PNNL-20436-7

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle Since 1965

PNNL Richland Campus Radionuclide Air Emissions Report for Calendar Year 2016

June 2017

SF Snyder
JM Barnett
LE Bisping

U.S. DEPARTMENT OF ENERGY

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

DISCLAIMER

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

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <http://www.ntis.gov/about/form.aspx>
Online ordering: http://www.ntis.gov

This document was printed on recycled paper.
(8/2010)

PNNL Richland Campus Radionuclide Air Emissions Report for Calendar Year 2016

SF Snyder
JM Barnett
LE Bisping

June 2017

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

Pacific Northwest National Laboratory
Richland, Washington 99352

***Cover photo**: Radiation Detection Laboratory, PNNL Richland Campus.*

Summary

The U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory (PNNL) facilities with potential emissions of radioactive materials at the DOE-SC PNNL Richland Campus are research laboratories at the Physical Sciences Facility, Life Sciences Laboratory-II, and Research Technology Laboratory complex. 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 2016 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 are inclusive of fugitive emissions with regard to complying with the dose standard. The regulations impose a standard of 10 millirem per year (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 from 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 dose to the Campus MEI from routine major and minor point source emissions in 2016 from PNNL Richland Campus sources is 5.8E-04 mrem (5.8E-06 mSv) EDE. The MEI dose from all PNNL Richland Campus fugitive sources is 1.9E-06 mrem (1.9E-08 mSv) EDE. The dose from radon emissions is 1.3E-08 mrem (1.3E-10 mSv) EDE. No nonroutine emissions from Campus facilities occurred in 2016. The total radiological dose to the MEI from all PNNL Richland Campus radionuclide emissions in 2016, including fugitive emissions and radon, is 5.8E-04 mrem (5.8E-06 mSv) EDE, or more than 10,000 times less than the federal and state standard of 10 mrem/yr, with which the PNNL Richland Campus is in compliance.

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

CERTIFICATION of PNNL-20436-7

DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2016

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)]

for RES

6-12-17

Roger E. Snyder, Manager
U.S. Department of Energy
Pacific Northwest Site Office

Date

Acronyms and Abbreviations

AREVA	AREVA Federal Services, LLC
Bq	becquerel(s)
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
LSLII	Life Sciences Laboratory-II
Major	a radioactive 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 radioactive point source having a radiological dose potential of less than or equal to 0.1 mrem/yr EDE, based on emissions that would result if all pollution-control equipment did not exist but facility operations were otherwise normal
mrem	millirem [i.e., 1.0×10^{-3} rem = 1.0E-03 rem]
mSv	millisievert
NA	not applicable
ND	not detected
NDRM	non-dispersible radioactive material
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
PCM	periodic confirmatory measurement
PIC-5	Potential Impact Category-5
PNNL	Pacific Northwest National Laboratory
PNSO	U.S. DOE Pacific Northwest Site Office
PSF	Physical Sciences Facility
QA	quality assurance
RAEL	radioactive air emissions license
rem	roentgen equivalent man
RTL	Research Technology Laboratory
SC	DOE Office of Science
VRRM	volumetrically released radioactive material
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

Contents

Figures

Tables

1.0 Introduction

This report documents calendar year (CY) 2016 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 (2011), "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," and in Washington Administrative Code (WAC) Chapter 246-247 (2016), "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 CY2016 operations.

This report is available online at https://science.energy.gov/pnso/resources/.

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

1.1 PNNL Richland Campus Description

The PNNL Richland Campus (PNSO 2013) is located in southeastern Washington State and encompasses the DOE PNNL Site (Figure 1.1; orange boundary and yellow boundary, respectively). It is less than 1 mile south of the much larger DOE Hanford Site (Figure 1.2): the Campus occupies 1.0 mi^2 (2.7 km^2) just south of the Hanford Site 300 Area, whereas the Hanford Site occupies about 580 mi^2 (1,502 km^2). The PNNL Site occupies an area of 0.54 mi^2 (1.4 km^2). 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 PNNL Richland Campus to the northeast. 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 chartered the Pacific Northwest Site Office within DOE-SC to oversee the operation of the 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 Site, with boundaries identified in Figure 1.1 (yellow boundary), was established in the last decade. The PNNL Richland Campus (orange boundary) includes the Physical Sciences Facility (PSF), Research Technology Laboratory (RTL), and Life Sciences Laboratory-II (LSLII) facilities, as identified in Figure 1.1. Other facilities on the PNNL Richland Campus have been owned or leased by Battelle since the mid-1960s.

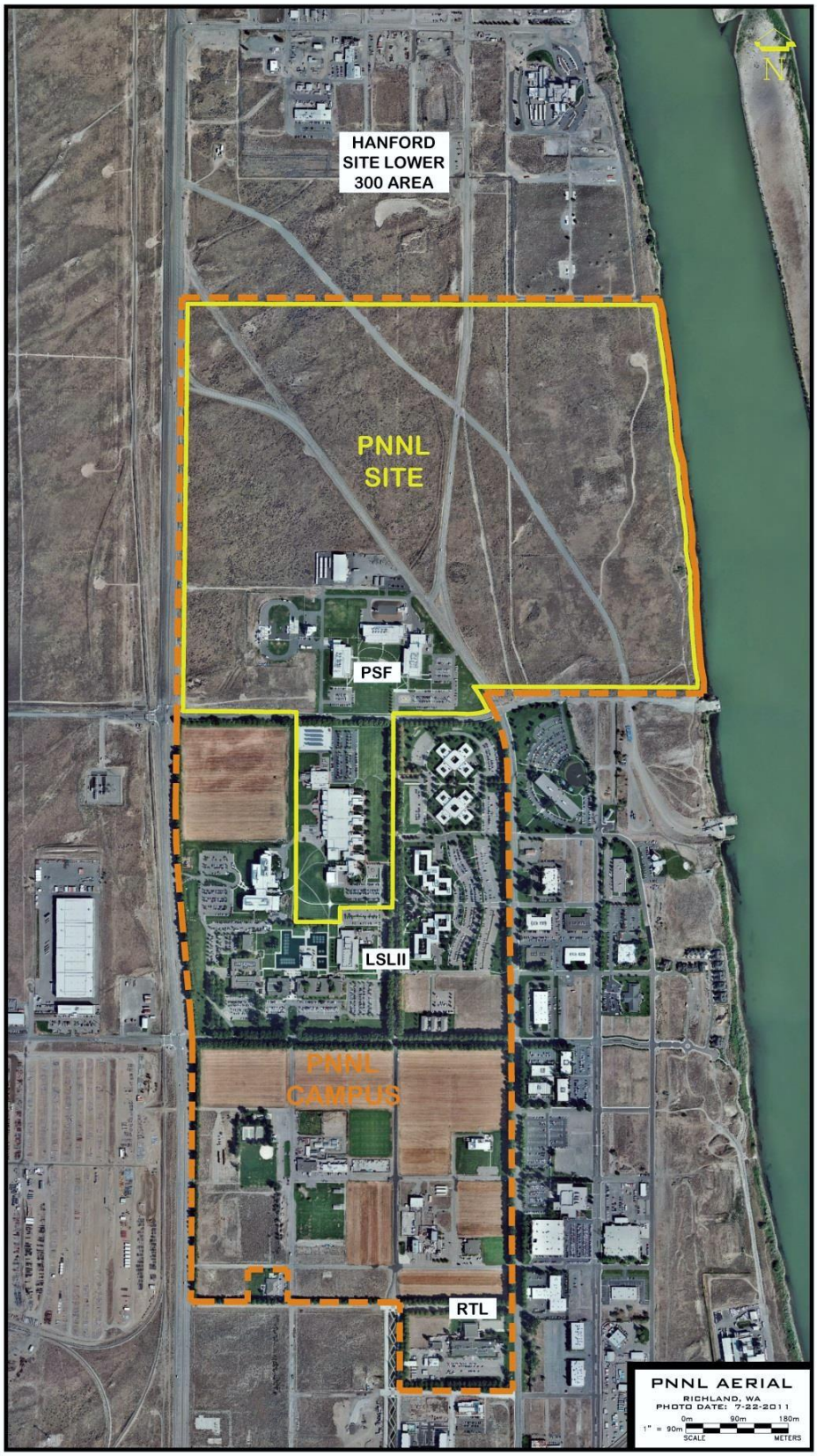

Figure 1.1. DOE-SC PNNL Richland Campus Emissions Units Locations

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

The seven buildings subject to 40 CFR 61, Subpart H, reporting are listed in Table 1.1. The four buildings of the PSF (3400 series buildings in Table 1.1) were constructed in 2009 and 2010 to replace aging laboratory infrastructure on the Hanford Site. The LSLII and RTL facilities had been regulated previously under a private Battelle license but were brought under the DOE radioactive air emissions license in October 2012.

Table 1.1. PNNL Richland Campus Licensed Buildings – 2016

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
LSLII – Life Sciences Laboratory-II	October 2012[a,b]
RTL-520 – Research Technology Laboratory-520	October 2012[b]
RTL-530 – Research Technology Laboratory Radioactive Storage	October 2012[b]

(a) Residual potential contamination in ducts only, no active radiological operations.
(b) Date of contractual transfer from Battelle private operations to DOE-SC.

As a group of research buildings, the PSF expects to host changing types of research over time. The LSLII facility had historically been used for radiological operations. No new or planned radiological operations occur at LSLII, other than the removal of radiologically contaminated ductwork from past operations. Research at the RTL is ending, with no new or planned radiological operations. Section 1.2.2 provides more detailed descriptions of the buildings subject to 40 CFR 61, Subpart H (2011), 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. The two principal DOE Offices that manage programs at the Hanford Site are the Richland Operations Office and the Office of River Protection.

1.1.2 PNNL Richland Campus Facilities and 2016 Activities

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) EDE 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.[1] 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

[1] For purposes of the 40 CFR 61, Subpart H, doses reported in this document, EDE and ED (effective dose) are considered equivalent. CAP88-PC Version 4 reports ED.

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 radioactive 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. If the dose is less than 1.0E-4 mrem/yr (1.0E-6 mSv/yr), this very low annual dose rate may be rounded to one significant digit (e.g., 3.9E-5 mrem would be rounded to 4E-5 mrem [4E-7mSv]). More significant digits may be reported if they provide informative resolution or if the value is significantly larger than most of the other values reported with it (e.g., a 5.9723E+1 Ci K-40 emission from one source and 2.4E-3 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-5 (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 (Ballinger, Gervais, and Barnett 2012).

In October 2016, the PNL-5 particulate monitoring station became operational for background monitoring. PNL-5 results are reported, herein, for the partial year of monitoring. However, because PNL-5 was operational for only part of the year, the Hanford Site's Yakima station is used for full-year background reporting, as in previous years. Next year, PNL-5 will represent Campus background. In addition, the Campus environmental surveillance program added thermoluminescent dosimeters in October 2016 to measure external radiation dose levels at the five air sampling station locations. Results provide baseline data for the Campus and will be documented in next year's report.

Table 1.2. Types of Emission Units under the DOE PNNL Richland Campus License – 2016

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
- /LSLII	Life Sciences Laboratory-II	Minor
RTL/RTL-520	Research Technology Laboratory	Minor
RTL/RTL-530	RTL Radioactive Material Storage	Fugitive
Campus	Volumetrically Released Radioactive Material (VRRM; PIC-5)	Fugitive
	Non-dispersible Radioactive Material (NDRM; PIC-5)	Fugitive
	Facilities Restoration (PIC-5)	Fugitive
	Low-level Sources (LLS; PIC-5)	Fugitive

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

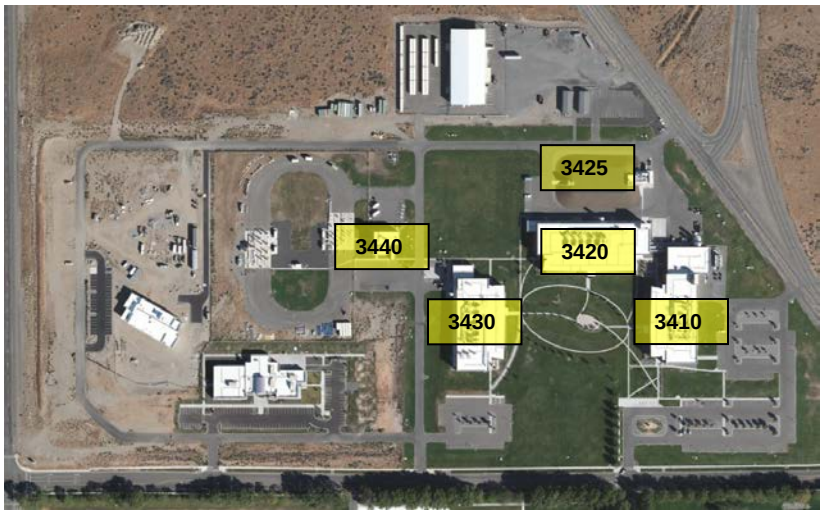

Figure 1.3. PNNL Richland Campus Physical Sciences Facility (PSF) with Buildings Identified

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 are cleanup, research, and office facilities. Radiological emissions from the Hanford Site are described in the Hanford Site Radionuclide Air Emissions Report (Johnson et al. 2017).

In addition to the Hanford Site, some privately and publicly owned facilities capable of generating airborne radioactive emissions are located adjacent to or near the PNNL Richland Campus. These facilities include 1) a low-level waste burial site operated by U.S. Ecology on the Hanford Site 200 Area plateau; 2) the Energy Northwest Columbia Generating Station commercial nuclear power reactor and associated buildings, near the Columbia River north of the Hanford Site 300 Area; 3) the Test America Richland Laboratory south of the Campus; 4) the AREVA Federal Services, LLC (AREVA) fuel fabrication facility west of the Campus; 5) the Perma-Fix Northwest, Inc. waste treatment business to the east of AREVA; and 6) the Interstate Nuclear Services 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 2016:

- Required continuous sampling or periodic confirmatory measurements (PCMs) (including 40 CFR 61, Appendix D calculations) in accordance with 40 CFR 61, Subpart H (2011), and with WAC 246-247 (2016)
- Was described in the Washington State Department of Health (WDOH)-issued RAEL-005

Table 1.3 lists the PNNL Richland Campus emission units registered with the WDOH for radiological emissions.

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.	Continuous sampling, Appendix D
3420	EP-3420-01-S	Major point source. Main Stack.	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.	Appendix D
3425	J-3425	Fugitive emissions. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
3430	EP-3430-01-S	Major point source. Main Stack.	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.	Appendix D
	EP-3430-1606P-S	Minor point source. Room 1606 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-3430-1608P-S	Minor point source. Room 1608 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-3430-1610P-S	Minor point source. Room 1610 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-3430-1612P-S	Minor point source. Room 1612 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-3430-1614P-S	Minor point source. Room 1614 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
LSLII	EP-LSLII-01-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-LSLII-02-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
RTL-520	EP-RTL-10-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
	EP-RTL-11-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D
RTL-530	J-RTL530	Fugitive emissions. Activities limited to waste management and storage.	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-LLS	Low-level sources	PIC-5

(a) Appendix D means that values are calculated from in-facility material inventories and estimates and 40 CFR 61, Appendix D (1989).

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. Effective discharge heights used in modeling range from 33 ft (10 m) for PSF fugitive emission points to a conservative 103 ft (31.3 m) applied to all PSF major stack emissions. RTL-520 was conservatively modeled with an average effective discharge height of 33 ft (10.0 m) and LSLII was 65.3 ft (19.9 m).

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 during 2016. 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	Average Temper-ature	Physical Discharge Height	Physical Discharge Diameter	Effective Discharge Height	Abatement Technology
Major EP-3410-01-S	21,700 ft^3/min (10.2 m^3/s)	1.14E+10 ft^3 (3.24E+08 m^3)	72º F (22.2º C)	44 ft (13.4 m)	3.3 ft (1.0 m)	103 ft (31.3 m)	Single-stage HEPA filter
Major EP-3420-01-S	47,200 ft^3/min (22.3 m^3/s)	2.49E+10 ft^3 (7.04E+08 m^3)	69º F (20.6º C)	45 ft (13.8 m)	4.3ft (1.3 m)	125 ft (38.2 m)	Single-stage HEPA filter
Major EP-3430-01-S	32,588 ft^3/min (15.4 m^3/s)	1.72E+10 ft^3 (4.86E+08 m^3)	70º F (21.1º C)	44 ft (13.4 m)	3.7 ft (1.1 m)	113 ft (34.4 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.

Research Technology Laboratory Facilities

RTL-520

RTL-520 provided laboratory, office, and storage space for a variety of research and development activities. Radioactive material and research activities have been relocated from this building to other permitted PNNL facilities to prepare for eventual building demolition. No new sources of radioactive material are planned for this facility. Radioactive material emissions are discharged from this building through two minor stacks.

RTL-530

RTL-530 is a small (136 ft^2) concrete block and brick storage area just west of RTL-520 that was used to temporarily store radioactive materials. This building is slated for removal as part of the overall RTL Complex demolition.

Life Sciences Laboratory-II Facility

The LSLII building consists primarily of two laboratory floors with mechanical/electrical service rooms attached at the north and south ends of the building. Research in this facility includes applied research, prototype development and testing, and system validation for engineered structural materials. Mechanical design, automation, computational mechanics, and advanced materials characterization activities are also conducted in LSLII. Some electronic technology development and wet chemical work are performed as well. No new sources of radioactive material are planned for this facility. Radioactive material emissions are discharged from this building through two minor stacks.

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.

Table 2.1 indicates emissions from sampled point sources on the Campus sampled in 2016. There were no fugitive emissions from RTL-530 in 2016. Table 2.2 shows the emissions that resulted in 99.95% of the dose impact from non-sampled PSF sources, whereas Table 2.3 shows the remaining 0.05%. Table 2.4 summarizes the nuclide emissions from major, minor, and fugitive sources that result in 99.95% or more of the total dose impact to the MEI. Appendix B lists the radioactive materials handled or potentially handled at the PNNL Richland Campus in 2016.

Table 2.1. Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2016

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total (Ci)
gross α [(a)]	2.57E-08	5.24E-08	2.77E-08	1.1E-07
gross β [(a)]	2.82E-07	5.60E-07	1.90E-07	1.0E-06
H-3	1.20E-04[(b)]	NA	NA	1.2E-04
Ar-37	0	9.0E-08[(b)]	0	9.0E-08
Ar-39	0	2.7E-11[(b)]	0	2.7E-11
Co-60	ND	ND	2.72E-08	2.7E-08
Kr-85	NA	8.10E-10	NA	8.10E-10
Xe-131m	NA	7.34E-08[(b)]	NA	7.3E-08
Xe-133	1.64E-23[(b)]	1.43E-06[(b)]	NA	1.4E-06
Xe-133m	NA	9.27E-08[(b)]	NA	9.3E-08
Xe-135	NA	1.51E-07[(b)]	NA	1.5E-07
Rn-222[(d)]	NA	9.55E-05[(b)]	NA	9.6E-05
U-233/234	NA	NA	6.02E-10	6.0E-10
Np-237	NA	1.60E-09	NA	1.6E-09
Pu-238	1.31E-10[(c)]	1.30E-09[(c)]	4.18E-10[(c)]	1.9E-09[(c)]
Pu-239/240	2.69E-08	5.67E-08	2.92E-08	1.1E-07
Am-241	ND	3.79E-09[(c)]	8.64E-10[(c)]	4.7E-09[(c)]
Am-243	2.00E-09[(c)]	3.54E-10[(c)]	2.27E-11[(c)]	2.4E-09[(c)]
Cm-243/244	NA	7.29E-11	9.05E-10[(c)]	9.8E-10

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 on calculated Appendix D methods of 40 CFR 61.
(d) Radon dose to MEI; see Sections 3.4.2 and 3.6.3.

Table 2.2. PNNL Richland Campus Appendix D Calculated and Release Record Radionuclide Emissions (Ci) from Minor Emissions Units and Fugitive Sources Resulting in 99.95% of the Offsite Dose – 2016[a,b]

Nuclide	EP-3420-02-S 3420 Building PSF	EP-3430-02-S 3430 Building PSF	EP-3430-nnnnP-S 3430 Building PSF[c]	J-3425 3425 Building PSF	EP-RTL-10V, -11V RTL-520 RTL Complex	EP-LSLII-01-V, -02-V Total LSLII[d]	Total (Ci)
H-3[a]	1.30E-13	NA	NA	NA	8.26E-11	2.90E-10	3.73E-10
Co-60	7.63E-10	1.17E-10	NA	1.63E-10	1.18E-12	NA	1.04E-09
Sr-90	2.16E-13	NA	NA	5.05E-13	2.10E-06	NA	2.10E-06
Tc-99	NA	NA	NA	NA	8.93E-05	NA	8.93E-05
Xe-133[a]	4.09E-10	NA	NA	4.41E-10	NA	NA	8.50E-10
Xe-133m[a]	1.00E-08	NA	NA	NA	NA	NA	1.00E-08
Xe-135[a]	2.52E-09	NA	NA	2.77E-09	NA	NA	5.29E-09
Cs-137	1.49E-09	8.70E-11	NA	1.25E-10	2.55E-12	0.00E+00	1.70E-09
Lu-177	1.11E-05	NA	NA	NA	NA	NA	1.11E-05
Rn-222[e]	6.00E-12	NA	NA	NA	NA	NA	6.00E-12
Ra-226	NA	1.19E-09	NA	NA	2.94E-10	NA	1.48E-09
U-233/234	9.40E-10	NA	NA	9.38E-10	5.34E-07	NA	5.36E-07
U-235	4.03E-11	NA	2.21E-19	4.02E-11	2.51E-08	NA	2.52E-08
U-238	5.26E-13	NA	NA	3.92E-13	6.27E-07	NA	6.27E-07
Np-237	NA	NA	1.98E-18	NA	NA	NA	1.98E-18
Pu-238	NA	NA	2.85E-17	NA	2.30E-14	NA	2.30E-14
Pu-239/240	NA	NA	8.64E-16	NA	3.65E-08	NA	3.65E-08
Pu-242	NA	NA	9.70E-19	NA	3.65E-08	NA	3.65E-08
Am-241	1.58E-10	6.54E-11	8.50E-17	7.10E-11	1.00E-12	5.02E-11	3.46E-10
Am-243	NA	NA	2.56E-15	NA	NA	NA	2.56E-15
Cm-243/244[e]	NA	NA	NA	NA	NA	NA	0.00E+00
Cf-249	NA	NA	NA	NA	1.01E-10	NA	1.01E-10
Cf-250	5.45E-16	NA	NA	NA	1.79E-09	NA	1.79E-09
Cf-252	NA	NA	NA	NA	1.62E-09	NA	1.62E-09

NA = not applicable for the indicated stack. 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 (Ballinger, Gervais, and Barnett 2011; Snyder and Barnett 2015) and 40 CFR 61, Appendix D (1989). Values for gases are based on release records.

(b) Listed nuclides account for 99.95% of dose impact from release record and Appendix D calculated Minor and Fugitive sources in 2016. Isotopes sampled at major emission units also included.

(c) Total from perchloric acid hoods in 3430 Building, where nnnn = 1606, 1608, 1610, 1612, and 1614.

(d) LSLII alpha-emitters assumed to be Am-241; there were no beta emitters in 2016.

(e) Radon dose to MEI; see Sections 3.4.2 and 3.6.3.

(f) Cm-243/244 listed here for completeness. Appendix D estimates were calculated for Cm-243/244, Am-241, Am-243, and Pu238 from Major emission units and are included with the Table 2.1 Sampled emissions.

Table 2.3. Nonsignificant (<0.05%) PNNL Richland Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2016

Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)
Ag-110m	1.08E-13	Cs-134	5.94E-14	Na-24	1.30E-08	Sr-85	9.37E-10
Am-240	5.41E-12	Cu-64	4.92E-14	Nb-94	4.24E-15	Sr-89	1.13E-16
Am-242	4.36E-19	Cu-67	5.30E-17	Nb-95	2.72E-11	Sr-91	2.35E-09
Au-198	6.60E-12	Eu-152	6.00E-10	Nb-95m	7.47E-14	Ta-182	6.60E-12
Ba-133	1.00E-10	Eu-154	4.68E-14	Nb-97	3.60E-09	Tb-160	2.92E-15
Ba-140	5.19E-10	Eu-155	4.67E-14	Nb-97m	3.17E-09	Tc-99m	1.00E-06
Be-7	1.08E-13	Fe-55	2.07E-13	Nd-147	7.03E-11	Te-123m	5.82E-15
Br-82	1.30E-08	Fe-59	1.00E-12	Np-236	6.95E-17	Te-129m	4.53E-13
C-14	3.00E-13	Hg-203	4.49E-10	P-32	1.00E-10	Te-131m	2.61E-11
Ca-47	1.89E-13	I-129	1.07E-13	Pa-234m	1.99E-06	Te-132	1.28E-09
Cd-109	9.68E-10	I-131	4.15E-10	Pb-210	2.18E-10	Th-231	9.01E-14
Ce-139	2.48E-10	I-132	1.32E-09	Pm-149	4.49E-10	Th-232	1.51E-11
Ce-141	7.45E-11	I-133	3.86E-09	Pm-151	5.82E-11	Th-234	4.13E-13
Ce-143	4.57E-09	I-135	1.65E-09	Pr-143	9.03E-11	U-236	8.04E-12
Ce-144	1.84E-11	Ir-192	1.08E-13	Pu-241	1.52E-15	W-187	6.60E-12
Cf-251	7.94E-11	K-42	1.32E-12	Pu-244	3.31E-19	Y-88	1.35E-09
Cm-245	3.95E-13	Kr-83m[(a)]	5.11E-12	Rh-105	1.81E-09	Y-90	1.18E-10
Cm-246	4.96E-11	Kr-85m[(a)]	3.48E-11	Ru-103	8.35E-12	Y-91m	1.52E-09
Cm-247	1.60E-16	La-140	2.26E-10	Ru-106	1.48E-12	Y-92	8.93E-10
Cm-248	7.53E-12	La-141	4.51E-10	Sb-125	3.17E-12	Y-93	2.99E-09
Co-57	2.25E-10	Mn-54	5.01E-13	Sc-46	5.40E-14	Zn-65	1.00E-10
Co-58	5.00E-14	Mn-56	1.29E-11	Sn-113	5.77E-10	Zr-95	1.35E-14
Cr-51	2.03E-13	Mo-99	2.05E-09	Sn-126	7.70E-14	Zr-97	3.34E-09
						Total (Ci)	**3.1E-06**

To convert Ci to GBq, multiply Ci by 37.

(a) Value based on release records for gases. Other emissions are calculated from in-facility material inventories and estimates (Ballinger, Gervais, and Barnett 2011; Snyder and Barnett 2015) and 40 CFR 61, Appendix D (1989).

Table 2.4. PNNL Richland Campus Radionuclide Emissions (Ci) in 2016

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units	Total (Ci)[a]
gross α [b]	1.1E-07	5.0E-11	1.1E-07
gross β [b]	1.0E-06	0	1.0E-06
H-3	1.2E-04[c]	3.7E-10	1.2E-04
Ar-37	9.0E-08[c]	1.7E-10	9.0E-08
Ar-39	2.7E-11	NA	2.7E-11
Co-60	2.7E-08	1.0E-09	2.8E-08
Kr-85	8.1E-10	NA	8.1E-10
Sr-90	8.10E-10	2.1E-06	2.1E-06
Tc-99	NA	8.9E-05	8.9E-05
Xe-131m	7.3E-08[c]	NA	7.3E-08
Xe-133	1.4E-06[c]	8.5E-10[c]	1.4E-06
Xe-133m	9.3E-08[c]	1.0E-08[c]	1.0E-07
Xe-135	1.5E-07[c]	5.3E-09[c]	1.6E-07
Cs-137	[b]	1.7E-09	1.7E-09
Lu-177	NA	1.1E-05	1.1E-05
Rn-222	9.6E-05	6.0E-12	9.6E-05
Ra-226	NA	1.5E-09	1.5E-09
U-233/234	6.0E-10	5.4E-07	5.4E-07
U-235	NA	2.5E-08	2.5E-08
U-238	NA	6.3E-07	6.3E-07
Np-237	1.6E-09	2.0E-18	1.6E-09
Pu-238	1.9E-09	2.3E-14	1.9E-09
Pu-239/240	1.1E-07	3.7E-08	1.5E-07
Pu-242	NA	3.7E-08	3.7E-08
Am-241	4.7E-09	3.0E-10	5.0E-09
Am-243	2.4E-09	2.6E-15	2.4E-09
Cm-243/244	9.8E-10	NA	9.8E-10
Cf-249	NA	1.0E-10	1.0E-10
Cf-250	NA	1.8E-09	1.8E-09
Cf-252	NA	1.6E-09	1.6E-09

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

(a) Nuclides that contribute 99.95% of the dose to the MEI. See Table 2.3 for the nuclides that contribute the remaining 0.05% of dose impact.

(b) Maximum of the biweekly or semi-annual average measurement. Gross α is assumed to be Pu-239 (major emission units) and Am-241 (LSLII, only) for dose assessment; gross β is assumed to be Cs-137.

(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

The dose to the MEI was calculated using the dose-modeling program Clean Air Act Assessment Package 1988-Personal Computer (CAP88-PC) Version 4 (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 (2011), and WAC 246-247 (2016).

CAP88-PC Version 4 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 to RAEL-005 permitted emissions 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 impact from emissions is determined. Due to the close proximity of offsite businesses and the annual variability of dispersion estimates at close distances, several options for maximally impacted locations are presented (Table 3.1) based on evaluations of average meteorology from 1983 through 2006, and individual year meteorology from 2006 through 2009. Table 3.1 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 model, 2) PNNL Richland Campus facility emissions, and 3) CY2016 meteorological data (Appendix A) to determine the 2016 MEI receptor location from Campus emissions. The receptor is presumed to produce his or her own food supply at the MEI location.

Table 3.1. Receptor Locations for the PNNL Richland Campus

Locale	Distance Relative to PSF km (mi)	Distance Relative to RTL-520 km (mi)	Distance Relative to LSLII km (mi)
2016 PNNL Richland Campus MEI			
Business, 2892 Pauling Ave	1.86 (1.16) S	0.15 (0.09) S	1.17 (0.73) SSE
Offsite nearest residence, business, school			
Residence[(a)]	0.97 (0.60) SE	0.15 (0.09) SSW	0.84 (0.52) E
School or preschool	1.6 (1.0) S	0.51 (0.32) WNW	0.84 (0.52) SSW
Business[(a)]	0.54 (0.33) SSE	0.15 (0.09) S	0.43 (0.27) E
Farm with potential for crops or livestock			
Nearest to PSF (east of Columbia River)	1.51 (0.93) E	1.81 (1.1) E	1.86 (1.2) E
Nearest to RTL (onsite leased farm field)	1.49 (0.93) S	0.30 (0.19) NW	0.76 (0.47) S
Potential 2016 MEI locations			
Business, 3200 George Washington Way	0.66 (0.41) SSE	1.11 (0.69) N	0.44 (0.27) ENE
Business, 2892 Pauling Ave[(b)]	1.86 (1.16) S	0.15 (0.09) S	1.17 (0.73) SSE
Offsite maximum annual air concentration[(c)]			
Lot SW of 3rd St. and George Washington Way	1.86 (1.16) S	0.15 (0.09) SSE	1.17 (0.73) SSE
PNL-1	0.66 (0.41) NW	2.23 (1.39) NNW	1.22 (0.76) NNW
Campus historical MEIs[(d)]			
CY2015 / 2.6E-4 mrem	1.86 (1.16) S	0.15 (0.09) S	1.17 (0.73) SSE
CY2014 / 2.9E-5 mrem	0.70 (0.43) SSE	1.05 (0.65) N	0.41 (0.25) E
CY2013 / 1.8E-5 mrem	0.75 (0.47) SSE	0.98 (0.61) N	0.40 (0.25) E
CY2012 / 9.2E-6 mrem	0.55 (0.34) SSE	1.2 (0.76) N	0.46 (0.29) E
CY2011 / 1.7E-5 mrem	0.55 (0.34) SSE	NA	NA
CY2010 / 8E-6 mrem	0.48 (0.30) SSE	NA	NA

(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 3.70 km south of the Hanford Site 300 Area.
(c) The lot location is the offsite maximum for modeled Campus emissions. The PNL-1 location is the boundary maximum for environmental surveillance results.
(d) To convert mrem to mSv, multiply mrem by 0.01.

3.2 Summary of Input Parameters

Radionuclide emissions data from the PNNL Richland Campus (Table 2.4) were used in the dose calculations. Emissions from PSF, RTL Complex, and LSLII were modeled in CAP88-PC Version 4 with 2016 meteorology and stack characteristics given in Section 1.2.1. In prior years, PSF emissions had the greatest dose impact of all Campus radioactive emissions. As in 2015, the 2016 conservative (over-estimating) Appendix D approach for calculating the RTL Complex emissions results in a greater dose impact to an offsite receptor outside the southern portion of the PNNL Richland Campus. The greatest dose impact from facility emissions is calculated for 2892 Pauling Ave, just south of the RTL Complex, where an office building is located; as a result, this is the 2016 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 data libraries. The entire hypothetical MEI diet was constructed using the “local” food production option in CAP88-PC Version 4

for ingestion-pathway parameters. This assumption greatly overestimates the dose to the MEI because no food is produced at the 2016 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 wind files were prepared from data collected at the Hanford Site 300 Area weather station just north of the PNNL Richland Campus (refer to Figure 5.1) and represent the average of hourly data recorded in 2016. Appendix A presents meteorological data for 2016 as joint frequency of wind speed, wind direction, and stability category for the station located at the Hanford Site 300 Area. The close proximity of the Hanford Site 300 Area meteorological station (less than 500 m from the Campus boundary) and lack of turbulent interference allows the Hanford Site 300 Area meteorological 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. Sections 3.4.1 and 3.4.2 give details on doses reported under 40 CFR 61, Subpart H, and the WAC, respectively.

Table 3.2. Summary of Reported Doses

	40 CFR 61, Subpart H Campus MEI (2892 Pauling)	**WAC 246-247 Campus MEI (2892 Pauling)**	**Offsite Maximum Air for Campus Emissions (lot SW of 3rd and GW)**
PNNL Richland Campus MEI Location			
Location relative to RTL Complex	0.150 km (0.09 mi) S	0.150 km (0.09 mi) S	0.150 km (0.09 mi) SSE
Location relative to PSF	1.86 km (1.16 mi) S	1.86 km (1.16 mi) S	1.86 km (1.16 mi) S
Radon Emissions			
Rn-220	NA	0 Ci	0 Ci
Rn-222			
3420-01-S	NA	9.5E-05 Ci	9.5E-05 Ci
3420-02-S	NA	6.0E-12 Ci	6.0E-12 Ci
Receptor Dose			
Dose excluding radon emissions[(a)]	5.8E-04 mrem	5.8E-04 mrem	6.7E-04 mrem
Radon	NA	5.9E-08 mrem	5.9E-08 mrem
Total	**5.8E-04 mrem**	**5.8E-04 mrem**	**6.7E-04 mrem**

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.

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 (2011), and applies to radionuclide air emissions, other than radon, from DOE facilities. For CY2016, the PNNL Richland Campus MEI location was 0.15 km (0.09 mi) south of the RTL Complex. The PNNL Richland Campus MEI dose is 5.8E-04 mrem (5.8E-06 mSv) (see Table 3.2, 40 CFR 61, Subpart H).

Table 3.3 indicates nuclide-specific doses to the CY2016 Campus MEI. The MEI dose includes routine and nonroutine point source emissions. Including fugitive PIC-5 category doses does not change

Table 3.3. PNNL Richland Campus 2016 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units and Fugitive Emissions

Radionuclide	Releases (Ci)	Campus MEI Dose (mrem EDE)	% of Total EDE
H-3[a]	1.2E-04	6.6E-09	<1%
Ar-37	9.0E-08	0.0E+00	<1%
Ar-39	2.7E-11	1.4E-17	<1%
Co-60	2.8E-08	3.0E-08	<1%
Kr-85	8.1E-10	8.5E-16	<1%
Sr-90[a]	2.1E-06	5.8E-05	10%
Tc-99[a]	8.9E-05	4.6E-04	79%
Xe-131m[a]	7.3E-08	1.9E-13	<1%
Xe-133[a]	1.4E-06	3.8E-12	<1%
Xe-133m[a]	1.0E-07	2.8E-13	<1%
Xe-135[a]	1.6E-07	3.4E-12	<1%
Cs-137[a,b]	1.7E-09	1.7E-06	<1%
Lu-177[a]	1.1E-05	9.1E-09	<1%
Ra-226[a,c]	1.5E-09	6.1E-08	<1%
U-233/234	5.4E-07	1.2E-05	2%
U-235[a]	2.5E-08	7.6E-07	<1%
U-238[a]	6.3E-07	1.7E-05	3%
Np-237	1.6E-09	1.3E-08	<1%
Pu-238[a]	1.9E-09	2.7E-08	<1%
Pu-239/240[d]	1.5E-07	1.6E-05	3%
Pu-242[a]	3.7E-08	1.3E-05	2%
Am-241[a,e]	5.0E-09	7.2E-08	<1%
Am-243[a]	2.4E-09	3.2E-08	<1%
Cm-243/244[a]	9.8E-10	9.8E-09	<1%
Cf-249[a]	1.0E-10	5.5E-08	<1%
Cf-250[a]	1.8E-09	4.5E-07	<1%
Cf-252[a]	1.6E-09	2.3E-07	<1%
Table 2.3 nuclides	3.1E-06	2.9E-07	<1%
PIC-5 emissions – VRRM	NA	9.4E-07[f]	<1%
PIC-5 emissions – Facilities Restoration	NA	8.4E-07[f]	<1%
PIC-5 emissions – NDRM	NA	6.6E-08[f]	<1%
PIC-5 emissions – LLS	3.4E-09	2.0E-12[g]	<1%
Total	**2.3E-04 Ci**	**5.8E-04 mrem EDE**	**100%**

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), or release records. Cm-243/244 activity is the sum of both Appendix D and measured emissions.

(b) Gross beta from PSF building sampling assumed to be Cs-137. Also, calculated Cs-137 release based on 40 CFR 61, Appendix D (1989), and LSLII gross beta.

(c) Dose includes progeny isotope Rn-222.

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

(e) Gross alpha from LSLII assigned as Am-241.

(f) The PIC-5 emission doses are assigned based on permit value.

(g) The LLS PIC-5 emission dose was assigned based on calculations from actual emissions, rather than the maximum permit value of 1.0E-06 mrem. The release point was conservatively assumed to be RTL-530.

the CY2016 PNNL Richland Campus MEI dose estimate. Table 3.4 provides the Campus MEI dose attributed to each emission point. RTL emissions contribute the majority of the dose to the MEI. The doses assigned to the fugitive VVRM, Facilities Restoration, and NDRM PIC-5 permitted emissions indicate a maximum dose impact. The PIC-5 permitted emissions for LLS indicate a dose impact from the actual emission of 3.40E-9 Ci (1.26E+02 Bq) Xe-133.

Table 3.4. Dose Contributions from Each Registered Emission Point

Facility/Building	Emission Point	Emissions[(a)]	Campus MEI Dose (mrem EDE)	% of Total MEI Dose
RTL/RTL-520	EP-RTL-11-V	Estimated	2.9E-04	49.5%
RTL/RTL-520	EP-RTL-10-V	Estimated	2.9E-04	49.5%
PSF/3420 Building	EP-3420-01-S	Sampled, Estimated	1.9E-06	<1%
Campus	J-VRRM	PIC-5	9.4E-07[(b)]	<1%
PSF/3410 Building	EP-3410-01-S	Sampled, Estimated	9.2E-07	<1%
Campus	J-Facilities Restoration	PIC-5	8.4E-07[(b)]	<1%
PSF/3430 Building	EP-3430-01-S	Sampled, Estimated	8.3E-07	<1%
Campus	J-NDRM	PIC-5	6.6E-08[(b)]	<1%
PSF/3420 Building	EP-3420-02-S	Estimated	2.1E-08	<1%
PSF/3430 Building	EP-3430-02-S	Estimated	1.8E-08	<1%
PSF/3425 Building	J-3425	Estimated	4.6E-09	<1%
LSLII	EP-LSLII-01-V	Estimated	9.9E-10	<1%
LSLII	EP-LSLII-02-V	Estimated	9.9E-10	<1%
Campus	J-LLS	PIC-5	2.0E-12[(b)]	<1%
PSF/3430 Building	EP-3430-1606P-S	Estimated	2.1E-14	<1%
PSF/3430 Building	EP-3430-1608P-S	Estimated	2.1E-14	<1%
PSF/3430 Building	EP-3430-1610P-S	Estimated	2.1E-14	<1%
PSF/3430 Building	EP-3430-1612P-S	Estimated	2.1E-14	<1%
PSF/3430 Building	EP-3430-1614P-S	Estimated	2.1E-14	<1%
RTL/RTL-530	J-RTL530	None	0	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.

For comparison, the Subpart H PNNL Richland Campus 2016 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 2016 MEI dose (40CFR61, Subpart H) 0.00058 mrem/yr**
- Per second natural background radiation 0.0000098 mrem/sec

Dose from man-made sources, overwhelmingly a result of medical procedure exposures, adds another 310 mrem (3.1 mSv) to the annual average U.S. dose (HPS 2012). The PNNL Richland Campus 2015 MEI dose was 2.6E-4 mrem/yr (2.6E-6 mSv/yr).

3.4.2 Washington Administrative Code

For PNNL Richland Campus radionuclide air emissions, Washington State in WAC 246-247-040(1) (2016) has adopted the federal dose standard of 10 mrem/yr found in 40 CFR 61, Subpart H (2011). 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 (2011), but it is encompassed by state regulations, as in WAC-246-247-040(6) (2016), 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). An additional assessment was performed for the location with maximum offsite nuclide air concentrations whether the reside/abide criterion is met or not. The maximum modeled air concentration from Campus emissions is located at the lot SW of 3rd St and George Washington Way (see Table 3.2, Offsite Maximum Air). If a person had occupied that lot with a subsistence farm for the entire year, the dose to that receptor would have been 6.7E-04 mrem/yr (6.7E-6 mSv/yr), about 20% greater than the reported MEI dose. For completeness, a maximum air concentration assessment based on an elevated ambient air sampler result at PNL-1 is discussed in Section 5.3.

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 CY2016 were reviewed. Both the PNNL Richland Campus and the Hanford Site (Johnson et al. 2017) are in compliance with the 10 mrem/yr regulatory standard for CY2016 radiological emissions.

The CY2016 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 2016. The dose to the PNNL Richland Campus MEI from the Hanford Site 300 Area emissions, excluding radon (emissions listed in Table 3-1 of Johnson et al. 2016), is indicated in Table 3.5. Most of the impact from Hanford Site 300 Area emissions to the PNNL Richland Campus MEI is attributable to H-3 emissions (99.92%). The table also indicates the dose to the 2016 Hanford Site MEI for emissions from the Hanford Site 300 Area sources. A PNNL facility is the location of the 2016 Hanford Site MEI; therefore, no dose was calculated to this receptor from PNNL Richland Campus emissions in 2016.

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

Receptor	Dose from 2016 PNNL Richland Campus Emissions	Dose from 2016 Hanford Site 300 Area Emissions
Hanford Site 2016 MEI	NA[(a)]	3.8E-02 mrem
PNNL Richland Campus 2016 MEI	5.8E-04 mrem	1.2E-02 mrem

To convert mrem to mSv, multiply mrem by 0.01.
(a) Hanford Site receptor located at the PNNL Richland Campus.

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No nonroutine emissions were reported in 2016.

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 Barnett et al. 2012. There are currently five particulate ambient air sampling stations. The Campus Environmental Monitoring Plan is documented in Snyder et al. 2011.

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 2016.

3.6.3 Radon-220 and Radon-222 Emissions

Radon-220 was not emitted from PNNL Richland Campus operations in 2016. 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 [2011]) 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 radioactive 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 [2016]). 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 J-3425 and J-RTL530. In 2016, only J-3425 had radioactive material emissions. 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-LLS Low-level sources

All four permitted emissions sources are managed such that the assigned dose (see Table 3.3) is larger than the actual dose from respective applicable Campus-wide releases. These permits include PIC-5 (Ballinger, Gervais, and Barnett 2012) levels of radionuclide emission and cover a broad range of the nuclides, listed in Appendix B.

The 2016 PNNL Richland Campus emissions from facility fugitive sources were estimated (see Table 2.2, with only emission unit J-3425 for 2016) and dose was determined (see Table 3.4). Table 3.4 also indicates the relative magnitude of the J-3425 and the permit-assigned doses from Campus-wide fugitive emission sources. Fugitive emissions from facility and permitted fugitive emissions account for 1.9E-06 mrem/yr (1.9E-08 mSv/yr) (<1%) of the total 5.8E-04 mrem/yr (5.8E-06 mSv/yr) MEI dose for 2016.

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 2016 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., Johnson et al. 2017).

5.0 Supplemental Information

This section provides the following supplemental information related to PNNL Richland Campus radionuclide air emissions in 2016:

- 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 (NOCs)
- 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 2016 was calculated using CAP88-PC Version 4. The population consists of approximately 432,000 residents within a 50-mi (80-km) radius of the Hanford Site 300 Area (Hamilton and Snyder 2011), with one adjustment to add 320 residents in the closest SSW sector to account for the 160 apartment units SSW of RTL. 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 2016 total collective dose from radionuclide air emissions estimated from nuclides that originated from the PNNL Richland Campus was 6.2E-4 person-rem (6.2E-6 person-Sv). CAP88-PC Version 4 calculates the collective dose by considering site-specific meteorology and population distributions and subsequently summing the individual sector doses. This represents a small increase over the 2015 estimate of 2.7E-4 person-rem (2.7E-6 person-Sv) (Snyder et al. 2016).

5.2 Compliance Status with 40 CFR, Subparts Q and T

In 40 CFR 61, Subpart Q (2000), "National Emission Standards for Radon Emissions From Department of Energy Facilities," paragraph 61.190 states that the Subpart Q provisions apply to the design and operation of all storage and disposal facilities for radium-bearing material that emits Rn-222 to the air. Paragraph 61.191(b) states that a source means any building, structure, pile, impoundment, or area used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit Rn-222 in excess of a standard of 20 pCi/m2/s. No operations from the storage and disposal of radium-bearing material resulting in radon emissions are conducted on the PNNL Richland Campus.

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

the Uranium Mill Tailings Control Act of 1978 or regulated under Title II of that act. No uranium milling and uranium ore processing activities are conducted on the PNNL Richland Campus.

Subparts Q and T do not apply to the PNNL Richland Campus for CY2016 operations.

5.3 Environmental Surveillance for the PNNL Richland Campus

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 2016 at four ambient air sampling locations within and along the perimeter of the PNNL Richland Campus. In October 2016, a new background monitoring station was established in Benton City, Washington, increasing the air sampling network from four to five ambient air sampling locations (Figure 5.1). The Yakima background results will remain the Campus background station for 2016 because of the availability of the full year of sampling results. In addition to Campus emissions, these samplers can collect radioactive particulates released from other nearby sources. During 2016, 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. 2011 and attachments (Meier 2011; Bisping 2011; Snyder 2011). During 2016, environmental air surveillance continued at PNL-1 (solar), PNL-2 (solar), PNL-3, PNL-4, and the newly established background station, PNL-5 (Figure 5.1).

Particulate air samples are routinely analyzed for gross alpha activity, gross beta activity, gamma-emitting isotopes, uranium isotopes (U-233/234, U-235, and U-238), and plutonium isotopes (Pu-238 and Pu-239/240).[3] Gamma-emitting isotope concentrations reported in 2016 include Co-60. In addition, americium isotopes (Am-241 and Am-243) and Cm-243/244 are analyzed. Also, the Hanford Site has several nearby community sampling locations within a 30-mi (48-km) radius of the PNNL Richland Campus as well as a background location at a single distant community station in Yakima (MSA 2016). The Yakima station is upwind of both the Campus (60 mi WNW) and the Hanford Site (36 mi W), and is considered to be unaffected by either of the DOE operations.

The particulate air sampling results are provided in Appendix C for the CY2016 PNNL Richland Campus sampling as well as the Yakima background station. Results are summarized in Table 5.1. The gross alpha and gross beta results were comparable to background levels. The PNL-5 background station was operational in October 2016 and will be used as the background station in the future. The 2016 PNL-5 background results (see Appendix C) are comparable to the Yakima results for the same time periods.

All nuclide-specific results shown in Table 5.1 were less than the values in Table 2 of 40 CFR 61, Appendix E (2011). Analytical results indicated one PNL-1 Pu-238 composite sample for the latter half of 2016 was elevated above internal review trigger levels. Two other Pu-238 composite samples (PNL-2 and PNL-4) and one Pu-239/240 (PNL-1) composite sample for the same time period indicated slightly elevated, but not atypical, results. Otherwise, there was no indication of elevated levels of monitored particulate radionuclides near the PNNL Richland Campus. Pu-238 is an isotope used in small quantities in research, but is most commonly associated with batteries used to power deep space exploration. A

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

review of potential nearby Pu-238 sources and ambient monitoring results was completed, but no correlation to any onsite or offsite emission source was identified.

While the Pu-238 result at PNL-1 does not correlate to a PNNL Richland Campus source or activity, a dose from this location was nevertheless estimated for a full-time resident farmer located at PNL-1. A maximum ambient air dose of 9.9E-02 mrem/yr (9.9E-04 mSv/yr) was estimated using CAP88-PC v4, based on the average annual Pu-238 and Pu-239 air concentrations with background subtracted (see Table 5.1). This dose to any member of the public in an unrestricted area, based on ambient air sampling, remains well below the 10 mrem/yr (0.10 mSv/yr) dose standard of WAC 173-480 for this monitoring station location.

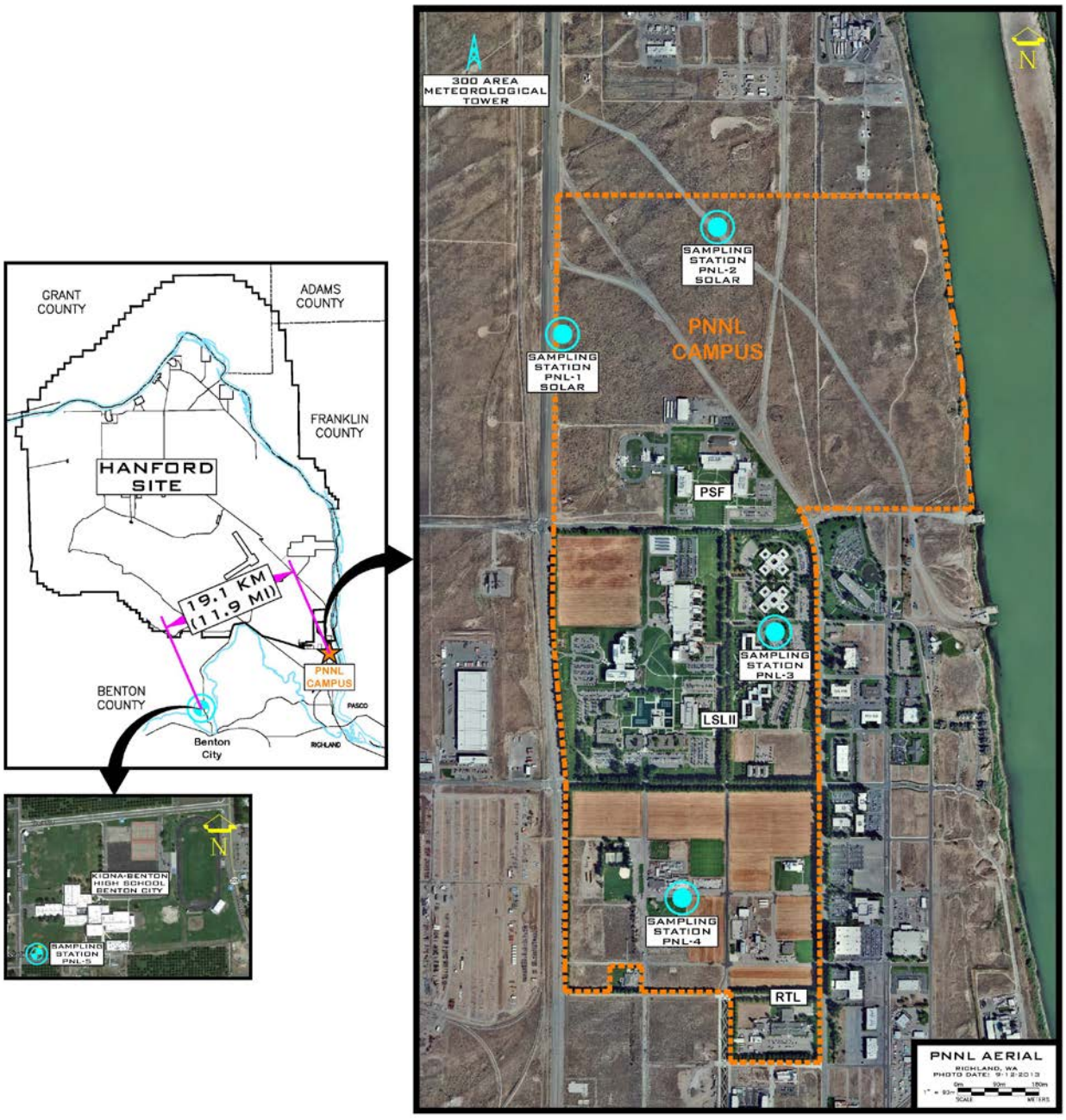

Figure 5.1. Air Surveillance Station Locations for the PNNL Richland Campus

Table 5.1. Summary of 2016 Air Sampling Results

Nuclide	Location[a]	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m3)[b]		
Gross Alpha	PNL-1	26	17	6.7E-04	±	1.8E-03
	PNL-2	26	15	6.7E-04	±	1.9E-03
	PNL-3	25	16	5.7E-04	±	1.7E-03
	PNL-4	25	16	6.3E-04	±	1.8E-03
	PNL-5	5	4	7.0E-04[d]	±	7.6E-04
	YAKIMA	27[c]	19	6.6E-04	±	1.7E-03
Gross Beta	PNL-1	26	26	1.8E-02	±	6.7E-03
	PNL-2	26	26	1.5E-02	±	6.1E-03
	PNL-3	25	25	1.6E-02	±	5.9E-03
	PNL-4	25	25	1.6E-02	±	6.0E-03
	PNL-5	5	5	1.8E-02[d]	±	2.6E-03
	YAKIMA	27[c]	27	1.5E-02	±	5.6E-03
Co-60	PNL-1	2	0	2.9E-05	±	5.7E-04
	PNL-2	2	0	-2.2E-04	±	6.1E-04
	PNL-3	2	0	1.0E-04	±	5.2E-04
	PNL-4	2	0	4.0E-05	±	3.3E-04
	PNL-5	1	0	-1.4E-04[d]	±	3.0E-04
	YAKIMA	2	0	1.1E-04	±	3.2E-04
U-233/234	PNL-1	2	2	4.5E-05	±	2.5E-05
	PNL-2	2	2	4.4E-05	±	2.3E-05
	PNL-3	2	2	5.8E-05	±	4.3E-05
	PNL-4	2	2	5.1E-05	±	2.3E-05
	PNL-5	1	1	5.7E-05[d]	±	1.7E-05
U-234	YAKIMA	2	2	7.7E-05	±	6.5E-05
Pu-238	PNL-1	2	1	1.1E-04	±	2.4E-05
	PNL-2	2	1	7.5E-06	±	6.2E-06
	PNL-3	2	0	2.0E-06	±	6.4E-06
	PNL-4	2	1	6.3E-06	±	4.7E-06
	PNL-5	1	0	2.0E-06[d]	±	4.4E-06
	YAKIMA	2	0	1.9E-06	±	2.0E-05
Pu-239/240	PNL-1	2	1	2.8E-06	±	3.9E-06
	PNL-2	2	0	1.4E-07	±	2.4E-06
	PNL-3	2	0	1.3E-06	±	6.9E-06
	PNL-4	2	0	2.2E-06	±	3.5E-06
	PNL-5	1	0	2.0E-06[d]	±	4.4E-06
	YAKIMA	2	0	1.3E-07	±	2.7E-05
Am-241	PNL-1	2	0	2.8E-07	±	4.3E-06
	PNL-2	2	0	1.3E-06	±	1.2E-05
	PNL-3	2	0	3.8E-07	±	1.2E-05
	PNL-4	2	0	-2.0E-06	±	6.3E-06
	PNL-5	1	0	-8.4E-07[d]	±	7.3E-06
	YAKIMA	0	0		NA[e]	
Am-243	PNL-1	2	0	4.1E-06	±	1.0E-05
	PNL-2	2	0	1.2E-06	±	9.4E-06
	PNL-3	2	0	-5.5E-07	±	1.7E-05
	PNL-4	2	0	-2.7E-06	±	8.2E-06
	PNL-5	1	0	-4.2E-06[d]	±	1.2E-05
	YAKIMA	0	0		NA[e]	

Table 5.1. (contd)

Nuclide	Location[(a)]	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m3)[(b)]
Cm-243/244	PNL-1	2	0	1.5E-06 ± 6.5E-06
	PNL-2	2	0	1.7E-07 ± 5.0E-06
	PNL-3	2	0	4.8E-08 ± 1.0E-05
	PNL-4	2	0	3.3E-06 ± 8.8E-06
	PNL-5	1	0	2.7E-06[(d)] ± 9.9E-06
	YAKIMA	0	0	NA[(e)]

NA = Not analyzed. To convert pCi/m^3 to Bq/m^3, multiply pCi/m^3 by 0.037.

(a) Refer to Figure 5.1 for PNL-1, PNL-2, PNL-3, PNL-4, and PNL-5 locations; Yakima sampler is about 97 km (60 mi) WNW of the PNNL Richland Campus.

(b) The value is the average of samples collected throughout the year; the error, based on individual conditions, is a total analytical error (2σ).

(c) The number of particulate filter results used for the Yakima station nuclide-specific composite samples; samples collected through January 04, 2017.

(d) Partial year result (October-December 2016).

(e) Am-241 values reported for PNNL Richland Campus locations use a more sensitive alpha spectroscopy analytical method, which differs from the method used for Yakima; therefore, Yakima Am-241 measurements are not directly applicable. Am-243 and Cm-243/244 are not analyzed at the Yakima background station.

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 Monitoring Plan (Snyder et al. 2011). The effluent monitoring QA elements described in PNNL 2013 were compatible with one or more of the documents shown in Table 5.2 during CY2016. QA requirements were implemented, as appropriate, at the Campus as new facilities became operational and programmatic plans were developed.

Table 5.2. Summary List of QA-Related Documents

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

(a) A gap analysis is being conducted for the transition from DOE 1991 to DOE 2015.

6.0 References

10 CFR 830. 2001. "Nuclear Safety Management." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Appendix B. 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. 2011. "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Subpart Q. 2000. "National Emission Standards for Radon Emissions from Department of Energy Facilities." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Subpart T. 2000. "National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings." Code of Federal Regulations, U.S. Government Printing Office, Washington, D.C.

ANSI/ASME NQA 1. 2000. *Quality Assurance Requirements for Nuclear Facility Applications, 2000 Edition*. American Society of Mechanical Engineers, New York, New York.

Ballinger MY, TL Gervais, and JM Barnett. 2011. *Assessment of Unabated Facility Emission Potentials for Evaluating Airborne Radionuclide Monitoring Requirements at Pacific Northwest National Laboratory - 2010*. PNNL-10855, Rev. 5, Pacific Northwest Laboratory, Richland, Washington.

Ballinger MY, TL Gervais, and JM Barnett. 2012. *Pacific Northwest National Laboratory Potential Impact Categories for Radiological Air Emission Monitoring*. PNNL-19904, Rev. 4, Pacific Northwest National Laboratory, Richland, Washington.

Barnett JM, KM Meier, SF Snyder, BG Fritz, TM Poston, and EJ Antonio. 2012. *Data Quality Objectives Supporting Radiological Air Emissions Monitoring for the PNNL Site*. PNNL-19427 Rev 1, Pacific Northwest National Laboratory, Richland, Washington.

Bisping LE. 2011. *EMP Attachment 2, DOE-SC PNNL Site, Data Management Plan*, PNNL-20919-2, Pacific Northwest National Laboratory, Richland, Washington.

DOE – U.S. Department of Energy. 1991. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. DOE/EH-0173T, Washington, D.C.

DOE – U.S. Department of Energy. 1995. Letter to E. Ramona, U.S. Environmental Protection Agency) from Raymond Berube, U.S. Department of Energy, Washington, D.C., May 16, "Memorandum of Understanding Between the U.S. Environmental Protection Agency and the U.S. Department of Energy Concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR Part 61 Including Subparts H, I, Q & T." Washington, D.C.

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

DOE – U.S. Department of Energy. 2015. *Environmental Radiological Effluent Monitoring and Environmental Surveillance*. DOE-HDBK-1216-2015. Washington, D.C.

DOE Order 414.1D. 2011. *Quality Assurance*, Contractor Requirements Document. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE Order 458.1, Change 2. 2011. *Radiation Protection of the Public and the Environment*. U.S. Department of Energy, Washington, D.C.

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

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

EPA – U.S. Environmental Protection Agency. 2013. *CAP88-PC Version 3.0 User Guide*. Office of Radiation and Indoor Air, Washington, D.C.

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

Hamilton EL and SF Snyder. 2011. *Hanford Site Regional Population – 2010 Census*. PNNL-20631, Pacific Northwest National Laboratory, Richland, Washington.

HEIS – Hanford Environmental Information System. 1989. Environmental Database Management, CH2M Hill Plateau Remediation Company, Richland, Washington.

HPS – Health Physics Society. 2012. *Background Radiation Fact Sheet*. Health Physics Society, McClean, VA. Last accessed March 2015 at http://hps.org/hpspublications/radiationfactsheets.html.

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

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

MSA – Mission Support Alliance, LLC. 2016. *Annual Hanford Site Environmental Reports*. Last accessed April 2016 at http://msa.hanford.gov/page.cfm/EnviroReports.

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

PNNL – Pacific Northwest National Laboratory. 2016. *Pacific Northwest National Laboratory Effluent Management Quality Assurance Plan.* EM-QA-1, Pacific Northwest National Laboratory, Richland, Washington.

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

Johnson SJ, SF Snyder, CJ Perkins and N Homan. 2017. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2016*. DOE/RL-2017-17, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Snyder SF. 2011. *EMP Attachment 3, DOE-SC PNNL Site, Dose Assessment Guidance*. PNNL-20919-3, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF and JM Barnett. 2015. *PNNL Campus Dose-per-Unit-Release Factors for Calculating Radionuclide Emissions Potential-to-Emit Doses*. PNNL-17847, Rev. 3, Pacific Northwest National Laboratory, Richland, Washington.

Snyder SF, JM Barnett, and LE Bisping. 2016. *Pacific Northwest National Laboratory Campus Radionuclide Air Emissions Report for Calendar Year 2015*. PNNL-20436-6, Pacific Northwest National Laboratory, Richland, Washington

Snyder SF, KM Meier, JM Barnett, LE Bisping, TM Poston, and K Rhoads. 2011. *Pacific Northwest Site Office Environmental Monitoring Plan for the DOE-SC PNNL Site*. PNNL-20919, Pacific Northwest National Laboratory, Richland, Washington.

WAC 173-480. 2007 “Ambient Air Quality Standards and Emission Limits for Radionuclides.” Washington Administrative Code, Olympia, Washington.

WAC 246-247. 2016. “Radiation Protection – Air Emissions.” Washington Administrative Code, Olympia, Washington.

Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

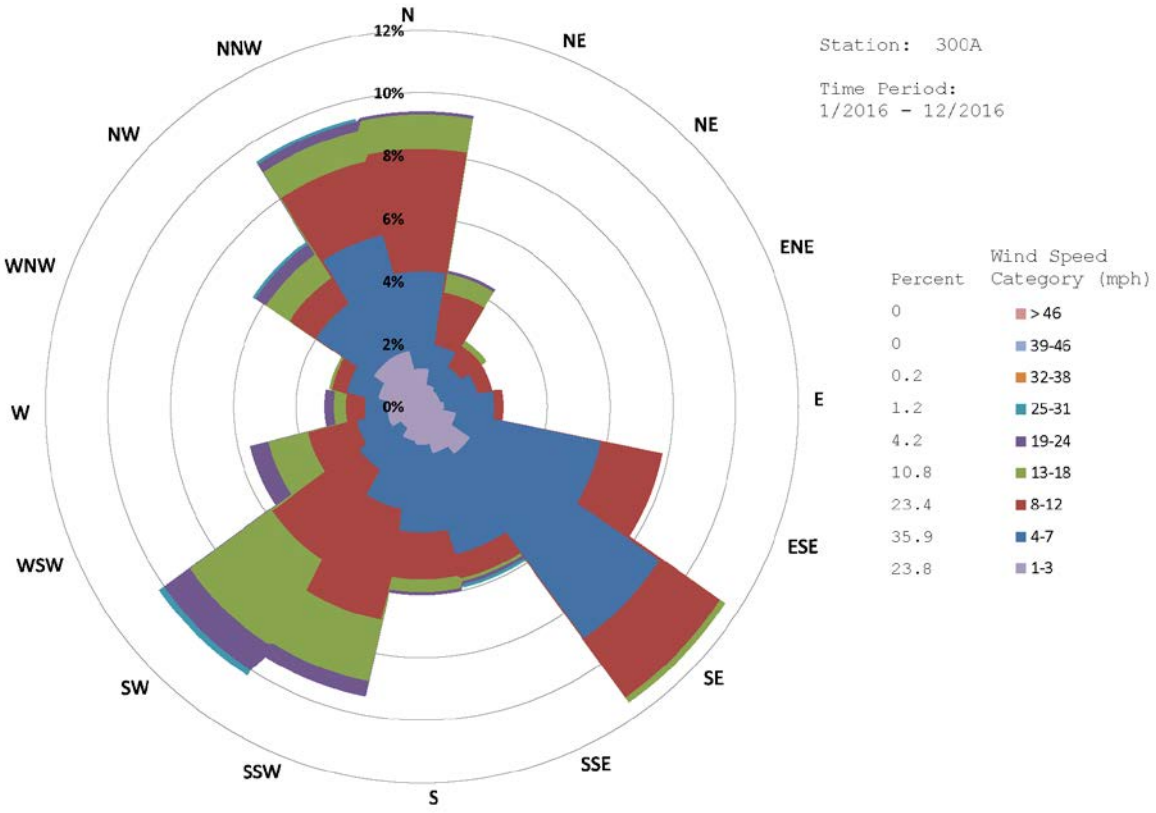

Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2016

Table A.1. Annual Average Joint Frequency During 2016 (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	0.06	0.07	0.06	0.02	0.05	0.06	0.10	0.04	0.03	0.03	0.02	0.02	0.06	0.03	0.08	0.11	**0.84**
	B	0.02	0.01	0.00	0.02	0.01	0.04	0.01	0.02	0.01	0.01	0.00	0.01	0.02	0.02	0.00	0.04	**0.24**
	C	0.07	0.05	0.07	0.08	0.07	0.03	0.15	0.09	0.05	0.01	0.02	0.04	0.01	0.03	0.07	0.07	**0.91**
	D	0.26	0.12	0.11	0.12	0.13	0.31	0.35	0.32	0.20	0.19	0.23	0.24	0.15	0.28	0.31	0.31	**3.63**
	E	0.29	0.22	0.24	0.20	0.20	0.37	0.65	0.60	0.47	0.51	0.41	0.48	0.51	0.56	0.69	0.64	**7.04**
	F	0.39	0.18	0.10	0.12	0.18	0.19	0.37	0.38	0.33	0.26	0.10	0.29	0.28	0.33	0.50	0.48	**4.48**
	G	0.14	0.04	0.08	0.03	0.05	0.12	0.18	0.13	0.13	0.08	0.02	0.03	0.04	0.13	0.20	0.14	**1.54**
	Total	**1.23**	**0.69**	**0.66**	**0.59**	**0.69**	**1.12**	**1.81**	**1.58**	**1.22**	**1.09**	**0.80**	**1.11**	**1.07**	**1.38**	**1.85**	**1.79**	**18.68**
2.65	A	0.21	0.17	0.20	0.14	0.23	0.34	0.30	0.14	0.11	0.12	0.14	0.06	0.05	0.04	0.07	0.13	**2.45**
	B	0.06	0.12	0.12	0.33	0.29	0.32	0.26	0.12	0.12	0.11	0.16	0.02	0.01	0.03	0.05	0.07	**2.19**
	C	0.15	0.14	0.25	0.39	0.28	0.37	0.62	0.26	0.25	0.25	0.13	0.03	0.01	0.02	0.05	0.13	**3.33**
	D	0.75	0.42	0.24	0.24	0.50	1.13	1.27	0.61	0.50	0.52	0.41	0.30	0.15	0.14	0.58	0.88	**8.64**
	E	1.14	0.28	0.07	0.08	0.20	1.28	1.95	0.93	1.04	0.85	0.58	0.40	0.35	0.49	0.82	1.42	**11.88**
	F	0.63	0.18	0.03	0.03	0.09	1.02	2.15	0.93	0.62	0.33	0.19	0.14	0.10	0.17	0.49	0.91	**8.01**
	G	0.21	0.04	0.00	0.00	0.02	0.24	0.61	0.34	0.11	0.07	0.04	0.02	0.03	0.07	0.18	0.29	**2.27**
	Total	**3.15**	**1.35**	**0.91**	**1.21**	**1.61**	**4.70**	**7.16**	**3.33**	**2.75**	**2.25**	**1.65**	**0.97**	**0.70**	**0.96**	**2.24**	**3.83**	**38.77**
4.70	A	0.23	0.45	0.23	0.04	0.02	0.23	0.25	0.11	0.18	0.41	0.46	0.15	0.04	0.04	0.05	0.12	**3.01**
	B	0.15	0.38	0.32	0.16	0.12	0.34	0.32	0.15	0.14	0.32	0.25	0.11	0.04	0.02	0.02	0.05	**2.89**
	C	0.18	0.27	0.18	0.14	0.09	0.25	0.24	0.15	0.09	0.50	0.42	0.17	0.02	0.03	0.04	0.06	**2.83**
	D	0.84	0.25	0.06	0.09	0.06	0.35	0.36	0.13	0.36	0.85	0.84	0.43	0.15	0.14	0.35	0.88	**6.14**
	E	1.51	0.21	0.02	0.04	0.01	0.26	0.47	0.21	0.50	1.04	1.02	0.58	0.24	0.23	0.47	0.67	**7.48**
	F	0.65	0.10	0.00	0.01	0.00	0.34	0.37	0.07	0.22	0.39	0.38	0.11	0.06	0.02	0.05	0.38	**3.15**
	G	0.35	0.03	0.00	0.00	0.00	0.19	0.31	0.03	0.03	0.05	0.08	0.03	0.01	0.00	0.02	0.22	**1.35**
	Total	**3.91**	**1.69**	**0.81**	**0.48**	**0.30**	**1.96**	**2.32**	**0.85**	**1.52**	**3.56**	**3.45**	**1.58**	**0.56**	**0.48**	**1.00**	**2.38**	**26.85**

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	0.11	0.38	0.07	0.01	0.00	0.01	0.03	0.01	0.06	0.34	0.72	0.33	0.03	0.03	0.10	0.14	**2.37**
	B	0.11	0.07	0.01	0.00	0.00	0.01	0.00	0.00	0.05	0.17	0.33	0.11	0.06	0.00	0.02	0.00	**0.94**
	C	0.09	0.05	0.02	0.00	0.00	0.00	0.01	0.01	0.04	0.27	0.30	0.13	0.03	0.01	0.04	0.03	**1.03**
	D	0.26	0.05	0.00	0.01	0.00	0.00	0.01	0.00	0.13	0.63	0.77	0.44	0.17	0.03	0.33	0.46	**3.29**
	E	0.32	0.03	0.03	0.03	0.00	0.01	0.10	0.05	0.10	0.42	0.86	0.22	0.11	0.04	0.36	0.31	**2.99**
	F	0.20	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.17	0.20	0.04	0.00	0.00	0.05	0.08	**0.78**
	G	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.03	0.01	0.00	0.00	0.00	**0.20**
	Total	**1.15**	**0.61**	**0.14**	**0.05**	**0.00**	**0.03**	**0.15**	**0.07**	**0.40**	**2.02**	**3.24**	**1.30**	**0.41**	**0.11**	**0.90**	**1.02**	**11.60**
9.8	A	0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.27	0.23	0.05	0.00	0.03	0.02	**0.85**
	B	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.06	0.08	0.07	0.00	0.00	0.00	**0.31**
	C	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.07	0.05	0.03	0.00	0.00	0.00	**0.19**
	D	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.20	0.19	0.16	0.09	0.04	0.21	0.22	**1.17**
	E	0.01	0.04	0.00	0.00	0.00	0.00	0.02	0.09	0.04	0.13	0.34	0.06	0.02	0.00	0.12	0.09	**0.96**
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	**0.06**
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	**0.06**
	Total	**0.10**	**0.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.09**	**0.10**	**0.54**	**1.03**	**0.58**	**0.26**	**0.04**	**0.36**	**0.33**	**3.60**
12.7	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.01	0.00	0.00	0.00	0.00	**0.08**
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.03	0.00	0.01	0.00	**0.07**
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	**0.05**
	D	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	0.06	0.04	**0.12**
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.09	0.00	0.00	0.00	0.03	0.01	**0.19**
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	**0.03**
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.01**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**	**0.00**	**0.02**	**0.21**	**0.04**	**0.05**	**0.00**	**0.11**	**0.06**	**0.55**

Wind Speed (m/sec)	Stability Class	Wind Direction Toward																**Total**
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
15.6	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
19	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total	A	0.63	1.14	0.56	0.21	0.30	0.64	0.68	0.30	0.41	1.05	1.66	0.80	0.23	0.14	0.33	0.52	9.60
	B	0.35	0.61	0.45	0.51	0.42	0.71	0.59	0.29	0.33	0.66	0.82	0.34	0.23	0.07	0.10	0.16	6.64
	C	0.51	0.51	0.52	0.61	0.44	0.65	1.02	0.51	0.44	1.04	0.95	0.43	0.11	0.09	0.21	0.30	8.34
	D	2.15	0.85	0.41	0.46	0.69	1.79	1.99	1.06	1.20	2.39	2.44	1.58	0.72	0.63	1.84	2.79	22.99
	E	3.27	0.78	0.36	0.35	0.41	1.92	3.19	1.94	2.15	2.95	3.30	1.74	1.23	1.32	2.49	3.14	30.54
	F	1.87	0.48	0.14	0.16	0.27	1.55	2.89	1.38	1.18	1.17	0.94	0.58	0.44	0.52	1.09	1.85	16.51
	G	0.76	0.12	0.08	0.03	0.07	0.55	1.10	0.50	0.28	0.22	0.27	0.11	0.09	0.20	0.40	0.65	5.43
	Total	**9.54**	**4.49**	**2.52**	**2.33**	**2.60**	**7.81**	**11.46**	**5.98**	**5.99**	**9.48**	**10.38**	**5.58**	**3.05**	**2.97**	**6.46**	**9.41**	**100.05**

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)

Food	Local	Regional	Imported
Vegetable	1.000	0.000	0.000
Meat	1.000	0.000	0.000
Milk	1.000	0.000	0.000

VALUES FOR RADIONUCLIDE-INDEPENDENT VARIABLES

HUMAN INHALATION RATE (cm^3/hr) = 5.26 E+03

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

BUILDUP TIMES
For activity in soil (yr) = 1.00 E+02
For radionuclides deposited on ground/water (d) = 3.65E+04

DELAY TIMES
Ingestion of pasture grass by animals (hr) = 0.00 E+00
Ingestion of stored feed by animals (hr) = 2.16 E+03
Ingestion of leafy vegetables by man (hr) = 3.36 E+02
Ingestion of produce by man (hours) = 3.36 E+02
Transport time from animal feed-milk-man (d) = 2.00 E+00
Time from slaughter to consumption (d) = 2.00 E+01

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

CROP EXPOSURE DURATION
Pasture grass (hr) = 7.20 E+02
Crops/leafy vegetables (hr) = 1.44 E+03

AGRICULTURAL PRODUCTIVITY
Grass-cow-milk-man pathway (kg/m^2) = 2.80 E–01
Produce/leafy veg for human consumption (kg/m^2) = 7.16 E-01

FALLOUT INTERCEPTION FRACTIONS
Vegetables = 2.00 E-01
Pasture = 5.70 E-01

GRAZING PARAMETERS
Fraction of year animals graze on pasture = 4.00 E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture = 4.30 E-01

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

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

Table A.2. (contd)

MEAT ANIMAL SLAUGHTER PARAMETERS
Muscle mass of animal at slaughter (kg) = 2.00 E+02
Fraction of herd slaughtered (per day) = 3.81 E-03

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

FRACTIONS GROWN IN GARDEN OF INTEREST
Produce ingested = 1.00 E+0
Leafy vegetables ingested = 1.00 E+00

INGESTION RATIOS:
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA
Vegetables = 1.00 E+00
Meat = 1.00 E+00
Milk = 1.00 E+00

MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA
(Minimum fractions of food types from outside area listed below are actual fixed values.)
Vegetables = 0.00 E+00
Meat = 0.00 E+00
Milk = 0.00 E+00

HUMAN FOOD UTILIZATION FACTORS
Produce ingestion (kg/yr) = 7.62 E+01
Milk ingestion (L/yr) = 5.30 E+01
Meat ingestion (kg/yr) = 8.40 E+01
Leafy vegetable ingestion (kg/yr) = 7.79 E+00

SWIMMING PARAMETERS
Fraction of time spent swimming = 0.00 E+00
Dilution depth for water (cm) = 1.00 E+00

EXTERNAL DOSE
Ground surface contamination correction factor = 5.00 E-01

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

HEIGHT OF LID
LIDAI = 1,000 m

RAINFALL RATE [2016]
RR = 19.4 cm/yr (7.64 in/yr)

AVERAGE AIR TEMPERATURE [2016]
A = 13.31 degrees C (55.96 degrees F; 286.5 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 2016

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Richland Campus in 2016

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Richland Campus in 2016

Ac-225	Au-195	C-11	Co-58m	F-18	Ho-166	K-42	Nb-92m	Pa-234m
Ac-226	Au-195m	C-14	Co-60	Fe-55	Ho-166m	Kr-81	Nb-93m	Pb-203
Ac-227	Au-196	C-15	Co-60m	Fe-59	I-122	Kr-81m	Nb-94	Pb-204m
Ac-228	Au-196m	Ca-41	Cr-49	Fr-221	I-123	Kr-83m	Nb-94m	Pb-205
Ag-105	Au-198	Ca-45	Cr-51	Fr-222	I-124	Kr-85	Nb-95	Pb-209
Ag-106m	Au-198m	Ca-47	Cr-55	Fr-223	I-125	Kr-85m	Nb-95m	Pb-210
Ag-108	Au-199	Cd-107	Cs-131	Ga-67	I-126	Kr-87	Nb-96	Pb-211
Ag-108m	Ba-131	Cd-109	Cs-132	Ga-68	I-128	Kr-88	Nb-97	Pb-212
Ag-109m	Ba-131m	Cd-111m	Cs-134	Ga-70	I-129	Kr-89	Nb-97m	Pb-214
Ag-110	Ba-133	Cd-113	Cs-134m	Ga-72	I-130	Kr-90	Nb-98	Pd-103
Ag-110m	Ba-133m	Cd-113m	Cs-135	Gd-148	I-130m	La-137	Nb-100	Pd-107
Ag-111	Ba-135m	Cd-115	Cs-135m	Gd-149	I-131	La-138	Nb-101	Pd-109
Ag-111m	Ba-137m	Cd-115m	Cs-136	Gd-150	I-132	La-140	Nb-103	Pd-109m
Ag-112	Ba-139	Cd-117	Cs-137	Gd-151	I-132m	La-141	Nd-144	Pd-111
Al-26	Ba-140	Cd-117m	Cs-138	Gd-152	I-133	La-142	Nd-147	Pd-112
Al-28	Ba-141	Ce-139	Cs-138m	Gd-153	I-133m	La-144	Ni-56	Pm-143
Am-240	Ba-142	Ce-141	Cs-139	Gd-159	I-134	Lu-177	Ni-57	Pm-144
Am-241	Ba-143	Ce-142	Cs-140	Ge-68	I-134m	Lu-177m	Ni-59	Pm-145
Am-242	Be-7	Ce-143	Cs-141	Ge-69	I-135	Mg-27	Ni-63	Pm-146
Am-242m	Be-10	Ce-144	Cu-64	Ge-71	In-106	Mg-28	Ni-65	Pm-147
Am-243	Bi-207	Cf-249	Cu-66	Ge-71m	In-111	Mn-52	Np-235	Pm-148
Am-244	Bi-208	Cf-250	Cu-67	Ge-75	In-111m	Mn-52m	Np-236	Pm-148m
Am-244m	Bi-210	Cf-251	Dy-159	Ge-77	In-112	Mn-53	Np-236m	Pm-149
Am-245	Bi-210m	Cf-252	Dy-165	Ge-77m	In-112m	Mn-54	Np-237	Pm-150
Am-246	Bi-211	Cl-36	Dy-169	H-3	In-113m	Mn-56	Np-238	Pm-151
Ar-37	Bi-212	Cm-241	Er-169	Hf-175	In-114	Mo-93	Np-239	Po-208
Ar-39	Bi-213	Cm-242	Er-171	Hf-177m	In-114m	Mo-93m	Np-240	Po-209
Ar-41	Bi-214	Cm-243	Es-254	Hf-178m	In-115	Mo-99	Np-240m	Po-210
Ar-42	Bk-247	Cm-244	Eu-150	Hf-179m	In-115m	Mo-103	O-15	Po-211
As-73	Bk-248m	Cm-245	Eu-150m	Hf-180m	In-116	Mo-104	O-19	Po-212
As-74	Bk-249	Cm-246	Eu-152	Hf-181	In-116m	Mo-105	Os-185	Po-212m
As-76	Bk-250	Cm-247	Eu-152m	Hf-182	In-117	N-13	Os-191	Po-213
As-77	Br-82	Cm-248	Eu-152n	Hg-203	In-117m	Na-22	P-32	Po-214
At-217	Br-82m	Cm-249	Eu-154	Hg-205	Ir-189	Na-24	P-33	Po-215
At-218	Br-83	Cm-250	Eu-154m	Hg-206	Ir-190	Na-24m	Pa-231	Po-216
Au-193	Br-84	Co-56	Eu-155	Ho-163	Ir-192	Nb-91	Pa-232	Po-218
Au-193m	Br-84m	Co-57	Eu-156	Ho-164	Ir-194	Nb-91m	Pa-233	Pr-142
Au-194	Br-85	Co-58	Eu-157	Ho-164m	K-40	Nb-92	Pa-234	Pr-142m

Table B.1 (cont'd)

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-97	Si-32	Sr-90	Te-123m	Tl-206	Xe-123	Yb-177
Pt-199	Rb-86	Ru-103	Sm-145	Sr-91	Te-125m	Tl-206m	Xe-125	Zn-65
Pt-199m	Rb-86m	Ru-105	Sm-146	Sr-92	Te-127	Tl-207	Xe-127	Zn-69
Pu-234	Rb-87	Ru-106	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	-
Pu-246	Rh-102	Sb-128	Sn-121	Tc-96	Th-229	U-236	Y-89m	-
Ra-223	Rh-102m	Sb-128m	Sn-121m	Tc-96m	Th-230	U-237	Y-90	-
Ra-224	Rh-103m	Sb-129	Sn-123	Tc-97	Th-231	U-238	Y-90m	-
Ra-225	Rh-104	Sc-44	Sn-123m	Tc-97m	Th-232	U-239	Y-91	-
Ra-226	Rh-104m	Sc-44m	Sn-125	Tc-98	Th-233	U-240	Y-91m	-

Appendix C

Ambient Air Sampling Results for PNNL Richland Campus Air Surveillance in 2016

Appendix C

Ambient Air Sampling Results for the PNNL Richland Campus Air Surveillance in 2016

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 Background Location: Yakima, 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 in Table C.2).
SAMP_DATE_TIME	date (DD-MMM-YY HH:MM [24 hr])	Date and time when air sampling started (time field is truncated in Table C.2).
CON_SHORT_NAME	text	ALPHA, BETA, Am-241, Am-241 (Gamma), 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 Am-241 is the result from alpha spectroscopy, which also is done for the Cm. The Am-241 (Gamma) is the gamma spectroscopy result, which is the less sensitive evaluation. 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	pCi 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”, and the VALUE_RPTD column is not blank, see comment 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.

(a) 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 and the Yakima Background Station for Calendar Year 2016

(Note: Yakima counting error and comment fields not available)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	388900001	12/23/2015 8:50	1/6/2016 9:15	ALPHA	1.2E-03	pCi/m3	4.4E-04	4.4E-04				
PNL-1	FILTER2 SOLAR	390132001	1/6/2016 9:15	1/20/2016 8:40	ALPHA	1.7E-03	pCi/m3	4.8E-04	4.8E-04				
PNL-1	FILTER2 SOLAR	390931001	1/20/2016 8:40	2/3/2016 9:15	ALPHA	4.3E-04	pCi/m3	2.8E-04	2.8E-04	O			
PNL-1	FILTER2 SOLAR	391693001	2/3/2016 9:15	2/17/2016 9:00	ALPHA	4.5E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-1	FILTER2 SOLAR	392423001	2/17/2016 9:00	3/2/2016 10:00	ALPHA	1.6E-04	pCi/m3	2.2E-04	2.2E-04	U			
PNL-1	FILTER2 SOLAR	393503001	3/2/2016 10:00	3/16/2016 10:00	ALPHA	-1.5E-05	pCi/m3	2.4E-04	2.4E-04	U			
PNL-1	FILTER2 SOLAR	394112001	3/16/2016 10:00	3/30/2016 10:00	ALPHA	2.4E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-1	FILTER2 SOLAR	395430001	3/30/2016 10:00	4/13/2016 9:30	ALPHA	5.8E-04	pCi/m3	3.3E-04	3.3E-04	O			
PNL-1	FILTER2 SOLAR	396369001	4/13/2016 9:30	4/27/2016 9:05	ALPHA	9.3E-04	pCi/m3	3.7E-04	3.7E-04	O			
PNL-1	FILTER2 SOLAR	397395001	4/27/2016 9:05	5/11/2016 8:30	ALPHA	3.8E-04	pCi/m3	2.6E-04	2.6E-04				
PNL-1	FILTER2 SOLAR	398322001	5/11/2016 8:30	5/25/2016 8:45	ALPHA	7.6E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-1	FILTER2 SOLAR	399158001	5/25/2016 8:45	6/8/2016 9:15	ALPHA	7.9E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-1	FILTER2 SOLAR	400050001	6/8/2016 9:15	6/22/2016 9:30	ALPHA	6.6E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-1	FILTER2 SOLAR	401348001	6/22/2016 9:30	7/6/2016 10:30	ALPHA	4.8E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-1	FILTER2 SOLAR	402216001	7/6/2016 10:30	7/20/2016 9:30	ALPHA	3.6E-05	pCi/m3	2.6E-04	2.6E-04	U			
PNL-1	FILTER2 SOLAR	403126001	7/20/2016 9:30	8/3/2016 8:00	ALPHA	8.2E-04	pCi/m3	4.0E-04	4.0E-04				
PNL-1	FILTER2 SOLAR	404253001	8/3/2016 8:00	8/17/2016 8:40	ALPHA	4.0E-04	pCi/m3	3.6E-04	3.6E-04	U			
PNL-1	FILTER2 SOLAR	405191001	8/17/2016 8:40	8/31/2016 8:30	ALPHA	3.6E-04	pCi/m3	3.5E-04	3.5E-04	U			
PNL-1	FILTER2 SOLAR	406090001	8/31/2016 8:30	9/14/2016 11:00	ALPHA	4.3E-04	pCi/m3	3.5E-04	3.5E-04	U	AIR SAMPLER #26472 EXPIRING 09/21/16 WAS REPLACED ON 09/14/16 WITH #21711 EXPIRES 07/13/17.		
PNL-1	FILTER2 SOLAR	407094001	9/14/2016 11:00	9/28/2016 9:15	ALPHA	8.1E-04	pCi/m3	3.4E-04	3.4E-04		DEPLOYED DOSIMETER.		
PNL-1	FILTER2 SOLAR	408254001	9/28/2016 9:15	10/12/2016 9:00	ALPHA	2.2E-04	pCi/m3	2.9E-04	2.9E-04	U			
PNL-1	FILTER2 SOLAR	409244001	10/12/2016 9:00	10/26/2016 9:15	ALPHA	3.2E-04	pCi/m3	3.1E-04	3.1E-04	U	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA.		
PNL-1	FILTER2 SOLAR	410486001	10/26/2016 9:15	11/9/2016 8:15	ALPHA	9.7E-04	pCi/m3	4.0E-04	4.0E-04				
PNL-1	FILTER2 SOLAR	411470001	11/9/2016 8:15	11/23/2016 8:35	ALPHA	1.9E-03	pCi/m3	5.4E-04	5.4E-04				
PNL-1	FILTER2 SOLAR	412214001	11/23/2016 8:35	12/7/2016 10:30	ALPHA	8.6E-04	pCi/m3	4.0E-04	4.0E-04				
PNL-1	FILTER2 SOLAR	413273001	12/7/2016 10:30	12/21/2016 10:00	ALPHA	1.5E-03	pCi/m3	4.9E-04	4.9E-04				
PNL-1	FILTER2 SOLAR	388900001	12/23/2015 8:50	1/6/2016 9:15	BETA	4.0E-02	pCi/m3	1.8E-03	2.5E-03	O			
PNL-1	FILTER2 SOLAR	390132001	1/6/2016 9:15	1/20/2016 8:40	BETA	4.4E-02	pCi/m3	1.8E-03	2.0E-03	O			
PNL-1	FILTER2 SOLAR	390931001	1/20/2016 8:40	2/3/2016 9:15	BETA	1.5E-02	pCi/m3	1.1E-03	1.3E-03	O			
PNL-1	FILTER2 SOLAR	391693001	2/3/2016 9:15	2/17/2016 9:00	BETA	2.0E-02	pCi/m3	1.2E-03	1.3E-03	O			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	392423001	2/17/2016 9:00	3/2/2016 10:00	BETA	1.3E-02	pCi/m3	9.8E-04	1.0E-03	O			
PNL-1	FILTER2 SOLAR	393503001	3/2/2016 10:00	3/16/2016 10:00	BETA	9.1E-03	pCi/m3	9.1E-04	9.8E-04	O			
PNL-1	FILTER2 SOLAR	394112001	3/16/2016 10:00	3/30/2016 10:00	BETA	1.1E-02	pCi/m3	9.3E-04	9.9E-04	O			
PNL-1	FILTER2 SOLAR	395430001	3/30/2016 10:00	4/13/2016 9:30	BETA	1.6E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-1	FILTER2 SOLAR	396369001	4/13/2016 9:30	4/27/2016 9:05	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	397395001	4/27/2016 9:05	5/11/2016 8:30	BETA	2.0E-02	pCi/m3	1.3E-03	1.5E-03	O			
PNL-1	FILTER2 SOLAR	398322001	5/11/2016 8:30	5/25/2016 8:45	BETA	1.6E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-1	FILTER2 SOLAR	399158001	5/25/2016 8:45	6/8/2016 9:15	BETA	1.9E-02	pCi/m3	1.2E-03	1.4E-03	O			
PNL-1	FILTER2 SOLAR	400050001	6/8/2016 9:15	6/22/2016 9:30	BETA	1.1E-02	pCi/m3	9.0E-04	9.1E-04	O			
PNL-1	FILTER2 SOLAR	401348001	6/22/2016 9:30	7/6/2016 10:30	BETA	1.4E-02	pCi/m3	1.0E-03	1.2E-03	O			
PNL-1	FILTER2 SOLAR	402216001	7/6/2016 10:30	7/20/2016 9:30	BETA	1.0E-02	pCi/m3	8.9E-04	9.3E-04	O			
PNL-1	FILTER2 SOLAR	403126001	7/20/2016 9:30	8/3/2016 8:00	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	404253001	8/3/2016 8:00	8/17/2016 8:40	BETA	1.5E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	405191001	8/17/2016 8:40	8/31/2016 8:30	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	406090001	8/31/2016 8:30	9/14/2016 11:00	BETA	1.0E-02	pCi/m3	8.3E-04	8.6E-04	O	AIR SAMPLER #26472 EXPIRING 09/21/16 WAS REPLACED ON 09/14/16 WITH #21711 EXPIRES 07/13/17.		
PNL-1	FILTER2 SOLAR	407094001	9/14/2016 11:00	9/28/2016 9:15	BETA	1.6E-02	pCi/m3	1.1E-03	1.2E-03	O	DEPLOYED DOSIMETER.		
PNL-1	FILTER2 SOLAR	408254001	9/28/2016 9:15	10/12/2016 9:00	BETA	1.2E-02	pCi/m3	9.0E-04	9.4E-04	O			
PNL-1	FILTER2 SOLAR	409244001	10/12/2016 9:00	10/26/2016 9:15	BETA	1.4E-02	pCi/m3	9.8E-04	1.1E-03	O	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA.		
PNL-1	FILTER2 SOLAR	410486001	10/26/2016 9:15	11/9/2016 8:15	BETA	1.8E-02	pCi/m3	1.1E-03	1.3E-03	O			
PNL-1	FILTER2 SOLAR	411470001	11/9/2016 8:15	11/23/2016 8:35	BETA	2.3E-02	pCi/m3	1.2E-03	1.3E-03	O			
PNL-1	FILTER2 SOLAR	412214001	11/23/2016 8:35	12/7/2016 10:30	BETA	9.3E-03	pCi/m3	8.2E-04	8.3E-04	O			
PNL-1	FILTER2 SOLAR	413273001	12/7/2016 10:30	12/21/2016 10:00	BETA	3.9E-02	pCi/m3	1.6E-03	2.4E-03	O			
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Be-7	4.2E-02	pCi/m3	1.3E-02	1.3E-02				Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Be-7	3.7E-02	pCi/m3	6.4E-03	7.2E-03				Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Co-60	1.6E-05	pCi/m3	5.4E-04	5.4E-04	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Co-60	4.2E-05	pCi/m3	1.8E-04	1.8E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Cs-134	-7.5E-05	pCi/m3	5.6E-04	5.6E-04	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Cs-134	-2.9E-05	pCi/m3	2.0E-04	2.0E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Cs-137	7.4E-04	pCi/m3	5.7E-04	6.6E-04	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Cs-137	7.8E-05	pCi/m3	1.9E-04	1.9E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Eu-152	-1.3E-03	pCi/m3	1.4E-03	1.5E-03	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Eu-152	2.4E-04	pCi/m3	6.2E-04	6.3E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Eu-154	3.5E-04	pCi/m3	1.5E-03	1.5E-03	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Eu-154	-1.8E-04	pCi/m3	5.1E-04	5.2E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Eu-155	-1.5E-04	pCi/m3	1.6E-03	1.6E-03	U			Y

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Eu-155	7.8E-05	pCi/m3	5.7E-04	5.7E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	K-40	-9.8E-04	pCi/m3	7.0E-03	7.0E-03	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	K-40	1.4E-03	pCi/m3	4.2E-03	4.2E-03	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Ru-106	-5.3E-04	pCi/m3	4.6E-03	4.6E-03	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Ru-106	2.4E-03	pCi/m3	4.5E-03	4.5E-03	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Sb-125	4.0E-05	pCi/m3	1.2E-03	1.2E-03	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Sb-125	2.2E-04	pCi/m3	4.9E-04	5.0E-04	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Am-241	-2.1E-06	pCi/m3	4.8E-06	4.8E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Am-241	5.5E-07	pCi/m3	3.1E-06	3.1E-06	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Am-243	4.0E-06	pCi/m3	7.1E-06	7.1E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Am-243	4.3E-06	pCi/m3	7.6E-06	7.7E-06	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Cm-243/244	1.2E-06	pCi/m3	5.4E-06	5.4E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Cm-243/244	1.9E-06	pCi/m3	3.6E-06	3.7E-06	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Pu-238	8.5E-07	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Pu-238	2.2E-04	pCi/m3	1.6E-05	2.4E-05			(a)	Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	Pu-239/240	0.0E+00	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	Pu-239/240	5.6E-06	pCi/m3	2.8E-06	2.9E-06				Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	U-233/234	4.2E-05	pCi/m3	1.9E-05	2.0E-05				Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	U-233/234	4.9E-05	pCi/m3	1.3E-05	1.5E-05				Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	U-235	-6.1E-07	pCi/m3	5.3E-06	5.3E-06	U			Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	U-235	1.6E-06	pCi/m3	4.0E-06	4.0E-06	U			Y
PNL-1	FILTER2 SOLAR	402174002	12/23/2015 8:50	6/22/2016 9:30	U-238	6.3E-05	pCi/m3	2.3E-05	2.5E-05				Y
PNL-1	FILTER2 SOLAR	413445002	6/22/2016 9:30	12/21/2016 10:00	U-238	5.0E-05	pCi/m3	1.3E-05	1.5E-05				Y
PNL-2	FILTER2 SOLAR	388900002	12/23/2015 9:05	1/6/2016 9:30	ALPHA	1.9E-03	pCi/m3	5.1E-04	5.1E-04				
PNL-2	FILTER2 SOLAR	390132002	1/6/2016 9:30	1/20/2016 8:55	ALPHA	1.0E-03	pCi/m3	4.2E-04	4.2E-04				
PNL-2	FILTER2 SOLAR	390931002	1/20/2016 8:55	2/3/2016 9:30	ALPHA	6.6E-04	pCi/m3	3.7E-04	3.7E-04	O			
PNL-2	FILTER2 SOLAR	391693002	2/3/2016 9:30	2/17/2016 9:30	ALPHA	8.4E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-2	FILTER2 SOLAR	392423002	2/17/2016 9:30	3/2/2016 10:30	ALPHA	8.1E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-2	FILTER2 SOLAR	393503002	3/2/2016 10:30	3/16/2016 10:30	ALPHA	4.0E-05	pCi/m3	2.4E-04	2.4E-04	U			
PNL-2	FILTER2 SOLAR	394112002	3/16/2016 10:30	3/30/2016 10:30	ALPHA	4.2E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-2	FILTER2 SOLAR	395430002	3/30/2016 10:30	4/13/2016 9:00	ALPHA	7.7E-04	pCi/m3	3.5E-04	3.5E-04	O			
PNL-2	FILTER2 SOLAR	396369002	4/13/2016 9:00	4/27/2016 9:30	ALPHA	4.3E-04	pCi/m3	3.6E-04	3.6E-04	UO			
PNL-2	FILTER2 SOLAR	397395002	4/27/2016 9:30	5/11/2016 8:55	ALPHA	5.4E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-2	FILTER2 SOLAR	398322002	5/11/2016 8:55	5/25/2016 9:00	ALPHA	2.5E-04	pCi/m3	2.4E-04	2.4E-04	U			
PNL-2	FILTER2 SOLAR	399158002	5/25/2016 9:00	6/8/2016 9:45	ALPHA	8.0E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-2	FILTER2 SOLAR	400050002	6/8/2016 9:45	6/22/2016 8:30	ALPHA	7.4E-04	pCi/m3	3.6E-04	3.6E-04		AIR SAMPLER #21710 EXPIRING 07/15/16 WAS REPLACED ON 06/22/16 WITH #24095 EXPIRES 05/20/17.		
PNL-2	FILTER2 SOLAR	401348002	6/22/2016 8:30	7/6/2016 11:00	ALPHA	2.6E-04	pCi/m3	2.6E-04	2.7E-04	U			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	402216002	7/6/2016 11:00	7/20/2016 10:00	ALPHA	3.8E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-2	FILTER2 SOLAR	403126002	7/20/2016 10:00	8/3/2016 8:30	ALPHA	5.2E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-2	FILTER2 SOLAR	404253002	8/3/2016 8:30	8/17/2016 9:00	ALPHA	3.9E-04	pCi/m3	3.4E-04	3.4E-04	U			
PNL-2	FILTER2 SOLAR	405191002	8/17/2016 9:00	8/31/2016 8:45	ALPHA	1.0E-03	pCi/m3	4.6E-04	4.6E-04				
PNL-2	FILTER2 SOLAR	406090002	8/31/2016 8:45	9/14/2016 10:00	ALPHA	4.8E-04	pCi/m3	3.7E-04	3.7E-04	U			
PNL-2	FILTER2 SOLAR	407094002	9/14/2016 10:00	9/28/2016 10:15	ALPHA	4.0E-04	pCi/m3	3.0E-04	3.0E-04	U	DEPLOYED DOSIMETER.		
PNL-2	FILTER2 SOLAR	408254002	9/28/2016 10:15	10/12/2016 9:30	ALPHA	9.8E-05	pCi/m3	2.6E-04	2.6E-04	U			
PNL-2	FILTER2 SOLAR	409244002	10/12/2016 9:30	10/26/2016 10:00	ALPHA	4.7E-04	pCi/m3	3.5E-04	3.5E-04	U			
PNL-2	FILTER2 SOLAR	410486002	10/26/2016 10:00	11/9/2016 8:30	ALPHA	5.3E-04	pCi/m3	3.8E-04	3.8E-04	U			
PNL-2	FILTER2 SOLAR	411470002	11/9/2016 8:30	11/23/2016 8:55	ALPHA	1.1E-03	pCi/m3	4.3E-04	4.3E-04				
PNL-2	FILTER2 SOLAR	412214002	11/23/2016 8:55	12/7/2016 11:00	ALPHA	3.2E-04	pCi/m3	3.3E-04	3.3E-04	U			
PNL-2	FILTER2 SOLAR	413273002	12/7/2016 11:00	12/21/2016 10:15	ALPHA	2.3E-03	pCi/m3	6.4E-04	6.5E-04				
PNL-2	FILTER2 SOLAR	388900002	12/23/2015 9:05	1/6/2016 9:30	BETA	3.9E-02	pCi/m3	1.7E-03	1.9E-03	O			
PNL-2	FILTER2 SOLAR	390132002	1/6/2016 9:30	1/20/2016 8:55	BETA	3.6E-02	pCi/m3	1.6E-03	1.8E-03	O			
PNL-2	FILTER2 SOLAR	390931002	1/20/2016 8:55	2/3/2016 9:30	BETA	1.2E-02	pCi/m3	9.6E-04	9.8E-04	O			
PNL-2	FILTER2 SOLAR	391693002	2/3/2016 9:30	2/17/2016 9:30	BETA	1.6E-02	pCi/m3	1.1E-03	1.3E-03	O			
PNL-2	FILTER2 SOLAR	392423002	2/17/2016 9:30	3/2/2016 10:30	BETA	1.1E-02	pCi/m3	9.2E-04	9.9E-04	O			
PNL-2	FILTER2 SOLAR	393503002	3/2/2016 10:30	3/16/2016 10:30	BETA	8.1E-03	pCi/m3	8.7E-04	9.4E-04	O			
PNL-2	FILTER2 SOLAR	394112002	3/16/2016 10:30	3/30/2016 10:30	BETA	8.5E-03	pCi/m3	7.9E-04	8.7E-04	O			
PNL-2	FILTER2 SOLAR	395430002	3/30/2016 10:30	4/13/2016 9:00	BETA	1.4E-02	pCi/m3	1.0E-03	1.0E-03	O			
PNL-2	FILTER2 SOLAR	396369002	4/13/2016 9:00	4/27/2016 9:30	BETA	1.4E-02	pCi/m3	1.0E-03	1.0E-03	O			
PNL-2	FILTER2 SOLAR	397395002	4/27/2016 9:30	5/11/2016 8:55	BETA	1.7E-02	pCi/m3	1.2E-03	1.3E-03	O			
PNL-2	FILTER2 SOLAR	398322002	5/11/2016 8:55	5/25/2016 9:00	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	399158002	5/25/2016 9:00	6/8/2016 9:45	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	400050002	6/8/2016 9:45	6/22/2016 8:30	BETA	1.0E-02	pCi/m3	9.3E-04	9.6E-04	O	AIR SAMPLER #21710 EXPIRING 07/15/16 WAS REPLACED ON 06/22/16 WITH #24095 EXPIRES 05/20/17.		
PNL-2	FILTER2 SOLAR	401348002	6/22/2016 8:30	7/6/2016 11:00	BETA	1.2E-02	pCi/m3	9.7E-04	1.0E-03	O			
PNL-2	FILTER2 SOLAR	402216002	7/6/2016 11:00	7/20/2016 10:00	BETA	1.0E-02	pCi/m3	8.7E-04	8.8E-04	O			
PNL-2	FILTER2 SOLAR	403126002	7/20/2016 10:00	8/3/2016 8:30	BETA	1.2E-02	pCi/m3	9.4E-04	9.5E-04	O			
PNL-2	FILTER2 SOLAR	404253002	8/3/2016 8:30	8/17/2016 9:00	BETA	1.3E-02	pCi/m3	9.7E-04	1.1E-03	O			
PNL-2	FILTER2 SOLAR	405191002	8/17/2016 9:00	8/31/2016 8:45	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	406090002	8/31/2016 8:45	9/14/2016 10:00	BETA	9.5E-03	pCi/m3	8.2E-04	8.8E-04	O			
PNL-2	FILTER2 SOLAR	407094002	9/14/2016 10:00	9/28/2016 10:15	BETA	1.5E-02	pCi/m3	1.0E-03	1.1E-03	O	DEPLOYED DOSIMETER.		
PNL-2	FILTER2 SOLAR	408254002	9/28/2016 10:15	10/12/2016 9:30	BETA	9.1E-03	pCi/m3	7.9E-04	8.3E-04	O			
PNL-2	FILTER2 SOLAR	409244002	10/12/2016 9:30	10/26/2016 10:00	BETA	1.3E-02	pCi/m3	9.6E-04	1.1E-03	O			
PNL-2	FILTER2 SOLAR	410486002	10/26/2016 10:00	11/9/2016 8:30	BETA	1.7E-02	pCi/m3	1.1E-03	1.3E-03	O			
PNL-2	FILTER2 SOLAR	411470002	11/9/2016 8:30	11/23/2016 8:55	BETA	2.1E-02	pCi/m3	1.3E-03	1.3E-03	O			
PNL-2	FILTER2 SOLAR	412214002	11/23/2016 8:55	12/7/2016 11:00	BETA	7.0E-03	pCi/m3	6.9E-04	7.0E-04	O			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	413273002	12/7/2016 11:00	12/21/2016 10:15	BETA	3.7E-02	pCi/m3	1.6E-03	2.4E-03	O			
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Be-7	3.2E-02	pCi/m3	1.3E-02	1.3E-02				Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Be-7	3.5E-02	pCi/m3	6.2E-03	6.4E-03				Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Co-60	-2.3E-04	pCi/m3	5.5E-04	5.6E-04	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Co-60	-2.0E-04	pCi/m3	2.3E-04	2.5E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Cs-134	1.6E-04	pCi/m3	5.3E-04	5.4E-04	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Cs-134	1.4E-04	pCi/m3	2.1E-04	2.2E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Cs-137	9.2E-05	pCi/m3	4.1E-04	4.1E-04	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Cs-137	-3.9E-05	pCi/m3	1.7E-04	1.7E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Eu-152	4.4E-04	pCi/m3	1.3E-03	1.4E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Eu-152	5.9E-06	pCi/m3	6.9E-04	6.9E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Eu-154	-1.8E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Eu-154	-1.3E-04	pCi/m3	4.8E-04	4.9E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Eu-155	1.2E-03	pCi/m3	1.4E-03	1.5E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Eu-155	2.5E-04	pCi/m3	6.4E-04	6.5E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	K-40	1.6E-03	pCi/m3	6.2E-03	6.2E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	K-40	8.4E-04	pCi/m3	3.6E-03	3.6E-03	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Ru-106	-3.9E-04	pCi/m3	3.9E-03	3.9E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Ru-106	1.0E-03	pCi/m3	2.2E-03	2.2E-03	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Sb-125	-2.1E-04	pCi/m3	1.3E-03	1.3E-03	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Sb-125	-8.2E-05	pCi/m3	5.2E-04	5.2E-04	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Am-241	1.5E-07	pCi/m3	1.1E-05	1.1E-05	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Am-241	2.5E-06	pCi/m3	4.9E-06	4.9E-06	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Am-243	2.4E-06	pCi/m3	6.7E-06	6.7E-06	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Am-243	-2.0E-06	pCi/m3	3.2E-06	3.2E-06	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Cm-243/244	-2.7E-06	pCi/m3	8.2E-06	8.2E-06	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Cm-243/244	3.4E-07	pCi/m3	3.5E-06	3.5E-06	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Pu-238	-6.4E-07	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Pu-238	1.5E-05	pCi/m3	4.2E-06	4.4E-06			(a)	Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	Pu-239/240	-1.6E-06	pCi/m3	2.2E-06	2.2E-06	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	Pu-239/240	2.9E-07	pCi/m3	1.7E-06	1.7E-06	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	U-233/234	5.2E-05	pCi/m3	1.9E-05	2.0E-05				Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	U-233/234	3.6E-05	pCi/m3	9.7E-06	1.1E-05				Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	U-235	0.0E+00	pCi/m3	3.9E-06	3.9E-06	U			Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	U-235	3.3E-06	pCi/m3	4.8E-06	4.8E-06	U			Y
PNL-2	FILTER2 SOLAR	402174003	12/23/2015 9:05	6/22/2016 8:30	U-238	2.9E-05	pCi/m3	1.4E-05	1.4E-05				Y
PNL-2	FILTER2 SOLAR	413445003	6/22/2016 8:30	12/21/2016 10:15	U-238	3.4E-05	pCi/m3	9.3E-06	1.0E-05				Y
PNL-3	FILTER2	388900003	12/23/2015 10:20	1/6/2016 10:30	ALPHA	8.5E-04	pCi/m3	4.1E-04	4.1E-04				
PNL-3	FILTER2	390132003	1/6/2016 10:30	1/20/2016 10:15	ALPHA	1.8E-03	pCi/m3	4.8E-04	4.8E-04				
PNL-3	FILTER2	390931003	1/20/2016 10:15	2/3/2016 9:00	ALPHA	4.0E-04	pCi/m3	3.9E-04	3.9E-04	UO			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-3	FILTER2		2/3/2016 9:00	2/17/2016 12:00	ALPHA						NO SAMPLE. SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP16-001; PUMP NOT RUNNING, REPLACED.		
PNL-3	FILTER2	392423003	2/17/2016 12:00	3/2/2016 9:30	ALPHA	2.5E-04	pCi/m3	2.1E-04	2.1E-04	U			
PNL-3	FILTER2	393503003	3/2/2016 9:30	3/16/2016 9:45	ALPHA	1.1E-04	pCi/m3	2.5E-04	2.5E-04	U			
PNL-3	FILTER2	394112003	3/16/2016 9:45	3/30/2016 9:45	ALPHA	5.0E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-3	FILTER2	395430003	3/30/2016 9:45	4/13/2016 10:15	ALPHA	3.4E-04	pCi/m3	2.7E-04	2.7E-04	UO			
PNL-3	FILTER2	396369003	4/13/2016 10:15	4/27/2016 8:45	ALPHA	7.6E-04	pCi/m3	4.0E-04	4.0E-04	O			
PNL-3	FILTER2	397395003	4/27/2016 8:45	5/11/2016 10:25	ALPHA	5.8E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-3	FILTER2	398322003	5/11/2016 10:25	5/25/2016 9:55	ALPHA	4.9E-04	pCi/m3	3.5E-04	3.5E-04	U			
PNL-3	FILTER2	399158003	5/25/2016 9:55	6/8/2016 9:00	ALPHA	8.1E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-3	FILTER2	400050003	6/8/2016 9:00	6/22/2016 10:30	ALPHA	5.7E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-3	FILTER2	401348003	6/22/2016 10:30	7/6/2016 10:00	ALPHA	3.7E-04	pCi/m3	3.8E-04	3.8E-04	U			
PNL-3	FILTER2	402216003	7/6/2016 10:00	7/20/2016 9:00	ALPHA	1.5E-04	pCi/m3	2.4E-04	2.4E-04	U			
PNL-3	FILTER2	403126003	7/20/2016 9:00	8/3/2016 9:30	ALPHA	4.7E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-3	FILTER2	404253003	8/3/2016 9:30	8/17/2016 10:15	ALPHA	7.5E-04	pCi/m3	3.9E-04	3.9E-04				
PNL-3	FILTER2	405191003	8/17/2016 10:15	8/31/2016 9:30	ALPHA	4.8E-04	pCi/m3	3.6E-04	3.6E-04		TOTALIZER #24966 REPLACED WITH TOTALIZER #28919 ON 08/31/16 AT 0930 HRS, START VOLUME 73612, EXPIRES 07/12/17.		
PNL-3	FILTER2	406090003	8/31/2016 9:30	9/14/2016 9:30	ALPHA	5.0E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-3	FILTER2	407094003	9/14/2016 9:30	9/28/2016 9:00	ALPHA	4.9E-04	pCi/m3	2.9E-04	2.9E-04		DEPLOYED DOSIMETER.		
PNL-3	FILTER2	408254003	9/28/2016 9:00	10/12/2016 11:00	ALPHA	5.4E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-3	FILTER2	409244003	10/12/2016 11:00	10/26/2016 10:15	ALPHA	3.4E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-3	FILTER2	410486003	10/26/2016 10:15	11/9/2016 9:15	ALPHA	6.3E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-3	FILTER2	411470003	11/9/2016 9:15	11/23/2016 9:45	ALPHA	8.2E-04	pCi/m3	4.6E-04	4.6E-04				
PNL-3	FILTER2	412214003	11/23/2016 9:45	12/7/2016 10:00	ALPHA	2.6E-04	pCi/m3	2.8E-04	2.8E-04	U			
PNL-3	FILTER2	413273003	12/7/2016 10:00	12/21/2016 9:45	ALPHA	1.1E-03	pCi/m3	3.6E-04	3.6E-04				
PNL-3	FILTER2	388900003	12/23/2015 10:20	1/6/2016 10:30	BETA	4.2E-02	pCi/m3	1.7E-03	1.9E-03	O			
PNL-3	FILTER2	390132003	1/6/2016 10:30	1/20/2016 10:15	BETA	3.9E-02	pCi/m3	1.7E-03	2.1E-03	O			
PNL-3	FILTER2	390931003	1/20/2016 10:15	2/3/2016 9:00	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-3	FILTER2		2/3/2016 9:00	2/17/2016 12:00	BETA						NO SAMPLE. SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP16-001; PUMP NOT RUNNING, REPLACED.		
PNL-3	FILTER2	392423003	2/17/2016 12:00	3/2/2016 9:30	BETA	1.2E-02	pCi/m3	8.8E-04	1.0E-03	O			
PNL-3	FILTER2	393503003	3/2/2016 9:30	3/16/2016 9:45	BETA	7.7E-03	pCi/m3	7.7E-04	8.4E-04	O			
PNL-3	FILTER2	394112003	3/16/2016 9:45	3/30/2016 9:45	BETA	1.1E-02	pCi/m3	8.9E-04	9.0E-04	O			
PNL-3	FILTER2	395430003	3/30/2016 9:45	4/13/2016 10:15	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-3	FILTER2	396369003	4/13/2016 10:15	4/27/2016 8:45	BETA	1.5E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-3	FILTER2	397395003	4/27/2016 8:45	5/11/2016 10:25	BETA	1.8E-02	pCi/m3	1.2E-03	1.4E-03	O			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-3	FILTER2	398322003	5/11/2016 10:25	5/25/2016 9:55	BETA	1.3E-02	pCi/m3	9.9E-04	1.0E-03	O			
PNL-3	FILTER2	399158003	5/25/2016 9:55	6/8/2016 9:00	BETA	1.5E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-3	FILTER2	400050003	6/8/2016 9:00	6/22/2016 10:30	BETA	8.9E-03	pCi/m3	7.9E-04	8.7E-04	O			
PNL-3	FILTER2	401348003	6/22/2016 10:30	7/6/2016 10:00	BETA	1.3E-02	pCi/m3	9.8E-04	1.0E-03	O			
PNL-3	FILTER2	402216003	7/6/2016 10:00	7/20/2016 9:00	BETA	8.8E-03	pCi/m3	7.9E-04	8.2E-04	O			
PNL-3	FILTER2	403126003	7/20/2016 9:00	8/3/2016 9:30	BETA	1.2E-02	pCi/m3	9.4E-04	9.9E-04	O			
PNL-3	FILTER2	404253003	8/3/2016 9:30	8/17/2016 10:15	BETA	1.3E-02	pCi/m3	9.8E-04	1.1E-03	O			
PNL-3	FILTER2	405191003	8/17/2016 10:15	8/31/2016 9:30	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O	TOTALIZER #24966 REPLACED WITH TOTALIZER #28919 ON 08/31/16 AT 0930 HRS, START VOLUME 73612, EXPIRES 07/12/17.		
PNL-3	FILTER2	406090003	8/31/2016 9:30	9/14/2016 9:30	BETA	8.8E-03	pCi/m3	7.9E-04	8.0E-04	O			
PNL-3	FILTER2	407094003	9/14/2016 9:30	9/28/2016 9:00	BETA	1.4E-02	pCi/m3	9.4E-04	9.8E-04	O	DEPLOYED DOSIMETER.		
PNL-3	FILTER2	408254003	9/28/2016 9:00	10/12/2016 11:00	BETA	1.0E-02	pCi/m3	7.9E-04	8.2E-04	O			
PNL-3	FILTER2	409244003	10/12/2016 11:00	10/26/2016 10:15	BETA	1.3E-02	pCi/m3	9.0E-04	1.0E-03	O			
PNL-3	FILTER2	410486003	10/26/2016 10:15	11/9/2016 9:15	BETA	1.6E-02	pCi/m3	1.0E-03	1.2E-03	O			
PNL-3	FILTER2	411470003	11/9/2016 9:15	11/23/2016 9:45	BETA	2.0E-02	pCi/m3	1.2E-03	1.3E-03	O			
PNL-3	FILTER2	412214003	11/23/2016 9:45	12/7/2016 10:00	BETA	1.1E-02	pCi/m3	8.7E-04	8.9E-04	O			
PNL-3	FILTER2	413273003	12/7/2016 10:00	12/21/2016 9:45	BETA	3.6E-02	pCi/m3	1.5E-03	1.7E-03	O			
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Be-7	3.8E-02	pCi/m3	1.2E-02	1.3E-02				Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Be-7	3.6E-02	pCi/m3	7.9E-03	8.1E-03				Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Co-60	2.0E-04	pCi/m3	3.6E-04	3.7E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Co-60	-8.0E-05	pCi/m3	2.9E-04	3.0E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Cs-134	-2.2E-05	pCi/m3	3.8E-04	3.8E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Cs-134	-1.2E-04	pCi/m3	2.6E-04	2.6E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Cs-137	7.5E-05	pCi/m3	3.8E-04	3.8E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Cs-137	-3.3E-05	pCi/m3	2.6E-04	2.6E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Eu-152	-3.1E-04	pCi/m3	9.8E-04	9.9E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Eu-152	-9.7E-05	pCi/m3	6.4E-04	6.4E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Eu-154	5.4E-04	pCi/m3	9.1E-04	9.5E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Eu-154	2.2E-04	pCi/m3	7.1E-04	7.1E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Eu-155	-9.8E-04	pCi/m3	1.1E-03	1.2E-03	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Eu-155	1.1E-05	pCi/m3	6.5E-04	6.5E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	K-40	4.6E-04	pCi/m3	6.1E-03	6.1E-03	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	K-40	3.1E-03	pCi/m3	5.4E-03	5.4E-03	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Ru-106	1.7E-03	pCi/m3	3.7E-03	3.8E-03	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Ru-106	3.6E-04	pCi/m3	2.1E-03	2.2E-03	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Sb-125	2.5E-04	pCi/m3	9.0E-04	9.1E-04	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Sb-125	1.2E-04	pCi/m3	5.5E-04	5.6E-04	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Am-241	-7.8E-06	pCi/m3	1.8E-05	1.8E-05	U			Y

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Am-241	7.7E-07	pCi/m3	8.8E-06	8.8E-06	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Am-243	-7.4E-07	pCi/m3	1.1E-05	1.1E-05	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Am-243	-3.7E-07	pCi/m3	1.3E-05	1.3E-05	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Cm-243/244	-1.5E-06	pCi/m3	6.7E-06	6.8E-06	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Cm-243/244	9.5E-08	pCi/m3	7.1E-06	7.1E-06	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Pu-238	0.0E+00	pCi/m3	4.6E-06	4.6E-06	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Pu-238	3.9E-06	pCi/m3	4.4E-06	4.4E-06	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	Pu-239/240	0.0E+00	pCi/m3	5.3E-06	5.3E-06	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	Pu-239/240	2.6E-06	pCi/m3	4.4E-06	4.4E-06	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	U-233/234	5.9E-05	pCi/m3	3.6E-05	3.7E-05				Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	U-233/234	5.7E-05	pCi/m3	2.1E-05	2.2E-05				Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	U-235	3.1E-06	pCi/m3	1.7E-05	1.7E-05	U			Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	U-235	4.4E-06	pCi/m3	1.2E-05	1.2E-05	U			Y
PNL-3	FILTER2	402174001	12/23/2015 10:20	6/22/2016 10:30	U-238	5.3E-05	pCi/m3	3.4E-05	3.5E-05				Y
PNL-3	FILTER2	413445001	6/22/2016 10:30	12/21/2016 9:45	U-238	6.9E-05	pCi/m3	2.3E-05	2.4E-05				Y
PNL-4	FILTER2	388900004	12/23/2015 10:35	1/6/2016 10:45	ALPHA	2.2E-03	pCi/m3	6.4E-04	6.4E-04		(b)		
PNL-4	FILTER2	390132004	1/6/2016 10:45	1/20/2016 10:30	ALPHA	1.6E-03	pCi/m3	4.6E-04	4.6E-04				
PNL-4	FILTER2	390931004	1/20/2016 10:30	2/3/2016 8:45	ALPHA	2.5E-04	pCi/m3	2.3E-04	2.3E-04	UO			
PNL-4	FILTER2	391693004	2/3/2016 8:45	2/17/2016 8:30	ALPHA	5.3E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-4	FILTER2	392423004	2/17/2016 8:30	3/2/2016 9:00	ALPHA	2.6E-04	pCi/m3	3.0E-04	3.0E-04	U			
PNL-4	FILTER2	393503004	3/2/2016 9:00	3/16/2016 9:30	ALPHA	4.0E-04	pCi/m3	4.1E-04	4.1E-04	U			
PNL-4	FILTER2		3/16/2016 9:30	3/30/2016 9:00	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP16-001; PUMP FAILED AND WAS REPLACED.		
PNL-4	FILTER2	395430004	3/30/2016 9:00	4/13/2016 10:00	ALPHA	8.1E-04	pCi/m3	3.3E-04	3.3E-04	O			
PNL-4	FILTER2	396369004	4/13/2016 10:00	4/27/2016 8:30	ALPHA	9.8E-04	pCi/m3	4.3E-04	4.3E-04	O			
PNL-4	FILTER2	397395004	4/27/2016 8:30	5/11/2016 10:45	ALPHA	4.2E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-4	FILTER2	398322004	5/11/2016 10:45	5/25/2016 10:10	ALPHA	4.7E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-4	FILTER2	399158004	5/25/2016 10:10	6/8/2016 8:45	ALPHA	4.3E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-4	FILTER2	400050004	6/8/2016 8:45	6/22/2016 10:15	ALPHA	4.5E-04	pCi/m3	3.0E-04	3.1E-04				
PNL-4	FILTER2	401348004	6/22/2016 10:15	7/6/2016 9:30	ALPHA	6.2E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-4	FILTER2	402216004	7/6/2016 9:30	7/20/2016 8:30	ALPHA	2.4E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-4	FILTER2	403126004	7/20/2016 8:30	8/3/2016 9:00	ALPHA	4.4E-04	pCi/m3	3.4E-04	3.4E-04	U			
PNL-4	FILTER2	404253004	8/3/2016 9:00	8/17/2016 10:35	ALPHA	5.7E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-4	FILTER2	405191004	8/17/2016 10:35	8/31/2016 10:00	ALPHA	3.2E-04	pCi/m3	3.2E-04	3.2E-04	U	TOTALIZER #28917 REPLACED WITH TOTALIZER #28921 ON 08/31/16 AT 1000 HRS, START VOLUME 0583, EXPIRES 05/02/17.		
PNL-4	FILTER2	406090004	8/31/2016 10:00	9/14/2016 9:00	ALPHA	8.1E-04	pCi/m3	3.4E-04	3.4E-04				

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-4	FILTER2	407094004	9/14/2016 9:00	9/28/2016 10:45	ALPHA	1.9E-04	pCi/m3	2.7E-04	2.7E-04	U	DEPLOYED DOSIMETER.		
PNL-4	FILTER2	408254004	9/28/2016 10:45	10/12/2016 11:15	ALPHA	5.4E-04	pCi/m3	3.2E-04	3.2E-04		FILTER STAND WET; RECORD BREAKING RAIN OCCURRED PRIOR WEEKEND.		
PNL-4	FILTER2	409244004	10/12/2016 11:15	10/26/2016 10:25	ALPHA	4.1E-04	pCi/m3	3.2E-04	3.2E-04	U			
PNL-4	FILTER2	410486004	10/26/2016 10:25	11/9/2016 9:25	ALPHA	7.4E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-4	FILTER2	411470004	11/9/2016 9:25	11/23/2016 10:00	ALPHA	9.1E-04	pCi/m3	4.3E-04	4.4E-04				
PNL-4	FILTER2	412214004	11/23/2016 10:00	12/7/2016 9:45	ALPHA	5.5E-05	pCi/m3	2.4E-04	2.4E-04	U			
PNL-4	FILTER2	413273004	12/7/2016 9:45	12/21/2016 9:30	ALPHA	1.2E-03	pCi/m3	3.9E-04	3.9E-04				
PNL-4	FILTER2	388900004	12/23/2015 10:35	1/6/2016 10:45	BETA	4.2E-02	pCi/m3	1.8E-03	1.9E-03	O	(b)		
PNL-4	FILTER2	390132004	1/6/2016 10:45	1/20/2016 10:30	BETA	3.6E-02	pCi/m3	1.6E-03	2.1E-03	O			
PNL-4	FILTER2	390931004	1/20/2016 10:30	2/3/2016 8:45	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-4	FILTER2	391693004	2/3/2016 8:45	2/17/2016 8:30	BETA	1.8E-02	pCi/m3	1.2E-03	1.2E-03	O			
PNL-4	FILTER2	392423004	2/17/2016 8:30	3/2/2016 9:00	BETA	1.3E-02	pCi/m3	9.4E-04	1.1E-03	O			
PNL-4	FILTER2	393503004	3/2/2016 9:00	3/16/2016 9:30	BETA	8.5E-03	pCi/m3	8.4E-04	9.5E-04	O			
PNL-4	FILTER2		3/16/2016 9:30	3/30/2016 9:00	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP16-001; PUMP FAILED AND WAS REPLACED.		
PNL-4	FILTER2	395430004	3/30/2016 9:00	4/13/2016 10:00	BETA	1.7E-02	pCi/m3	1.2E-03	1.2E-03	O			
PNL-4	FILTER2	396369004	4/13/2016 10:00	4/27/2016 8:30	BETA	1.7E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-4	FILTER2	397395004	4/27/2016 8:30	5/11/2016 10:45	BETA	1.9E-02	pCi/m3	1.2E-03	1.2E-03	O			
PNL-4	FILTER2	398322004	5/11/2016 10:45	5/25/2016 10:10	BETA	1.3E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-4	FILTER2	399158004	5/25/2016 10:10	6/8/2016 8:45	BETA	1.5E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-4	FILTER2	400050004	6/8/2016 8:45	6/22/2016 10:15	BETA	7.8E-03	pCi/m3	7.7E-04	7.9E-04	O			
PNL-4	FILTER2	401348004	6/22/2016 10:15	7/6/2016 9:30	BETA	1.1E-02	pCi/m3	9.9E-04	1.0E-03	O			
PNL-4	FILTER2	402216004	7/6/2016 9:30	7/20/2016 8:30	BETA	1.0E-02	pCi/m3	9.3E-04	1.0E-03	O			
PNL-4	FILTER2	403126004	7/20/2016 8:30	8/3/2016 9:00	BETA	1.2E-02	pCi/m3	9.2E-04	9.6E-04	O			
PNL-4	FILTER2	404253004	8/3/2016 9:00	8/17/2016 10:35	BETA	1.2E-02	pCi/m3	9.3E-04	9.7E-04	O			
PNL-4	FILTER2	405191004	8/17/2016 10:35	8/31/2016 10:00	BETA	1.4E-02	pCi/m3	9.7E-04	1.0E-03	O	TOTALIZER #28917 REPLACED WITH TOTALIZER #28921 ON 08/31/16 AT 1000 HRS, START VOLUME 0583, EXPIRES 05/02/17.		
PNL-4	FILTER2	406090004	8/31/2016 10:00	9/14/2016 9:00	BETA	1.0E-02	pCi/m3	8.2E-04	8.4E-04	O			
PNL-4	FILTER2	407094004	9/14/2016 9:00	9/28/2016 10:45	BETA	1.5E-02	pCi/m3	9.8E-04	1.2E-03	O	DEPLOYED DOSIMETER.		
PNL-4	FILTER2	408254004	9/28/2016 10:45	10/12/2016 11:15	BETA	1.1E-02	pCi/m3	8.9E-04	9.8E-04	O	FILTER STAND WET; RECORD BREAKING RAIN OCCURRED PRIOR WEEKEND.		
PNL-4	FILTER2	409244004	10/12/2016 11:15	10/26/2016 10:25	BETA	1.3E-02	pCi/m3	9.6E-04	1.1E-03	O			
PNL-4	FILTER2	410486004	10/26/2016 10:25	11/9/2016 9:25	BETA	1.7E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-4	FILTER2	411470004	11/9/2016 9:25	11/23/2016 10:00	BETA	2.1E-02	pCi/m3	1.2E-03	1.3E-03	O			
PNL-4	FILTER2	412214004	11/23/2016 10:00	12/7/2016 9:45	BETA	8.4E-03	pCi/m3	8.2E-04	9.0E-04	O			

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-4	FILTER2	413273004	12/7/2016 9:45	12/21/2016 9:30	BETA	3.8E-02	pCi/m3	1.5E-03	1.6E-03	O			
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Be-7	3.1E-02	pCi/m3	1.0E-02	1.0E-02				Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Be-7	3.6E-02	pCi/m3	4.9E-03	5.1E-03				Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Co-60	7.8E-05	pCi/m3	3.0E-04	3.0E-04	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Co-60	2.4E-06	pCi/m3	1.5E-04	1.5E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Cs-134	-2.0E-04	pCi/m3	3.9E-04	4.0E-04	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Cs-134	-1.0E-05	pCi/m3	1.6E-04	1.6E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Cs-137	6.7E-05	pCi/m3	4.0E-04	4.0E-04	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Cs-137	1.0E-04	pCi/m3	1.7E-04	1.8E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Eu-152	-3.0E-04	pCi/m3	9.7E-04	9.8E-04	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Eu-152	-1.7E-04	pCi/m3	4.4E-04	4.5E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Eu-154	-8.4E-05	pCi/m3	1.0E-03	1.0E-03	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Eu-154	1.7E-05	pCi/m3	4.3E-04	4.3E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Eu-155	-3.6E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Eu-155	1.4E-04	pCi/m3	4.2E-04	4.3E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	K-40	4.0E-03	pCi/m3	4.1E-03	4.2E-03	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	K-40	9.1E-06	pCi/m3	4.5E-03	4.5E-03	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Ru-106	-2.5E-03	pCi/m3	4.3E-03	4.4E-03	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Ru-106	4.8E-04	pCi/m3	1.5E-03	1.6E-03	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Sb-125	-7.0E-05	pCi/m3	9.7E-04	9.7E-04	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Sb-125	-6.3E-05	pCi/m3	4.1E-04	4.1E-04	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Am-241	-1.9E-06	pCi/m3	4.4E-06	4.4E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Am-241	-2.1E-06	pCi/m3	4.5E-06	4.5E-06	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Am-243	-2.1E-06	pCi/m3	7.3E-06	7.3E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Am-243	-3.3E-06	pCi/m3	3.8E-06	3.8E-06	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Cm-243/244	5.4E-06	pCi/m3	7.8E-06	7.9E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Cm-243/244	1.2E-06	pCi/m3	4.0E-06	4.0E-06	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Pu-238	2.5E-06	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Pu-238	1.0E-05	pCi/m3	3.7E-06	3.8E-06			(a)	Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	Pu-239/240	2.1E-06	pCi/m3	2.8E-06	2.8E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	Pu-239/240	2.3E-06	pCi/m3	2.1E-06	2.2E-06	U			Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	U-233/234	4.7E-05	pCi/m3	1.7E-05	1.8E-05				Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	U-233/234	5.4E-05	pCi/m3	1.2E-05	1.4E-05				Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	U-235	8.9E-06	pCi/m3	9.0E-06	9.1E-06	U			Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	U-235	5.5E-06	pCi/m3	4.8E-06	4.8E-06				Y
PNL-4	FILTER2	402174004	12/23/2015 10:35	6/22/2016 10:15	U-238	5.5E-05	pCi/m3	1.8E-05	2.0E-05				Y
PNL-4	FILTER2	413445004	6/22/2016 10:15	12/21/2016 9:30	U-238	4.0E-05	pCi/m3	1.0E-05	1.1E-05				Y
PNL-5	FILTER2		10/5/2016 14:15	10/12/2016 12:00	ALPHA						(c)		
PNL-5	FILTER2	409244005	10/12/2016 12:00	10/26/2016 11:00	ALPHA	3.4E-04	pCi/m3	2.3E-04	2.4E-04				
PNL-5	FILTER2	410486005	10/26/2016 11:00	11/9/2016 10:15	ALPHA	6.4E-04	pCi/m3	3.0E-04	3.0E-04				

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-5	FILTER2	411470005	11/9/2016 10:15	11/23/2016 10:45	ALPHA	1.0E-03	pCi/m3	4.2E-04	4.2E-04		(d)		
PNL-5	FILTER2	412214005	11/23/2016 10:45	12/7/2016 12:00	ALPHA	1.0E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-5	FILTER2	413273005	12/7/2016 12:00	12/21/2016 11:15	ALPHA	1.4E-03	pCi/m3	4.3E-04	4.3E-04				
PNL-5	FILTER2		10/5/2016 14:15	10/12/2016 12:00	BETA						(c)		
PNL-5	FILTER2	409244005	10/12/2016 12:00	10/26/2016 11:00	BETA	1.1E-02	pCi/m3	7.7E-04	8.3E-04	O			
PNL-5	FILTER2	410486005	10/26/2016 11:00	11/9/2016 10:15	BETA	1.4E-02	pCi/m3	8.6E-04	9.4E-04	O			
PNL-5	FILTER2	411470005	11/9/2016 10:15	11/23/2016 10:45	BETA	2.0E-02	pCi/m3	1.2E-03	1.2E-03	O	(d)		
PNL-5	FILTER2	412214005	11/23/2016 10:45	12/7/2016 12:00	BETA	7.4E-03	pCi/m3	7.0E-04	7.0E-04	O			
PNL-5	FILTER2	413273005	12/7/2016 12:00	12/21/2016 11:15	BETA	3.7E-02	pCi/m3	1.6E-03	1.7E-03	O			
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Be-7	4.5E-02	pCi/m3	9.8E-03	1.0E-02				Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Co-60	-1.4E-04	pCi/m3	2.9E-04	3.0E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Cs-134	1.6E-04	pCi/m3	3.3E-04	3.4E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Cs-137	5.4E-04	pCi/m3	5.7E-04	5.7E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Eu-152	-2.1E-04	pCi/m3	9.3E-04	9.4E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Eu-154	-2.8E-04	pCi/m3	8.1E-04	8.2E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Eu-155	-3.9E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	K-40	1.6E-03	pCi/m3	5.5E-03	5.5E-03	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Ru-106	-4.9E-04	pCi/m3	2.9E-03	2.9E-03	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Sb-125	-4.0E-04	pCi/m3	9.1E-04	9.3E-04	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Am-241	-8.4E-07	pCi/m3	7.3E-06	7.3E-06	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Am-243	-4.2E-06	pCi/m3	1.2E-05	1.2E-05	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Cm-243/244	2.7E-06	pCi/m3	9.9E-06	9.9E-06	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Pu-238	2.0E-06	pCi/m3	4.4E-06	4.4E-06	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	Pu-239/240	2.0E-06	pCi/m3	4.4E-06	4.4E-06	U			Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	U-233/234	5.7E-05	pCi/m3	1.6E-05	1.7E-05				Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	U-235	1.5E-05	pCi/m3	9.3E-06	9.4E-06				Y
PNL-5	FILTER2	413445005	10/5/2016 14:15	12/21/2016 11:15	U-238	3.4E-05	pCi/m3	1.2E-05	1.3E-05				Y
YAKIMA	FILTER1	389175008	12/21/2015 11:05	1/5/2016 11:13	ALPHA	5.8E-04	pCi/m3	3.3E-04	3.3E-04				
YAKIMA	FILTER1	390150018	1/5/2016 11:13	1/20/2016 8:58	ALPHA	3.3E-03	pCi/m3	7.0E-04	7.0E-04				
YAKIMA	FILTER1	390934008	1/20/2016 8:58	2/3/2016 8:42	ALPHA	5.7E-04	pCi/m3	3.8E-04	3.8E-04				
YAKIMA	FILTER1	391828018	2/3/2016 8:42	2/17/2016 8:44	ALPHA	7.6E-04	pCi/m3	3.4E-04	3.4E-04				
YAKIMA	FILTER1	392714008	2/17/2016 8:44	3/2/2016 8:51	ALPHA	2.8E-04	pCi/m3	2.4E-04	2.4E-04	U			
YAKIMA	FILTER1	393603016	3/2/2016 8:51	3/15/2016 10:38	ALPHA	1.4E-04	pCi/m3	2.1E-04	2.1E-04	U			
YAKIMA	FILTER1	394582011	3/15/2016 10:38	3/30/2016 8:59	ALPHA	3.0E-04	pCi/m3	2.4E-04	2.4E-04	U			
YAKIMA	FILTER1	395611018	3/30/2016 8:59	4/13/2016 8:53	ALPHA	5.7E-04	pCi/m3	3.0E-04	3.0E-04				

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
YAKIMA	FILTER1	396589008	4/13/2016 8:53	4/26/2016 11:10	ALPHA	4.0E-04	pCi/m3	2.5E-04	2.5E-04				
YAKIMA	FILTER1	397516009	4/26/2016 11:10	5/11/2016 8:24	ALPHA	7.0E-04	pCi/m3	3.5E-04	3.6E-04				
YAKIMA	FILTER1	398436008	5/11/2016 8:24	5/25/2016 8:25	ALPHA	7.9E-04	pCi/m3	3.4E-04	3.4E-04				
YAKIMA	FILTER1	399290009	5/25/2016 8:25	6/8/2016 8:31	ALPHA	6.3E-04	pCi/m3	3.4E-04	3.4E-04				
YAKIMA	FILTER1	400211016	6/8/2016 8:33	6/22/2016 9:03	ALPHA	1.8E-04	pCi/m3	2.4E-04	2.4E-04	U			
YAKIMA	FILTER1	401345009	6/22/2016 9:03	7/6/2016 8:43	ALPHA	3.0E-04	pCi/m3	2.4E-04	2.4E-04	U			
YAKIMA	FILTER1	402400012	7/6/2016 8:43	7/20/2016 9:02	ALPHA	3.7E-04	pCi/m3	3.0E-04	3.0E-04	U			
YAKIMA	FILTER1	403510009	7/20/2016 9:02	8/3/2016 9:08	ALPHA	3.0E-04	pCi/m3	2.8E-04	2.8E-04	U			
YAKIMA	FILTER1	404365009	8/3/2016 9:08	8/17/2016 8:57	ALPHA	5.6E-04	pCi/m3	3.0E-04	3.0E-04				
YAKIMA	FILTER1	405340016	8/17/2016 8:57	8/31/2016 10:13	ALPHA	5.6E-04	pCi/m3	2.6E-04	2.6E-04				
YAKIMA	FILTER1	406253009	8/31/2016 10:13	9/14/2016 8:52	ALPHA	1.7E-04	pCi/m3	2.0E-04	2.0E-04	U			
YAKIMA	FILTER1	407402009	9/14/2016 8:52	9/28/2016 8:57	ALPHA	6.9E-04	pCi/m3	3.2E-04	3.2E-04				
YAKIMA	FILTER1	408415009	9/28/2016 8:57	10/12/2016 8:57	ALPHA	7.1E-04	pCi/m3	3.3E-04	3.4E-04				
YAKIMA	FILTER1	409496009	10/12/2016 8:57	10/26/2016 8:49	ALPHA	5.5E-04	pCi/m3	3.5E-04	3.6E-04				
YAKIMA	FILTER1	410602014	10/26/2016 8:49	11/9/2016 9:02	ALPHA	1.1E-03	pCi/m3	3.5E-04	3.5E-04				
YAKIMA	FILTER1	411472009	11/9/2016 9:02	11/22/2016 8:23	ALPHA	1.1E-03	pCi/m3	4.2E-04	4.2E-04				
YAKIMA	FILTER1	412663009	11/22/2016 8:23	12/7/2016 8:56	ALPHA	6.3E-04	pCi/m3	2.7E-04	2.7E-04				
YAKIMA	FILTER1	413420009	12/7/2016 8:56	12/21/2016 11:43	ALPHA	1.3E-03	pCi/m3	4.1E-04	4.2E-04				
YAKIMA	FILTER1	414191014	12/21/2016 11:43	1/4/2017 12:03	ALPHA	3.5E-04	pCi/m3	2.3E-04	2.3E-04				
YAKIMA	FILTER1	389175008	12/21/2015 11:05	1/5/2016 11:13	BETA	3.2E-02	pCi/m3	1.7E-03	1.7E-03				
YAKIMA	FILTER1	390150018	1/5/2016 11:13	1/20/2016 8:58	BETA	5.2E-02	pCi/m3	2.1E-03	2.4E-03				
YAKIMA	FILTER1	390934008	1/20/2016 8:58	2/3/2016 8:42	BETA	1.2E-02	pCi/m3	8.4E-04	1.0E-03				
YAKIMA	FILTER1	391828018	2/3/2016 8:42	2/17/2016 8:44	BETA	1.7E-02	pCi/m3	1.1E-03	1.2E-03				
YAKIMA	FILTER1	392714008	2/17/2016 8:44	3/2/2016 8:51	BETA	1.1E-02	pCi/m3	9.0E-04	9.3E-04				
YAKIMA	FILTER1	393603016	3/2/2016 8:51	3/15/2016 10:38	BETA	8.7E-03	pCi/m3	7.7E-04	7.9E-04				
YAKIMA	FILTER1	394582011	3/15/2016 10:38	3/30/2016 8:59	BETA	1.1E-02	pCi/m3	8.0E-04	8.3E-04				
YAKIMA	FILTER1	395611018	3/30/2016 8:59	4/13/2016 8:53	BETA	1.3E-02	pCi/m3	9.1E-04	9.2E-04				
YAKIMA	FILTER1	396589008	4/13/2016 8:53	4/26/2016 11:10	BETA	1.6E-02	pCi/m3	1.0E-03	1.1E-03				
YAKIMA	FILTER1	397516009	4/26/2016 11:10	5/11/2016 8:24	BETA	1.4E-02	pCi/m3	1.0E-03	1.0E-03				
YAKIMA	FILTER1	398436008	5/11/2016 8:24	5/25/2016 8:25	BETA	1.1E-02	pCi/m3	8.0E-04	8.1E-04				
YAKIMA	FILTER1	399290009	5/25/2016 8:25	6/8/2016 8:31	BETA	1.5E-02	pCi/m3	1.0E-03	1.2E-03				
YAKIMA	FILTER1	400211016	6/8/2016 8:33	6/22/2016 9:03	BETA	8.3E-03	pCi/m3	7.2E-04	7.3E-04				
YAKIMA	FILTER1	401345009	6/22/2016 9:03	7/6/2016 8:43	BETA	1.2E-02	pCi/m3	8.6E-04	8.8E-04				
YAKIMA	FILTER1	402400012	7/6/2016 8:43	7/20/2016 9:02	BETA	7.6E-03	pCi/m3	6.8E-04	6.8E-04				
YAKIMA	FILTER1	403510009	7/20/2016 9:02	8/3/2016 9:08	BETA	1.1E-02	pCi/m3	7.9E-04	8.0E-04				

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
YAKIMA	FILTER1	404365009	8/3/2016 9:08	8/17/2016 8:57	BETA	1.1E-02	pCi/m3	7.9E-04	8.1E-04				
YAKIMA	FILTER1	405340016	8/17/2016 8:57	8/31/2016 10:13	BETA	1.3E-02	pCi/m3	8.6E-04	8.8E-04				
YAKIMA	FILTER1	406253009	8/31/2016 10:13	9/14/2016 8:52	BETA	8.7E-03	pCi/m3	6.7E-04	6.8E-04				
YAKIMA	FILTER1	407402009	9/14/2016 8:52	9/28/2016 8:57	BETA	1.3E-02	pCi/m3	8.5E-04	8.8E-04				
YAKIMA	FILTER1	408415009	9/28/2016 8:57	10/12/2016 8:57	BETA	1.3E-02	pCi/m3	8.4E-04	1.0E-03				
YAKIMA	FILTER1	409496009	10/12/2016 8:57	10/26/2016 8:49	BETA	1.0E-02	pCi/m3	7.6E-04	7.7E-04				
YAKIMA	FILTER1	410602014	10/26/2016 8:49	11/9/2016 9:02	BETA	1.5E-02	pCi/m3	9.0E-04	9.5E-04				
YAKIMA	FILTER1	411472009	11/9/2016 9:02	11/22/2016 8:23	BETA	2.0E-02	pCi/m3	1.1E-03	1.1E-03				
YAKIMA	FILTER1	412663009	11/22/2016 8:23	12/7/2016 8:56	BETA	1.2E-02	pCi/m3	7.6E-04	7.8E-04				
YAKIMA	FILTER1	413420009	12/7/2016 8:56	12/21/2016 11:43	BETA	3.7E-02	pCi/m3	1.4E-03	1.5E-03				
YAKIMA	FILTER1	414191014	12/21/2016 11:43	1/4/2017 12:03	BETA	1.5E-02	pCi/m3	9.0E-04	1.0E-03				
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Am-241 (Gamma)	1.5E-04	pCi/m3	1.6E-03	1.6E-03	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Am-241 (Gamma)	-5.4E-05	pCi/m3	3.2E-04	3.2E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Co-60	-1.5E-04	pCi/m3	2.9E-04	3.0E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Co-60	2.2E-04	pCi/m3	2.0E-04	2.2E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Cs-134	2.6E-04	pCi/m3	3.3E-04	3.5E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Cs-134	2.1E-05	pCi/m3	2.7E-04	2.8E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Cs-137	-2.1E-04	pCi/m3	3.1E-04	3.3E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Cs-137	6.7E-05	pCi/m3	2.3E-04	2.3E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Eu-152	3.4E-05	pCi/m3	9.5E-04	9.5E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Eu-152	-1.7E-04	pCi/m3	6.8E-04	6.8E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Eu-154	6.9E-04	pCi/m3	1.2E-03	1.2E-03	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Eu-154	-2.3E-04	pCi/m3	7.5E-04	7.6E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Eu-155	3.1E-04	pCi/m3	9.4E-04	9.6E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Eu-155	-7.9E-05	pCi/m3	5.4E-04	5.4E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	K-40	2.7E-03	pCi/m3	4.6E-03	4.8E-03	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	K-40	2.8E-03	pCi/m3	5.4E-03	5.5E-03	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Ru-106	5.1E-04	pCi/m3	3.1E-03	3.1E-03	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Ru-106	-1.4E-03	pCi/m3	2.2E-03	2.3E-03	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Sb-125	2.4E-04	pCi/m3	8.0E-04	8.1E-04	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Sb-125	4.3E-04	pCi/m3	6.0E-04	6.3E-04	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Pu-238	-1.6E-06	pCi/m3	1.3E-05	1.3E-05	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Pu-238	3.8E-06	pCi/m3	1.4E-05	1.4E-05	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	Pu-239/240	2.6E-07	pCi/m3	1.9E-05	1.9E-05	U			Y

Table C.2 (cont'd)

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 QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	Pu-239/240	-3.6E-06	pCi/m3	1.1E-05	1.1E-05	U			Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	U-234	8.8E-05	pCi/m3	4.9E-05	5.1E-05				Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	U-234	6.5E-05	pCi/m3	3.9E-05	4.0E-05				Y
YAKIMA	FILTER1	402028010	12/21/2015 11:05	6/22/2016 9:03	U-235	1.2E-05	pCi/m3	2.3E-05	2.4E-05	U			Y
YAKIMA	FILTER1	414835010	6/22/2016 9:03	1/4/2017 12:03	U-235	0.0E+00	pCi/m3	1.4E-05	0.0E+00	U			Y
YAKIMA	FILTER1		12/21/2015 11:05	6/22/2016 9:03	U-238	4.2E-05	pCi/m3		3.5E-05				Y
YAKIMA	FILTER1		6/22/2016 9:03	1/4/2017 12:03	U-238	2.8E-05	pCi/m3		2.9E-05				Y

(a) PER THE PNSO EMP FOR THE PNNL CAMPUS, GEL LABORATORIES NOTIFIED PNNL 09MAR2017, REGARDING THE DETECTION OF PU-238 IN THREE ENVIRONMENTAL SURVEILLANCE 2016 BI-ANNUAL COMPOSITE AIR SAMPLES. THE SAMPLES WERE REANALYZED CONFIRMING THE ORIGINAL RESULTS WHICH WERE REPORTED, REVIEWED BY PROJECT STAFF, AND LOADED TO THE PROJECT DATABASE. ALL VALUES WERE LESS THAN THE 40 CFR 61, APPENDIX E, TABLE 2 VALUE FOR PU-238 (2.1E-03 pCi/m3). ONLY PNL-1 SAMPLE B362P0 PU-238 (2.21E-04 pCi/m3) EXCEEDED THE NOTIFICATION LEVEL, WHICH IS 10% OF THE TABLE 2 VALUE, WITHOUT CONSIDERING MEASUREMENT UNCERTAINTY.

(b) TOTALIZER RECORDED 164 M3; TOTAL SAMPLE VOLUME MANUALLY CALCULATED (913.3 M3) USING SAMPLE ON/OFF DATES. TOTALIZER #28914 REPLACED WITH TOTALIZER #28917 ON 1/6/16 AT 1125 HRS, START VOLUME 7805, EXPIRES 11/02/16.

(c) NO SAMPLE. SAVE FOR COMPOSITE. NEW AIR SAMPLER INSTALLED AT BENTON CITY ON 10/5/16. SAMPLER RAN FOR ONE WEEK AND COLLECTED 10/12/16 TO COINCIDE WITH THE BI-WEEKLY COLLECTION SCHEDULE; LOW SAMPLE VOLUME.

(d) TOTALIZER RECORDED 635 M3; TOTAL SAMPLE VOLUME MANUALLY CALCULATED (914 M3) USING SAMPLE ON/OFF DATES. DIGITS ON DISPLAY NOT ROLLING OVER CONSISTENTLY, SINTER FILTER CHECKED AND OKAY. TOTALIZER #28917 REPLACED WITH TOTALIZER #24966 ON 11/23/16, START VOLUME 0850, EXPIRES 09/13/17.

Distribution

No. of Copies

6 U.S. Department of Energy-Headquarters
1000 Independence Avenue SW
Washington, D.C. 20585-0001

JM Blaikie	SC-31
AC Lawrence	AU-20
RL Natoli	AU-23
CA Ostrowski	(PDF)[1]
EP Regnier	(PDF)
A Wallo III	(PDF)

1 U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
P.O. Box 5400
Albuquerque, NM 87185-5400

D Bytwerk (PDF)

1 U.S. Environmental Protection Agency
Region 10
Stationary Source Unit
Office of Air and Waste
1200 Sixth Avenue, Suite 900, AWT-150
Seattle, WA 98101-3140

J McAuley (PDF)

3 U.S. Environmental Protection Agency
William Jefferson Clinton West Building
1301 Constitution Avenue NW
Washington, D.C. 20004

RT Peake	(PDF)
DJ Schultheisz	(PDF)
JP Walsh	1408D

1 Washington State Department of Ecology
Eastern Regional Office
4601 N. Monroe Street
Spokane, WA 99205-1265

K Wood

No. of Copies

1 Washington State Department of Ecology
Hanford Project Office
3100 Port of Benton Boulevard
Richland, WA 99354-1670

R Skinnarland H0-57

7 Washington State Department of Health
Radioactive Air Emissions Section
309 Bradley Boulevard, Suite 201
Richland, WA 99352-4524

SD Berven	(PDF)
BJ Conroy	(PDF)
PJ Martell, Manager (2)	B1-42
CD Mathey	(PDF)
CN Sanders	(PDF)
JW Schmidt	(PDF)
TA Rogers	(PDF)

1 Confederated Tribes of the Umatilla Indian Reservation
Nixyáawii Governance Center
46411 Timíne Way
Pendleton, Oregon 97801-9467

R Skeen, Division Leader

1 Nez Perce Tribe
Environmental Restoration and Waste Management
P.O. Box 365
Lapwai, ID 83540-0365

G Bohnee

2 Yakama Nation
Environmental Restoration Waste Management Program
P.O. Box 151
Toppenish, WA 98948-0632

R Jim
P Rigdon

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

No. of Copies

LIBRARIES

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

1 Mid-Columbia Libraries (PDF)
Michael Huff, Collections and Services Director
405 S Dayton Street
Kennewick, WA 99336-5660

ON SITE

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

DW Bowser	(PDF)

7 U.S. Department of Energy
Richland Operations Office

ET Faust	A5-19
TW Ferns	(PDF)
DL Kreske	(PDF)
KD Leary	(PDF)
MK Marvin	(PDF)
MD Silberstein	(PDF)
DOE-RL Public Reading Room	H2-53

2 Mission Support Alliance, LLC

SJ Johnson	(PDF)
AF Shattuck	(PDF)

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

AS Arend	(PDF)
SB Bigger	(PDF)
JL Carlson	(PDF)
TM McDermott (2)	K9-42
TP Pietrok	(PDF)

No. of Copies

35 Pacific Northwest National Laboratory
Laboratory

CM Andersen	(PDF)
BG Anderson	(PDF)
EJ Antonio	(PDF)
EV Arntzen	(PDF)
MY Ballinger	(PDF)
JM Barnett (4)	J2-25
CP Beus	(PDF)
LE Bisping	K7-68
JE Cabe	(PDF)
SD Cooke	(PDF)
JP Duncan	K7-70
DL Edwards	(PDF)
BG Fritz	(PDF)
EE Hickey	(PDF)
JR Holland	(PDF)
KM McDonald	J2-25
AL Miracle	(PDF)
CJ Nichols	(PDF)
RM Pierson	(PDF)
JP Rishel	(PDF)
MR Sackschewsky	(PDF)
SB Sadler	(PDF)
SK Sanan	(PDF)
RD Sharp	(PDF)
SF Snyder (2)	K7-68
JA Stegen	(PDF)
MJ Stephenson	J2-25
J Su-Coker	(PDF)
HT Tilden II	(PDF)
DJ Warren	(PDF)
PNNL Technical Library	K5-02
Rad Air File Plan A1.1.1.2	J2-25

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

U.S. DEPARTMENT OF
ENERGY

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
1-888-375-PNNL (7665)

www.pnnl.gov