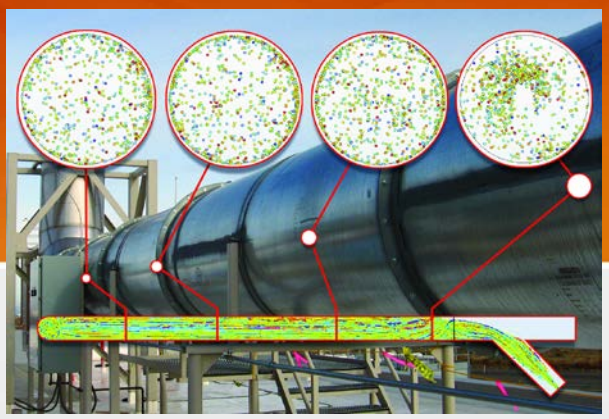
PNNL-20436-6



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Pacific Northwest National Laboratory Campus Radionuclide Air Emissions Report for Calendar Year 2015

June 2016

SF Snyder
JM Barnett
LE Bisping

U.S. DEPARTMENT OF ENERGY

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

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Richland, Washington 99352

***Cover photo**: Modeled particulate mixing overlay as a function of downstream distance from the 3410 Building stack air blender (PNNL-22185). Image credit: Michael C. Perkins*

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 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 2015 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 Campus sources.

The dose to the PNNL Campus MEI from routine major and minor point source emissions in 2015 from PNNL Campus sources is 2.6E-04 mrem (2.6E-06 mSv) EDE. The MEI dose from all fugitive sources is 1.8E-06 mrem (1.8E-08 mSv) EDE. The dose from radon emissions is 4.4E-08 mrem (4.4E-10 mSv) EDE. No nonroutine emissions occurred in 2015. The total radiological dose to the MEI from all PNNL Campus radionuclide emissions in 2015, including fugitive emissions and radon, is 2.6E-04 mrem (2.6E-06 mSv) EDE, or more than 10,000 times less than the federal and state standard of 10 mrem/yr, with which the PNNL 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@pnso.science.doe.gov.

CERTIFICATION of PNNL-20436-6

DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2015

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

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

6/10/16
Date

Acronyms and Abbreviations

AREVA	AREVA Federal Services, LLC
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
HEPA	high-efficiency particulate air (filter)
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

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1.0 Introduction

This report documents calendar year (CY) 2015 radionuclide air emissions from the U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory (PNNL) Campus (hereafter, PNNL 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 Campus license, Radioactive Air Emissions License (RAEL)-005, for CY2015 operations.

This report is available online at http://www.pnnl.gov/about/RAE_compliance_reports/.

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

1.1 PNNL Campus Description

The PNNL 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 PNNL 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 PNNL 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 Campus is developed with office, laboratory, residential, and retail space. The Columbia River borders the PNNL Campus to the northeast. Environmental conditions of non-operational Hanford Site areas are also characteristic of the PNNL 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 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 Campus have been owned or leased by Battelle since the mid-1960s.

Figure 1.1. DOE-SC PNNL Campus Emissions Units Locations

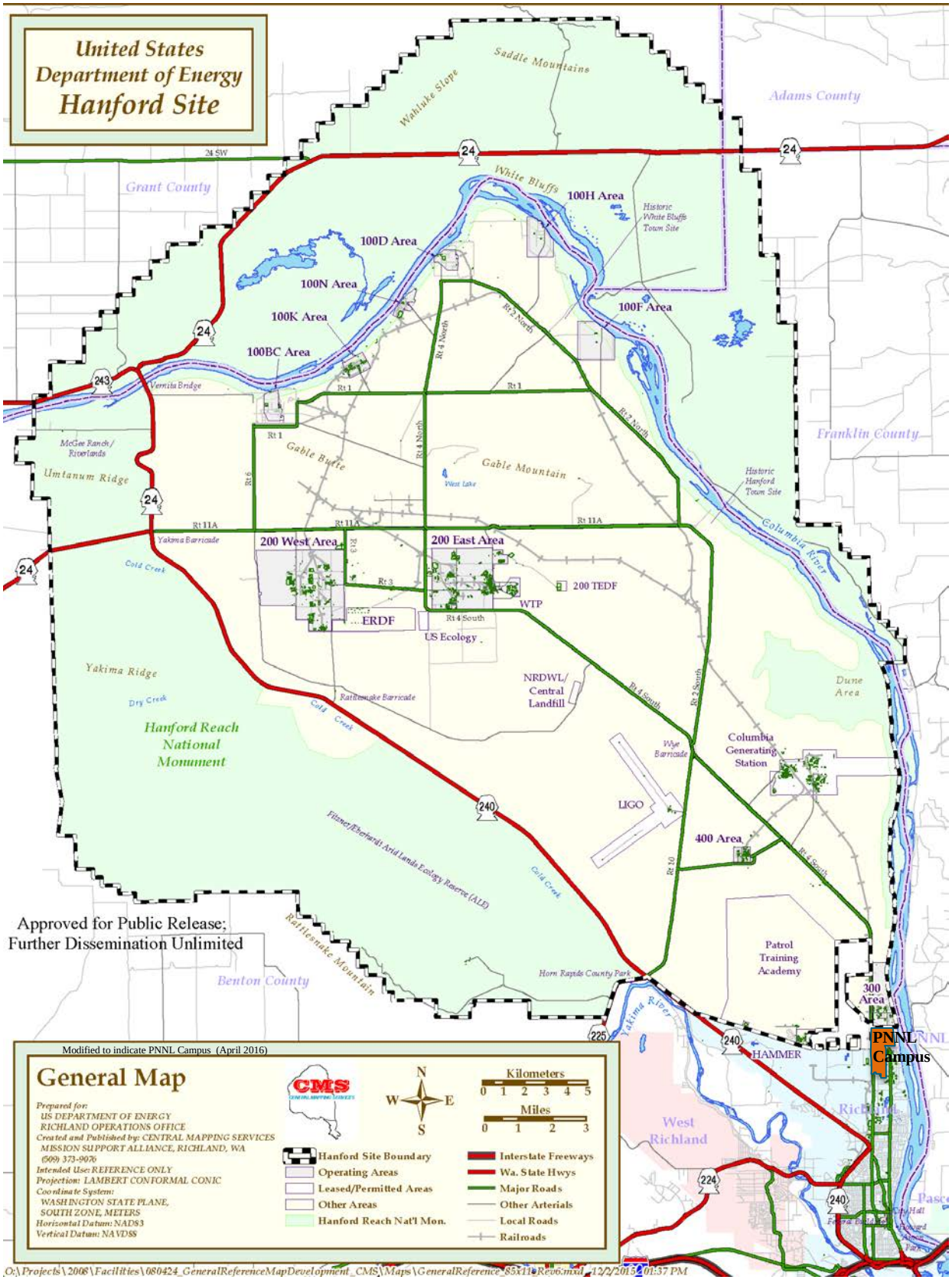

Figure 1.2. Location of the Hanford Site in Relation to the PNNL Campus

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 Campus Licensed Buildings – 2015

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 Campus and because it is a source of radiological airborne emissions that could affect the PNNL 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 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 Campus Facilities and 2015 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 EDE to the nearest member of the public not employed by DOE or its contractors associated with the PNNL Campus and who lives near and/or has unrestricted access to a place of employment on the PNNL 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 characterized as

[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.

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 PNNL 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).

Notable events in CY2015 relevant to radioactive airborne emissions monitoring and reporting include a change in the Hanford Site boundary on the other side of the highway bordering the western PNNL Site boundary. This undeveloped land was transferred to private ownership and commercial development of the property is anticipated. While the transfer does not currently influence PNNL Campus operations, it could limit future operations due to the expected proximity of new offsite businesses.

Table 1.2. Types of Emission Units under the DOE PNNL Campus License – 2015

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
PNNL 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 Campus Physical Sciences Facility (PSF) with Buildings Identified

1.1.3 Facilities Adjacent to the PNNL Campus

Land adjacent to the PNNL 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 PNNL 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 (Rokkan et al. 2016).

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 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 PNNL Campus; 4) the AREVA Federal Services, LLC (AREVA) fuel fabrication facility west of the PNNL Campus; 5) Perma-Fix Northwest, Inc. to the east of AREVA; and 6) Interstate Nuclear Services southwest of the PNNL Campus. AREVA is a nuclear reactor fuel fabrication facility, and Perma-Fix Northwest manages and treats low-level and mixed radioactive waste. 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 Campus.

1.2 Point Source Descriptions

This section describes point sources that emit or have the potential to emit radionuclides at the PNNL Campus. A point source is reported in this document if it met the following two criteria during 2015:

- 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 Campus emission units registered with the WDOH for radiological emissions.

Table 1.3. PNNL Campus Registered Radioactive Air Emissions Units

Building	Discharge Point ID	Discharge Point Description	Compliance Method
3410	EP-3410-01-S	Major point source. Main Stack.	Continuous sampling
3420	EP-3420-01-S	Major point source. Main Stack.	Continuous sampling
	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[(a)]
3425	J-3425	Fugitive emissions. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
3430	EP-3430-01-S	Major point source. Main Stack.	Continuous sampling
	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[(a)]
	EP-3430-1606P-S	Minor point source. Room 1606 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1608P-S	Minor point source. Room 1608 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1610P-S	Minor point source. Room 1610 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1612P-S	Minor point source. Room 1612 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-3430-1614P-S	Minor point source. Room 1614 perchloric acid hood. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
LSLII	EP-LSLII-01-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-LSLII-02-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
RTL-520	EP-RTL-10-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
	EP-RTL-11-V	Minor point source. Calculations used to determine radionuclide emissions in lieu of monitoring.	Appendix D[(a)]
RTL-530	J-RTL530	Fugitive emissions. Activities limited to waste management and storage.	Appendix D[(a)]
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) 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 104 ft (31.6 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).

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 Discharg e Height	Abatement Technology
Major EP-3410-01-S	21,150 ft^3/min (10.0 m^3/s)	1.11E+10 ft^3 (3.15E+8 m^3)	75º F (23.9º C)	44 ft (13.4 m)	3.3 ft (1.0 m)	104 ft (31.6 m)	Single-stage HEPA filter
Major EP-3420-01-S	42,650 ft^3/min (20.1 m^3/s)	2.24E+10 ft^3 (6.35E+8 m^3)	78º F (25.6º C)	45 ft (13.8 m)	4.3ft (1.3 m)	128 ft (39.1 m)	Single-stage HEPA filter
Major EP-3430-01-S	29,450 ft^3/min (13.9 m^3/s)	1.55E+10 ft^3 (4.38E+8 m^3)	79º F (26.1º C)	44 ft (13.4 m)	3.7 ft (1.1 m)	115 ft (35.2 m)	Single-stage HEPA filter

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 2015. 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.

1.2.2 PNNL Campus Radiological Operations

This section describes the handling and processing of radioactive material in each facility on the PNNL 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 provides laboratory, office, and storage space for a variety of research and development activities. Research includes chemical toxicology, environmental health physics, dosimetry, atmospheric science modeling, and soil and groundwater contamination studies. Coating and coating technologies; laser and electrochemical machining; and electrodeposition research are performed. The solid-liquid interface of geologic materials is also studied here. Radioactive material and research activities are being relocated from this building to other permitted PNNL facilities to support eventual building demolition. Radioactive material emissions are discharged from this building through a minor stack.

RTL-530

RTL-530 is a small (136 ft^2) concrete block and brick storage area just west of the RTL-520 and is used to temporarily store radioactive materials. Radioactive material emissions from this building would be fugitive emissions.

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 a minor stack.

2.0 Radionuclide Air Emissions

This section presents information on quantities of radionuclide emissions on the PNNL 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 PNNL Campus sampled in 2015. There were no fugitive emissions from RTL-530 in 2015. Table 2.2 shows the emissions that resulted in 99.9% of the dose impact from non-sampled PSF sources, whereas Table 2.3 shows the remaining 0.1%. Table 2.4 summarizes the nuclide emissions from major, minor, and fugitive sources that result in 99.9% or more of the total dose impact to the MEI. Appendix B lists the radioactive materials handled or potentially handled at the PNNL Campus in 2015.

Table 2.1. PNNL Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2015

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total (Ci)
gross α [(a)]	3.08E-08	3.55E-08	3.47E-08	1.0E-07
gross β [(a)]	3.05E-07	4.73E-07	2.27E-07	1.0E-06
H-3	1.20E-04[(b)]	NA	NA	1.2E-04
Co-60	7.25E-09[(c)]	2.02E-09[(c)]	2.87E-11[(c)]	9.3E-09[(c)]
Xe-131m	NA	2.26E-07[(b)]	NA	2.3E-07
Xe-133	NA	1.03E-06[(b)]	NA	1.0E-06
Xe-133m	NA	8.00E-08[(b)]	NA	8.0E-08
Rn-222[(d)]	NA	2.52E-04[(b)]	NA	2.5E-04
U-233/234	NA	NA	3.00E-10	3.0E-10
Np-237	NA	8.59E-10	NA	8.6E-10
Pu-238	1.91E-11[(c)]	1.22E-09[(c)]	1.89E-10[(c)]	1.4E-09[(c)]
Pu-239/240	1.27E-09	1.80E-09	1.03E-09	4.1E-09
Am-241	5.06E-11	ND	6.63E-12[(c)]	5.7E-11
Am-243	3.14E-12[(c)]	3.54E-10[(c)]	2.27E-11[(c)]	3.8E-10[(c)]
Cm-243/244	2.48E-14[(c)]	7.02E-11	9.05E-10[(c)]	9.8E-10

NA = not applicable; ND = not detected

(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 Campus Appendix D Calculated and Release Record Radionuclide Emissions (Ci) from Minor Emissions Units and Fugitive Sources Resulting in 99.9% of the Offsite Dose – 2015[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]	NA	NA	NA	NA	1.47E-08	NA	1.5E-08
C-14	NA	NA	NA	NA	1.10E-04	NA	1.1E-04
Ca-45	NA	NA	NA	NA	1.00E-06	NA	1.0E-06
Co-60	3.21E-10	9.23E-11	NA	1.33E-10	5.44E-12	NA	5.5E-10
Sr-85	2.66E-10	7.08E-11	NA	4.19E-11	2.00E-06	NA	2.0E-06
Sr-90	4.73E-12	NA	NA	NA	3.24E-06	NA	3.2E-06
Tc-99	NA	NA	NA	NA	1.20E-05	NA	1.2E-05
I-131	1.95E-08	NA	NA	1.85E-10	NA	NA	2.0E-08
Xe-131m[a]	5.68E-13	NA	NA	NA	NA	NA	5.7E-13
Xe-133[a]	6.50E-09	NA	NA	3.77E-10	NA	NA	6.9E-09
Xe-133m[a]	NA	NA	NA	NA	NA	NA	NA
Cs-137	1.22E-09	7.02E-11	NA	5.41E-11	2.94E-7	0.00E+00	3.0E-07
Lu-177	1.11E-05	NA	NA	NA	NA	NA	1.1E-05
Ra-226	NA	1.19E-09	NA	NA	2.94E-10	NA	1.5E-09
Th-232	9.98E-10	NA	NA	NA	1.52E-08	NA	1.6E-08
U-233/234	1.91E-08	NA	NA	9.38E-10	6.38E-07	NA	6.6E-07
U-235	8.19E-10	NA	2.21E-19	4.02E-11	4.19E-08	NA	4.3E-08
U-238	8.68E-12	NA	NA	3.92E-13	1.54E-06	NA	1.5E-06
Np-237	NA	NA	1.98E-18	NA	6.45E-15	NA	6.5E-15
Pu-238	NA	NA	2.85E-17	NA	9.15E-12	NA	9.2E-12
Pu-239/240	NA	NA	8.64E-16	NA	1.98E-10	NA	2.0E-10
Am-241	8.93E-11	6.20E-11	8.50E-17	1.67E-11	1.52E-10	1.47E-11	3.3E-10
Am-243	NA	NA	2.56E-15	NA	1.07E-13	NA	1.1E-13
Cm-243/244	NA	NA	NA	NA	3.21E-13	NA	3.2E-13
Cf-252	5.45E-16	NA	NA	NA	1.62E-09	NA	1.6E-09

NA = not applicable for the indicated stack.

(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 99.9% of dose impact from release record and Appendix D calculated Minor and Fugitive sources in 2015. 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 2015.

Table 2.3. Nonsignificant (<0.1%) PNNL Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2015

Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)
Ac-227	2.7E-16	Eu-152	2.0E-09	Ni-63	4.4E-11	Sn-126	1.1E-13
Ag-108m	5.5E-18	Eu-154	2.1E-09	Np-236	7.0E-17	Sr-89	1.1E-09
Ag-110m	5.4E-14	Eu-155	2.6E-11	P-32	4.0E-09	Sr-91	9.8E-10
Am-240	5.4E-12	Fe-55	2.0E-13	P-33	3.4E-15	Ta-182	3.6E-12
Am-242	4.4E-19	Fe-59	1.0E-12	Pa-231	1.5E-16	Tc-99m	1.1E-06
Ar-37[(a)]	1.0E-07	Hg-203	2.1E-10	Pa-234m	8.7E-14	Te-123m	3.9E-16
Au-193	5.0E-11	I-129	2.3E-13	Pb-210	5.6E-10	Te-127	5.7E-11
Au-194	1.1E-09	I-132	2.9E-08	Pm-147	4.3E-12	Te-127m	6.7E-13
Au-195	1.4E-10	I-133	3.4E-08	Pm-149	1.7E-08	Te-129	1.7E-10
Au-196	5.0E-09	I-135	6.8E-10	Pm-151	5.6E-11	Te-129m	2.7E-10
Au-198	6.3E-10	In-114m	2.7E-16	Po-210	6.4E-12	Te-131	1.2E-11
Ba-137m	5.8E-09	In-115	5.4E-17	Pr-143	3.0E-08	Te-131m	5.5E-11
Ba-140	2.0E-08	In-115m	4.1E-12	Pr-144	1.1E-10	Te-132	2.8E-08
Be-7	5.4E-14	Ir-192	5.4E-14	Pr-144m	1.5E-12	Th-229	1.2E-15
Bi-210	4.2E-12	K-40	1.0E-12	Pu-241	2.3E-10	Th-231	3.5E-12
Br-82	1.3E-08	Kr-85m[(a)]	1.7E-11	Pu-242	2.0E-15	Th-234	9.3E-14
Ca-47	2.0E-11	La-140	3.9E-08	Pu-244	3.3E-19	U-232	1.8E-15
Cd-109	2.4E-09	La-141	1.8E-10	Ra-228	1.8E-15	U-236	8.6E-11
Cd-111m	8.9E-16	Mn-52	1.1E-11	Rh-103m	4.0E-10	W-187	3.3E-12
Cd-113m	3.1E-13	Mn-54	4.7E-11	Rh-105	1.7E-08	Xe-135[(a)]	2.3E-09
Cd-115	2.9E-12	Mo-99	7.5E-08	Rn-222	6.0E-12	Xe-135m[(a)]	1.8E-11
Cd-115m	1.6E-19	Na-22	1.8E-18	Ru-103	4.1E-10	Y-88	6.6E-10
Ce-139	7.8E-11	Na-24	1.3E-08	Ru-106	7.7E-20	Y-90	1.6E-07
Ce-141	1.2E-08	Nb-93m	2.4E-13	S-35	3.4E-15	Y-91	2.6E-12
Ce-143	6.5E-08	Nb-94	3.4E-11	Sb-125	4.4E-12	Y-91m	6.3E-10
Ce-144	1.1E-10	Nb-95	1.4E-10	Sb-127	6.0E-11	Y-92	3.5E-10
Cm-242	2.0E-13	Nb-95m	4.3E-12	Sc-46	8.6E-11	Y-93	1.3E-09
Co-56	1.4E-11	Nb-97	2.0E-08	Sc-47	2.1E-09	Zn-65	2.5E-11
Co-57	1.7E-10	Nb-97m	1.8E-08	Se-75	9.2E-11	Zr-93	2.9E-13
Co-58	2.1E-11	Nd-147	1.1E-08	Se-79	5.1E-13	Zr-95	5.7E-10
Cr-51	2.2E-11	Ni-56	1.5E-12	Sm-151	1.4E-09	Zr-97	1.9E-08
Cs-134	3.9E-14	Ni-57	5.0E-10	Sm-153	3.5E-11	-	-
Cu-64	5.5E-13	Ni-59	4.8E-13	Sn-113	2.9E-10	-	-
						Total (Ci)	**1.8E-06**

(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 Campus Total Radionuclide Emissions (Ci) in 2015

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units[a]	Total (Ci)
gross α [b]	1.0E-07	1.5E-11	1.0E-07
gross β [b]	1.0E-06	0.0E-00	1.0E-06
^{3}H-3	1.2E-04 [c]	1.5E-08	1.2E-04
C-14	NA	1.1E-04	1.1E-04
Ca-45	NA	1.0E-06	1.0E-06
Co-60	9.3E-09	5.5E-10	9.9E-09
Sr-85	NA	2.0E-06	2.0E-06
Sr-90	NA	3.2E-06	3.2E-06
Tc-99	NA	1.2E-05	1.2E-05
I-131	NA	2.0E-08	2.0E-08
Xe-131m	2.3E-07[c]	5.7E-13[c]	2.3E-07
Xe-133	1.0E-06[c]	6.9E-09[c]	1.0E-06
Xe-133m	8.0E-08[c]	NA	8.0E-08
Cs-137	NA	3.0E-07	3.0E-07
Lu-177	NA	1.1E-05	1.1E-05
Rn-222	2.5E-04	NA	2.5E-04
Ra-226	NA	1.5E-09	1.5E-09
Th-232	NA	1.6E-08	1.6E-08
U-233/234	3.0E-10	6.6E-07	6.6E-07
U-235	NA	4.3E-08	4.3E-08
U-238	NA	1.5E-06	1.5E-06
Np-237	8.6E-10	6.5E-15	8.6E-10
Pu-238	1.4E-09	9.2E-12	1.4E-09
Pu-239/240	4.1E-09	2.0E-10	4.3E-09
Am-241	5.7E-11	3.3E-10	3.9E-10
Am-243	3.8E-10	1.1E-13	3.8E-10
Cm-243/244	9.8E-10	3.2E-13	9.8E-10
Cf-252	NA	1.6E-09	1.6E-09

NA = not applicable

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

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

(c) Value based on release records.

3.0 Dose Assessment

This section presents the method for determining the MEI dose from PNNL 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 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 PNNL Campus radionuclide emissions (Table 2.4).

The nearest location (e.g., dwelling, business, school, office) to the PNNL 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 PNNL Campus northwest fenceline 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 Campus MEI is a member of the public who hypothetically receives the highest calculated radiological dose attributable to exposure to PNNL 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 Campus facility emissions, and 3) CY2015 meteorological data (Appendix A) to determine the 2015 MEI receptor location from PNNL 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 Campus

Locale	Distance Relative to PSF km (mi)	Distance Relative to RTL-520 km (mi)	Distance Relative to LSLII km (mi)
2015 PNNL 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 2015 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			
Lot SW of 3rd St. and George Washington Way	1.86 (1.16) S	0.15 (0.09) SSE	1.17 (0.73) SSE
PNNL Campus historical MEIs			
CY2014	0.70 (0.43) SSE	1.05 (0.65) N	0.41 (0.25) E
CY2013	0.75 (0.47) SSE	0.98 (0.61) N	0.40 (0.25) E
CY2012	0.55 (0.34) SSE	1.2 (0.76) N	0.46 (0.29) E
CY2011	0.55 (0.34) SSE	NA	NA
CY2010	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 Campus.
(b) This location is 3.70 km south of the Hanford Site 300 Area.

3.2 Summary of Input Parameters

Last year, CAP88-PC Version 3 (EPA 2013) was used, which offered more flexibility in its use of site-specific exposure and intake parameters. CAP88-PC Version 4 applies none of the Hanford Site-specific parameters of DOE 2008, which were implementable in Version 3. While a 50-year build-up parameter could have been applied under DOE 2008, a 100-year buildup was used.

Radionuclide emissions data from the PNNL 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 2015 meteorology and stack characteristics given in Section 1.2.1. In prior years, PSF emissions had the greatest dose impact of all PNNL Campus radioactive emissions. In 2015, the 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 Campus. In prior years, more exact emissions estimates were determined from sampling RTL facility emissions. 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 2015 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 this MEI location.

Figure 3.1. Locations of PNNL 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 Campus (refer to Figure 5.1) and represent the average of hourly data recorded in 2015. Appendix A presents meteorological data for 2015 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 PNNL Campus boundary) and lack of turbulent interference allows the Hanford Site 300 Area meteorological data to be used to represent the PNNL 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 PNNL Campus MEI (2892 Pauling)	WAC 246-247 PNNL Campus MEI (2892 Pauling)	Offsite Maximum Air (lot SW of 3rd and GW)
PNNL 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 at PSF	NA	2.5E-04 Ci	2.5E-04 Ci
3420-02-S at PSF	NA	6.0E-12 Ci	6.0E-12 Ci
Receptor Dose			
Dose excluding radon emissions[(a)]	2.6E-04 mrem	2.6E-04 mrem	3.2E-04 mrem
Radon	NA	4.4E-08 mrem	2.1E-07 mrem
Total	**2.6E-04 mrem**	**2.6E-04 mrem**	**3.2E-04 mrem**

(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 EDE. The standard is in 40 CFR 61, Subpart H (2011), and applies to radionuclide air emissions, other than radon, from DOE facilities. For CY2015, the PNNL Campus MEI location was 0.15 km (0.09 mi) south of the RTL Complex. The PNNL Campus MEI dose is 2.6E-04 mrem (2.6E-06 mSv) (see Table 3.2, 40 CFR 61, Subpart H).

Table 3.3 indicates nuclide-specific doses to the CY2015 PNNL Campus MEI. The MEI dose includes routine and nonroutine point source emissions. Including fugitive PIC-5 category doses does not change the CY2015 PNNL Campus MEI dose estimate. Table 3.4 provides the PNNL Campus MEI dose attributed to each emission point. RTL emissions contribute the majority of the dose to the MEI. The table includes the four fugitive PIC-5 permitted emissions, which indicate a maximum dose impact.

Table 3.3. PNNL Campus 2015 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units and Fugitive Emissions

Radionuclide	Releases (Ci)	PNNL Campus MEI Dose (mrem EDE)	% of Total EDE
H-3[a]	1.2E-04	7.5E-09	<1%
C-14[a]	1.1E-04	1.8E-05	7%
Ca-45[a]	1.0E-06	7.0E-08	<1%
Co-60[a]	9.9E-09	1.2E-08	<1%
Sr-85[a]	2.0E-06	4.4E-07	<1%
Sr-90[a]	3.2E-06	9.6E-05	37%
Tc-99[a]	1.2E-05	6.6E-05	25%
I-131[a]	2.0E-08	5.5E-09	<1%
Xe-131m[a]	2.3E-07	6.7E-13	<1%
Xe-133[a]	1.0E-06	3.1E-12	<1%
Xe-133m[a]	8.0E-08	2.2E-13	<1%
Cs-137[b]	1.3E-06	1.3E-05	5%
Lu-177[a]	1.1E-05	1.1E-08	<1%
Ra-226[a,c]	1.5E-09	6.6E-08	<1%
Th-232[a]	1.6E-08	3.9E-06	1%
U-233/234[a]	6.6E-07	1.6E-05	6%
U-235[a]	4.3E-08	1.4E-06	1%
U-238[a]	1.5E-06	4.4E-05	17%
Np-237[a]	8.6E-10	7.5E-09	<1%
Pu-238[a]	1.4E-09	2.7E-08	<1%
Pu-239/240[d]	1.1E-07	1.9E-06	1%
Am-241[a,e]	3.9E-10	5.8E-08	<1%
Am-243[a]	3.8E-10	5.8E-09	<1%
Cm-243/244[a]	9.8E-10	1.1E-08	<1%
Cf-252[a]	1.6E-09	2.5E-07	<1%
Table 2.3 nuclides	1.8E-06	2.6E-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 – LLS	NA	0[f]	0%
PIC-5 emissions – NDRM	NA	6.6E-08[f]	<1%
Total	**5.2E-04 Ci**	**2.6E-04 mrem EDE**	**100%**

(a) Release based on 40 CFR 61, Appendix D (1989), or release records.
(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. The LLS permit was not used in CY2015.

Table 3.4. Dose Contributions from Each Registered Emission Point

Facility/Building	Emission Point	Emissions[a]	PNNL Campus MEI (mrem EDE)	% of Total MEI Dose
RTL/RTL-520	EP-RTL-11-V	Estimated	1.3E-04	48.9%
RTL/RTL-520	EP-RTL-10-V	Estimated	1.3E-04	48.9%
PSF/3420 Building	EP-3420-01-S	Sampled	1.5E-06	1%
PSF/3410 Building	EP-3410-01-S	Sampled	1.1E-06	<1%
PSF/3430 Building	EP-3430-01-S	Sampled	1.0E-06	<1%
Campus	J-VRRM	PIC-5	9.4E-07[b]	<1%
Campus	J-Facilities Restoration	PIC-5	8.4E-07[b]	<1%
PSF/3420 Building	EP-3420-02-S	Estimated	1.0E-07	<1%
Campus	J-NDRM	PIC-5	6.6E-08[b]	<1%
PSF/3430 Building	EP-3430-02-S	Estimated	2.1E-08	<1%
PSF/3425 Building	J-3425	Estimated	3.4E-09	<1%
LSLII	EP-LSLII-01-V	Estimated	1.4E-10	<1%
LSLII	EP-LSLII-02-V	Estimated	1.4E-10	<1%
PSF/3430 Building	EP-3430-1606P-S	Estimated	2.4E-14	<1%
PSF/3430 Building	EP-3430-1608P-S	Estimated	2.4E-14	<1%
PSF/3430 Building	EP-3430-1610P-S	Estimated	2.4E-14	<1%
PSF/3430 Building	EP-3430-1612P-S	Estimated	2.4E-14	<1%
PSF/3430 Building	EP-3430-1614P-S	Estimated	2.4E-14	<1%
RTL/RTL-530	J-RTL530	None	0	0%
Campus	J-LLS	None	0[b]	0%

(a) Emissions "estimated" are determined by 40 CFR 61, Appendix D.
(b) Dose assigned by permit determination. J-LLS permit was not used in 2015.

For comparison, the Subpart H PNNL Campus 2015 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 Campus 2015 MEI dose (40 CFR 61, Subpart H) 0.00026 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 Campus 2014 MEI dose was 2.9E-5 mrem/yr. (See Section 6.0, which indicates the corrected dose reported in Snyder, Barnett, and Bisping 2015.)

3.4.2 Washington Administrative Code

For PNNL 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 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 about 25% greater than the reported MEI dose.

3.4.3 PNNL 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 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 CY2015 were reviewed. Both the PNNL Campus and the Hanford Site (Rokkan et al. 2016) are in compliance with the 10 mrem/yr regulatory standard for CY2015 radiological emissions.

The CY2015 Hanford Site MEI location is on the PNNL Campus, directly south of the Hanford Site 300 Area. As a result, no dose to the Hanford Site MEI from PNNL Campus emissions was estimated for 2015. The dose to the PNNL Campus MEI from the Hanford Site 300 Area emissions excluding radon (emissions listed in Table 3-1 of Rokkan et al. 2016) is indicated in Table 3.5. Most of the impact from Hanford Site 300 Area emissions to the PNNL Campus MEI is attributable to ^{3}H emissions (99.97%). The table also indicates the dose to the 2015 Hanford Site MEI for emissions from the Hanford Site 300 Area sources. A PNNL facility is the location of the 2015 Hanford Site MEI; therefore, no dose was calculated to this receptor from PNNL Campus emissions in 2015.

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

Receptor	Dose from 2015 PNNL Campus Emissions	Dose from 2015 Hanford Site 300 Area Emissions
Hanford Site 2015 MEI	NA[(a)]	6.7E-02 mrem
PNNL Campus 2015 MEI	2.6E-04 mrem	2.2E-02 mrem

(a) Hanford Site receptor located at the PNNL Campus.

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No nonroutine emissions were reported in 2015.

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 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 four particulate air sampling stations. The PNNL 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 2015.

3.6.3 Radon-220 and Radon-222 Emissions

Radon-220 was not emitted from PNNL Campus operations in 2015. 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 Campus has no diffuse sources.

PNNL facility-specific fugitive sources include J-3425 and J-RTL530. In 2015, only J-3425 had radioactive material emissions. In addition to facility-specific fugitive sources, PNNL 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 Garnett 2012) levels of radionuclide emission and cover a broad range of the nuclides, listed in Appendix B.

The 2015 PNNL Campus emissions from facility fugitive sources were estimated (see Table 2.2, with only emission unit J-3425 for 2015) 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 1.8E-06 mrem/yr (<1%) of the total 2.6E-04 mrem MEI dose for 2015.

Emissions from fugitive sources mix with ambient air, which may also include emissions from point sources. Emissions from all PNNL Campus sources *and* non-PNNL and background sources are monitored by four particulate air sampling stations. The air surveillance program conducted in 2015 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 Campus. The Hanford Site fugitive emissions are evaluated in detail in their Radiological Air Emissions Report (e.g., Rokkan et al. 2016).

5.0 Supplemental Information

This section provides the following supplemental information related to PNNL Campus radionuclide air emissions in 2015:

- 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 Campus air emissions in 2015 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 PNNL 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 2015 total collective dose from radionuclide air emissions estimated from nuclides that originated from the PNNL Campus was 2.7E-4 person-rem (2.7E-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 decrease over the 2014 estimate of 1.2E-2 person-rem (1.2E-4 person-Sv) (Snyder, Barnett, and Bisping 2015). The 2014 population dose was calculated more conservatively as the product of the 2014 MEI dose and the total 50-mile population. This change in calculation method largely accounts for the significant reduction in population dose for 2015.

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 Campus.

Activities at the PNNL 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 Campus.

Subparts Q and T do not apply to the PNNL Campus for CY2015 operations.

5.3 Environmental Surveillance for the PNNL Campus

A particulate air sampling network was established in 2010 to monitor radioactive particulates in ambient air near the PNNL 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 2015 at four ambient air sampling locations within and along the perimeter of the PNNL Campus (Figure 5.1). In addition to PNNL Campus emissions, these samplers can collect radioactive particulates released from other nearby sources. During 2015, the Hanford Site 300 Area would have contributed most of the non-PNNL particulates detected from offsite facilities.

Routine surveillance activities at the PNNL 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 2015, environmental air surveillance continued at PNL-1 (solar), PNL-2 (solar), PNL-3, and PNL-4 (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 2015 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 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 PNNL 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 CY2015 PNNL Campus sampling as well as the Yakima background station. Results are summarized in Table 5.1 for the PNNL Campus stations and the Yakima background station. The gross alpha and gross beta results were comparable to background levels. All nuclide-specific results shown in Figure 5.1 were less than the values in Table 2 of 40 CFR 61, Appendix E (2011). There was no indication of substantially elevated levels of monitored particulate radionuclides near the PNNL Campus from either onsite or other nearby sources.

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

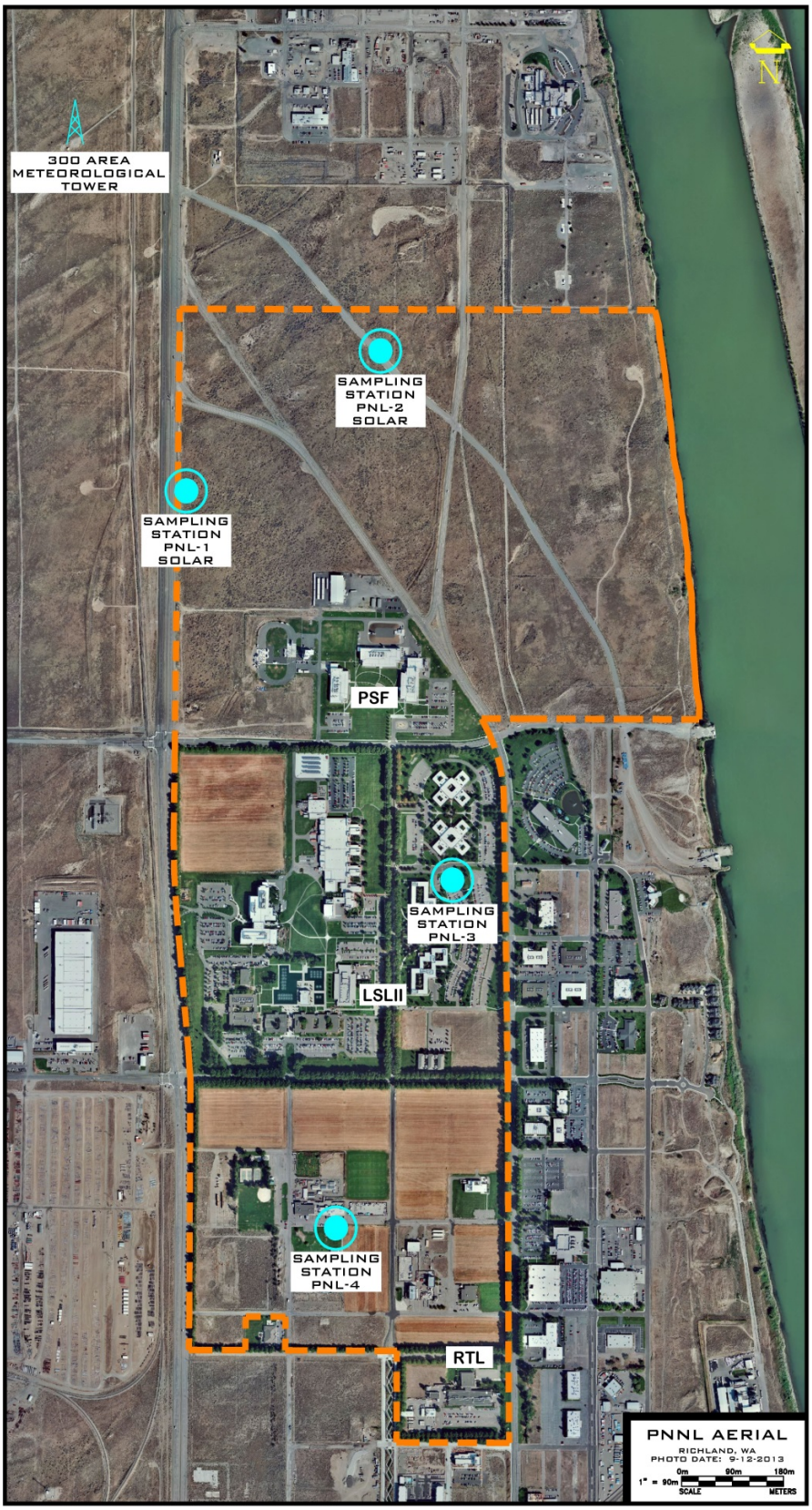

Figure 5.1. Air Surveillance Station Locations for the PNNL Campus

Table 5.1. Summary of 2015 Air Sampling Results

Nuclide	Location[a]	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m3)[b]
Gross Alpha	PNL-1	24	21	7.8E-04 ± 1.9E-03
	PNL-2	24	17	6.8E-04 ± 1.8E-03
	PNL-3	25	16	7.7E-04 ± 1.8E-03
	PNL-4	25	21	7.6E-04 ± 1.8E-03
	YAKIMA	26	22	9.0E-04 ± 2.0E-03
Gross Beta	PNL-1	24	24	2.0E-02 ± 6.7E-03
	PNL-2	24	24	1.7E-02 ± 6.0E-03
	PNL-3	25	25	1.7E-02 ± 6.3E-03
	PNL-4	25	25	1.8E-02 ± 6.5E-03
	YAKIMA	26	26	1.7E-02 ± 9.4E-03
Co-60	PNL-1	2	0	9.4E-05 ± 5.5E-04
	PNL-2	2	0	-1.4E-04 ± 5.7E-04
	PNL-3	2	0	3.6E-05 ± 4.4E-04
	PNL-4	2	0	-1.2E-04 ± 6.3E-04
	YAKIMA	2	0	1.4E-04 ± 7.2E-04
U-233/234	PNL-1	2	2	5.8E-05 ± 2.2E-05
	PNL-2	2	2	5.6E-05 ± 1.6E-05
	PNL-3	2	2	5.4E-05 ± 1.4E-05
	PNL-4	2	2	5.8E-05 ± 1.6E-05
U-234	YAKIMA	2	1	4.1E-05 ± 4.1E-05
Pu-238	PNL-1	2	0	-8.9E-07 ± 4.8E-06
	PNL-2	2	0	1.9E-06 ± 3.6E-06
	PNL-3	2	0	1.4E-06 ± 3.6E-06
	PNL-4	2	0	3.5E-07 ± 3.1E-06
	YAKIMA	2	0	-2.1E-06 ± 1.8E-05
Pu-239/240	PNL-1	2	0	1.6E-06 ± 5.7E-06
	PNL-2	2	0	1.7E-06 ± 3.0E-06
	PNL-3	2	0	1.5E-06 ± 3.9E-06
	PNL-4	2	0	2.2E-06 ± 3.3E-06
	YAKIMA	2	0	1.1E-06 ± 3.7E-06
Am-241	PNL-1	2	0	9.8E-06 ± 2.2E-05
	PNL-2	2	0	6.2E-07 ± 1.9E-06
	PNL-3	2	0	8.0E-07 ± 4.2E-06
	PNL-4	2	1	3.9E-06 ± 5.9E-06
	YAKIMA	0	0	NA[c]
Am-243	PNL-1	2	0	7.1E-06 ± 9.6E-06
	PNL-2	2	0	4.5E-06 ± 7.5E-06
	PNL-3	2	0	6.6E-07 ± 3.6E-06
	PNL-4	2	0	4.8E-06 ± 1.0E-05
	YAKIMA	0	0	NA[c]
Cm-243/244	PNL-1	2	0	-7.5E-07 ± 1.1E-05
	PNL-2	2	0	-3.1E-07 ± 2.8E-06
	PNL-3	2	0	9.1E-07 ± 3.9E-06
	PNL-4	2	0	1.5E-06 ± 4.8E-06
	YAKIMA	0	0	NA[c]

NA = Not analyzed

(a) Refer to Figure 5.1 for PNL-1, PNL-2, PNL-3, and PNL-4 locations; Yakima sampler is about 97 km (60 mi) WNW of the PNNL 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) Am-241 values reported for PNNL 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 2013) and in the PNNL 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 CY2015. QA requirements were implemented, as appropriate, at the PNNL 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 Corrigendum

The gross alpha and gross beta results for the periodically sampled RTL-520 facility emission units were slightly under-reported in the prior report (Snyder, Barnett, and Bisping 2015). Gross alpha and gross beta results were assigned as Pu-239 or Am-241 and Cs-137, respectively, for dose assessment purposes. The following corrections to Snyder, Barnett, and Bisping 2015 are presented. The corrections slightly increase the MEI dose from 2.7E-05 mrem (2.7E-07 mSv) EDE to 2.9E-05 mrem (2.7E-09 mSv), still more than 100,000 times smaller than the federal standard of 10 mrem/yr.

Table 6.1 shows the corrections to Table 2.1 of Snyder, Barnett, and Bisping 2015, resulting in total gross alpha (all sources) of 3.4E-07 Ci and gross beta (all sources) of 1.1E-06 Ci. Table 6.2 provides the corrected total gross alpha and gross beta results for all emissions units.

Table 6.1. Snyder, Barnett, and Bisping (2015) Table 2.1 Corrections

	Old Value		Corrected Value	
Nuclide	EP-RTL-10-V RTL-520	EP-RTL-11-V RTL-520	EP-RTL-10-V RTL-520	EP-RTL-11-V RTL-520
Gross α [(a)] (Ci)	1.47E-09	1.80E-09	1.46E-08	2.38E-08
Gross β [(a)] (Ci)	2.30E-09	4.45E-09	1.55E-08	5.36E-08

(a) Maximum of the biweekly or composited average measurement

Table 6.2. Snyder, Barnett, and Bisping (2015) Table 2.4 Corrections

	Old Value		Corrected Value	
Nuclide	Major Emission Units	Total (All Emission Units)	Major Emission Units	Total (All Emission Units)
Gross α[(a)] (Ci)	2.9E-07	2.9E-07	3.4E-07	3.4E-07
Gross β[(a)] (Ci)	9.9E-07	1.0E-06	1.1E-06	1.1E-06

(a) Maximum of the biweekly or composited average measurement

The corrected emissions results were then evaluated to determine their impact to the 2014 MEI dose reported in Snyder, Barnett, and Bisping 2015, Section 3.4.1.

Old Text (Snyder, Barnett, and Bisping 2015, Section 3.4.1)

- The regulatory standard for a maximum dose to any member of the public is 10 mrem/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 CY2015, the PNNL Campus MEI location was 0.70 km (0.43 mi) SSE of the PSF. The dose to the PNNL Campus MEI from routine and nonroutine point source emissions was 2.4E-05 mrem (2.4E-07 mSv) EDE. Including the fugitive PIC-5 category doses increases the total MEI dose to 2.7E-05 mrem (2.7E-07 mSv) EDE.

  And

- PNNL Campus 2015 MEI dose (40 CFR61, Subpart H) 0.000027 mrem/yr

Corrected Text (bolded) (Snyder, Barnett, and Bisping 2015, Section 3.4.1)

- The regulatory standard for a maximum dose to any member of the public is 10 mrem/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 CY2015, the PNNL Campus MEI location was 0.70 km (0.43 mi) SSE of the PSF. The dose to the PNNL Campus MEI from routine and nonroutine point source emissions was **2.6E-05 mrem (2.6E-07 mSv) EDE**. Including the fugitive PIC-5 category doses increases the total MEI dose to **2.9E-05 mrem (2.9E-07 mSv)** EDE.

  And

- PNNL Campus 2015 MEI dose (40 CFR61, Subpart H) **0.000029** **mrem/yr**

The corrections to Tables 3.2 and 3.3 of Snyder, Barnett, and Bisping 2015 are indicated below.

Table 6.3. Snyder, Barnett, and Bisping (2015) Table 3.2 Corrections

Radionuclide	Releases (Ci)	Dose to MEI (mrem EDE)	% of Total EDE
Old Values			
Sr-90[(b)]	9.9E-07	4.2E-06	16%
Cs-137[(b)]	7.2E-09	2.0E-08	<1%
U-233/234	2.2E-08	4.0E-07	2%
Pu-239/240[(d)]	3.1E-07	1.9E-05	71%
PIC-5 emissions – LLS	NA	1.0E-06[(f)]	4%
Total	1.7E-04	2.7E-05	100%
Corrected Values (changes in bold font)			
Sr-90[(b)]	9.9E-07	4.2E-06	**14%**
Cs-137[(b)]	**7.0E-08**	**1.7E-07**	<1%
U-233/234	2.2E-08	4.0E-07	**1%**
Pu-239/240[(d)]	**3.4E-07**	**2.1E-05**	**73%**
PIC-5 emissions – LLS	NA	1.0E-06[(f)]	**3%**
Total	1.7E-04	**2.9E-05**	100%

<All original footnotes retained, intact>

(a) Release based on 40 CFR 61, Appendix D (1989), or release records.
(b) Gross beta from PSF building sampling assumed to be Sr-90. Gross beta from RTL-520 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 RTL-520 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 emissions doses are assigned based on permit value.

Table 6.4. Snyder, Barnett, and Bisping (2015) Table 3.3 Corrections

Facility/Building	Emission Point	Emissions[a]	Dose to MEI (mrem EDE)	% of Total MEI Dose
Old Values				
PSF/3420 Building	EP-3420-01-S	Sampled	1.0E-05	38%
PSF/3410 Building	EP-3410-01-S	Sampled	8.4E-06	31%
PSF/3430 Building	EP-3430-01-S	Sampled	4.5E-06	17%
Campus	J-LLS	PIC-5	1.0E-06[b]	4%
Campus	J-VRRM	PIC-5	9.4E-07[b]	3%
Campus	J-Facilities Restoration	PIC-5	8.4E-07[b]	3%
PSF/3420 Building	EP-3420-02-S	Estimated	6.7E-07	2%
RTL/RTL-520	EP-RTL-11-V	Sampled	1.2E-07	<1%
RTL/RTL-520	EP-RTL-10-V	Sampled	9.8E-08	<1%
Corrected Values (changes in bold font)				
PSF/3420 Building	EP-3420-01-S	Sampled	1.0E-05	**35%**
PSF/3410 Building	EP-3410-01-S	Sampled	8.4E-06	**29%**
PSF/3430 Building	EP-3430-01-S	Sampled	4.5E-06	**15%**
RTL/RTL-520	**EP-RTL-11-V**	**Sampled**	**1.6E-06**	**6%**
Campus	J-LLS	PIC-5	1.0E-06[b]	**3%**
RTL/RTL-520	**EP-RTL-10-V**	**Sampled**	**9.6E-07**	**3%**
Campus	J-VRRM	PIC-5	9.4E-07[b]	3%
Campus	J-Facilities Restoration	PIC-5	8.4E-07[b]	3%
PSF/3420 Building	EP-3420-02-S	Estimated	6.7E-07	2%

(a) Estimated emissions are determined by 40 CFR 61, Appendix D.
(b) Dose assigned by permit determination.

7.0 References

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Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

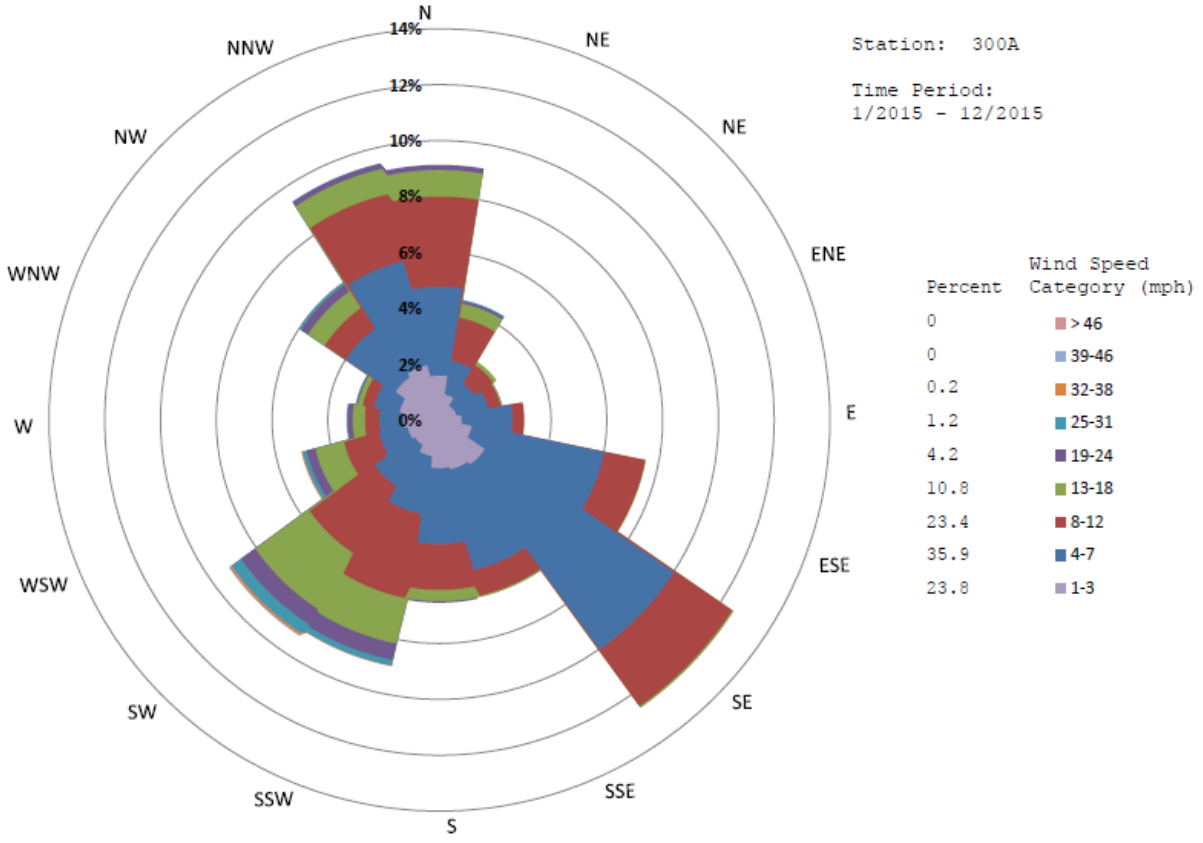

Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2015

Table A.1. Annual Average Joint Frequency During 2015 (as percent of time) of Wind Speed, Stability Class, and Direction for the Hanford Site 300 Area (Station 11) at the 10-Meter Level (3 sheets)

Wind Speed (m/sec)	Stability Class	Wind Direction Toward																**Total**
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
0.89	A	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.01	0.01	0.00	0.02	0.00	**0.12**
	B	0.01	0.00	0.02	0.01	0.01	0.00	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	**0.12**
	C	0.03	0.02	0.05	0.13	0.06	0.05	0.12	0.13	0.08	0.03	0.03	0.03	0.01	0.01	0.00	0.04	**0.82**
	D	0.42	0.35	0.20	0.21	0.23	0.37	0.47	0.27	0.37	0.29	0.24	0.22	0.24	0.34	0.43	0.61	**5.26**
	E	0.46	0.21	0.09	0.11	0.23	0.24	0.44	0.60	0.51	0.49	0.48	0.45	0.56	0.52	0.59	0.64	**6.62**
	F	0.46	0.26	0.21	0.14	0.18	0.38	0.62	0.59	0.58	0.40	0.23	0.33	0.40	0.46	0.56	0.51	**6.31**
	G	0.24	0.08	0.03	0.02	0.09	0.16	0.30	0.22	0.20	0.12	0.11	0.14	0.08	0.13	0.27	0.23	**2.42**
	Total	**1.63**	**0.94**	**0.61**	**0.63**	**0.80**	**1.20**	**1.96**	**1.84**	**1.76**	**1.35**	**1.09**	**1.18**	**1.30**	**1.46**	**1.87**	**2.05**	**21.67**
2.65	A	0.00	0.04	0.06	0.05	0.02	0.05	0.04	0.01	0.05	0.04	0.07	0.04	0.03	0.02	0.01	0.00	**0.53**
	B	0.03	0.11	0.14	0.26	0.38	0.35	0.22	0.13	0.07	0.13	0.11	0.05	0.00	0.00	0.03	0.03	**2.04**
	C	0.13	0.10	0.20	0.43	0.62	0.84	0.57	0.30	0.23	0.19	0.18	0.03	0.04	0.03	0.02	0.03	**3.94**
	D	1.10	0.48	0.45	0.31	0.45	1.19	2.02	0.88	0.68	0.70	0.62	0.33	0.25	0.19	0.71	1.42	**11.78**
	E	1.03	0.32	0.07	0.08	0.26	1.12	2.22	1.01	0.89	0.66	0.58	0.44	0.43	0.51	0.76	1.24	**11.62**
	F	0.75	0.14	0.00	0.02	0.07	0.95	2.36	1.03	0.66	0.30	0.18	0.11	0.09	0.13	0.51	0.83	**8.13**
	G	0.15	0.02	0.00	0.00	0.02	0.33	0.67	0.34	0.12	0.09	0.02	0.03	0.04	0.05	0.10	0.28	**2.26**
	Total	**3.19**	**1.21**	**0.92**	**1.15**	**1.82**	**4.83**	**8.10**	**3.70**	**2.70**	**2.11**	**1.76**	**1.03**	**0.88**	**0.93**	**2.14**	**3.83**	**40.30**
4.70	A	0.11	0.19	0.22	0.03	0.04	0.05	0.06	0.03	0.01	0.18	0.14	0.06	0.01	0.07	0.00	0.00	**1.20**
	B	0.05	0.21	0.31	0.12	0.09	0.19	0.22	0.11	0.15	0.38	0.29	0.07	0.02	0.00	0.01	0.10	**2.32**
	C	0.18	0.30	0.15	0.18	0.14	0.19	0.37	0.22	0.24	0.55	0.52	0.09	0.04	0.03	0.04	0.04	**3.28**
	D	0.71	0.51	0.09	0.09	0.13	0.28	0.51	0.31	0.56	0.69	0.78	0.45	0.21	0.10	0.41	0.90	**6.73**
	E	1.05	0.21	0.03	0.02	0.02	0.28	0.52	0.19	0.47	0.80	0.81	0.52	0.22	0.21	0.38	0.89	**6.62**
	F	0.81	0.13	0.00	0.01	0.02	0.37	0.64	0.07	0.16	0.29	0.22	0.10	0.03	0.01	0.05	0.40	**3.31**
	G	0.31	0.02	0.00	0.00	0.00	0.14	0.17	0.02	0.06	0.17	0.10	0.01	0.00	0.00	0.00	0.12	**1.12**
	Total	**3.22**	**1.57**	**0.80**	**0.45**	**0.44**	**1.50**	**2.49**	**0.95**	**1.65**	**3.06**	**2.86**	**1.30**	**0.53**	**0.42**	**0.89**	**2.45**	**24.58**

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	0.14	0.24	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.23	0.22	0.05	0.00	0.04	0.05	**1.06**
	B	0.14	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.16	0.33	0.16	0.05	0.03	0.03	0.04	**1.04**
	C	0.10	0.05	0.03	0.00	0.00	0.00	0.02	0.00	0.04	0.29	0.32	0.16	0.06	0.01	0.01	0.05	**1.14**
	D	0.16	0.11	0.02	0.01	0.00	0.02	0.02	0.03	0.12	0.57	0.71	0.27	0.17	0.11	0.35	0.24	**2.91**
	E	0.26	0.04	0.06	0.03	0.00	0.00	0.01	0.02	0.18	0.41	0.59	0.23	0.12	0.02	0.29	0.44	**2.70**
	F	0.12	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.04	0.16	0.14	0.03	0.00	0.00	0.00	0.10	**0.63**
	G	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00	**0.09**
	Total	**0.95**	**0.51**	**0.15**	**0.05**	**0.00**	**0.03**	**0.06**	**0.05**	**0.41**	**1.66**	**2.37**	**1.07**	**0.45**	**0.17**	**0.72**	**0.92**	9.57
9.8	A	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.03	0.03	0.02	0.02	0.02	**0.26**
	B	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.05	0.03	0.00	0.00	0.01	**0.16**
	C	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.09	0.07	0.04	0.01	0.00	0.01	0.00	**0.24**
	D	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.32	0.15	0.08	0.01	0.16	0.12	**1.04**
	E	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.31	0.16	0.05	0.04	0.02	0.11	0.03	**0.87**
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	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	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Total	**0.19**	**0.10**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.07**	**0.59**	**0.63**	**0.32**	**0.19**	**0.05**	**0.30**	**0.18**	2.63
12.7	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.03	0.02	0.01	0.00	0.00	**0.12**
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.05	0.00	**0.10**
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.01	0.00	**0.07**
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.04	0.01	0.02	0.02	0.02	**0.31**
	E	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.03	0.01	0.00	0.00	0.00	**0.30**
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	**0.02**
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.00	0.00	0.00	0.00	0.00	**0.07**
	Total	**0.00**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.21**	**0.42**	**0.15**	**0.04**	**0.03**	**0.08**	**0.02**	0.99
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	0.02	0.00	0.00	0.00	0.00	**0.02**
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	**0.01**

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	
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.01**
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.01	0.00	0.00	0.00	0.00	**0.08**
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	**0.02**
	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**	**0.03**	**0.07**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.14**
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	0.04	0.00	0.00	0.00	0.00	0.00	**0.04**
	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**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**
Total	A	0.30	0.52	0.32	0.09	0.06	0.10	0.10	0.05	0.06	0.37	0.50	0.41	0.15	0.12	0.09	0.07	**3.31**
	B	0.24	0.39	0.47	0.39	0.48	0.54	0.46	0.26	0.27	0.69	0.78	0.37	0.10	0.03	0.12	0.20	**5.79**
	C	0.45	0.47	0.43	0.75	0.82	1.08	1.08	0.65	0.59	1.15	1.17	0.37	0.16	0.08	0.09	0.16	**9.50**
	D	2.45	1.48	0.76	0.62	0.81	1.86	3.02	1.49	1.75	2.44	2.88	1.47	0.96	0.77	2.08	3.31	**28.15**
	E	2.87	0.85	0.25	0.24	0.51	1.64	3.19	1.82	2.10	2.78	2.75	1.72	1.38	1.28	2.13	3.24	**28.75**
	F	2.14	0.54	0.22	0.18	0.27	1.71	3.62	1.69	1.44	1.18	0.82	0.57	0.52	0.60	1.12	1.84	**18.46**
	G	0.73	0.12	0.03	0.02	0.11	0.63	1.14	0.58	0.38	0.40	0.34	0.18	0.12	0.18	0.37	0.63	**5.96**
	Total	**9.18**	**4.37**	**2.48**	**2.29**	**3.06**	**7.56**	**12.61**	**6.54**	**6.59**	**9.01**	**9.24**	**5.09**	**3.39**	**3.06**	**6.00**	**9.45**	**99.92**

Table A.2. Exposure and Consumption Data for the PNNL 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 Campus Meteorological Data — General Information

HEIGHT OF LID
LIDAI = 1,000 m

RAINFALL RATE [2015]
RR = 16.5 cm/yr

AVERAGE AIR TEMPERATURE [2015]
A = 14.2 degrees C (57.6 degrees F; 287.4 K)

SURFACE ROUGHNESS LENGTH
0 = 0.010 m

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

STABILITY E	0.073
STABILITY F	0.109
STABILITY G	0.146

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2015

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2015

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Campus in 2015

Ac-225	Bk-249	Cs-134m	Ho-166	Mn-56	Pd-109	Rh-102	Ta-179	Tm-171
Ac-227	Bk-250	Cs-135	Ho-166m	Mo-93	Pm-143	Rh-102m	Ta-180	U-232
Ac-228	Br-82	Cs-136	I-122	Mo-99	Pm-144	Rh-103m	Ta-182	U-233
Ag-108	Br-82m	Cs-137	I-123	Mo-103	Pm-145	Rh-104	Ta-182m	U-234
Ag-108m	Br-83	Cs-138	I-125	Mo-104	Pm-146	Rh-105	Ta-183	U-235
Ag-109m	Br-84	Cs-139	I-126	Mo-105	Pm-147	Rh-105m	Tb-157	U-235m
Ag-110	Br-84m	Cs-140	I-128	N-13	Pm-148	Rh-106	Tb-158	U-236
Ag-110m	Br-85	Cs-141	I-129	Na-22	Pm-148m	Rn-219	Tb-160	U-237
Ag-111	C-11	Cu-64	I-130	Na-24	Pm-149	Rn-220	Tb-161	U-238
Al-26	C-14	Cu-66	I-130m	Na-24m	Pm-151	Rn-222	Tc-95	U-239
Al-28	C-15	Cu-67	I-131	Nb-91	Po-208	Rn-224	Tc-95m	U-240
Am-240	Ca-41	Dy-159	I-132	Nb-91m	Po-209	Ru-97	Tc-97	V-48
Am-241	Ca-45	Dy-165	I-132m	Nb-92	Po-210	Ru-103	Tc-97m	V-49
Am-242	Ca-47	Dy-169	I-133	Nb-93m	Po-211	Ru-105	Tc-98	W-181
Am-242m	Cd-107	Er-169	I-133m	Nb-94	Po-212	Ru-106	Tc-99	W-185
Am-243	Cd-109	Er-171	I-134	Nb-95	Po-213	S-35	Tc-99m	W-187
Am-245	Cd-111m	Es-254	I-134m	Nb-95m	Po-214	Sb-122	Tc-101	W-188
Am-246	Cd-113	Eu-150	I-135	Nb-97	Po-215	Sb-124	Tc-103	Xe-122
Ar-37	Cd-113m	Eu-152	In-106	Nb-97m	Po-216	Sb-125	Tc-106	Xe-123
Ar-39	Cd-115	Eu-152m	In-111	Nb-98	Po-218	Sb-126	Te-121	Xe-125
Ar-41	Cd-115m	Eu-154	In-113m	Nb-100	Pr-143	Sb-126m	Te-121m	Xe-127
Ar-42	Cd-117	Eu-155	In-114	Nb-101	Pr-144	Sb-127	Te-123	Xe-127m
As-74	Cd-117m	Eu-156	In-114m	Nb-103	Pr-144m	Sb-129	Te-123m	Xe-129m
As-76	Ce-139	Eu-157	In-115	Nd-144	Pu-234	Sc-44	Te-125m	Xe-131m
As-77	Ce-141	F-18	In-115m	Nd-147	Pu-236	Sc-46	Te-127	Xe-133
At-217	Ce-142	Fe-55	In-116	Ni-56	Pu-237	Sc-47	Te-127m	Xe-133m
Au-193	Ce-143	Fe-59	In-116m	Ni-57	Pu-238	Se-75	Te-129	Xe-135
Au-194	Ce-144	Fr-221	In-117	Ni-59	Pu-239	Se-79	Te-129m	Xe-135m
Au-195	Cf-249	Fr-223	In-117m	Ni-63	Pu-240	Se-79m	Te-131	Xe-137
Au-196	Cf-250	Ga-67	Ir-192	Ni-65	Pu-241	Si-31	Te-131m	Xe-138
Au-198	Cf-251	Ga-68	K-40	Np-235	Pu-242	Si-32	Te-132	Xe-139
Au-198m	Cf-252	Ga-70	K-42	Np-236	Pu-243	Sm-145	Te-133	Y-88
Au-199	Cl-36	Ga-72	Kr-81	Np-237	Pu-244	Sm-146	Te-133m	Y-90
Ba-131	Cm-241	Gd-148	Kr-81m	Np-238	Pu-246	Sm-147	Te-134	Y-90m
Ba-133	Cm-242	Gd-149	Kr-83m	Np-239	Ra-223	Sm-148	Th-227	Y-91
Ba-133m	Cm-243	Gd-151	Kr-85	Np-240	Ra-224	Sm-151	Th-228	Y-91m
Ba-137m	Cm-244	Gd-152	Kr-85m	Np-240m	Ra-225	Sm-153	Th-229	Y-92
Ba-139	Cm-245	Gd-153	Kr-87	O-15	Ra-226	Sm-157	Th-230	Y-93
Ba-140	Cm-246	Gd-159	Kr-88	O-19	Ra-228	Sn-113	Th-231	Yb-164
Ba-141	Cm-247	Ge-68	Kr-89	Os-191	Rb-81	Sn-117m	Th-232	Yb-169
Ba-142	Cm-248	Ge-71	Kr-90	P-32	Rb-82	Sn-119m	Th-233	Yb-175
Ba-143	Cm-250	Ge-71m	La-137	P-33	Rb-83	Sn-121	Th-234	Yb-177
Be-7	Co-56	Ge-75	La-138	Pa-231	Rb-84	Sn-121m	Ti-44	Zn-65
Be-10	Co-57	Ge-77	La-140	Pa-233	Rb-86	Sn-123	Ti-45	Zn-69
Bi-207	Co-58	Ge-77m	La-141	Pa-234	Rb-87	Sn-125	Ti-51	Zn-69m
Bi-208	Co-60	H-3	La-142	Pa-234m	Rb-88	Sn-126	Tl-201	Zr-88
Bi-210	Co-60m	Hf-175	La-144	Pb-209	Rb-89	Sr-82	Tl-204	Zr-89
Bi-210m	Cr-49	Hf-178m	Lu-177	Pb-210	Rb-90	Sr-85	Tl-206	Zr-93
Bi-211	Cr-51	Hf-179m	Lu-177m	Pb-211	Rb-90m	Sr-87m	Tl-207	Zr-95
Bi-212	Cr-55	Hf-181	Mg-27	Pb-212	Re-186	Sr-89	Tl-208	Zr-97
Bi-213	Cs-131	Hf-182	Mg-28	Pb-214	Re-187	Sr-90	Tl-209	Zr-98
Bi-214	Cs-132	Hg-203	Mn-52	Pd-103	Re-188	Sr-91	Tm-168	Zr-99
Bk-247	Cs-134	Ho-163	Mn-54	Pd-107	Rh-101	Sr-92	Tm-170	Zr-100

Appendix C

Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2015

Appendix C

Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2015

Table C.1. Definitions for Air Sampling Data

Column Heading	Data Type/Format	Content
SAMP_SITE_NAME	text	Location of monitoring station: PNNL Campus monitoring stations: PNL-1, PNL-2, PNL-3, PNL-4 Background Location: Yakima
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 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 Campus and the Yakima Background Station for Calendar Year 2015

(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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	365707001	07-Jan-15	21-Jan-15	ALPHA	1.3E-03	pCi/m3	4.1E-04	4.1E-04				
PNL-1	FILTER2 SOLAR	366636001	21-Jan-15	04-Feb-15	ALPHA	5.1E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-1	FILTER2 SOLAR	367485001	04-Feb-15	18-Feb-15	ALPHA	3.6E-04	pCi/m3	3.0E-04	3.0E-04	U			
PNL-1	FILTER2 SOLAR	368404001	18-Feb-15	04-Mar-15	ALPHA	7.8E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-1	FILTER2 SOLAR	369241001	04-Mar-15	18-Mar-15	ALPHA	7.9E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-1	FILTER2 SOLAR	370046001	18-Mar-15	01-Apr-15	ALPHA	6.2E-04	pCi/m3	3.9E-04	3.9E-04				
PNL-1	FILTER2 SOLAR	371432001	01-Apr-15	15-Apr-15	ALPHA	5.8E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-1	FILTER2 SOLAR	372301001	15-Apr-15	29-Apr-15	ALPHA	4.1E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-1	FILTER2 SOLAR	373176001	29-Apr-15	13-May-15	ALPHA	1.2E-03	pCi/m3	4.5E-04	4.6E-04		AIR SAMPLER #24094 EXPIRING 05/16/15 WAS REPLACED ON 05/13/15 WITH #22974 EXPIRES 04/15/16.		
PNL-1	FILTER2 SOLAR	374163001	13-May-15	27-May-15	ALPHA	7.1E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-1	FILTER2 SOLAR	375033001	27-May-15	10-Jun-15	ALPHA	5.3E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-1	FILTER2 SOLAR	375726001	10-Jun-15	24-Jun-15	ALPHA	6.2E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-1	FILTER2 SOLAR	376918001	24-Jun-15	08-Jul-15	ALPHA	7.7E-04	pCi/m3	3.9E-04	3.9E-04		DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH AIR FLOW CALIBRATOR READING HIGH AT 1.875; TRIPLE DIGIT TEMPERATURES AND SMOKE FROM SURROUNDING FIRES; FILTER PAPER WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-1	FILTER2 SOLAR	377977001	08-Jul-15	22-Jul-15	ALPHA	3.4E-04	pCi/m3	3.1E-04	3.1E-04	U			
PNL-1	FILTER2 SOLAR	378915001	22-Jul-15	05-Aug-15	ALPHA	7.2E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-1	FILTER2 SOLAR	379744001	05-Aug-15	19-Aug-15	ALPHA	5.8E-04	pCi/m3	3.5E-04	3.5E-04		REPLACED #22974 WITH #24094; TOTAL FLOW AND AS-FOUND AIR FLOW LOW AND AIR FLOW CALIBRATOR READING HIGH. DIRTY FILTER SMOKE IN AIR. SAMPLER #24094 AIR FLOW CHECKED BY BOTH AIR FLOW		
PNL-1	FILTER2 SOLAR		19-Aug-15	02-Sep-15	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. TOTAL FLOW AND AS-FOUND AIR FLOW LOW. VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-1	FILTER2 SOLAR	381461001	02-Sep-15	16-Sep-15	ALPHA	7.6E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-1	FILTER2 SOLAR	382239001	16-Sep-15	30-Sep-15	ALPHA	4.1E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-1	FILTER2 SOLAR	389307001	30-Sep-15	14-Oct-15	ALPHA	2.8E-03	pCi/m3	6.4E-04	6.4E-04		REFER TO DISCREPANCY REPORT EMP15-006; THE MINUTES TO HOUR MANUAL CONVERSION FOR ELAPSED TIME (I.E. EXPOSURE HOURS) WAS MISCALCULATED AT ONLY 137 HOURS. TOTAL FLOW AND FLOW RATE ACCEPTABLE, EXPOSURE HOURS RECALCULATED BASED ON SAMPLE DATE/TIME INFORMATION.	REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-1	FILTER2 SOLAR	384427001	14-Oct-15	28-Oct-15	ALPHA	1.4E-03	pCi/m3	4.9E-04	4.9E-04		REPLACED #24094 WITH #26472. REFER TO DISCREPANCY REPORT EMP15-006; THE MINUTES TO HOUR MANUAL CONVERSION FOR ELAPSED TIME (I.E. EXPOSURE HOURS) WAS MISCALCULATED AT ONLY 133.7 HOURS. TOTAL FLOW AND FLOW RATE ACCEPTABLE, EXPOSURE HOURS RECALCULATED BASED ON SAMPLE DATE/TIME INFORMATION.		
PNL-1	FILTER2 SOLAR	385571001	28-Oct-15	11-Nov-15	ALPHA	6.6E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-1	FILTER2 SOLAR	386473001	11-Nov-15	25-Nov-15	ALPHA	7.4E-04	pCi/m3	4.1E-04	4.1E-04				
PNL-1	FILTER2 SOLAR	387376001	25-Nov-15	09-Dec-15	ALPHA	1.0E-03	pCi/m3	3.9E-04	3.9E-04				
PNL-1	FILTER2 SOLAR	388137001	09-Dec-15	23-Dec-15	ALPHA	2.3E-04	pCi/m3	2.9E-04	2.9E-04	U			
PNL-1	FILTER2 SOLAR	365707001	07-Jan-15	21-Jan-15	BETA	3.5E-02	pCi/m3	1.6E-03	1.8E-03				
PNL-1	FILTER2 SOLAR	366636001	21-Jan-15	04-Feb-15	BETA	1.8E-02	pCi/m3	1.2E-03	1.5E-03				
PNL-1	FILTER2 SOLAR	367485001	04-Feb-15	18-Feb-15	BETA	1.8E-02	pCi/m3	1.2E-03	1.3E-03				
PNL-1	FILTER2 SOLAR	368404001	18-Feb-15	04-Mar-15	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03	O			
PNL-1	FILTER2 SOLAR	369241001	04-Mar-15	18-Mar-15	BETA	2.3E-02	pCi/m3	1.3E-03	1.4E-03	O			
PNL-1	FILTER2 SOLAR	370046001	18-Mar-15	01-Apr-15	BETA	1.2E-02	pCi/m3	9.7E-04	1.1E-03	O			
PNL-1	FILTER2 SOLAR	371432001	01-Apr-15	15-Apr-15	BETA	1.1E-02	pCi/m3	9.2E-04	9.4E-04	O			
PNL-1	FILTER2 SOLAR	372301001	15-Apr-15	29-Apr-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	373176001	29-Apr-15	13-May-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.3E-03	O	AIR SAMPLER #24094 EXPIRING 05/16/15 WAS REPLACED ON 05/13/15 WITH #22974 EXPIRES 04/15/16.		
PNL-1	FILTER2 SOLAR	374163001	13-May-15	27-May-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	375033001	27-May-15	10-Jun-15	BETA	1.5E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	375726001	10-Jun-15	24-Jun-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.1E-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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-1	FILTER2 SOLAR	376918001	24-Jun-15	08-Jul-15	BETA	2.3E-02	pCi/m3	1.4E-03	1.7E-03	O	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH AIR FLOW CALIBRATOR READING HIGH AT 1.875; TRIPLE DIGIT TEMPERATURES AND SMOKE FROM SURROUNDING FIRES; FILTER PAPER WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-1	FILTER2 SOLAR	377977001	08-Jul-15	22-Jul-15	BETA	2.0E-02	pCi/m3	1.2E-03	1.5E-03	O			
PNL-1	FILTER2 SOLAR	378915001	22-Jul-15	05-Aug-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	379744001	05-Aug-15	19-Aug-15	BETA	1.8E-02	pCi/m3	1.3E-03	1.3E-03	O	REPLACED #22974 WITH #24094; TOTAL FLOW AND AS-FOUND AIR FLOW LOW AND AIR FLOW CALIBRATOR READING HIGH. DIRTY FILTER SMOKE IN AIR. SAMPLER #24094 AIR FLOW CHECKED BY BOTH AIR FLOW CALIBRATORS AND HIGH.		
PNL-1	FILTER2 SOLAR		19-Aug-15	02-Sep-15	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. TOTAL FLOW AND AS-FOUND AIR FLOW LOW. VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-1	FILTER2 SOLAR	381461001	02-Sep-15	16-Sep-15	BETA	2.1E-02	pCi/m3	1.3E-03	1.4E-03	O			
PNL-1	FILTER2 SOLAR	382239001	16-Sep-15	30-Sep-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-1	FILTER2 SOLAR	389307001	30-Sep-15	14-Oct-15	BETA	3.3E-02	pCi/m3	1.6E-03	1.7E-03	O	REFER TO DISCREPANCY REPORT EMP15-006; THE MINUTES TO HOUR MANUAL CONVERSION FOR ELAPSED TIME (I.E. EXPOSURE HOURS) WAS MISCALCULATED AT ONLY 137 HOURS. TOTAL FLOW AND FLOW RATE ACCEPTABLE, EXPOSURE HOURS RECALCULATED BASED ON SAMPLE DATE/TIME INFORMATION.	REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-1	FILTER2 SOLAR	384427001	14-Oct-15	28-Oct-15	BETA	3.1E-02	pCi/m3	1.6E-03	2.0E-03	O	REPLACED #24094 WITH #26472. REFER TO DISCREPANCY REPORT EMP15-006; THE MINUTES TO HOUR MANUAL CONVERSION FOR ELAPSED TIME (I.E. EXPOSURE HOURS) WAS MISCALCULATED AT ONLY 133.7 HOURS. TOTAL FLOW AND FLOW RATE ACCEPTABLE, EXPOSURE HOURS RECALCULATED BASED ON SAMPLE DATE/TIME INFORMATION.		
PNL-1	FILTER2 SOLAR	385571001	28-Oct-15	11-Nov-15	BETA	1.3E-02	pCi/m3	9.8E-04	9.9E-04	O			
PNL-1	FILTER2 SOLAR	386473001	11-Nov-15	25-Nov-15	BETA	9.5E-03	pCi/m3	9.1E-04	9.4E-04	O			
PNL-1	FILTER2 SOLAR	387376001	25-Nov-15	09-Dec-15	BETA	4.2E-02	pCi/m3	1.7E-03	1.8E-03	O			
PNL-1	FILTER2 SOLAR	388137001	09-Dec-15	23-Dec-15	BETA	8.1E-03	pCi/m3	8.4E-04	9.1E-04	O			
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Be-7	3.8E-02	pCi/m3	1.3E-02	1.3E-02				Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Be-7	3.7E-02	pCi/m3	7.1E-03	7.7E-03				Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Co-60	1.7E-04	pCi/m3	4.6E-04	4.7E-04	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Co-60	2.0E-05	pCi/m3	2.9E-04	2.9E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Cs-134	7.2E-05	pCi/m3	4.7E-04	4.7E-04	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Cs-134	5.4E-06	pCi/m3	3.1E-04	3.1E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Cs-137	-9.4E-05	pCi/m3	5.9E-04	5.9E-04	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Cs-137	-1.5E-04	pCi/m3	3.1E-04	3.2E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Eu-152	4.2E-04	pCi/m3	1.8E-03	1.8E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Eu-152	-6.7E-05	pCi/m3	9.7E-04	9.7E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Eu-154	-6.4E-04	pCi/m3	1.3E-03	1.3E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Eu-154	3.2E-04	pCi/m3	7.3E-04	7.5E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Eu-155	9.7E-04	pCi/m3	1.5E-03	1.6E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Eu-155	4.8E-05	pCi/m3	8.8E-04	8.8E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	K-40	-2.7E-04	pCi/m3	6.0E-03	6.0E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	K-40	5.8E-03	pCi/m3	4.0E-03	4.0E-03	X		Data rejected due to high peak-width.	Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Ru-106	6.9E-04	pCi/m3	4.3E-03	4.3E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Ru-106	-7.3E-04	pCi/m3	2.7E-03	2.7E-03	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Sb-125	1.4E-05	pCi/m3	2.7E-03	2.7E-03	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Sb-125	-2.5E-04	pCi/m3	7.2E-04	7.3E-04	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Am-241	1.7E-05	pCi/m3	2.1E-05	2.2E-05	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Am-241	2.8E-06	pCi/m3	3.8E-06	3.8E-06	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Am-243	8.3E-06	pCi/m3	8.1E-06	8.3E-06	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Am-243	6.0E-06	pCi/m3	4.8E-06	4.8E-06	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Cm-243/244	-1.2E-06	pCi/m3	9.9E-06	9.9E-06	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Cm-243/244	-3.4E-07	pCi/m3	3.5E-06	3.5E-06	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Pu-238	-1.1E-06	pCi/m3	3.1E-06	3.1E-06	UO			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Pu-238	-7.2E-07	pCi/m3	3.7E-06	3.7E-06	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	Pu-239/240	-1.4E-06	pCi/m3	4.8E-06	4.8E-06	U			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	Pu-239/240	3.2E-06	pCi/m3	4.0E-06	4.0E-06	U			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	U-233/234	3.9E-05	pCi/m3	1.2E-05	1.3E-05	O			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	U-233/234	7.6E-05	pCi/m3	1.6E-05	1.8E-05	O			Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	U-235	6.2E-06	pCi/m3	5.7E-06	5.8E-06	O			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	U-235	2.4E-05	pCi/m3	1.2E-05	1.2E-05				Y
PNL-1	FILTER2 SOLAR	375819001	07-Jan-15	24-Jun-15	U-238	5.2E-05	pCi/m3	1.3E-05	1.5E-05	O			Y
PNL-1	FILTER2 SOLAR	389547001	24-Jun-15	23-Dec-15	U-238	8.4E-05	pCi/m3	1.7E-05	1.9E-05	O			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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	365707002	07-Jan-15	21-Jan-15	ALPHA	1.7E-03	pCi/m3	4.4E-04	4.4E-04		AIR SAMPLER #22974 EXPIRES 1/28/15, REPLACED WITH #24095 EXPIRES 12/23/15.		
PNL-2	FILTER2 SOLAR	366636002	21-Jan-15	04-Feb-15	ALPHA	6.8E-04	pCi/m3	3.4E-04	3.5E-04				
PNL-2	FILTER2 SOLAR	367485002	04-Feb-15	18-Feb-15	ALPHA	3.9E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-2	FILTER2 SOLAR	368404002	18-Feb-15	04-Mar-15	ALPHA	5.1E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-2	FILTER2 SOLAR	369241002	04-Mar-15	18-Mar-15	ALPHA	8.9E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-2	FILTER2 SOLAR	370046002	18-Mar-15	01-Apr-15	ALPHA	5.8E-04	pCi/m3	3.4E-04	3.5E-04				
PNL-2	FILTER2 SOLAR	371432002	01-Apr-15	15-Apr-15	ALPHA	5.8E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-2	FILTER2 SOLAR	372301002	15-Apr-15	29-Apr-15	ALPHA	3.3E-04	pCi/m3	3.0E-04	3.0E-04	U			
PNL-2	FILTER2 SOLAR		29-Apr-15	13-May-15	ALPHA						NO SAMPLE. SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP15-002. SAMPLER #24095 NOT RUNNING AND REPLACED 05/06/15 WITH #22494. SAMPLER #22494 UNABLE TO MAINTAIN 1.6 FLOW RATE AND REPLACED 05/13/15 WITH #21711.		
PNL-2	FILTER2 SOLAR	374163002	13-May-15	27-May-15	ALPHA	2.1E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-2	FILTER2 SOLAR	375033002	27-May-15	10-Jun-15	ALPHA	6.0E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-2	FILTER2 SOLAR	375726002	10-Jun-15	24-Jun-15	ALPHA	4.6E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-2	FILTER2 SOLAR	376918002	24-Jun-15	08-Jul-15	ALPHA	4.4E-04	pCi/m3	3.4E-04	3.5E-04	U	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH AIR FLOW CALIBRATOR READING HIGH AT 1.875; TRIPLE DIGIT TEMPERATURES AND SMOKE FROM SURROUNDING FIRES; FILTER PAPER WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-2	FILTER2 SOLAR	377977002	08-Jul-15	22-Jul-15	ALPHA	7.0E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-2	FILTER2 SOLAR	378915002	22-Jul-15	05-Aug-15	ALPHA	4.5E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-2	FILTER2 SOLAR	379744002	05-Aug-15	19-Aug-15	ALPHA	3.6E-04	pCi/m3	2.8E-04	2.8E-04	U	DIRTY FILTER SMOKE IN AIR.		
PNL-2	FILTER2 SOLAR	380810002	19-Aug-15	02-Sep-15	ALPHA	1.4E-03	pCi/m3	5.6E-04	5.7E-04		VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-2	FILTER2 SOLAR	381461002	02-Sep-15	16-Sep-15	ALPHA	3.6E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-2	FILTER2 SOLAR	382239002	16-Sep-15	30-Sep-15	ALPHA	3.4E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-2	FILTER2 SOLAR	389307002	30-Sep-15	14-Oct-15	ALPHA	2.3E-03	pCi/m3	6.4E-04	6.6E-04			REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-2	FILTER2 SOLAR	384427002	14-Oct-15	28-Oct-15	ALPHA	1.1E-03	pCi/m3	4.2E-04	4.2E-04				
PNL-2	FILTER2 SOLAR	385571002	28-Oct-15	11-Nov-15	ALPHA	5.8E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-2	FILTER2 SOLAR	386473002	11-Nov-15	25-Nov-15	ALPHA	6.1E-04	pCi/m3	3.8E-04	3.9E-04				
PNL-2	FILTER2 SOLAR	387376002	25-Nov-15	09-Dec-15	ALPHA	6.3E-04	pCi/m3	3.9E-04	3.9E-04				
PNL-2	FILTER2 SOLAR	388137002	09-Dec-15	23-Dec-15	ALPHA	2.3E-04	pCi/m3	2.5E-04	2.5E-04	U			
PNL-2	FILTER2 SOLAR	365707002	07-Jan-15	21-Jan-15	BETA	3.6E-02	pCi/m3	1.6E-03	1.6E-03		AIR SAMPLER #22974 EXPIRES 1/28/15, REPLACED WITH #24095 EXPIRES 12/23/15.		
PNL-2	FILTER2 SOLAR	366636002	21-Jan-15	04-Feb-15	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03				
PNL-2	FILTER2 SOLAR	367485002	04-Feb-15	18-Feb-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.4E-03				
PNL-2	FILTER2 SOLAR	368404002	18-Feb-15	04-Mar-15	BETA	2.2E-02	pCi/m3	1.2E-03	1.6E-03	O			
PNL-2	FILTER2 SOLAR	369241002	04-Mar-15	18-Mar-15	BETA	2.5E-02	pCi/m3	1.4E-03	1.4E-03	O			
PNL-2	FILTER2 SOLAR	370046002	18-Mar-15	01-Apr-15	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	371432002	01-Apr-15	15-Apr-15	BETA	1.3E-02	pCi/m3	9.7E-04	1.0E-03	O			
PNL-2	FILTER2 SOLAR	372301002	15-Apr-15	29-Apr-15	BETA	3.9E-03	pCi/m3	6.0E-04	6.3E-04	O		REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-002; RECOUNT SIMILAR TO ORIGINAL RESULT, NO CHANGE TO	
PNL-2	FILTER2 SOLAR		29-Apr-15	13-May-15	BETA						NO SAMPLE. SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP15-002. SAMPLER #24095 NOT RUNNING AND REPLACED 05/06/15 WITH #22494. SAMPLER #22494 UNABLE TO MAINTAIN 1.6 FLOW RATE AND REPLACED 05/13/15 WITH		
PNL-2	FILTER2 SOLAR	374163002	13-May-15	27-May-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	375033002	27-May-15	10-Jun-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-2	FILTER2 SOLAR	375726002	10-Jun-15	24-Jun-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	376918002	24-Jun-15	08-Jul-15	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03	O	DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA ALTHOUGH AIR FLOW CALIBRATOR READING HIGH AT 1.875; TRIPLE DIGIT TEMPERATURES AND SMOKE FROM SURROUNDING FIRES; FILTER PAPER WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-2	FILTER2 SOLAR	377977002	08-Jul-15	22-Jul-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	378915002	22-Jul-15	05-Aug-15	BETA	1.1E-02	pCi/m3	9.1E-04	9.2E-04	O			
PNL-2	FILTER2 SOLAR	379744002	05-Aug-15	19-Aug-15	BETA	1.2E-02	pCi/m3	9.7E-04	9.9E-04	O	DIRTY FILTER SMOKE IN AIR.		
PNL-2	FILTER2 SOLAR	380810002	19-Aug-15	02-Sep-15	BETA	1.4E-02	pCi/m3	1.1E-03	1.2E-03	O	VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-2	FILTER2 SOLAR	381461002	02-Sep-15	16-Sep-15	BETA	1.4E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-2	FILTER2 SOLAR	382239002	16-Sep-15	30-Sep-15	BETA	1.3E-02	pCi/m3	9.9E-04	1.0E-03	O			
PNL-2	FILTER2 SOLAR	389307002	30-Sep-15	14-Oct-15	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03	O		REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-2	FILTER2 SOLAR	384427002	14-Oct-15	28-Oct-15	BETA	2.2E-02	pCi/m3	1.3E-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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-2	FILTER2 SOLAR	385571002	28-Oct-15	11-Nov-15	BETA	1.2E-02	pCi/m3	9.8E-04	1.0E-03	O			
PNL-2	FILTER2 SOLAR	386473002	11-Nov-15	25-Nov-15	BETA	7.8E-03	pCi/m3	7.9E-04	8.2E-04	O			
PNL-2	FILTER2 SOLAR	387376002	25-Nov-15	09-Dec-15	BETA	3.4E-02	pCi/m3	1.6E-03	1.6E-03	O			
PNL-2	FILTER2 SOLAR	388137002	09-Dec-15	23-Dec-15	BETA	7.1E-03	pCi/m3	7.6E-04	7.7E-04	O			
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Be-7	4.0E-02	pCi/m3	1.1E-02	1.1E-02				Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Be-7	3.1E-02	pCi/m3	6.3E-03	6.8E-03				Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Co-60	-2.5E-04	pCi/m3	4.8E-04	4.9E-04	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Co-60	-2.1E-05	pCi/m3	2.9E-04	2.9E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Cs-134	7.9E-04	pCi/m3	8.0E-04	8.8E-04	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Cs-134	2.8E-04	pCi/m3	3.8E-04	4.0E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Cs-137	1.1E-04	pCi/m3	5.8E-04	5.8E-04	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Cs-137	-5.4E-05	pCi/m3	2.8E-04	2.8E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Eu-152	5.3E-05	pCi/m3	1.7E-03	1.7E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Eu-152	-2.1E-04	pCi/m3	8.8E-04	8.8E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Eu-154	6.3E-04	pCi/m3	1.9E-03	1.9E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Eu-154	-1.5E-04	pCi/m3	8.0E-04	8.1E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Eu-155	-1.8E-04	pCi/m3	1.4E-03	1.4E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Eu-155	3.8E-05	pCi/m3	8.4E-04	8.4E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	K-40	-2.2E-03	pCi/m3	9.5E-03	9.5E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	K-40	-2.9E-04	pCi/m3	4.1E-03	4.1E-03	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Ru-106	4.5E-03	pCi/m3	5.6E-03	6.0E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Ru-106	1.5E-03	pCi/m3	2.6E-03	2.7E-03	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Sb-125	3.1E-03	pCi/m3	3.2E-03	3.5E-03	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Sb-125	-4.2E-04	pCi/m3	9.3E-04	9.5E-04	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Am-241	-1.5E-06	pCi/m3	2.8E-06	2.8E-06	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Am-241	1.2E-06	pCi/m3	1.3E-06	1.3E-06	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Am-243	7.1E-06	pCi/m3	6.0E-06	6.1E-06	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Am-243	1.9E-06	pCi/m3	4.3E-06	4.4E-06	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Cm-243/244	0.0E+00	pCi/m3	2.0E-06	2.0E-06	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Cm-243/244	-6.1E-07	pCi/m3	1.5E-06	1.5E-06	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Pu-238	1.8E-07	pCi/m3	1.6E-06	1.6E-06	UO			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Pu-238	3.6E-06	pCi/m3	3.3E-06	3.3E-06	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	Pu-239/240	1.6E-06	pCi/m3	1.5E-06	1.5E-06	U			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	Pu-239/240	1.8E-06	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	U-233/234	5.2E-05	pCi/m3	9.6E-06	1.2E-05	O			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	U-233/234	6.0E-05	pCi/m3	9.4E-06	1.1E-05	O			Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	U-235	5.0E-06	pCi/m3	3.9E-06	4.0E-06	O			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	U-235	6.3E-06	pCi/m3	3.5E-06	3.6E-06				Y
PNL-2	FILTER2 SOLAR	375819002	07-Jan-15	24-Jun-15	U-238	5.1E-05	pCi/m3	9.7E-06	1.2E-05	O			Y
PNL-2	FILTER2 SOLAR	389547002	24-Jun-15	23-Dec-15	U-238	6.1E-05	pCi/m3	9.5E-06	1.1E-05	O			Y
PNL-3	FILTER2	365707003	07-Jan-15	21-Jan-15	ALPHA	1.4E-03	pCi/m3	4.3E-04	4.3E-04				
PNL-3	FILTER2	366636003	21-Jan-15	04-Feb-15	ALPHA	4.3E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-3	FILTER2	367485003	04-Feb-15	18-Feb-15	ALPHA	3.0E-04	pCi/m3	2.8E-04	2.8E-04	U			
PNL-3	FILTER2	368404003	18-Feb-15	04-Mar-15	ALPHA	6.6E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-3	FILTER2	369241003	04-Mar-15	18-Mar-15	ALPHA	8.5E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-3	FILTER2	370046003	18-Mar-15	01-Apr-15	ALPHA	3.6E-04	pCi/m3	2.6E-04	2.6E-04	U			
PNL-3	FILTER2	371432003	01-Apr-15	15-Apr-15	ALPHA	1.7E-04	pCi/m3	1.9E-04	1.9E-04	U			
PNL-3	FILTER2	372301003	15-Apr-15	29-Apr-15	ALPHA	6.8E-04	pCi/m3	4.0E-04	4.0E-04				
PNL-3	FILTER2	373176003	29-Apr-15	13-May-15	ALPHA	1.0E-03	pCi/m3	4.7E-04	4.8E-04				
PNL-3	FILTER2	374163003	13-May-15	27-May-15	ALPHA	3.6E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-3	FILTER2	375033003	27-May-15	10-Jun-15	ALPHA	1.6E-04	pCi/m3	2.6E-04	2.6E-04	U			
PNL-3	FILTER2	375726003	10-Jun-15	24-Jun-15	ALPHA	8.8E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-3	FILTER2	376918003	24-Jun-15	08-Jul-15	ALPHA	1.1E-03	pCi/m3	3.7E-04	3.8E-04				
PNL-3	FILTER2	377977003	08-Jul-15	22-Jul-15	ALPHA	4.6E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-3	FILTER2	378915003	22-Jul-15	05-Aug-15	ALPHA	8.4E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-3	FILTER2	379744003	05-Aug-15	19-Aug-15	ALPHA	2.9E-04	pCi/m3	3.5E-04	3.5E-04	U	DIRTY FILTER SMOKE IN AIR.		
PNL-3	FILTER2	380810003	19-Aug-15	02-Sep-15	ALPHA	1.4E-03	pCi/m3	4.5E-04	4.5E-04		VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-3	FILTER2	381461003	02-Sep-15	16-Sep-15	ALPHA	7.1E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-3	FILTER2	382239003	16-Sep-15	30-Sep-15	ALPHA	3.1E-04	pCi/m3	3.3E-04	3.3E-04	U			
PNL-3	FILTER2	389307003	30-Sep-15	14-Oct-15	ALPHA	3.9E-03	pCi/m3	7.1E-04	7.2E-04			REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED	
PNL-3	FILTER2	384427003	14-Oct-15	28-Oct-15	ALPHA	7.4E-04	pCi/m3	4.6E-04	4.6E-04				
PNL-3	FILTER2	385571003	28-Oct-15	11-Nov-15	ALPHA	3.7E-04	pCi/m3	3.0E-04	3.0E-04	U			
PNL-3	FILTER2	386473003	11-Nov-15	25-Nov-15	ALPHA	7.6E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-3	FILTER2	387376003	25-Nov-15	09-Dec-15	ALPHA	9.3E-04	pCi/m3	3.7E-04	3.8E-04				
PNL-3	FILTER2	388137003	09-Dec-15	23-Dec-15	ALPHA	2.9E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-3	FILTER2	365707003	07-Jan-15	21-Jan-15	BETA	3.5E-02	pCi/m3	1.6E-03	1.7E-03				
PNL-3	FILTER2	366636003	21-Jan-15	04-Feb-15	BETA	2.0E-02	pCi/m3	1.2E-03	1.3E-03				
PNL-3	FILTER2	367485003	04-Feb-15	18-Feb-15	BETA	1.8E-02	pCi/m3	1.1E-03	1.2E-03				

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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-3	FILTER2	368404003	18-Feb-15	04-Mar-15	BETA	2.1E-02	pCi/m3	1.2E-03	1.6E-03	O			
PNL-3	FILTER2	369241003	04-Mar-15	18-Mar-15	BETA	2.4E-02	pCi/m3	1.3E-03	1.4E-03	O			
PNL-3	FILTER2	370046003	18-Mar-15	01-Apr-15	BETA	1.1E-02	pCi/m3	9.5E-04	9.8E-04	O			
PNL-3	FILTER2	371432003	01-Apr-15	15-Apr-15	BETA	1.0E-02	pCi/m3	8.7E-04	8.8E-04	O			
PNL-3	FILTER2	372301003	15-Apr-15	29-Apr-15	BETA	1.1E-02	pCi/m3	9.1E-04	9.7E-04	O			
PNL-3	FILTER2	373176003	29-Apr-15	13-May-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-3	FILTER2	374163003	13-May-15	27-May-15	BETA	1.2E-02	pCi/m3	9.2E-04	9.3E-04	O			
PNL-3	FILTER2	375033003	27-May-15	10-Jun-15	BETA	1.4E-02	pCi/m3	9.7E-04	9.8E-04	O			
PNL-3	FILTER2	375726003	10-Jun-15	24-Jun-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-3	FILTER2	376918003	24-Jun-15	08-Jul-15	BETA	1.8E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-3	FILTER2	377977003	08-Jul-15	22-Jul-15	BETA	1.3E-02	pCi/m3	1.0E-03	1.0E-03	O			
PNL-3	FILTER2	378915003	22-Jul-15	05-Aug-15	BETA	1.2E-02	pCi/m3	9.4E-04	9.6E-04	O			
PNL-3	FILTER2	379744003	05-Aug-15	19-Aug-15	BETA	1.4E-02	pCi/m3	9.7E-04	9.9E-04	O	DIRTY FILTER SMOKE IN AIR.		
PNL-3	FILTER2	380810003	19-Aug-15	02-Sep-15	BETA	1.5E-02	pCi/m3	1.1E-03	1.3E-03	O	VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-3	FILTER2	381461003	02-Sep-15	16-Sep-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-3	FILTER2	382239003	16-Sep-15	30-Sep-15	BETA	1.4E-02	pCi/m3	9.9E-04	1.0E-03	O			
PNL-3	FILTER2	389307003	30-Sep-15	14-Oct-15	BETA	2.7E-02	pCi/m3	1.4E-03	1.9E-03	O		REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-3	FILTER2	384427003	14-Oct-15	28-Oct-15	BETA	2.3E-02	pCi/m3	1.3E-03	1.5E-03	O			
PNL-3	FILTER2	385571003	28-Oct-15	11-Nov-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.2E-03	O			
PNL-3	FILTER2	386473003	11-Nov-15	25-Nov-15	BETA	1.6E-02	pCi/m3	1.1E-03	1.1E-03	O			
PNL-3	FILTER2	387376003	25-Nov-15	09-Dec-15	BETA	3.8E-02	pCi/m3	1.7E-03	2.2E-03	O			
PNL-3	FILTER2	388137003	09-Dec-15	23-Dec-15	BETA	8.3E-03	pCi/m3	8.0E-04	8.1E-04	O			
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Be-7	5.4E-02	pCi/m3	1.4E-02	1.5E-02				Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Be-7	2.7E-02	pCi/m3	6.7E-03	7.0E-03				Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Co-60	-6.4E-04	pCi/m3	8.7E-04	9.1E-04	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Co-60	7.2E-05	pCi/m3	3.1E-04	3.1E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Cs-134	-3.4E-04	pCi/m3	9.3E-04	9.4E-04	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Cs-134	2.4E-04	pCi/m3	3.0E-04	3.2E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Cs-137	-5.1E-04	pCi/m3	8.2E-04	8.6E-04	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Cs-137	-1.7E-05	pCi/m3	2.9E-04	2.9E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Eu-152	-2.5E-03	pCi/m3	2.3E-03	2.6E-03	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Eu-152	2.0E-04	pCi/m3	8.3E-04	8.3E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Eu-154	6.9E-04	pCi/m3	2.5E-03	2.5E-03	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Eu-154	-3.9E-04	pCi/m3	7.6E-04	7.8E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Eu-155	4.3E-04	pCi/m3	1.6E-03	1.6E-03	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Eu-155	-3.1E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	K-40	9.3E-03	pCi/m3	9.9E-03	1.1E-02	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	K-40	3.6E-03	pCi/m3	4.6E-03	4.6E-03	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Ru-106	1.7E-03	pCi/m3	7.1E-03	7.2E-03	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Ru-106	-7.6E-04	pCi/m3	2.7E-03	2.7E-03	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Sb-125	-1.8E-03	pCi/m3	2.1E-03	2.2E-03	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Sb-125	-4.4E-04	pCi/m3	7.6E-04	7.8E-04	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Am-241	0.0E+00	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Am-241	1.6E-06	pCi/m3	3.1E-06	3.1E-06	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Am-243	-4.4E-06	pCi/m3	6.2E-06	6.2E-06	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Am-243	1.3E-06	pCi/m3	2.5E-06	2.5E-06	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Cm-243/244	0.0E+00	pCi/m3	2.8E-06	2.8E-06	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Cm-243/244	1.8E-06	pCi/m3	2.7E-06	2.7E-06	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Pu-238	2.2E-06	pCi/m3	2.6E-06	2.6E-06	UO			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Pu-238	5.3E-07	pCi/m3	2.5E-06	2.5E-06	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	Pu-239/240	-4.4E-07	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	Pu-239/240	3.1E-06	pCi/m3	2.8E-06	2.8E-06	U			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	U-233/234	4.5E-05	pCi/m3	8.2E-06	1.0E-05	O			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	U-233/234	6.3E-05	pCi/m3	8.4E-06	1.0E-05	O			Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	U-235	3.3E-06	pCi/m3	3.1E-06	3.1E-06	UO			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	U-235	6.9E-06	pCi/m3	3.3E-06	3.4E-06				Y
PNL-3	FILTER2	375819003	07-Jan-15	24-Jun-15	U-238	4.1E-05	pCi/m3	8.0E-06	9.5E-06	O			Y
PNL-3	FILTER2	389547003	24-Jun-15	23-Dec-15	U-238	6.2E-05	pCi/m3	8.2E-06	1.0E-05	O			Y
PNL-4	FILTER2	365707004	07-Jan-15	21-Jan-15	ALPHA	1.3E-03	pCi/m3	4.1E-04	4.1E-04				
PNL-4	FILTER2	366636004	21-Jan-15	04-Feb-15	ALPHA	3.7E-04	pCi/m3	2.8E-04	2.8E-04	U			
PNL-4	FILTER2	367485004	04-Feb-15	18-Feb-15	ALPHA	1.5E-04	pCi/m3	2.2E-04	2.2E-04	U			
PNL-4	FILTER2	368404004	18-Feb-15	04-Mar-15	ALPHA	9.3E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-4	FILTER2	369241004	04-Mar-15	18-Mar-15	ALPHA	1.8E-03	pCi/m3	4.7E-04	4.8E-04			REFER TO FOLLOW-UP ANALYSIS #A15-001 AND DISCREPANCY REPORT EMP15-001, ORIGINAL VALUE REPLACED BY RECOUNT VALUE.	
PNL-4	FILTER2	370046004	18-Mar-15	01-Apr-15	ALPHA	3.4E-04	pCi/m3	2.4E-04	2.4E-04				
PNL-4	FILTER2	371432004	01-Apr-15	15-Apr-15	ALPHA	2.9E-04	pCi/m3	2.6E-04	2.6E-04	U			
PNL-4	FILTER2	372301004	15-Apr-15	29-Apr-15	ALPHA	5.0E-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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-4	FILTER2	373176004	29-Apr-15	13-May-15	ALPHA	7.0E-04	pCi/m3	3.6E-04	3.7E-04				
PNL-4	FILTER2	374163004	13-May-15	27-May-15	ALPHA	4.4E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-4	FILTER2	375033004	27-May-15	10-Jun-15	ALPHA	9.9E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-4	FILTER2	375726004	10-Jun-15	24-Jun-15	ALPHA	4.1E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-4	FILTER2	376918004	24-Jun-15	08-Jul-15	ALPHA	4.8E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-4	FILTER2	377977004	08-Jul-15	22-Jul-15	ALPHA	3.1E-04	pCi/m3	2.4E-04	2.4E-04				
PNL-4	FILTER2	378915004	22-Jul-15	05-Aug-15	ALPHA	5.2E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-4	FILTER2	379744004	05-Aug-15	19-Aug-15	ALPHA	8.3E-04	pCi/m3	4.1E-04	4.1E-04		DIRTY FILTER SMOKE IN AIR.		
PNL-4	FILTER2	380810004	19-Aug-15	02-Sep-15	ALPHA	9.4E-04	pCi/m3	3.8E-04	3.9E-04		VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-4	FILTER2	381461004	02-Sep-15	16-Sep-15	ALPHA	4.1E-04	pCi/m3	2.6E-04	2.6E-04				
PNL-4	FILTER2	382239004	16-Sep-15	30-Sep-15	ALPHA	6.9E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-4	FILTER2	389307004	30-Sep-15	14-Oct-15	ALPHA	2.3E-03	pCi/m3	5.5E-04	5.6E-04			REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-4	FILTER2	384427004	14-Oct-15	28-Oct-15	ALPHA	1.3E-03	pCi/m3	4.7E-04	4.7E-04				
PNL-4	FILTER2	385571004	28-Oct-15	11-Nov-15	ALPHA	8.9E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-4	FILTER2	386473004	11-Nov-15	25-Nov-15	ALPHA	1.5E-03	pCi/m3	4.6E-04	4.6E-04				
PNL-4	FILTER2	387376004	25-Nov-15	09-Dec-15	ALPHA	5.7E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-4	FILTER2	388137004	09-Dec-15	23-Dec-15	ALPHA	6.8E-05	pCi/m3	2.2E-04	2.2E-04	U			
PNL-4	FILTER2	365707004	07-Jan-15	21-Jan-15	BETA	3.5E-02	pCi/m3	1.6E-03	1.8E-03				
PNL-4	FILTER2	366636004	21-Jan-15	04-Feb-15	BETA	2.0E-02	pCi/m3	1.2E-03	1.2E-03				
PNL-4	FILTER2	367485004	04-Feb-15	18-Feb-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.1E-03				
PNL-4	FILTER2	368404004	18-Feb-15	04-Mar-15	BETA	2.1E-02	pCi/m3	1.2E-03	1.5E-03	O			
PNL-4	FILTER2	369241004	04-Mar-15	18-Mar-15	BETA	2.2E-02	pCi/m3	1.2E-03	1.5E-03	O		REFER TO FOLLOW-UP ANALYSIS #A15-001 AND DISCREPANCY REPORT EMP15-001, ORIGINAL VALUE REPLACED BY RECOUNT VALUE.	
PNL-4	FILTER2	370046004	18-Mar-15	01-Apr-15	BETA	1.2E-02	pCi/m3	9.3E-04	9.4E-04	O			
PNL-4	FILTER2	371432004	01-Apr-15	15-Apr-15	BETA	9.5E-03	pCi/m3	8.3E-04	8.4E-04	O			
PNL-4	FILTER2	372301004	15-Apr-15	29-Apr-15	BETA	1.3E-02	pCi/m3	9.5E-04	1.0E-03	O			
PNL-4	FILTER2	373176004	29-Apr-15	13-May-15	BETA	1.5E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-4	FILTER2	374163004	13-May-15	27-May-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.2E-03	O			
PNL-4	FILTER2	375033004	27-May-15	10-Jun-15	BETA	1.5E-02	pCi/m3	1.0E-03	1.3E-03	O			
PNL-4	FILTER2	375726004	10-Jun-15	24-Jun-15	BETA	1.2E-02	pCi/m3	9.8E-04	1.1E-03	O			
PNL-4	FILTER2	376918004	24-Jun-15	08-Jul-15	BETA	2.0E-02	pCi/m3	1.2E-03	1.5E-03	O			
PNL-4	FILTER2	377977004	08-Jul-15	22-Jul-15	BETA	1.3E-02	pCi/m3	9.6E-04	9.7E-04	O			
PNL-4	FILTER2	378915004	22-Jul-15	05-Aug-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.2E-03	O			
PNL-4	FILTER2	379744004	05-Aug-15	19-Aug-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.0E-03	O	DIRTY FILTER SMOKE IN AIR.		
PNL-4	FILTER2	380810004	19-Aug-15	02-Sep-15	BETA	1.4E-02	pCi/m3	1.1E-03	1.2E-03	O	VERY DIRTY FILTER, SMOKE IN AIR BUT IS CLEARING.		
PNL-4	FILTER2	381461004	02-Sep-15	16-Sep-15	BETA	1.8E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-4	FILTER2	382239004	16-Sep-15	30-Sep-15	BETA	1.7E-02	pCi/m3	1.1E-03	1.3E-03	O			
PNL-4	FILTER2	389307004	30-Sep-15	14-Oct-15	BETA	2.5E-02	pCi/m3	1.3E-03	1.4E-03	O		REFER TO FOLLOW-UP ANALYSIS REQUEST #A15-003; ORIGINAL DATA SET NOT LOADED, DATA REREPORTED 01/15/2016.	
PNL-4	FILTER2	384427004	14-Oct-15	28-Oct-15	BETA	2.7E-02	pCi/m3	1.4E-03	1.5E-03	O			
PNL-4	FILTER2	385571004	28-Oct-15	11-Nov-15	BETA	1.4E-02	pCi/m3	1.0E-03	1.0E-03	O			
PNL-4	FILTER2	386473004	11-Nov-15	25-Nov-15	BETA	1.5E-02	pCi/m3	1.1E-03	1.2E-03	O			
PNL-4	FILTER2	387376004	25-Nov-15	09-Dec-15	BETA	3.9E-02	pCi/m3	1.8E-03	2.5E-03	O			
PNL-4	FILTER2	388137004	09-Dec-15	23-Dec-15	BETA	7.9E-03	pCi/m3	7.6E-04	7.7E-04	O			
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Be-7	4.3E-02	pCi/m3	1.4E-02	1.5E-02				Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Be-7	2.5E-02	pCi/m3	6.9E-03	7.2E-03				Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Co-60	-7.1E-06	pCi/m3	5.7E-04	5.7E-04	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Co-60	-2.3E-04	pCi/m3	2.5E-04	2.7E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Cs-134	4.9E-04	pCi/m3	4.1E-04	4.7E-04	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Cs-134	1.3E-04	pCi/m3	2.6E-04	2.7E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Cs-137	6.8E-06	pCi/m3	4.7E-04	4.7E-04	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Cs-137	1.3E-04	pCi/m3	3.9E-04	3.9E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Eu-152	-8.4E-04	pCi/m3	1.5E-03	1.5E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Eu-152	-2.0E-05	pCi/m3	7.3E-04	7.3E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Eu-154	-1.4E-03	pCi/m3	1.5E-03	1.6E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Eu-154	2.0E-04	pCi/m3	6.9E-04	6.9E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Eu-155	-8.5E-05	pCi/m3	1.4E-03	1.4E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Eu-155	-4.9E-04	pCi/m3	7.3E-04	7.6E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	K-40	-4.6E-04	pCi/m3	3.9E-03	3.9E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	K-40	3.6E-03	pCi/m3	5.0E-03	5.0E-03	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Ru-106	1.6E-03	pCi/m3	3.5E-03	3.5E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Ru-106	3.2E-03	pCi/m3	2.1E-03	2.1E-03	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Sb-125	-1.6E-04	pCi/m3	1.4E-03	1.4E-03	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Sb-125	-1.6E-04	pCi/m3	7.0E-04	7.1E-04	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Am-241	5.4E-06	pCi/m3	5.6E-06	5.7E-06	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Am-241	2.4E-06	pCi/m3	1.5E-06	1.5E-06				Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Am-243	7.3E-06	pCi/m3	9.4E-06	9.5E-06	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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Am-243	2.2E-06	pCi/m3	3.4E-06	3.4E-06	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Cm-243/244	2.7E-06	pCi/m3	4.7E-06	4.7E-06	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Cm-243/244	2.6E-07	pCi/m3	1.1E-06	1.1E-06	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Pu-238	-7.0E-07	pCi/m3	1.7E-06	1.7E-06	UO			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Pu-238	7.0E-07	pCi/m3	2.2E-06	2.2E-06	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	Pu-239/240	2.0E-06	pCi/m3	2.0E-06	2.0E-06	U			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	Pu-239/240	2.5E-06	pCi/m3	2.7E-06	2.7E-06	U			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	U-233/234	5.7E-05	pCi/m3	9.4E-06	1.2E-05	O			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	U-233/234	5.9E-05	pCi/m3	9.3E-06	1.1E-05	O			Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	U-235	6.3E-06	pCi/m3	3.9E-06	4.0E-06	O			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	U-235	3.5E-06	pCi/m3	3.0E-06	3.0E-06				Y
PNL-4	FILTER2	375819004	07-Jan-15	24-Jun-15	U-238	4.6E-05	pCi/m3	8.5E-06	1.0E-05	O			Y
PNL-4	FILTER2	389547004	24-Jun-15	23-Dec-15	U-238	6.3E-05	pCi/m3	9.3E-06	1.1E-05	O			Y
YAKIMA	FILTER1	S952952	22-Dec-14	7-Jan-15	ALPHA	2.3E-03	pCi/m3		6.2E-04				
YAKIMA	FILTER1	S953272	7-Jan-15	21-Jan-15	ALPHA	3.1E-03	pCi/m3		6.4E-04				
YAKIMA	FILTER1	S953803	21-Jan-15	3-Feb-15	ALPHA	1.0E-03	pCi/m3		3.9E-04				
YAKIMA	FILTER1	S954463	3-Feb-15	18-Feb-15	ALPHA	4.5E-04	pCi/m3		2.4E-04				
YAKIMA	FILTER1	S954985	18-Feb-15	4-Mar-15	ALPHA	1.4E-03	pCi/m3		4.8E-04				
YAKIMA	FILTER1	S955455	4-Mar-15	18-Mar-15	ALPHA	5.7E-04	pCi/m3		3.2E-04				
YAKIMA	FILTER1	S955964	18-Mar-15	31-Mar-15	ALPHA	2.9E-04	pCi/m3		2.6E-04	U			
YAKIMA	FILTER1	S957302	31-Mar-15	15-Apr-15	ALPHA	4.4E-04	pCi/m3		2.7E-04				
YAKIMA	FILTER1	S958173	15-Apr-15	29-Apr-15	ALPHA	6.2E-04	pCi/m3		2.9E-04				
YAKIMA	FILTER1	S958645	29-Apr-15	13-May-15	ALPHA	5.9E-04	pCi/m3		2.9E-04				
YAKIMA	FILTER1	S959661	13-May-15	27-May-15	ALPHA	6.2E-04	pCi/m3		2.9E-04				
YAKIMA	FILTER1	S960082	27-May-15	10-Jun-15	ALPHA	7.6E-04	pCi/m3		3.0E-04				
YAKIMA	FILTER1	S962237	10-Jun-15	24-Jun-15	ALPHA	4.8E-04	pCi/m3		2.7E-04				
YAKIMA	FILTER1	S963037	24-Jun-15	8-Jul-15	ALPHA	1.4E-03	pCi/m3		4.4E-04				
YAKIMA	FILTER1	S963711	8-Jul-15	22-Jul-15	ALPHA	-1.2E-04	pCi/m3		2.5E-04	U			
YAKIMA	FILTER1	S964448	22-Jul-15	5-Aug-15	ALPHA	7.0E-04	pCi/m3		3.4E-04				
YAKIMA	FILTER1	S965201	5-Aug-15	19-Aug-15	ALPHA	6.6E-04	pCi/m3		3.4E-04				
YAKIMA	FILTER1	S966346	19-Aug-15	2-Sep-15	ALPHA	4.5E-04	pCi/m3		3.5E-04	U			
YAKIMA	FILTER1	S966973	2-Sep-15	16-Sep-15	ALPHA	8.0E-04	pCi/m3		3.1E-04				
YAKIMA	FILTER1	S967567	16-Sep-15	30-Sep-15	ALPHA	7.4E-04	pCi/m3		3.5E-04				
YAKIMA	FILTER1	S967888	30-Sep-15	14-Oct-15	ALPHA	6.7E-04	pCi/m3		4.2E-04				
YAKIMA	FILTER1	S968494	14-Oct-15	28-Oct-15	ALPHA	1.0E-03	pCi/m3		4.5E-04				
YAKIMA	FILTER1	S969135	28-Oct-15	11-Nov-15	ALPHA	4.9E-04	pCi/m3		2.8E-04				
YAKIMA	FILTER1	S969473	11-Nov-15	23-Nov-15	ALPHA	7.4E-04	pCi/m3		3.4E-04				
YAKIMA	FILTER1	S969868	23-Nov-15	9-Dec-15	ALPHA	3.0E-03	pCi/m3		6.5E-04				
YAKIMA	FILTER1	S970676	9-Dec-15	21-Dec-15	ALPHA	3.6E-04	pCi/m3		3.1E-04	U			
YAKIMA	FILTER1	S952952	22-Dec-14	7-Jan-15	BETA	3.0E-02	pCi/m3		2.6E-03				
YAKIMA	FILTER1	S953272	7-Jan-15	21-Jan-15	BETA	3.7E-02	pCi/m3		3.2E-03				
YAKIMA	FILTER1	S953803	21-Jan-15	3-Feb-15	BETA	1.9E-02	pCi/m3		2.0E-03				
YAKIMA	FILTER1	S954463	3-Feb-15	18-Feb-15	BETA	1.3E-02	pCi/m3		1.4E-03				
YAKIMA	FILTER1	S954985	18-Feb-15	4-Mar-15	BETA	2.3E-02	pCi/m3		2.1E-03				
YAKIMA	FILTER1	S955455	4-Mar-15	18-Mar-15	BETA	1.8E-02	pCi/m3		1.6E-03				
YAKIMA	FILTER1	S955964	18-Mar-15	31-Mar-15	BETA	9.4E-03	pCi/m3		1.1E-03				
YAKIMA	FILTER1	S957302	31-Mar-15	15-Apr-15	BETA	9.2E-03	pCi/m3		1.0E-03				
YAKIMA	FILTER1	S958173	15-Apr-15	29-Apr-15	BETA	1.1E-02	pCi/m3		1.2E-03				
YAKIMA	FILTER1	S958645	29-Apr-15	13-May-15	BETA	1.4E-02	pCi/m3		1.4E-03				
YAKIMA	FILTER1	S959661	13-May-15	27-May-15	BETA	1.7E-02	pCi/m3		1.7E-03				
YAKIMA	FILTER1	S960082	27-May-15	10-Jun-15	BETA	1.3E-02	pCi/m3		1.3E-03				
YAKIMA	FILTER1	S962237	10-Jun-15	24-Jun-15	BETA	1.0E-02	pCi/m3		1.1E-03				
YAKIMA	FILTER1	S963037	24-Jun-15	8-Jul-15	BETA	1.9E-02	pCi/m3		2.0E-03				
YAKIMA	FILTER1	S963711	8-Jul-15	22-Jul-15	BETA	1.2E-02	pCi/m3		1.3E-03				
YAKIMA	FILTER1	S964448	22-Jul-15	5-Aug-15	BETA	1.3E-02	pCi/m3		1.3E-03				
YAKIMA	FILTER1	S965201	5-Aug-15	19-Aug-15	BETA	1.6E-02	pCi/m3		1.8E-03				
YAKIMA	FILTER1	S966346	19-Aug-15	2-Sep-15	BETA	1.0E-02	pCi/m3		1.2E-03				
YAKIMA	FILTER1	S966973	2-Sep-15	16-Sep-15	BETA	1.4E-02	pCi/m3		1.3E-03				
YAKIMA	FILTER1	S967567	16-Sep-15	30-Sep-15	BETA	1.7E-02	pCi/m3		1.6E-03				
YAKIMA	FILTER1	S967888	30-Sep-15	14-Oct-15	BETA	2.3E-02	pCi/m3		2.1E-03				
YAKIMA	FILTER1	S968494	14-Oct-15	28-Oct-15	BETA	2.2E-02	pCi/m3		2.1E-03				
YAKIMA	FILTER1	S969135	28-Oct-15	11-Nov-15	BETA	1.0E-02	pCi/m3		1.1E-03				
YAKIMA	FILTER1	S969473	11-Nov-15	23-Nov-15	BETA	1.1E-02	pCi/m3		1.2E-03				
YAKIMA	FILTER1	S969868	23-Nov-15	9-Dec-15	BETA	4.5E-02	pCi/m3		4.1E-03				
YAKIMA	FILTER1	S970676	9-Dec-15	21-Dec-15	BETA	1.1E-02	pCi/m3		1.3E-03				
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Am-241(Gamma)	-1.0E-04	pCi/m3		1.0E-03	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Am-241 (Gamma)	-3.5E-05	pCi/m3		3.5E-04	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Co-60	-3.9E-05	pCi/m3		3.2E-04	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Co-60	2.8E-04	pCi/m3		5.1E-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	COUNTING ERROR	TOTAL ANAL ERROR 2-SIGMA	LAB QUALI-FIER	SAMP COMMENT	RESULT COMMENT	COM-POSITE FLAG
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Cs-134	1.2E-06	pCi/m3		1.2E-05	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Cs-134	-8.1E-05	pCi/m3		4.6E-04	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Cs-137	-3.3E-07	pCi/m3		3.3E-06	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Cs-137	-5.2E-05	pCi/m3		4.1E-04	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Eu-152	-2.5E-04	pCi/m3		6.2E-04	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Eu-152	-3.9E-04	pCi/m3		1.1E-03	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Eu-154	5.7E-04	pCi/m3		6.7E-04	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Eu-154	6.5E-04	pCi/m3		1.3E-03	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Eu-155	2.5E-05	pCi/m3		2.5E-04	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Eu-155	3.5E-04	pCi/m3		1.0E-03	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	K-40	4.4E-03	pCi/m3		4.7E-03	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	K-40	4.2E-03	pCi/m3		4.9E-03	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	U-234	4.6E-05	pCi/m3		2.2E-05				
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	U-234	3.5E-05	pCi/m3		3.5E-05	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	U-235	9.3E-06	pCi/m3		9.4E-06				
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	U-235	-1.9E-06	pCi/m3		1.6E-05	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	U-238	5.6E-05	pCi/m3		2.5E-05				
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	U-238	1.3E-05	pCi/m3		2.2E-05	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Pu-238	-2.1E-13	pCi/m3		2.1E-12	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Pu-238	-4.1E-06	pCi/m3		1.8E-05	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Pu-239/240	2.2E-06	pCi/m3		2.6E-06	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Pu-239/240	-1.7E-06	pCi/m3		1.7E-05	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Ru-106	-9.4E-04	pCi/m3		2.2E-03	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Ru-106	2.2E-03	pCi/m3		4.3E-03	U			
YAKIMA	FILTER1	S963851	22-Dec-14	24-Jun-15	Sb-125	2.7E-04	pCi/m3		5.8E-04	U			
YAKIMA	FILTER1	S971651	24-Jun-15	21-Dec-15	Sb-125	1.6E-03	pCi/m3		1.4E-03	U			

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