-3, PNL-4 <u>Background Location</u> PNL-5
SAMP MTHD	text	The method used to collect the sample: FILTER2 2" filter paper; 120-volt AC system FILTER2 SOLAR 2" filter paper; 24-volt solar-powered system
LAB SAMP ID	9-digit number	
SAMP DATE TIME ON	date (DD-MMM-YY HH:MM [24 hr])	Date and time when air sampling started (time field is truncated and not displayed in Table C.2).
SAMP DATE TIME	date (DD-MMM-YY HH:MM [24 hr])	Date and time when air sampling ended (time field is truncated and not displayed in Table C.2).
CON SHORT NAME	text	ALPHA, BETA, Am-241, Am-243, Be-7, Cm-243/244, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, K-40, Pu-238, Pu-239/240, Ru-106, Sb-125, U-233/234, U-234, U-235, U-238. The sum of U-233 and U-234 is reported as either U-233/234 or U-234 and used for U-233 reporting.
VALUE RPTD	number (usually scientific notation)	Result reported by the analytical laboratory.
ANAL UNITS RPTD	text	Picocuries per cubic meter. Units associated with the values shown in the VALUE RPTD, COUNTING ERROR, and TOTAL ANAL ERROR 2-SIGMA columns.
COUNTING ERROR	number (usually scientific notation)	The 2-sigma counting error for the radioanalytical results only.
TOTAL ANAL ERROR 2-SIGMA	number (usually scientific notation)	The 2-sigma total analytical error for the radioanalytical results only.
LAB QUALIFIER	text or blank	If "U", the VALUE RPTD was not detected above limiting criteria, which may include any of the following: value_rptd < 0, or < counting_error, or < total_analytical_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.
SAMP COMMENT	text or blank	Contains pertinent information about the sample. If blank, no comment was needed
RESULT COMMENT	text or blank	Comment on the result. If blank, no comment was needed.
COMPOSITE FLAG	Y or blank	If "Y", several samples from the same sampling station were composited and the composite measured for radioactivity. If blank, a single sample was evaluated.

Further details on each PNNL Richland Campus sample event (e.g., sample volume, analysis method) can be obtained from the project Site Environmental Monitoring (SEM) database and/or the Hanford Environmental Information Systems (HEIS 1989) database.

Table C.2. Air Sampling Results for the PNNL Richland Campus for Calendar Year 2020

SAMP SITE	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL 2-SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-1	FILTER2	501502001	31-Dec-19	15-Jan-20	ALPHA	4.48E-04	pCi/m3	2.99E-04	3.00E-04				
SOLAR													
PNL-1	FILTER2	503226001	15-Jan-20	29-Jan-20	ALPHA	6.64E-04	pCi/m3	3.78E-04	3.79E-04		DISPLAY PANEL INDICATED AIR FLOW FAILURE; SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH UNIT WAS PROBABLY CLOSE TO SHUTTING DOWN WITH AN AS-FOUND FLOW RATE READING OF 0.0 CFM. SNOW, RAIN AND WIND MAY HAVE CONTRIBUTED TO THE LOW FLOW RATE (READINGS CONSISTENT WITH PNL-2 STATION).		
SOLAR													
PNL-1	FILTER2	504706001	29-Jan-20	12-Feb-20	ALPHA	7.83E-04	pCi/m3	3.71E-04	3.71E-04				
SOLAR													
PNL-1	FILTER2	506009001	12-Feb-20	26-Feb-20	ALPHA	7.23E-04	pCi/m3	4.26E-04	4.26E-04				
SOLAR													
PNL-1	FILTER2	507090001	26-Feb-20	11-Mar-20	ALPHA	3.84E-04	pCi/m3	3.40E-04	3.40E-04	UO			
SOLAR													
PNL-1	FILTER2	507996001	11-Mar-20	25-Mar-20	ALPHA	1.63E-03	pCi/m3	5.57E-04	5.58E-04				
SOLAR													
PNL-1	FILTER2	509102001	25-Mar-20	8-Apr-20	ALPHA	7.61E-04	pCi/m3	3.67E-04	3.68E-04				
SOLAR													
PNL-1	FILTER2	510128001	8-Apr-20	22-Apr-20	ALPHA	7.24E-04	pCi/m3	3.66E-04	3.66E-04		AIR SAMPLER #22974 EXPIRING 05/09/20 WAS REPLACED ON 04/22/20 WITH AIR SAMPLER #27818, EXPIRES 01/31/21. DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA.		
SOLAR													
PNL-1	FILTER2	511164001	22-Apr-20	6-May-20	ALPHA	6.51E-04	pCi/m3	3.29E-04	3.30E-04		DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
SOLAR													
PNL-1	FILTER2	512005001	6-May-20	20-May-20	ALPHA	5.35E-04	pCi/m3	2.80E-04	2.80E-04				
SOLAR													
PNL-1	FILTER2	513197001	20-May-20	3-Jun-20	ALPHA	6.05E-04	pCi/m3	3.05E-04	3.06E-04				
SOLAR													
PNL-1	FILTER2	514086001	3-Jun-20	17-Jun-20	ALPHA	3.80E-04	pCi/m3	2.57E-04	2.57E-04				
SOLAR													

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE ON	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-1	FILTER2 SOLAR	515186001	17-Jun-20	1-Jul-20	1-Jul-20	ALPHA	8.47E-04	pCi/m3	3.29E-04	3.29E-04	O			
PNL-1	FILTER2 SOLAR	516218001	1-Jul-20	1-Jul-20	15-Jul-20	ALPHA	4.70E-04	pCi/m3	2.87E-04	2.88E-04	O			
PNL-1	FILTER2 SOLAR	517093001	15-Jul-20	15-Jul-20	29-Jul-20	ALPHA	4.08E-04	pCi/m3	2.27E-04	2.27E-04				
PNL-1	FILTER2 SOLAR	518719001	29-Jul-20	29-Jul-20	12-Aug-20	ALPHA	4.77E-04	pCi/m3	2.58E-04	2.58E-04				
PNL-1	FILTER2 SOLAR	520023001	12-Aug-20	12-Aug-20	26-Aug-20	ALPHA	5.04E-04	pCi/m3	3.48E-04	3.48E-04	O			
PNL-1	FILTER2 SOLAR	521289001	26-Aug-20	26-Aug-20	9-Sep-20	ALPHA	5.54E-04	pCi/m3	3.01E-04	3.01E-04		DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS, STATION CHECKED ONE DAY EARLIER AND CONFIRMED OPERATING. AS FOUND AIR FLOW LOW, SAMPLE FILTER COLLECTED SUBSTANTIAL AIRBORNE PARTICLES.		
PNL-1	FILTER2 SOLAR	521798001	9-Sep-20	9-Sep-20	16-Sep-20	ALPHA	7.70E-03	pCi/m3	1.88E-03	1.89E-03		REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.	REFER TO DISCREPANCY RPT EMP20-006 AND ANOMALOUS DATA REPORT. ONE-WEEK AIR FILTER EXCEEDED THE ALPHA PROJECT LIMIT (0.0025 pCi/m3).	
PNL-1	FILTER2 SOLAR		16-Sep-20	16-Sep-20	23-Sep-20	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.		
PNL-1	FILTER2 SOLAR	524619001	23-Sep-20	23-Sep-20	7-Oct-20	ALPHA	5.61E-04	pCi/m3	2.98E-04	2.99E-04				
PNL-1	FILTER2 SOLAR	525255001	7-Oct-20	7-Oct-20	21-Oct-20	ALPHA	2.81E-04	pCi/m3	1.96E-04	1.96E-04	O			
PNL-1	FILTER2 SOLAR	526700001	21-Oct-20	21-Oct-20	4-Nov-20	ALPHA	8.92E-04	pCi/m3	3.22E-04	3.22E-04				
PNL-1	FILTER2 SOLAR	528348001	4-Nov-20	4-Nov-20	18-Nov-20	ALPHA	6.39E-04	pCi/m3	3.06E-04	3.06E-04				
PNL-1	FILTER2 SOLAR	529604001	18-Nov-20	18-Nov-20	2-Dec-20	ALPHA	1.46E-03	pCi/m3	4.31E-04	4.33E-04				
PNL-1	FILTER2 SOLAR	530881001	2-Dec-20	2-Dec-20	16-Dec-20	ALPHA	1.51E-03	pCi/m3	4.09E-04	4.10E-04				
PNL-1	FILTER2 SOLAR	531349001	16-Dec-20	16-Dec-20	30-Dec-20	ALPHA	7.67E-04	pCi/m3	3.16E-04	3.16E-04				
PNL-1	FILTER2 SOLAR	501502001	31-Dec-19	31-Dec-19	15-Jan-20	BETA	8.89E-03	pCi/m3	7.67E-04	8.41E-04	O			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS	COUNT-ING ERROR	TOTAL ANAL SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	503226001	15-Jan-20	29-Jan-20	BETA	1.57E-02	pCi/m3	1.05E-03	1.07E-03	O	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH UNIT WAS PROBABLY CLOSE TO SHUTTING DOWN WITH AN AS-FOUND FLOW RATE READING OF 0.0 CFM. SNOW, RAIN AND WIND MAY HAVE CONTRIBUTED TO THE LOW FLOW RATE (READINGS CONSISTENT WITH PNL-2 STATION).		
PNL-1	FILTER2 SOLAR	504706001	29-Jan-20	12-Feb-20	BETA	9.16E-03	pCi/m3	7.93E-04	8.02E-04	O			
PNL-1	FILTER2 SOLAR	506009001	12-Feb-20	26-Feb-20	BETA	1.30E-02	pCi/m3	9.38E-04	9.65E-04	O			
PNL-1	FILTER2 SOLAR	507090001	26-Feb-20	11-Mar-20	BETA	9.03E-03	pCi/m3	8.66E-04	9.52E-04	O			
PNL-1	FILTER2 SOLAR	507996001	11-Mar-20	25-Mar-20	BETA	2.17E-02	pCi/m3	1.21E-03	1.28E-03	O			
PNL-1	FILTER2 SOLAR	509102001	25-Mar-20	8-Apr-20	BETA	9.01E-03	pCi/m3	7.98E-04	8.08E-04	O			
PNL-1	FILTER2 SOLAR	510128001	8-Apr-20	22-Apr-20	BETA	1.61E-02	pCi/m3	1.04E-03	1.05E-03	O	AIR SAMPLER #22974 EXPIRING 05/09/20 WAS REPLACED ON 04/22/20 WITH AIR SAMPLER #27818, EXPIRES 01/31/21. DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA.		
PNL-1	FILTER2 SOLAR	511164001	22-Apr-20	6-May-20	BETA	9.74E-03	pCi/m3	8.28E-04	8.39E-04	O	DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-1	FILTER2 SOLAR	512005001	6-May-20	20-May-20	BETA	8.58E-03	pCi/m3	7.64E-04	7.74E-04	O			
PNL-1	FILTER2 SOLAR	513197001	20-May-20	3-Jun-20	BETA	1.14E-02	pCi/m3	9.17E-04	9.51E-04	O			
PNL-1	FILTER2 SOLAR	514086001	3-Jun-20	17-Jun-20	BETA	9.02E-03	pCi/m3	7.86E-04	7.98E-04	O			
PNL-1	FILTER2 SOLAR	515186001	17-Jun-20	1-Jul-20	BETA	1.02E-02	pCi/m3	8.27E-04	8.36E-04	O			
PNL-1	FILTER2 SOLAR	516218001	1-Jul-20	15-Jul-20	BETA	1.06E-02	pCi/m3	8.38E-04	9.99E-04	O			
PNL-1	FILTER2 SOLAR	517093001	15-Jul-20	29-Jul-20	BETA	1.21E-02	pCi/m3	8.94E-04	9.11E-04	O			
PNL-1	FILTER2 SOLAR	518719001	29-Jul-20	12-Aug-20	BETA	1.50E-02	pCi/m3	1.03E-03	1.05E-03	O			
PNL-1	FILTER2 SOLAR	520023001	12-Aug-20	26-Aug-20	BETA	1.37E-02	pCi/m3	9.86E-04	1.01E-03	O			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS	ANAL COUNT-ING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	521289001	26-Aug-20	9-Sep-20	BETA	1.43E-02	pCi/m3	1.01E-03	1.02E-03	O	DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS, STATION CHECKED ONE DAY EARLIER AND CONFIRMED OPERATING. AS FOUND AIR FLOW LOW, SAMPLE FILTER COLLECTED SUBSTANTIAL AIRBORNE PARTICLES.		
PNL-1	FILTER2 SOLAR	521798001	9-Sep-20	16-Sep-20	BETA	4.09E-02	pCi/m3	3.23E-03	3.40E-03	O	REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.	REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK AIR FILTER.	
PNL-1	FILTER2 SOLAR		16-Sep-20	23-Sep-20	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.		
PNL-1	FILTER2 SOLAR	524619001	23-Sep-20	7-Oct-20	BETA	2.47E-02	pCi/m3	1.25E-03	1.27E-03	O			
PNL-1	FILTER2 SOLAR	525255001	7-Oct-20	21-Oct-20	BETA	1.01E-02	pCi/m3	8.42E-04	8.81E-04	O			
PNL-1	FILTER2 SOLAR	526700001	21-Oct-20	4-Nov-20	BETA	2.94E-02	pCi/m3	1.39E-03	1.58E-03	O			
PNL-1	FILTER2 SOLAR	528348001	4-Nov-20	18-Nov-20	BETA	1.15E-02	pCi/m3	8.67E-04	8.96E-04	O			
PNL-1	FILTER2 SOLAR	529604001	18-Nov-20	2-Dec-20	BETA	1.73E-02	pCi/m3	1.16E-03	1.34E-03	O			
PNL-1	FILTER2 SOLAR	530881001	2-Dec-20	16-Dec-20	BETA	3.75E-02	pCi/m3	1.54E-03	1.62E-03	O			
PNL-1	FILTER2 SOLAR	531349001	16-Dec-20	30-Dec-20	BETA	1.52E-02	pCi/m3	1.00E-03	1.02E-03	O			
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Be-7	5.70E-02	pCi/m3	4.12E-03	6.63E-03				Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Be-7	3.27E-02	pCi/m3	2.43E-03	3.98E-03				Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Co-60	1.68E-05	pCi/m3	8.01E-05	8.05E-05	U			Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Co-60	-7.91E-06	pCi/m3	1.01E-04	1.01E-04	U			Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Cs-134	1.32E-05	pCi/m3	8.85E-05	8.87E-05	U			Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Cs-134	-6.98E-06	pCi/m3	6.89E-05	6.90E-05	U			Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Cs-137	7.97E-06	pCi/m3	7.85E-05	7.86E-05	U			Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Cs-137	-1.44E-05	pCi/m3	5.25E-05	5.29E-05	U			Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT-ING ERROR	TOTAL ANAL SIGMA	LAB QUAL-IFER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Eu-152	9.11E-05	pCi/m3	1.98E-04	2.02E-04	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Eu-152	4.56E-05	pCi/m3	1.33E-04	1.35E-04	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Eu-154	-5.43E-05	pCi/m3	2.61E-04	2.62E-04	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Eu-154	1.70E-05	pCi/m3	2.04E-04	2.04E-04	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Eu-155	3.17E-05	pCi/m3	1.45E-04	1.46E-04	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Eu-155	6.74E-05	pCi/m3	1.34E-04	1.38E-04	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	K-40	2.58E-03	pCi/m3	2.08E-03	2.10E-03	X				Results are considered a false positive due to high counting uncertainty.	Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	K-40	3.79E-03	pCi/m3	1.48E-03	1.52E-03						Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Ru-106	2.57E-04	pCi/m3	6.50E-04	6.61E-04	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Ru-106	-1.55E-04	pCi/m3	5.75E-04	5.80E-04	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Sb-125	-1.43E-05	pCi/m3	1.68E-04	1.68E-04	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Sb-125	4.14E-06	pCi/m3	1.30E-04	1.30E-04	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Am-241	-1.94E-06	pCi/m3	5.25E-06	5.26E-06	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Am-241	0.00E+00	pCi/m3	1.75E-05	1.75E-05	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Am-243	3.89E-06	pCi/m3	7.68E-06	7.71E-06	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Am-243	1.78E-05	pCi/m3	3.49E-05	3.50E-05	U				REFER TO ANOMALOUS DATA REPORT.	Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Cm-243/244	-2.39E-06	pCi/m3	3.86E-06	3.87E-06	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Cm-243/244	-6.27E-06	pCi/m3	1.74E-05	1.74E-05	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Pu-238	4.81E-06	pCi/m3	7.23E-06	7.26E-06	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Pu-238	1.49E-06	pCi/m3	1.05E-05	1.05E-05	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	Pu-239/240	-1.55E-06	pCi/m3	4.19E-06	4.20E-06	U					Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	Pu-239/240	6.96E-07	pCi/m3	7.27E-06	7.28E-06	U					Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	U-233/234	3.16E-05	pCi/m3	1.49E-05	1.56E-05						Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS	ANAL COUNT-ING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	U-233/234	2.80E-05	pCi/m3	2.74E-05	2.78E-05	U			Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	U-235	7.12E-08	pCi/m3	5.28E-06	5.28E-06	U			Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	U-235	-2.32E-06	pCi/m3	1.03E-05	1.03E-05	U			Y
PNL-1	FILTER2 SOLAR	517129001	31-Dec-19	17-Jun-20	U-238	3.34E-05	pCi/m3	1.52E-05	1.59E-05				Y
PNL-1	FILTER2 SOLAR	533893001	1-Jul-20	30-Dec-20	U-238	5.40E-05	pCi/m3	3.10E-05	3.21E-05				Y
PNL-2	FILTER2 SOLAR	501502002	31-Dec-19	15-Jan-20	ALPHA	2.16E-04	pCi/m3	2.20E-04	2.20E-04	U			
PNL-2	FILTER2 SOLAR	503226002	15-Jan-20	29-Jan-20	ALPHA	8.95E-04	pCi/m3	4.67E-04	4.68E-04		AIR SAMPLER #27818 EXPIRING 02/04/2020 WAS REPLACED ON 01/29/2020 WITH #24094 EXPIRES 10/02/2020. SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH UNIT WAS PROBABLY CLOSE TO SHUTTING DOWN WITH AN AS-FOUND FLOW RATE READING OF 0.05 CFM. SNOW, RAIN AND WIND MAY HAVE CONTRIBUTED TO THE LOW FLOW RATE (READINGS CONSISTENT WITH PNL-1 STATION).		
PNL-2	FILTER2 SOLAR	504706002	29-Jan-20	12-Feb-20	ALPHA	4.99E-04	pCi/m3	3.15E-04	3.16E-04				
PNL-2	FILTER2 SOLAR	506009002	12-Feb-20	26-Feb-20	ALPHA	9.11E-04	pCi/m3	4.56E-04	4.56E-04				
PNL-2	FILTER2 SOLAR	507090002	26-Feb-20	11-Mar-20	ALPHA	3.79E-04	pCi/m3	2.92E-04	2.92E-04	UO			
PNL-2	FILTER2 SOLAR	507996002	11-Mar-20	25-Mar-20	ALPHA	8.19E-04	pCi/m3	4.06E-04	4.06E-04				
PNL-2	FILTER2 SOLAR	509102002	25-Mar-20	8-Apr-20	ALPHA	5.94E-04	pCi/m3	3.28E-04	3.29E-04				
PNL-2	FILTER2 SOLAR	510128002	8-Apr-20	22-Apr-20	ALPHA	5.25E-04	pCi/m3	3.41E-04	3.42E-04				
PNL-2	FILTER2 SOLAR	511164002	22-Apr-20	7-May-20	ALPHA	5.48E-04	pCi/m3	3.02E-04	3.03E-04		DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-2	FILTER2 SOLAR	512005002	7-May-20	20-May-20	ALPHA	3.75E-04	pCi/m3	2.37E-04	2.37E-04				
PNL-2	FILTER2 SOLAR	513197002	20-May-20	3-Jun-20	ALPHA	1.86E-04	pCi/m3	2.58E-04	2.59E-04	U			
PNL-2	FILTER2 SOLAR	514086002	3-Jun-20	17-Jun-20	ALPHA	2.65E-04	pCi/m3	2.72E-04	2.72E-04	U			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE ON TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT-ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	515186002	17-Jun-20	1-Jul-20	ALPHA	5.81E-04	pCi/m3	2.81E-04	2.82E-04	O			
PNL-2	FILTER2 SOLAR	516218002	1-Jul-20	15-Jul-20	ALPHA	5.25E-04	pCi/m3	2.94E-04	2.94E-04	O			
PNL-2	FILTER2 SOLAR	517093002	15-Jul-20	29-Jul-20	ALPHA	5.12E-04	pCi/m3	2.70E-04	2.70E-04				
PNL-2	FILTER2 SOLAR	518719002	29-Jul-20	12-Aug-20	ALPHA	3.00E-04	pCi/m3	2.62E-04	2.62E-04	U			
PNL-2	FILTER2 SOLAR	520023002	12-Aug-20	26-Aug-20	ALPHA	4.91E-04	pCi/m3	2.57E-04	2.58E-04	O			
PNL-2	FILTER2 SOLAR	521289002	26-Aug-20	9-Sep-20	ALPHA	1.12E-03	pCi/m3	3.88E-04	3.88E-04		DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS, STATION CHECKED ONE DAY EARLIER AND CONFIRMED OPERATING. AS FOUND AIR FLOW LOW, SAMPLE FILTER COLLECTED SUBSTANTIAL AIRBORNE PARTICLES.		
PNL-2	FILTER2 SOLAR	521798002	9-Sep-20	16-Sep-20	ALPHA	5.70E-03	pCi/m3	1.43E-03	1.43E-03		REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.	REFER TO DISCREPANCY RPT EMP20-006 AND ANOMALOUS DATA REPORT. ONE-WEEK AIR FILTER EXCEEDED THE ALPHA PROJECT LIMIT (0.0025 pCi/m3).	
PNL-2	FILTER2 SOLAR		16-Sep-20	23-Sep-20	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME. AIR WAS REPLACED ON 09/23/20 WITH AIR SAMPLER #22974, EXPIRES 07/20/21.		
PNL-2	FILTER2 SOLAR	524619002	23-Sep-20	7-Oct-20	ALPHA	7.08E-04	pCi/m3	3.46E-04	3.47E-04				
PNL-2	FILTER2 SOLAR	525255002	7-Oct-20	21-Oct-20	ALPHA	4.90E-04	pCi/m3	2.84E-04	2.84E-04	O			
PNL-2	FILTER2 SOLAR	526700002	21-Oct-20	4-Nov-20	ALPHA	6.24E-04	pCi/m3	3.09E-04	3.09E-04				
PNL-2	FILTER2 SOLAR	528348002	4-Nov-20	18-Nov-20	ALPHA	6.10E-04	pCi/m3	2.99E-04	2.99E-04				
PNL-2	FILTER2 SOLAR	529604002	18-Nov-20	2-Dec-20	ALPHA	3.00E-04	pCi/m3	2.28E-04	2.28E-04	U			
PNL-2	FILTER2 SOLAR	530881002	2-Dec-20	16-Dec-20	ALPHA	1.10E-03	pCi/m3	3.80E-04	3.81E-04				
PNL-2	FILTER2 SOLAR	531349002	16-Dec-20	30-Dec-20	ALPHA	5.87E-04	pCi/m3	2.83E-04	2.83E-04				
PNL-2	FILTER2 SOLAR	501502002	31-Dec-19	15-Jan-20	BETA	8.53E-03	pCi/m3	7.56E-04	7.79E-04	O			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS	ANAL COUNT-ING ERROR	TOTAL ANAL ERROR 2- SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2	503226002	15-Jan-20	29-Jan-20	BETA	1.49E-02	pCi/m3	1.01E-03	1.04E-03	O	AIR SAMPLER #27818 EXPIRING 02/04/2020 WAS REPLACED ON 01/29/2020 WITH #24094 EXPIRES 10/02/2020. SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH UNIT WAS PROBABLY CLOSE TO SHUTTING DOWN WITH AN AS-FOUND FLOW RATE READING OF 0.05 CFM. SNOW, RAIN AND WIND MAY HAVE CONTRIBUTED TO THE LOW FLOW RATE (READINGS CONSISTENT WITH PNL-1 STATION).		
PNL-2	FILTER2	504706002	29-Jan-20	12-Feb-20	BETA	9.42E-03	pCi/m3	8.08E-04	8.97E-04	O			
PNL-2	FILTER2	506009002	12-Feb-20	26-Feb-20	BETA	1.16E-02	pCi/m3	9.06E-04	9.23E-04	O			
PNL-2	FILTER2	507090002	26-Feb-20	11-Mar-20	BETA	9.42E-03	pCi/m3	8.44E-04	9.19E-04	O			
PNL-2	FILTER2	507996002	11-Mar-20	25-Mar-20	BETA	2.01E-02	pCi/m3	1.16E-03	1.47E-03	O			
PNL-2	FILTER2	509102002	25-Mar-20	8-Apr-20	BETA	9.18E-03	pCi/m3	7.93E-04	8.03E-04	O			
PNL-2	FILTER2	510128002	8-Apr-20	22-Apr-20	BETA	1.45E-02	pCi/m3	9.74E-04	1.23E-03	O			
PNL-2	FILTER2	511164002	22-Apr-20	7-May-20	BETA	9.59E-03	pCi/m3	8.14E-04	8.29E-04	O	DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-2	FILTER2	512005002	7-May-20	20-May-20	BETA	9.05E-03	pCi/m3	8.20E-04	8.31E-04	O			
PNL-2	FILTER2	513197002	20-May-20	3-Jun-20	BETA	1.16E-02	pCi/m3	8.86E-04	9.09E-04	O			
PNL-2	FILTER2	514086002	3-Jun-20	17-Jun-20	BETA	7.93E-03	pCi/m3	7.37E-04	7.57E-04	O			
PNL-2	FILTER2	515186002	17-Jun-20	1-Jul-20	BETA	9.69E-03	pCi/m3	7.98E-04	8.07E-04	O			
PNL-2	FILTER2	516218002	1-Jul-20	15-Jul-20	BETA	1.08E-02	pCi/m3	8.90E-04	9.02E-04	O			
PNL-2	FILTER2	517093002	15-Jul-20	29-Jul-20	BETA	1.22E-02	pCi/m3	9.14E-04	9.30E-04	O			
PNL-2	FILTER2	518719002	29-Jul-20	12-Aug-20	BETA	1.48E-02	pCi/m3	1.01E-03	1.02E-03	O			
PNL-2	FILTER2	520023002	12-Aug-20	26-Aug-20	BETA	1.32E-02	pCi/m3	9.29E-04	9.44E-04	O			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT-ING ERROR	ANAL SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	521289002	26-Aug-20	9-Sep-20	BETA	1.36E-02	pCi/m3	9.67E-04	9.81E-04	O	DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS, STATION CHECKED ONE DAY EARLIER AND CONFIRMED OPERATING. AS FOUND AIR FLOW LOW, SAMPLE FILTER COLLECTED SUBSTANTIAL AIRBORNE PARTICLES.		
PNL-2	FILTER2 SOLAR	521798002	9-Sep-20	16-Sep-20	BETA	3.42E-02	pCi/m3	2.55E-03	2.67E-03	O	REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME.	REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK AIR FILTER.	
PNL-2	FILTER2 SOLAR		16-Sep-20	23-Sep-20	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP20-006, ONE-WEEK SAMPLE DUE TO SMOKE IN THE AIR FROM FIRES IN SURROUNDING AREAS; LOW AIR FLOW AND TOTAL VOLUME. SAMPLER #24094 EXPIRING 10/02/20 WAS REPLACED ON 09/23/20 WITH AIR SAMPLER #22974, EXPIRES 07/20/21.		
PNL-2	FILTER2 SOLAR	524619002	23-Sep-20	7-Oct-20	BETA	2.45E-02	pCi/m3	1.24E-03	1.28E-03	O			
PNL-2	FILTER2 SOLAR	525255002	7-Oct-20	21-Oct-20	BETA	1.03E-02	pCi/m3	8.58E-04	8.69E-04	O			
PNL-2	FILTER2 SOLAR	526700002	21-Oct-20	4-Nov-20	BETA	2.99E-02	pCi/m3	1.39E-03	1.58E-03	O			
PNL-2	FILTER2 SOLAR	528348002	4-Nov-20	18-Nov-20	BETA	1.05E-02	pCi/m3	8.51E-04	9.74E-04	O			
PNL-2	FILTER2 SOLAR	529604002	18-Nov-20	2-Dec-20	BETA	1.27E-02	pCi/m3	9.28E-04	9.40E-04	O			
PNL-2	FILTER2 SOLAR	530881002	2-Dec-20	16-Dec-20	BETA	3.62E-02	pCi/m3	1.52E-03	1.67E-03	O			
PNL-2	FILTER2 SOLAR	531349002	16-Dec-20	30-Dec-20	BETA	1.56E-02	pCi/m3	1.01E-03	1.03E-03	O			
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	Be-7	4.79E-02	pCi/m3	3.34E-03	5.65E-03				Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	Be-7	3.37E-02	pCi/m3	2.71E-03	4.31E-03				Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	Co-60	1.68E-05	pCi/m3	6.62E-05	6.66E-05	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	Co-60	1.51E-05	pCi/m3	8.63E-05	8.65E-05	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	Cs-134	-3.35E-06	pCi/m3	6.86E-05	6.87E-05	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	Cs-134	7.06E-05	pCi/m3	7.58E-05	8.27E-05	U			Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Cs-137	4.04E-05	pCi/m3	6.00E-05	6.29E-05	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Cs-137	-9.25E-06	pCi/m3	7.02E-05	7.03E-05	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Eu-152	-5.11E-05	pCi/m3	1.72E-04	1.73E-04	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Eu-152	-4.95E-05	pCi/m3	1.50E-04	1.51E-04	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Eu-154	2.00E-05	pCi/m3	2.23E-04	2.23E-04	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Eu-154	-9.06E-05	pCi/m3	2.12E-04	2.16E-04	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Eu-155	6.21E-05	pCi/m3	1.63E-04	1.65E-04	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Eu-155	3.67E-05	pCi/m3	1.16E-04	1.17E-04	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	K-40	1.73E-03	pCi/m3	2.69E-03	2.70E-03	UX	Results are considered a false positive due to high counting uncertainty.		Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	K-40	5.12E-03	pCi/m3	1.50E-03	1.58E-03				Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Ru-106	7.00E-04	pCi/m3	5.96E-04	6.80E-04	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Ru-106	-3.69E-04	pCi/m3	5.70E-04	5.95E-04	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Sb-125	1.91E-05	pCi/m3	1.70E-04	1.70E-04	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Sb-125	-9.38E-09	pCi/m3	1.35E-04	1.35E-04	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Am-241	8.70E-07	pCi/m3	9.09E-06	9.12E-06	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Am-241	1.50E-05	pCi/m3	1.84E-05	1.85E-05	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Am-243	-4.43E-06	pCi/m3	4.27E-06	4.29E-06	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Am-243	3.52E-06	pCi/m3	3.01E-05	3.01E-05	U	REFER TO ANOMALOUS DATA REPORT.		Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Cm-243/244	-2.97E-06	pCi/m3	6.88E-06	6.91E-06	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Cm-243/244	9.95E-06	pCi/m3	1.19E-05	1.20E-05	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Pu-238	-1.55E-06	pCi/m3	5.23E-06	5.24E-06	U			Y
PNL-2	FILTER2 SOLAR	533893002	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Pu-238	7.68E-07	pCi/m3	8.75E-06	8.76E-06	U			Y
PNL-2	FILTER2 SOLAR	517129002	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Pu-239/240	5.37E-07	pCi/m3	6.12E-06	6.13E-06	U			Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS	COUNT- ING ERROR	TOTAL ANAL ERROR	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-2	FILTER2	533893002	1-Jul-20	30-Dec-20	Pu-239/240	1.92E-06	pCi/m3	8.59E-06	8.60E-06	U					Y
PNL-2	SOLAR														
PNL-2	FILTER2	517129002	31-Dec-19	17-Jun-20	U-233/234	4.24E-05	pCi/m3	1.69E-05	1.80E-05						Y
PNL-2	SOLAR														
PNL-2	FILTER2	533893002	1-Jul-20	30-Dec-20	U-233/234	7.41E-05	pCi/m3	2.31E-05	2.59E-05						Y
PNL-2	SOLAR														
PNL-2	FILTER2	517129002	31-Dec-19	17-Jun-20	U-235	1.84E-06	pCi/m3	5.18E-06	5.18E-06	U					Y
PNL-2	SOLAR														
PNL-2	FILTER2	533893002	1-Jul-20	30-Dec-20	U-235	1.71E-06	pCi/m3	7.67E-06	7.68E-06	U					Y
PNL-2	SOLAR														
PNL-2	FILTER2	517129002	31-Dec-19	17-Jun-20	U-238	3.73E-05	pCi/m3	1.56E-05	1.65E-05						Y
PNL-2	SOLAR														
PNL-2	FILTER2	533893002	1-Jul-20	30-Dec-20	U-238	5.47E-05	pCi/m3	2.03E-05	2.20E-05						Y
PNL-2	SOLAR														
PNL-3	FILTER2	501502003	31-Dec-19	15-Jan-20	ALPHA	6.69E-04	pCi/m3	2.93E-04	2.93E-04						
PNL-3	FILTER2	503226003	15-Jan-20	29-Jan-20	ALPHA	8.10E-04	pCi/m3	3.93E-04	3.94E-04						
PNL-3	FILTER2	504706003	29-Jan-20	12-Feb-20	ALPHA	6.45E-04	pCi/m3	3.63E-04	3.64E-04						
PNL-3	FILTER2	506009003	12-Feb-20	26-Feb-20	ALPHA	9.19E-04	pCi/m3	4.23E-04	4.23E-04						
PNL-3	FILTER2	507090003	26-Feb-20	11-Mar-20	ALPHA	4.36E-04	pCi/m3	2.94E-04	2.94E-04	O			TOTALIZER #28915 EXPIRING 03/19/20 WAS REPLACED ON 03/11/20 WITH TOTALIZER #42288. EXPIRES 12/26/20. TOTAL VOLUME LOW.		
PNL-3	FILTER2	507996003	11-Mar-20	25-Mar-20	ALPHA	1.61E-03	pCi/m3	9.06E-04	9.07E-04						
PNL-3	FILTER2	509102003	25-Mar-20	8-Apr-20	ALPHA	4.27E-04	pCi/m3	2.61E-04	2.61E-04						
PNL-3	FILTER2	510128003	8-Apr-20	22-Apr-20	ALPHA	5.10E-04	pCi/m3	2.94E-04	2.95E-04						
PNL-3	FILTER2	511164003	22-Apr-20	7-May-20	ALPHA	2.85E-04	pCi/m3	2.11E-04	2.11E-04				DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-3	FILTER2	512005003	7-May-20	20-May-20	ALPHA	4.51E-04	pCi/m3	2.64E-04	2.64E-04						
PNL-3	FILTER2	513197003	20-May-20	3-Jun-20	ALPHA	6.61E-04	pCi/m3	3.27E-04	3.27E-04						
PNL-3	FILTER2	514086003	3-Jun-20	17-Jun-20	ALPHA	3.46E-04	pCi/m3	2.43E-04	2.43E-04						
PNL-3	FILTER2	515186003	17-Jun-20	1-Jul-20	ALPHA	3.22E-04	pCi/m3	2.37E-04	2.37E-04	UO					
PNL-3	FILTER2	516218003	1-Jul-20	15-Jul-20	ALPHA	5.65E-04	pCi/m3	2.85E-04	2.87E-04	O					
PNL-3	FILTER2	517093003	15-Jul-20	29-Jul-20	ALPHA	5.98E-04	pCi/m3	2.94E-04	2.95E-04				PUMP REPLACED. TOTALIZER NOT RUNNING AFTER RESETTNG GFCL, REPLACED THE PUMP.		
PNL-3	FILTER2	518719003	29-Jul-20	12-Aug-20	ALPHA	5.95E-04	pCi/m3	3.11E-04	3.11E-04						
PNL-3	FILTER2	520023003	12-Aug-20	26-Aug-20	ALPHA	3.34E-04	pCi/m3	2.29E-04	2.29E-04	O					
PNL-3	FILTER2	521289003	26-Aug-20	9-Sep-20	ALPHA	4.83E-04	pCi/m3	2.49E-04	2.49E-04						
PNL-3	FILTER2	522713003	9-Sep-20	23-Sep-20	ALPHA	1.76E-03	pCi/m3	4.21E-04	4.22E-04						
PNL-3	FILTER2	524619003	23-Sep-20	7-Oct-20	ALPHA	6.39E-04	pCi/m3	3.06E-04	3.06E-04						

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS	ANAL COUNT-ING ERROR	TOTAL ANAL SIGMA	LAB QUAL-IFIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-3	FILTER2	525255003	7-Oct-20	21-Oct-20	ALPHA	5.59E-04	pCi/m3	2.70E-04	2.71E-04	O	TOTAL SAMPLE VOLUME MANUALLY CALCULATED (912 M3) USING SAMPLE ON/OFF DATES. DIGITS ON DISPLAY NOT ROLLING OVER. TOTALIZER 42288 REPLACED WITH 24562 ON 10/21/2020, START VOLUME 5138 M3, EXPIRES 05/28/2021.				
PNL-3	FILTER2	526700003	21-Oct-20	4-Nov-20	ALPHA	7.14E-04	pCi/m3	3.16E-04	3.16E-04						
PNL-3	FILTER2	528348003	4-Nov-20	18-Nov-20	ALPHA	4.90E-04	pCi/m3	2.85E-04	2.85E-04						
PNL-3	FILTER2	529604003	18-Nov-20	2-Dec-20	ALPHA	7.82E-04	pCi/m3	3.12E-04	3.12E-04						
PNL-3	FILTER2	530881003	2-Dec-20	16-Dec-20	ALPHA	1.54E-03	pCi/m3	4.28E-04	4.30E-04						
PNL-3	FILTER2	531349003	16-Dec-20	30-Dec-20	ALPHA	2.53E-04	pCi/m3	2.17E-04	2.17E-04	U					
PNL-3	FILTER2	501502003	31-Dec-19	15-Jan-20	BETA	9.70E-03	pCi/m3	7.89E-04	8.00E-04	O					
PNL-3	FILTER2	503226003	15-Jan-20	29-Jan-20	BETA	1.64E-02	pCi/m3	1.04E-03	1.06E-03	O					
PNL-3	FILTER2	504706003	29-Jan-20	12-Feb-20	BETA	8.86E-03	pCi/m3	7.87E-04	8.71E-04	O					
PNL-3	FILTER2	506009003	12-Feb-20	26-Feb-20	BETA	1.37E-02	pCi/m3	9.43E-04	9.70E-04	O					
PNL-3	FILTER2	507090003	26-Feb-20	11-Mar-20	BETA	8.65E-03	pCi/m3	7.48E-04	7.59E-04	O			TOTALIZER #28915 EXPIRING 03/19/20 WAS REPLACED ON 03/11/20 WITH TOTALIZER #42288, EXPIRES 12/26/20. TOTAL VOLUME LOW.		
PNL-3	FILTER2	507996003	11-Mar-20	25-Mar-20	BETA	5.27E-02	pCi/m3	2.90E-03	3.30E-03	O					
PNL-3	FILTER2	509102003	25-Mar-20	8-Apr-20	BETA	9.23E-03	pCi/m3	7.69E-04	8.59E-04	O					
PNL-3	FILTER2	510128003	8-Apr-20	22-Apr-20	BETA	1.27E-02	pCi/m3	8.88E-04	9.03E-04	O					
PNL-3	FILTER2	511164003	22-Apr-20	7-May-20	BETA	8.93E-03	pCi/m3	7.51E-04	7.61E-04	O			DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-3	FILTER2	512005003	7-May-20	20-May-20	BETA	9.30E-03	pCi/m3	8.10E-04	8.17E-04	O					
PNL-3	FILTER2	513197003	20-May-20	3-Jun-20	BETA	1.06E-02	pCi/m3	8.24E-04	8.39E-04	O					
PNL-3	FILTER2	514086003	3-Jun-20	17-Jun-20	BETA	9.00E-03	pCi/m3	7.55E-04	8.05E-04	O					
PNL-3	FILTER2	515186003	17-Jun-20	1-Jul-20	BETA	8.77E-03	pCi/m3	7.41E-04	7.53E-04	O					
PNL-3	FILTER2	516218003	1-Jul-20	15-Jul-20	BETA	1.02E-02	pCi/m3	7.88E-04	8.95E-04	O					
PNL-3	FILTER2	517093003	15-Jul-20	29-Jul-20	BETA	1.13E-02	pCi/m3	8.46E-04	9.46E-04	O			PUMP REPLACED. TOTALIZER NOT RUNNING AFTER RESETING GFCL, REPLACED THE PUMP.		
PNL-3	FILTER2	518719003	29-Jul-20	12-Aug-20	BETA	1.44E-02	pCi/m3	1.01E-03	1.03E-03	O					
PNL-3	FILTER2	520023003	12-Aug-20	26-Aug-20	BETA	1.20E-02	pCi/m3	8.84E-04	8.97E-04	O					
PNL-3	FILTER2	521289003	26-Aug-20	9-Sep-20	BETA	1.19E-02	pCi/m3	8.40E-04	8.60E-04	O					
PNL-3	FILTER2	522713003	9-Sep-20	23-Sep-20	BETA	1.12E-02	pCi/m3	8.12E-04	8.29E-04	O					
PNL-3	FILTER2	524619003	23-Sep-20	7-Oct-20	BETA	2.63E-02	pCi/m3	1.39E-03	1.72E-03	O					

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS	COUNT- ING ERROR	TOTAL ANAL ERROR	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-3	FILTER2	525255003	7-Oct-20	21-Oct-20		BETA	1.10E-02	pCi/m3	8.59E-04	9.03E-04	O	TOTAL SAMPLE VOLUME MANUALLY CALCULATED (912 M3) USING SAMPLE ON/OFF DATES, DIGITS ON DISPLAY NOT ROLLING OVER. TOTALIZER 42288 REPLACED WITH 24562 ON 10/21/2020, START VOLUME 5138 M3, EXPIRES 05/28/2021.		
PNL-3	FILTER2	526700003	21-Oct-20	4-Nov-20		BETA	3.12E-02	pCi/m3	1.40E-03	1.54E-03	O			
PNL-3	FILTER2	528348003	4-Nov-20	18-Nov-20		BETA	1.18E-02	pCi/m3	9.13E-04	9.79E-04	O			
PNL-3	FILTER2	529604003	18-Nov-20	2-Dec-20		BETA	1.48E-02	pCi/m3	9.73E-04	9.89E-04	O			
PNL-3	FILTER2	530881003	2-Dec-20	16-Dec-20		BETA	4.05E-02	pCi/m3	1.60E-03	1.84E-03	O			
PNL-3	FILTER2	531349003	16-Dec-20	30-Dec-20		BETA	1.59E-02	pCi/m3	1.03E-03	1.05E-03	O			
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Be-7	5.29E-02	pCi/m3	3.57E-03	6.10E-03				Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Be-7	3.20E-02	pCi/m3	2.45E-03	4.18E-03				Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Co-60	-8.60E-05	pCi/m3	9.11E-05	9.94E-05	U			Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Co-60	7.80E-05	pCi/m3	6.66E-05	7.56E-05	U			Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Cs-134	2.12E-05	pCi/m3	6.25E-05	6.33E-05	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Cs-134	-8.50E-07	pCi/m3	7.07E-05	7.07E-05	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Cs-137	5.72E-05	pCi/m3	6.87E-05	7.36E-05	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Cs-137	2.21E-05	pCi/m3	6.44E-05	6.52E-05	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Eu-152	-2.55E-05	pCi/m3	1.52E-04	1.52E-04	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Eu-152	-3.79E-05	pCi/m3	1.49E-04	1.50E-04	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Eu-154	2.43E-05	pCi/m3	1.84E-04	1.84E-04	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Eu-154	1.32E-04	pCi/m3	1.80E-04	1.89E-04	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Eu-155	1.00E-05	pCi/m3	1.49E-04	1.49E-04	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Eu-155	1.96E-04	pCi/m3	2.06E-04	2.25E-04	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		K-40	2.98E-03	pCi/m3	1.69E-03	1.72E-03			Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		K-40	2.81E-03	pCi/m3	1.93E-03	1.95E-03			Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Ru-106	3.32E-04	pCi/m3	5.66E-04	5.87E-04	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Ru-106	-4.90E-04	pCi/m3	5.26E-04	5.75E-04	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Sb-125	-4.44E-05	pCi/m3	1.55E-04	1.56E-04	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Sb-125	-8.18E-05	pCi/m3	1.31E-04	1.36E-04	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Am-241	2.18E-06	pCi/m3	8.41E-06	8.41E-06	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Am-241	1.42E-05	pCi/m3	1.67E-05	1.67E-05	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Am-243	-8.21E-07	pCi/m3	4.83E-06	4.83E-06	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Am-243	7.22E-06	pCi/m3	2.45E-05	2.45E-05	U	REFER TO ANOMALOUS DATA REPORT.	Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Cm-243/244	2.09E-06	pCi/m3	7.14E-06	7.15E-06	U		Y	
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20		Cm-243/244	2.81E-06	pCi/m3	1.99E-05	1.99E-05	U		Y	
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20		Pu-238	5.60E-06	pCi/m3	6.41E-06	6.45E-06	U		Y	

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20	Pu-238	1.31E-13	pCi/m3	3.07E-06	3.07E-06	U			Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20	Pu-239/240	-3.14E-07	pCi/m3	2.70E-06	2.71E-06	U			Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20	Pu-239/240	7.82E-07	pCi/m3	4.60E-06	4.60E-06	U			Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20	U-233/234	6.14E-05	pCi/m3	1.97E-05	2.16E-05				Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20	U-233/234	4.02E-05	pCi/m3	1.67E-05	1.79E-05				Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20	U-235	7.28E-08	pCi/m3	5.40E-06	5.40E-06	U			Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20	U-235	-1.94E-06	pCi/m3	4.49E-06	4.51E-06	U			Y
PNL-3	FILTER2	517129003	31-Dec-19	17-Jun-20	U-238	6.90E-05	pCi/m3	2.05E-05	2.27E-05				Y
PNL-3	FILTER2	533893003	1-Jul-20	30-Dec-20	U-238	5.93E-05	pCi/m3	1.98E-05	2.19E-05				Y
PNL-4	FILTER2	501502004	31-Dec-19	15-Jan-20	ALPHA	6.36E-04	pCi/m3	3.37E-04	3.38E-04				
PNL-4	FILTER2	503226004	15-Jan-20	29-Jan-20	ALPHA	8.14E-04	pCi/m3	3.93E-04	3.94E-04				
PNL-4	FILTER2	504706004	29-Jan-20	12-Feb-20	ALPHA	1.04E-03	pCi/m3	4.96E-04	4.97E-04				
PNL-4	FILTER2	506009004	12-Feb-20	26-Feb-20	ALPHA	4.57E-04	pCi/m3	3.23E-04	3.23E-04				
PNL-4	FILTER2	507090004	26-Feb-20	11-Mar-20	ALPHA	5.23E-04	pCi/m3	2.98E-04	2.98E-04	O			
PNL-4	FILTER2	507996004	11-Mar-20	25-Mar-20	ALPHA	8.26E-04	pCi/m3	4.74E-04	4.75E-04				
PNL-4	FILTER2	509102004	25-Mar-20	8-Apr-20	ALPHA	9.88E-04	pCi/m3	4.74E-04	4.74E-04				
PNL-4	FILTER2	510128004	8-Apr-20	22-Apr-20	ALPHA	8.36E-04	pCi/m3	3.82E-04	3.82E-04				
PNL-4	FILTER2	511164004	22-Apr-20	7-May-20	ALPHA	3.77E-04	pCi/m3	2.45E-04	2.45E-04		DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-4	FILTER2	512005004	7-May-20	20-May-20	ALPHA	2.75E-04	pCi/m3	2.50E-04	2.51E-04	U			
PNL-4	FILTER2	513197004	20-May-20	3-Jun-20	ALPHA	3.68E-04	pCi/m3	2.39E-04	2.39E-04				
PNL-4	FILTER2	514086004	3-Jun-20	17-Jun-20	ALPHA	5.34E-04	pCi/m3	2.82E-04	2.82E-04				
PNL-4	FILTER2	515186004	17-Jun-20	1-Jul-20	ALPHA	3.63E-04	pCi/m3	2.93E-04	2.93E-04	UO			
PNL-4	FILTER2	516218004	1-Jul-20	15-Jul-20	ALPHA	4.04E-04	pCi/m3	2.52E-04	2.53E-04	O			
PNL-4	FILTER2	517093004	15-Jul-20	29-Jul-20	ALPHA	4.52E-04	pCi/m3	2.61E-04	2.62E-04				
PNL-4	FILTER2	518719004	29-Jul-20	12-Aug-20	ALPHA	2.78E-04	pCi/m3	2.17E-04	2.17E-04	U			
PNL-4	FILTER2	520023004	12-Aug-20	26-Aug-20	ALPHA	3.99E-04	pCi/m3	2.81E-04	2.81E-04	O			
PNL-4	FILTER2	521289004	26-Aug-20	9-Sep-20	ALPHA	9.31E-04	pCi/m3	3.63E-04	3.63E-04				
PNL-4	FILTER2	522713004	9-Sep-20	23-Sep-20	ALPHA	1.34E-03	pCi/m3	3.18E-04	3.21E-04				
PNL-4	FILTER2	524619004	23-Sep-20	7-Oct-20	ALPHA	7.97E-04	pCi/m3	3.18E-04	3.18E-04		TOTALIZER #41444 EXPIRING 10/07/20 WAS REPLACED ON 10/07/20 WITH TOTALIZER #24966. EXPIRES 09/09/21.		
PNL-4	FILTER2	525255004	7-Oct-20	21-Oct-20	ALPHA	4.02E-04	pCi/m3	2.51E-04	2.51E-04	O			
PNL-4	FILTER2	526700004	21-Oct-20	4-Nov-20	ALPHA	8.68E-04	pCi/m3	3.42E-04	3.42E-04				
PNL-4	FILTER2	528348004	4-Nov-20	18-Nov-20	ALPHA	7.82E-04	pCi/m3	4.30E-04	4.30E-04				
PNL-4	FILTER2	529604004	18-Nov-20	2-Dec-20	ALPHA	5.36E-04	pCi/m3	2.87E-04	2.87E-04				
PNL-4	FILTER2	530881004	2-Dec-20	16-Dec-20	ALPHA	1.13E-03	pCi/m3	4.35E-04	4.39E-04				

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-4	FILTER2	531349004	16-Dec-20	30-Dec-20	ALPHA	4.81E-04	pCi/m3	3.41E-04	3.41E-04	U			
PNL-4	FILTER2	501502004	31-Dec-19	15-Jan-20	BETA	9.23E-03	pCi/m3	8.19E-04	8.37E-04	O			
PNL-4	FILTER2	503226004	15-Jan-20	29-Jan-20	BETA	1.35E-02	pCi/m3	1.01E-03	1.15E-03	O			
PNL-4	FILTER2	504706004	29-Jan-20	12-Feb-20	BETA	1.00E-02	pCi/m3	8.64E-04	9.46E-04	O			
PNL-4	FILTER2	506009004	12-Feb-20	26-Feb-20	BETA	1.41E-02	pCi/m3	1.00E-03	1.01E-03	O			
PNL-4	FILTER2	507090004	26-Feb-20	11-Mar-20	BETA	1.02E-02	pCi/m3	8.60E-04	8.73E-04	O			
PNL-4	FILTER2	507996004	11-Mar-20	25-Mar-20	BETA	2.16E-02	pCi/m3	1.25E-03	1.31E-03	O			
PNL-4	FILTER2	509102004	25-Mar-20	8-Apr-20	BETA	1.06E-02	pCi/m3	9.95E-04	1.03E-03	O			
PNL-4	FILTER2	510128004	8-Apr-20	22-Apr-20	BETA	1.58E-02	pCi/m3	1.10E-03	1.12E-03	O			
PNL-4	FILTER2	511164004	22-Apr-20	7-May-20	BETA	9.95E-03	pCi/m3	8.32E-04	9.29E-04	O	DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.		
PNL-4	FILTER2	512005004	7-May-20	20-May-20	BETA	8.35E-03	pCi/m3	7.67E-04	8.78E-04	O			
PNL-4	FILTER2	513197004	20-May-20	3-Jun-20	BETA	1.03E-02	pCi/m3	7.97E-04	8.02E-04	O			
PNL-4	FILTER2	514086004	3-Jun-20	17-Jun-20	BETA	7.67E-03	pCi/m3	7.05E-04	7.76E-04	O			
PNL-4	FILTER2	515186004	17-Jun-20	1-Jul-20	BETA	8.80E-03	pCi/m3	7.51E-04	7.75E-04	O			
PNL-4	FILTER2	516218004	1-Jul-20	15-Jul-20	BETA	1.05E-02	pCi/m3	8.54E-04	8.80E-04	O			
PNL-4	FILTER2	517093004	15-Jul-20	29-Jul-20	BETA	1.15E-02	pCi/m3	8.57E-04	9.80E-04	O			
PNL-4	FILTER2	518719004	29-Jul-20	12-Aug-20	BETA	1.31E-02	pCi/m3	9.59E-04	1.00E-03	O			
PNL-4	FILTER2	520023004	12-Aug-20	26-Aug-20	BETA	1.29E-02	pCi/m3	9.27E-04	9.37E-04	O			
PNL-4	FILTER2	521289004	26-Aug-20	9-Sep-20	BETA	1.19E-02	pCi/m3	8.63E-04	9.01E-04	O			
PNL-4	FILTER2	522713004	9-Sep-20	23-Sep-20	BETA	8.83E-03	pCi/m3	6.12E-04	6.23E-04	O			
PNL-4	FILTER2	524619004	23-Sep-20	7-Oct-20	BETA	2.15E-02	pCi/m3	1.14E-03	1.17E-03	O	TOTALIZER #41444 EXPIRING 10/07/20 WAS REPLACED ON 10/07/20 WITH TOTALIZER #24966. EXPIRES 09/09/21.		
PNL-4	FILTER2	525255004	7-Oct-20	21-Oct-20	BETA	1.13E-02	pCi/m3	9.30E-04	9.62E-04	O			
PNL-4	FILTER2	526700004	21-Oct-20	4-Nov-20	BETA	3.37E-02	pCi/m3	1.54E-03	1.71E-03	O			
PNL-4	FILTER2	528348004	4-Nov-20	18-Nov-20	BETA	1.17E-02	pCi/m3	9.40E-04	9.56E-04	O			
PNL-4	FILTER2	529604004	18-Nov-20	2-Dec-20	BETA	1.41E-02	pCi/m3	9.72E-04	9.97E-04	O			
PNL-4	FILTER2	530881004	2-Dec-20	16-Dec-20	BETA	4.00E-02	pCi/m3	1.69E-03	2.37E-03	O			
PNL-4	FILTER2	531349004	16-Dec-20	30-Dec-20	BETA	1.58E-02	pCi/m3	1.06E-03	1.11E-03	O			
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Be-7	5.45E-02	pCi/m3	3.02E-03	5.80E-03				Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Be-7	3.07E-02	pCi/m3	2.06E-03	3.57E-03				Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Co-60	1.50E-05	pCi/m3	7.01E-05	7.05E-05	U			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Co-60	-1.49E-05	pCi/m3	7.72E-05	7.75E-05	U			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Cs-134	1.35E-05	pCi/m3	5.92E-05	5.95E-05	U			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Cs-134	-1.87E-05	pCi/m3	6.52E-05	6.57E-05	U			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Cs-137	-1.72E-05	pCi/m3	6.22E-05	6.27E-05	U			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Cs-137	2.72E-05	pCi/m3	5.92E-05	6.05E-05	U			Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	ANAL COUNT- ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Eu-152	5.26E-05	pCi/m3	1.34E-04	1.36E-04	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Eu-152	8.39E-05	pCi/m3	1.52E-04	1.57E-04	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Eu-154	-1.34E-05	pCi/m3	1.85E-04	1.85E-04	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Eu-154	5.57E-05	pCi/m3	1.91E-04	1.92E-04	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Eu-155	5.02E-05	pCi/m3	1.32E-04	1.34E-04	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Eu-155	-3.21E-05	pCi/m3	1.55E-04	1.56E-04	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	K-40	3.20E-03	pCi/m3	1.95E-03	1.97E-03			Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	K-40	4.72E-03	pCi/m3	1.62E-03	1.70E-03			Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Ru-106	-1.71E-04	pCi/m3	5.68E-04	5.73E-04	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Ru-106	2.98E-04	pCi/m3	5.73E-04	5.90E-04	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Sb-125	2.99E-05	pCi/m3	1.45E-04	1.46E-04	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Sb-125	-3.35E-05	pCi/m3	1.49E-04	1.49E-04	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Am-241	1.61E-06	pCi/m3	4.47E-06	4.48E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Am-241	2.12E-05	pCi/m3	2.14E-05	2.16E-05	U		Y	REFER TO ANOMALOUS DATA REPORT.		Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Am-243	-6.30E-07	pCi/m3	4.45E-06	4.45E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Am-243	-6.39E-06	pCi/m3	2.66E-05	2.66E-05	U		Y	REFER TO ANOMALOUS DATA REPORT.		Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Cm-243/244	-8.03E-07	pCi/m3	4.17E-06	4.17E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Cm-243/244	-6.02E-06	pCi/m3	2.36E-05	2.36E-05	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Pu-238	6.20E-06	pCi/m3	7.31E-06	7.35E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Pu-238	2.78E-06	pCi/m3	9.52E-06	9.53E-06	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	Pu-239/240	-7.89E-07	pCi/m3	3.49E-06	3.50E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	Pu-239/240	-5.13E-06	pCi/m3	6.46E-06	6.48E-06	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	U-233/234	5.26E-05	pCi/m3	1.67E-05	1.81E-05			Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	U-233/234	6.43E-05	pCi/m3	2.13E-05	2.37E-05			Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	U-235	2.66E-06	pCi/m3	6.04E-06	6.05E-06	U		Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	U-235	1.69E-06	pCi/m3	7.58E-06	7.58E-06	U		Y			Y
PNL-4	FILTER2	517129004	31-Dec-19	17-Jun-20	U-238	5.27E-05	pCi/m3	1.64E-05	1.77E-05			Y			Y
PNL-4	FILTER2	533893004	1-Jul-20	30-Dec-20	U-238	5.18E-05	pCi/m3	1.90E-05	2.08E-05			Y			Y
PNL-5	FILTER2	501502005	31-Dec-19	15-Jan-20	ALPHA	6.05E-04	pCi/m3	2.97E-04	2.97E-04						
PNL-5	FILTER2	503226005	15-Jan-20	29-Jan-20	ALPHA	7.16E-04	pCi/m3	3.72E-04	3.73E-04						
PNL-5	FILTER2	504706005	29-Jan-20	12-Feb-20	ALPHA	4.00E-04	pCi/m3	2.76E-04	2.76E-04						
PNL-5	FILTER2	506009005	12-Feb-20	26-Feb-20	ALPHA	4.20E-04	pCi/m3	2.89E-04	2.89E-04						
SAMPLER TURNED OFF ON 2/26/20; PLANNED MAINTENANCE OUTAGE, SAMPLER MOVING ~6-10 FEET.															
PLANNED MAINTENANCE OUTAGE, SAMPLER MOVING ~6-10 FEET. NO SAMPLE. DO NOT SAVE FOR COMPOSITING. (a)															
PNL-5	FILTER2		26-Feb-20	11-Mar-20	ALPHA										

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL- ERROR SIGMA	LAB QUAL- IFER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-5	FILTER2	507996005	11-Mar-20	25-Mar-20	ALPHA	1.72E-03	pCi/m3	5.51E-04	5.52E-04						
PNL-5	FILTER2	509102005	25-Mar-20	8-Apr-20	ALPHA	8.19E-04	pCi/m3	3.28E-04	3.29E-04						
PNL-5	FILTER2	510128005	8-Apr-20	22-Apr-20	ALPHA	8.80E-04	pCi/m3	3.61E-04	3.62E-04						
PNL-5	FILTER2	511164005	22-Apr-20	7-May-20	ALPHA	5.50E-04	pCi/m3	2.78E-04	2.78E-04						
DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.															
PNL-5	FILTER2	512005005	7-May-20	20-May-20	ALPHA	5.23E-04	pCi/m3	2.70E-04	2.70E-04						
PNL-5	FILTER2	513197005	20-May-20	3-Jun-20	ALPHA	3.60E-04	pCi/m3	2.48E-04	2.49E-04						
PNL-5	FILTER2	514086005	3-Jun-20	17-Jun-20	ALPHA	4.87E-04	pCi/m3	2.89E-04	2.89E-04						
PNL-5	FILTER2	515186005	17-Jun-20	1-Jul-20	ALPHA	3.88E-04	pCi/m3	2.57E-04	2.58E-04			O			
PNL-5	FILTER2	516218005	1-Jul-20	15-Jul-20	ALPHA	5.97E-05	pCi/m3	2.15E-04	2.15E-04			UO			
PNL-5	FILTER2	517093005	15-Jul-20	29-Jul-20	ALPHA	8.78E-04	pCi/m3	3.43E-04	3.44E-04						
PNL-5	FILTER2	518719005	29-Jul-20	12-Aug-20	ALPHA	4.17E-04	pCi/m3	2.41E-04	2.41E-04						
PNL-5	FILTER2	520023005	12-Aug-20	26-Aug-20	ALPHA	3.07E-04	pCi/m3	2.46E-04	2.46E-04			UO			
PNL-5	FILTER2	521289005	26-Aug-20	9-Sep-20	ALPHA	7.42E-04	pCi/m3	3.06E-04	3.07E-04						
PNL-5	FILTER2	522713005	9-Sep-20	23-Sep-20	ALPHA	1.69E-03	pCi/m3	4.35E-04	4.36E-04						
PNL-5	FILTER2	524619005	23-Sep-20	7-Oct-20	ALPHA	4.00E-04	pCi/m3	2.37E-04	2.37E-04						
PNL-5	FILTER2	525255005	7-Oct-20	21-Oct-20	ALPHA	6.19E-04	pCi/m3	2.69E-04	2.70E-04			O			
PNL-5	FILTER2	526700005	21-Oct-20	4-Nov-20	ALPHA	5.71E-04	pCi/m3	2.46E-04	2.46E-04						
PNL-5	FILTER2	528348005	4-Nov-20	18-Nov-20	ALPHA	5.52E-04	pCi/m3	2.88E-04	2.88E-04						
PNL-5	FILTER2	529604005	18-Nov-20	2-Dec-20	ALPHA	3.51E-04	pCi/m3	2.52E-04	2.52E-04			U			
PNL-5	FILTER2	530881005	2-Dec-20	16-Dec-20	ALPHA	8.18E-04	pCi/m3	3.31E-04	3.33E-04						
PNL-5	FILTER2	531349005	16-Dec-20	30-Dec-20	ALPHA	5.91E-04	pCi/m3	2.73E-04	2.74E-04						
PNL-5	FILTER2	501502005	31-Dec-19	15-Jan-20	BETA	8.75E-03	pCi/m3	7.39E-04	7.65E-04			O			
PNL-5	FILTER2	503226005	15-Jan-20	29-Jan-20	BETA	1.53E-02	pCi/m3	1.07E-03	1.13E-03			O			
PNL-5	FILTER2	504706005	29-Jan-20	12-Feb-20	BETA	8.52E-03	pCi/m3	7.36E-04	7.46E-04			O			
PNL-5	FILTER2	506009005	12-Feb-20	26-Feb-20	BETA	1.19E-02	pCi/m3	8.39E-04	8.53E-04			O			
SAMPLER TURNED OFF ON 2/26/20; PLANNED MAINTENANCE OUTAGE, SAMPLER MOVING ~6-10 FEET.															
PNL-5	FILTER2		26-Feb-20	11-Mar-20	BETA										
PLANNED MAINTENANCE OUTAGE, SAMPLER MOVING ~6-10 FEET. NO SAMPLE. DO NOT SAVE FOR COMPOSITING. ^(a)															
PNL-5	FILTER2	507996005	11-Mar-20	25-Mar-20	BETA	1.87E-02	pCi/m3	1.08E-03	1.12E-03			O			
PNL-5	FILTER2	509102005	25-Mar-20	8-Apr-20	BETA	9.47E-03	pCi/m3	7.89E-04	8.01E-04			O			
PNL-5	FILTER2	510128005	8-Apr-20	22-Apr-20	BETA	1.37E-02	pCi/m3	9.12E-04	9.28E-04			O			
PNL-5	FILTER2	511164005	22-Apr-20	7-May-20	BETA	9.58E-03	pCi/m3	8.21E-04	8.56E-04			O			
DUE TO OTHER REQUIRED SAMPLING ACTIVITIES, AIR SAMPLING OCCURRED OVER TWO-DAYS.															
PNL-5	FILTER2	512005005	7-May-20	20-May-20	BETA	8.98E-03	pCi/m3	7.73E-04	7.81E-04			O			

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL ERROR	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-5	FILTER2	513197005	20-May-20	3-Jun-20	17-Jun-20	3-Jun-20	BETA	9.00E-03	pCi/m3	7.29E-04	7.39E-04	O			
PNL-5	FILTER2	514086005	3-Jun-20	17-Jun-20	17-Jun-20	17-Jun-20	BETA	7.68E-03	pCi/m3	6.98E-04	7.58E-04	O			
PNL-5	FILTER2	515186005	17-Jun-20	1-Jul-20	1-Jul-20	1-Jul-20	BETA	9.45E-03	pCi/m3	7.75E-04	8.29E-04	O			
PNL-5	FILTER2	516218005	1-Jul-20	15-Jul-20	15-Jul-20	15-Jul-20	BETA	8.70E-03	pCi/m3	7.88E-04	8.48E-04	O			
PNL-5	FILTER2	517093005	15-Jul-20	29-Jul-20	29-Jul-20	29-Jul-20	BETA	1.19E-02	pCi/m3	8.74E-04	9.44E-04	O			
PNL-5	FILTER2	518719005	29-Jul-20	12-Aug-20	12-Aug-20	12-Aug-20	BETA	1.38E-02	pCi/m3	9.66E-04	1.09E-03	O			
PNL-5	FILTER2	520023005	12-Aug-20	26-Aug-20	26-Aug-20	26-Aug-20	BETA	1.32E-02	pCi/m3	9.38E-04	9.55E-04	O			
PNL-5	FILTER2	521289005	26-Aug-20	9-Sep-20	9-Sep-20	9-Sep-20	BETA	1.39E-02	pCi/m3	9.20E-04	1.02E-03	O			
PNL-5	FILTER2	522713005	9-Sep-20	23-Sep-20	23-Sep-20	23-Sep-20	BETA	1.26E-02	pCi/m3	9.09E-04	9.23E-04	O			
PNL-5	FILTER2	524619005	23-Sep-20	7-Oct-20	7-Oct-20	7-Oct-20	BETA	2.03E-02	pCi/m3	1.09E-03	1.12E-03	O			
PNL-5	FILTER2	525255005	7-Oct-20	21-Oct-20	21-Oct-20	21-Oct-20	BETA	9.54E-03	pCi/m3	8.01E-04	8.74E-04	O			
PNL-5	FILTER2	526700005	21-Oct-20	4-Nov-20	4-Nov-20	4-Nov-20	BETA	2.98E-02	pCi/m3	1.32E-03	1.38E-03	O			
PNL-5	FILTER2	528348005	4-Nov-20	18-Nov-20	18-Nov-20	18-Nov-20	BETA	8.52E-03	pCi/m3	7.72E-04	7.79E-04	O			
PNL-5	FILTER2	529604005	18-Nov-20	2-Dec-20	2-Dec-20	2-Dec-20	BETA	1.19E-02	pCi/m3	8.34E-04	8.74E-04	O			
PNL-5	FILTER2	530881005	2-Dec-20	16-Dec-20	16-Dec-20	16-Dec-20	BETA	3.30E-02	pCi/m3	1.38E-03	1.82E-03	O			
PNL-5	FILTER2	531349005	16-Dec-20	30-Dec-20	30-Dec-20	30-Dec-20	BETA	1.47E-02	pCi/m3	9.67E-04	1.15E-03	O			
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Be-7	4.80E-02	pCi/m3	3.42E-03	5.79E-03			REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Be-7	3.18E-02	pCi/m3	3.32E-03	4.44E-03				Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Co-60	3.79E-05	pCi/m3	7.33E-05	7.53E-05	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Co-60	7.95E-06	pCi/m3	7.26E-05	7.27E-05	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Cs-134	-2.23E-05	pCi/m3	7.80E-05	7.87E-05	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Cs-134	4.05E-05	pCi/m3	8.84E-05	9.04E-05	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Cs-137	-2.60E-05	pCi/m3	7.56E-05	7.66E-05	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Cs-137	1.06E-05	pCi/m3	7.26E-05	7.28E-05	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	17-Jun-20	17-Jun-20	Eu-152	5.98E-05	pCi/m3	1.94E-04	1.96E-04	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	30-Dec-20	30-Dec-20	Eu-152	-6.06E-05	pCi/m3	2.11E-04	2.13E-04	U			Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE	SAMP TIME ON	SAMP DATE	SAMP TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS	ANAL COUNT-ING ERROR	TOTAL ANAL ERROR SIGMA	LAB QUAL-IFER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Eu-154	2.12E-04	pCi/m3	2.18E-04	2.39E-04	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Eu-154	2.15E-04	pCi/m3	3.03E-04	3.19E-04	U					Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Eu-155	-4.20E-05	pCi/m3	1.61E-04	1.63E-04	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Eu-155	-2.11E-05	pCi/m3	2.24E-04	2.24E-04	U					Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	K-40	1.47E-03	pCi/m3	1.38E-03	1.53E-03	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	K-40	2.43E-03	pCi/m3	2.76E-03	2.77E-03	UX				Results are considered a false positive due to high counting uncertainty.	Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Ru-106	-7.35E-05	pCi/m3	6.73E-04	6.74E-04	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Ru-106	1.62E-04	pCi/m3	7.03E-04	7.07E-04	U					Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Sb-125	-3.56E-05	pCi/m3	1.89E-04	1.90E-04	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Sb-125	8.60E-06	pCi/m3	2.09E-04	2.09E-04	U					Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Am-241	9.25E-06	pCi/m3	8.59E-06	8.67E-06	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Am-241	-5.96E-06	pCi/m3	2.34E-05	2.34E-05	U				REFER TO ANOMALOUS DATA REPORT.	Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Am-243	2.02E-06	pCi/m3	4.85E-06	4.86E-06	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Am-243	3.89E-05	pCi/m3	2.83E-05	2.86E-05	U					Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Cm-243/244	1.32E-06	pCi/m3	7.73E-06	7.74E-06	U				REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED	Y

Table C.2 (contd)

SAMP SITE NAME	SAMP MTHD	LAB SAMP ID	SAMP DATE TIME ON	SAMP DATE TIME	CON SHORT NAME	VALUE RPTD	ANAL UNITS RPTD	COUNT- ING ERROR	TOTAL ANAL ERROR 2- SIGMA	LAB QUAL- IFIER	SAMP COMMENT	RESULT COMMENT	COM- POSITE FLAG
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Cm-243/244	-5.92E-06	pCi/m3	3.18E-05	3.18E-05	U		OUTAGE WAS INCLUDED IN COMPOSITE VOLUME. REFER TO ANOMALOUS DATA REPORT.	Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Pu-238	9.55E-07	pCi/m3	5.99E-06	5.99E-06	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Pu-238	-1.16E-06	pCi/m3	3.50E-06	3.51E-06	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	Pu-239/240	-2.92E-06	pCi/m3	5.36E-06	5.36E-06	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	Pu-239/240	-7.07E-07	pCi/m3	4.88E-06	4.89E-06	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	U-233/234	4.22E-05	pCi/m3	2.41E-05	2.48E-05			REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	U-233/234	5.98E-05	pCi/m3	1.82E-05	2.03E-05				Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	U-235	4.95E-06	pCi/m3	1.14E-05	1.14E-05	U		REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	U-235	1.63E-06	pCi/m3	4.59E-06	4.60E-06	U			Y
PNL-5	FILTER2	517129005	31-Dec-19	17-Jun-20	U-238	2.67E-05	pCi/m3	1.98E-05	2.01E-05			REFER TO DISCREPANCY REPORT EMP20-005, FILTER B3VCP3 (423 m3) COLLECTED DURING PLANNED OUTAGE WAS INCLUDED IN COMPOSITE VOLUME.	Y
PNL-5	FILTER2	533893005	1-Jul-20	30-Dec-20	U-238	3.38E-05	pCi/m3	1.38E-05	1.47E-05				Y

(a) Refer to Discrepancy Report EMP20-005 regarding biannual composite (LAB SAMP ID 517129005); composite included sample volume collected from PNL-5 on 11-Mar-20 during a planned maintenance outage.

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