PNNL-20436-5

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Department of Energy – Office of Science

Pacific Northwest National Laboratory Campus Radionuclide Air Emissions Report for Calendar Year 2014

June 2015

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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operated by
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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

The U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory (PNNL) 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 (LSLII), and Research Technology Laboratory (RTL). Operations conform to the Washington Department of Health issued Radioactive Air Emissions License-005.

This report documents radionuclide air emissions that result in the 2014 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. Those regulations impose a standard of 10 millirem (mrem)/year (yr) EDE, which is not to be exceeded. Washington State adopted the 40 CFR 61 standard of 10 mrem/yr EDE into its regulations that require the calculation 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 Clean Air Act Amendments of 1989 revised the NESHAP regulations (i.e., 40 CFR 61, Subpart H) to govern emissions of radionuclides from DOE facilities. Those regulations are intended for the measurement of point source emissions but are inclusive of fugitive emissions with regard to complying with the dose standard.

The dose to the PNNL Campus MEI due to routine major and minor point source emissions in 2014 from PNNL Campus sources is 2E-05 mrem (2E-07 mSv) EDE. The dose from all fugitive sources is 3E-6 mrem (3E-8 mSv) EDE. The dose from radon emissions is 1E-6 mrem (1E-8 mSv) EDE. No nonroutine emissions occurred in 2014. The total radiological dose for 2014 to the MEI from all PNNL Campus radionuclide emissions, including fugitive emissions and radon, is 3E-5 mrem (3E-7 mSv) EDE, or more than 100,000 times smaller than the federal and state standard of 10 mrem/yr, to which the PNNL Campus is in compliance.

For further information concerning this report, you may contact Thomas M. McDermott, U.S. Department of Energy, Pacific Northwest Site Office, by telephone at (509) 372-4675 or by e-mail at tom.mcdermott@pnso.science.doe.gov.

CERTIFICATION of PNNL-20436-5

DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2014

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

6/2/15
Date

Acronyms and Abbreviations

AREVA	AREVA Federal Services, LLC
ASME	American Society of Mechanical Engineers
CAP88-PC	Clean Air Act Assessment Package 1988-Personal Computer
CFR	Code of Federal Regulations
Ci	curie(s)
CY	calendar year (when paired with a specific year)
DOE	U.S. Department of Energy
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOE-SC	U.S. Department of Energy, Office of Science
EDE	effective dose equivalent
EMSL	Environmental Molecular Sciences Laboratory
EPA	U.S. Environmental Protection Agency
ft	feet
HEPA	high-efficiency particulate air (filter)
km	kilometer(s)
LSLII	Life Sciences Laboratory-II
m	meter(s)
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
mi	mile(s)
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., 1×10^{-3} rem]
NA	not applicable
ND	not detected
NDRM	non-dispersible radioactive material
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
PIC-5	Potential Impact Category-5
PCM	periodic confirmatory measurement
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
RTL	Research Technology Laboratory

rem	roentgen equivalent man
SC	DOE Office of Science
SD	standard deviation
VRRM	Volumetrically released radioactive material
WAC	Washington Administrative Code
WDOH	Washington State Department of Health
yr	year

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Tables

1.0 Introduction

This report documents calendar year (CY) 2014 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. The report complies with reporting requirements in the Code of Federal Regulations (CFR), Title 40, Protection of the Environment, Part 61, *National Emission Standards for Hazardous Air Pollutants*, Subpart H (2002), "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" and in the Washington Administrative Code (WAC) Chapter 246-247 (2014), "Radiation Protection—Air Emissions." This report satisfies the annual reporting requirements under the DOE PNNL Campus license, Radioactive Air Emissions License (RAEL)-005, for CY2014 operations.

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 586 mi^2 (1,518 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, 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 (NEPA) Characterization* (Duncan et al. 2007).

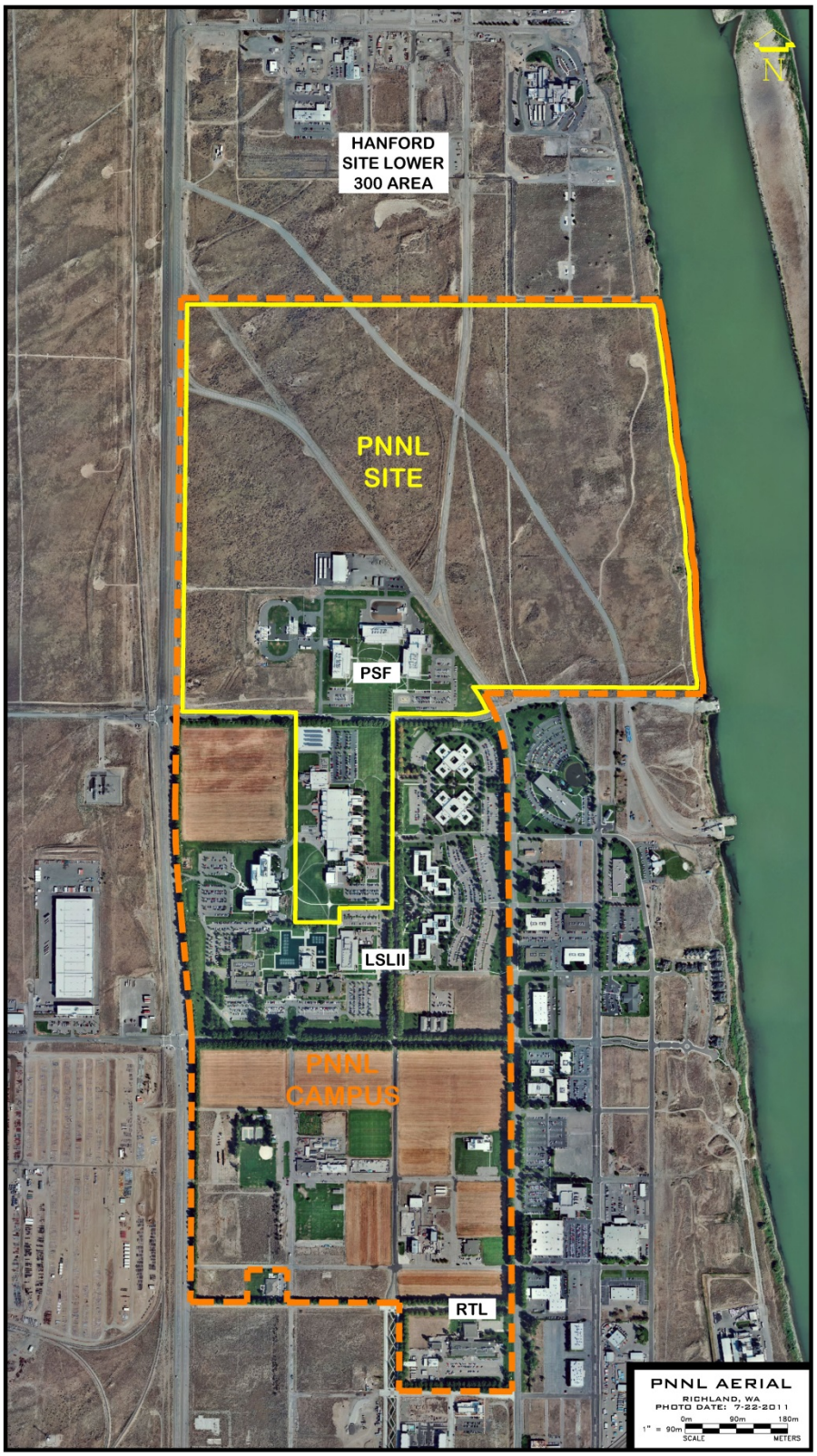

Figure 1.1. DOE-SC PNNL Campus Emissions Units Locations

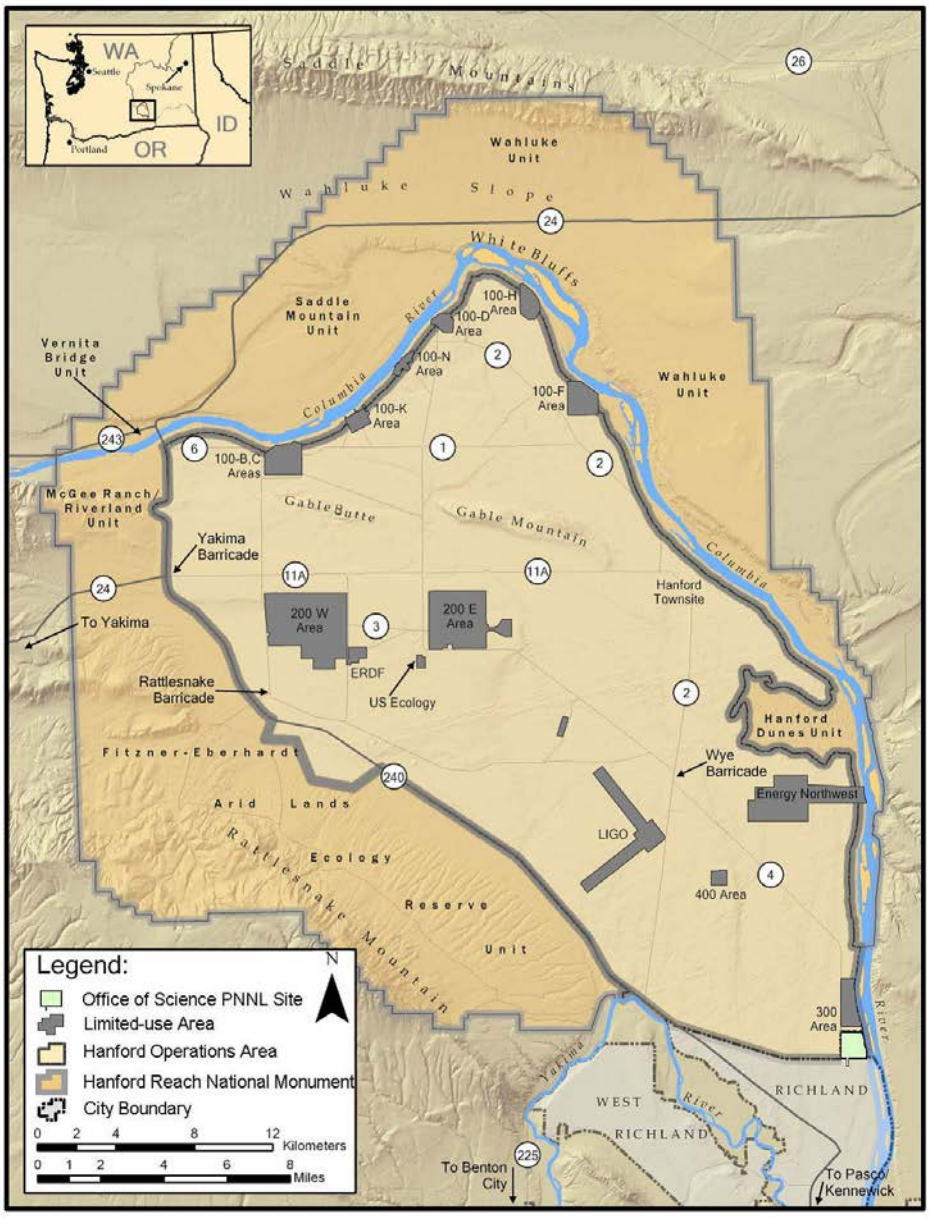

Figure 1.2. Location of the Hanford Site in Relation to the PNNL Campus

1.1.1 Historical Background

DOE chartered the Pacific Northwest Site Office (PNSO) December 2003 within the 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 includes the Environmental Molecular Sciences Laboratory (EMSL), Physical Sciences Facility (PSF), Research Technology Laboratory (RTL), and Life Sciences Laboratory-II (LSLII) facilities. The locations of PSF, EMSL, RTL, and LSLII facilities are identified in Figure 1.1. Other facilities in the PNNL Campus have been owned or leased by Battelle since the mid-1960s.

EMSL is a single 224,000 gross square feet (ft^2) building that was constructed in 1997 and is designated as a national scientific user facility. The EMSL facility was exempted from the air permitting process in 2004 and is now authorized to conduct work with volumetrically released materials and limited non-dispersible materials released from radiological controls under the PNNL Campus Potential Impact Category-5 (PIC-5) permits.

The seven buildings subject to 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. No change in radiological operations at these facilities occurred during the year.

Table 1.1. PNNL Campus Licensed Buildings – 2014

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 contamination in ducts only, no active radiological operations.
(b) Date of contractual transfer from Battelle private operations to DOE-SC with no change in operations from earlier in the calendar year.

As research buildings, the PSF and RTL facilities are expected 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. Ductwork contamination levels are low and continue to be monitored. More detailed descriptions of buildings subject to 40 CFR 61, Subpart H (2002) reporting are provided in Section 1.2.2.

The Hanford Site history is briefly described here because of its proximity adjacent to the PNNL Campus and because it is a source of radiological airborne emissions that could impact the PNNL Campus. From the mid 1940s, facilities at the Hanford Site were dedicated to operations that produced 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 (DOE-RL) and the Office of River Protection (DOE-ORP).

1.1.2 PNNL Campus Facilities and 2014 Activities

Point source emission units are characterized as major or minor. The label for the emission unit considers whether radiological emissions are expected to result in a member of the public potential dose

greater or less than 0.1 millirem (mrem)/year (yr). In addition, a source could be characterized as a fugitive emission if a potential source of radioactive material is not actively monitored or ventilated at the point of release.[1] Types of emission units under the license include both major and minor emission units as well as fugitive emissions, including 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).

Table 1.2. Types of Emission Units Under the DOE PNNL Campus License – 2014

Facility/Building ID	Building 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

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

[1] A more detailed discussion of fugitive emissions is provided in Section 4.0.

Notable events in CY2014 relevant to radioactive airborne emissions monitoring and reporting include the Washington State Department of Health (WDOH) approval of two additional PNNL PIC-5 permits for Campus-wide radioactive material releases associated with facility restoration and low-level sources. These two permits allow for the removal of potentially internally contaminated equipment in non-radiological buildings and for the use of low-level radioactive source material for instrument checks in the environment, respectively.

1.1.3 Facilities Adjacent to the PNNL Campus

Land adjacent to the PNNL Campus is occupied by the U.S. DOE 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 has radiological operations that need to be considered in conjunction with releases, dose estimates, and environmental monitoring of the PNNL Campus. Many Hanford Site operations are currently focused on environmental cleanup associated with past production of radioactive materials for the U.S. nuclear weapons program. 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, Perkins, and Snyder 2015).

In addition to DOE's 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 office 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. adjacent to the east side of the 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 will be 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 includes descriptions of point sources at the PNNL Campus. A point source is reported in this document if it met the following three criteria during 2014:

- required continuous sampling or periodic confirmatory measurements (PCMs) (including 40 CFR 61, Appendix D calculations) in accordance with 40 CFR 61, Subpart H (2002), and with WAC 246-247 (2014)
- was described in the WDOH-issued RAEL-005
- emitted or had the potential to emit radionuclides

The PNNL Campus emission units registered with the WDOH for radiological emissions are given in Table 1.3.

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. Periodic confirmatory sampling conducted.	Periodic Sampling
	EP-RTL-11-V	Minor point source. Periodic confirmatory sampling conducted.	Periodic Sampling
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. Emission point characteristics for the sampled emission units are indicated in Table 1.4. Effective discharge heights used in modeling range from 33 feet (ft; 10 meters [m]) for PSF fugitive emission points to a conservative 103 ft (31.4 m) applied to all PSF main stack emissions. RTL-520 was conservatively modeled with an average effective discharge height of 67.75 ft (20.65 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	Physical Discharge Height	Physical Discharge Diameter	Effective Discharge Height	Abatement Technology
Major EP-3410-01-S	21,900 ft^3/min (10.3 m^3/s)	44 ft (13.4 m)	3.3 ft (1.0 m)	103 ft (31.4 m)	Single-stage HEPA filter
Major EP-3420-01-S	43,500 ft^3/min (20.5 m^3/s)	45 ft (13.8 m)	4.3ft (1.3 m)	125 ft (38.0 m)	Single-stage HEPA filter
Major EP-3430-01-S	32,900 ft^3/min (15.5 m^3/s)	44 ft (13.4 m)	3.7 ft (1.1 m)	115 ft (35.0 m)	Single-stage HEPA filter
Minor EP-RTL-10-V	13,900 ft^3/min (6.6 m^3/s)	26 ft (7.9 m)	2.7 ft (0.81 m)	65.3 ft (19.9 m)	Single-stage HEPA filter
Minor EP-RTL-11-V	18,900 ft^3/min (8.92 m^3/s)	26 ft (7.9 m)	2.7 ft (0.81 m)	70.2 ft (21.4 m)	Single-stage HEPA filter

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.[2] 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.

Fugitive sources of radioactive emissions are generally those not actively ventilated, not sealed to prevent the escape of volatile or resuspended radioactive material to the ambient air, and not as amenable to routine sampling in a controlled manner 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.

The principal emission abatement method used at the major emission units to remove radioactive constituents from stack emissions during 2014 was high-efficiency particulate air (HEPA) filters. 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 (see Table 1.4 for a listing of emission abatement technology at sampled stacks). The single-stage HEPA filter abatement technology listed in the table has a minimum acceptable test criteria rating of 99% efficient.

[2] 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 3 reports ED.

1.2.2 PNNL Campus Radiological Operations

The following paragraphs describe the handling and processing of radioactive material in each facility on the PNNL Campus.

Physical Science Facility (PSF) Buildings

3410 Building – Materials Sciences and Technology Laboratory

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

3420 Building – Radiation Detection Laboratory

The 3420 Building contains laboratories for research to perform 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 from this building are 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 from this building are through either the major stack or a minor stack.

Research Technology Laboratory (RTL) Facilities

RTL-520

RTL-520 provides laboratory, office, and storage space in support of 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 is performed. Additionally, research related to the solid-liquid interface of geologic materials is conducted. Radioactive material emissions from this building are 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 for the temporary storage of radioactive materials. Radioactive material emissions from this building would be fugitive emissions.

Life Sciences Laboratory–II (LSLII) Facility

LSLII

LSLII building consists primarily of two laboratory floors with mechanical/electrical service rooms attached at the north and south ends of the building. Research conducted 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. Radioactive material emissions from this building are through a minor stack.

2.0 Radionuclide Air Emissions

This Section presents information on quantities of radionuclide emissions at 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 2014 sampled point sources at the PNNL Campus. There were no fugitive emissions from RTL-530 in 2014. Table 2.2 shows the emissions that result in 99% of the dose impact from non-sampled PSF sources, whereas Table 2.3 shows the remaining 1%. A summary of the nuclide activity emissions from major, minor, and fugitive emissions that result in 99% or more of the total dose impact to the MEI is provided in Table 2.4. Appendix B lists the radioactive materials handled or potentially handled at the PNNL Campus in 2014.

Table 2.1. PNNL Campus Radionuclide Emissions (Ci) from Sampled Point Sources in 2014

Nuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	EP-RTL-10-V RTL-520	EP-RTL-11-V RTL-520	Total (Ci)
gross α [(a)]	1.03E-07	1.28E-07	5.31E-08	1.47E-09	1.80E-09	2.9E-07
gross β [(a)]	3.18E-07	4.41E-07	2.31E-07	2.30E-09	4.45E-09	1.0E-06
^{3}H	7.35E-05[(b)]	NA	NA	NA	NA	7.4E-05
^{133}Xe	NA	9.23E-05[(b)]	NA	NA	NA	9.2E-05
^{222}Rn[(c)]	NA	1.43E-04[(b)]	NA	NA	NA	1.4E-04
$^{233/234}$U	NA	NA	6.60E-10	NA	NA	6.6E-10
$^{239/240}$Pu	1.05E-08	5.79E-09	3.63E-09	NA	NA	2.0E-08
^{241}Am	5.99E-11	9.17E-11	NA	NA	NA	1.5E-10
$^{243/244}$Cm	NA	5.50E-11	NA	NA	NA	5.5E-11

(a) Maximum of the biweekly or composited average measurement.
(b) Value based on release records.
(c) Radon dose to MEI presented in Sections 3.4.2 and 3.6.3.
NA = not applicable

Table 2.2. PNNL Campus Appendix D Calculated and Release Record Radionuclide Emissions (Ci) from Minor Emissions Units and Fugitive Sources Resulting in 99% of the Offsite Dose – 2014[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-LSLII-01-V, -02-V Total LSLII[d]	Total Appendix D (Ci)
^{60}Co	2.75E-10	5.29E-11	NA	7.67E-11	NA	4.05E-10
^{57}Ni	5.00E-10	NA	NA	NA	NA	5.00E-10
^{109}Cd	2.63E-09	3.85E-10	NA	6.35E-11	NA	3.08E-09
^{131}I	1.99E-08	NA	NA	3.72E-11	NA	1.99E-08
^{132}I	2.84E-08	NA	NA	6.52E-11	NA	2.85E-08
^{133}I	3.20E-08	NA	NA	2.55E-10	NA	3.23E-08
^{133}Xe[a]	1.40E-07	5.40E-08	NA	NA	NA	1.94E-07
^{137}Cs	3.93E-10	4.34E-11	NA	2.95E-11	0.00E+00	4.66E-10
^{140}Ba	1.97E-08	NA	NA	3.27E-11	NA	1.97E-08
^{140}La	3.93E-08	NA	NA	1.00E-10	NA	3.94E-08
^{194}Au	1.05E-09	NA	NA	NA	NA	1.05E-09
^{196}Au	5.00E-09	NA	NA	NA	NA	5.00E-09
^{210}Pb	9.91E-10	2.52E-12	NA	4.53E-11	NA	1.04E-09
^{226}Ra	NA	1.19E-09	NA	NA	NA	1.19E-09
$^{233/234}$U	2.13E-08	NA	NA	3.10E-14	NA	2.13E-08
^{235}U	9.12E-10	NA	2.21E-19	9.35E-16	NA	9.12E-10
^{236}U	9.16E-11	NA	NA	6.03E-17	NA	9.16E-11
^{238}U	4.73E-11	NA	NA	8.50E-18	NA	4.73E-11
^{238}Pu	NA	NA	2.85E-17	NA	NA	2.85E-17
^{239}Pu	NA	NA	6.35E-16	NA	NA	6.35E-16
^{240}Pu	NA	NA	2.29E-16	NA	NA	2.29E-16
^{240}Am	NA	NA	NA	5.41E-12	NA	5.41E-12
^{241}Am	1.20E-10	5.73E-11	8.50E-17	4.67E-12	1.25E-11	1.94E-10
^{243}Am	NA	NA	2.56E-15	NA	NA	2.56E-15

(a) Values are not from actual measurements but calculated from in-facility material inventories and estimates (Ballinger, Gervais, and Barnett 2011; Rhoads and Barnett 2009) and 40 CFR 61, Appendix D (1989). Values for gases are based on release records.

(b) Listed nuclides account for 99% of dose impact from release record and Appendix D calculated Minor and Fugitive sources in 2014.

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

(d) LSLII alpha-emitters assumed to be ^{241}Am; there were no beta emitters in 2014.

NA = not applicable for the indicated stack

Table 2.3. Non-significant (1%) PNNL Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources – 2014

Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)
^{108m}Ag	5.5E-18	^{154}Eu	4.3E-13	^{236}Np	7.0E-17	^{90}Sr	4.7E-12
^{110m}Ag	3.1E-16	^{155}Eu	4.8E-13	^{237}Np	2.0E-18	^{91}Sr	9.3E-11
^{242}Am	4.4E-19	^{55}Fe	6.7E-18	^{32}P	6.8E-15	^{182}Ta	3.6E-12
^{243}Am	2.6E-15	^{59}Fe	5.3E-21	^{33}P	3.4E-15	^{99m}Tc	6.8E-08
^{37}Ar[(a)]	3.6E-07	^{203}Hg	1.8E-10	^{234m}Pa	3.2E-13	^{123m}Te	3.9E-16
^{193}Au	5.0E-11	^{125}I	4.9E-14	^{147}Pm	4.3E-12	^{127}Te	5.7E-11
^{195}Au	1.4E-10	^{135}I	1.1E-10	^{149}Pm	1.7E-08	^{127m}Te	6.7E-13
^{198}Au	6.3E-10	^{114m}In	2.7E-16	^{151}Pm	5.6E-11	^{129}Te	1.7E-10
^{133}Ba	3.2E-11	^{115}In	5.4E-17	^{143}Pr	3.1E-08	^{129m}Te	2.7E-10
^{137m}Ba	4.6E-12	^{115m}In	4.1E-12	^{144}Pr	1.1E-10	^{131}Te	1.2E-11
^{214}Bi	1.6E-14	^{192}Ir	1.2E-16	^{144m}Pr	1.5E-12	^{131m}Te	5.5E-11
^{82}Br	1.3E-08	^{40}K	4.0E-15	^{238}Pu	2.8E-17	^{132}Te	2.8E-08
^{47}Ca	2.0E-11	^{83m}Kr[(a)]	1.0E-05	^{241}Pu	1.5E-15	^{231}Th	3.5E-12
^{111m}Cd	8.9E-16	^{85}Kr[(a)]	2.0E-09	^{242}Pu	9.7E-19	^{232}Th	3.3E-17
^{115}Cd	2.9E-12	^{85m}Kr[(a)]	1.7E-11	^{244}Pu	3.3E-19	^{234}Th	2.8E-13
^{115m}Cd	1.6E-19	^{141}La	3.8E-11	^{103m}Rh	5.3E-10	^{187}W	3.3E-12
^{139}Ce	7.3E-11	^{52}Mn	1.1E-11	^{105}Rh	1.7E-08	^{131m}Xe[(a)]	2.4E-05
^{141}Ce	1.2E-08	^{54}Mn	4.6E-11	^{103}Ru	5.3E-10	^{133m}Xe[(a)]	2.4E-07
^{143}Ce	6.5E-08	^{99}Mo	7.5E-08	^{106}Ru	3.7E-12	^{135}Xe[(a)]	1.8E-07
^{144}Ce	1.3E-10	^{22}Na	1.8E-18	^{35}S	3.4E-15	^{135m}Xe[(a)]	1.8E-11
^{252}Cf	5.4E-16	^{24}Na	1.3E-08	^{125}Sb	6.4E-13	^{88}Y	7.1E-10
^{56}Co	1.4E-11	^{94}Nb	4.5E-11	^{127}Sb	6.0E-11	^{90}Y	2.2E-08
^{57}Co	1.6E-10	^{95}Nb	2.4E-10	^{46}Sc	8.6E-11	^{91}Y	1.3E-10
^{58}Co	2.1E-11	^{95m}Nb	4.3E-12	^{47}Sc	2.1E-09	^{91m}Y	6.0E-11
^{51}Cr	2.2E-11	^{97}Nb	1.9E-08	^{75}Se	1.2E-10	^{92}Y	5.7E-11
^{134}Cs	4.3E-12	^{97m}Nb	1.7E-08	^{153}Sm	3.5E-11	^{93}Y	2.4E-10
^{134m}Cs	6.8E-11	^{147}Nd	1.2E-08	^{113}Sn	2.7E-10	^{65}Zn	1.6E-10
^{64}Cu	5.5E-13	^{56}Ni	1.5E-12	^{85}Sr	3.0E-10	^{95}Zr	7.1E-10
^{152}Eu	2.2E-14	^{63}Ni	1.3E-19	^{89}Sr	1.2E-09	^{97}Zr	1.8E-08
						Total	**3.50E-05**

(a) Value based on release records for gases. Other emissions are calculated from in-facility material inventories and estimates (Ballinger, Gervais, and Barnett 2011; Rhoads and Barnett 2009) and 40 CFR 61, Appendix D (1989).

Table 2.4. PNNL Campus Total Radionuclide Emissions (Ci) in 2014

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units[a]	Total (Ci)
gross α [b]	2.9E-07	3.3E-09	2.9E-07
gross β [b]	9.9E-07	6.8E-09	1.0E-06
^{3}H	7.4E-05 [c]	NA	7.4E-05
^{60}Co	NA	4.1E-10	4.1E-10
^{57}Ni	NA	5.0E-10	5.0E-10
^{109}Cd	NA	3.1E-09	3.1E-09
^{131}I	NA	2.0E-08	2.0E-08
^{132}I	NA	2.9E-08	2.9E-08
^{133}I	NA	3.2E-08	3.2E-08
^{133}Xe	9.2E-05[c]	1.9E-07[c]	9.3E-05
^{137}Cs	NA	4.7E-10	4.7E-10
^{140}Ba	NA	2.0E-08	2.0E-08
^{140}La	NA	3.9E-08	3.9E-08
^{194}Au	NA	1.1E-09	1.1E-09
^{196}Au	NA	5.0E-09	5.0E-09
^{210}Pb	NA	1.0E-09	1.0E-09
^{226}Ra	NA	1.2E-09	1.2E-09
$^{233/234}U$	6.6E-10	2.1E-08	2.2E-08
^{235}U	NA	9.1E-10	9.1E-10
^{236}U	NA	9.2E-11	9.2E-11
$^{239/240}Pu$	3.0E-07	8.6E-16[d]	3.0E-07
^{240}Am	NA	5.4E-12	5.4E-12
^{241}Am	1.5E-10	1.8E-10	3.3E-10
^{243}Am	NA	2.6E-15	2.6E-15
$^{243/244}Cm$	5.5E-11	NA	5.5E-11

(a) Nuclides that contribute 99% of the dose to the MEI from minor and fugitive sources. See Table 2.3 for the nuclides that contribute the remaining 1% of dose impact.
(b) Maximum of the biweekly or semi-annual average measurement. These are assumed to be ^{137}Cs, ^{239}Pu, or ^{241}Am for dose assessment.
(c) Value based on release records.
(d) Non-significant contributor to dose relative to the major emission unit release.
NA = not applicable

3.0 Dose Assessment

The method for determining the MEI dose from PNNL Campus radiological emissions is evaluated in this Section.

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 3 (EPA 2013), approved by the EPA. 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 in 40 CFR 61, Subpart H (2002) and WAC 246-247 (2014).

CAP88-PC Version 3 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 for a public receptor who 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 fence line location was not considered because no one individual routinely occupies this location, which is in a shrub-steppe field. In addition to the physically nearest location, the location determined to have the greatest impact from emissions is provided. 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. Information on these nearest receptors is provided in Table 3.1, 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.

For information purposes only, the location of the historic Hanford Site MEI at a residence, near Sagemoor Road directly east and across the Columbia River from the Hanford Site 300 Area, is also indicated. In CY2014, the Hanford Site MEI was determined to be at the PNNL Campus PSF. This information is used determine dose to the Hanford Site MEI from PNNL Campus emissions in order to compare the impacts of radiological emissions from the two DOE sites.

When the potential MEI locations of Table 3.1 as well as year 2014 annual meteorological data (Appendix A) were evaluated with CAP88-PC Version 3 model, the 2014 receptor of maximum impact from PSF emissions (i.e., the MEI) was determined to be 700 m SSE of PSF (Figure 3.1). This is 50 m closer than last year’s MEI location due to flow rate changes at PSF in 2014. The MEI location is a boundary location with offsite offices located on the east side of George Washington Way. This receptor would not have produced his or her own food supply at this location, but it was conservatively assumed that this was the case, in accordance with State requirements.

Table 3.1. Locations of PNNL Campus Potential Receptors

Locale	Distance relative to PSF km (mi)	Distance relative to RTL-520 km (mi)	Distance relative to LSLII km (mi)
Offsite residence, nearest			
Townhomes	0.97 (0.60) SE	1.18 (0.73) NE	0.84 (0.52) E
Offsite business			
Physically nearest business[(a)]	0.17 (0.11) SSE	0.30 (0.19) SSE	0.43 (0.27) E
Location of maximum impact: George Washington Way, just south of 10th St[(b)]	0.70 (0.43) SSE	1.05 (0.65) N	0.41 (0.25) E
Onsite public receptor			
Physically nearest (ISB1 maintenance staff)	0.24 (0.15) SSE	0.52 (0.32) NNE	1.46 (0.91) N
Farm with potential for crops or livestock			
Nearest to PSF (east of Columbia River)	1.5 (0.93) E	1.81 (1.1) E	1.86 (1.2) E
PNNL Campus historic MEIs			
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	n/a	n/a
CY2010	0.48 (0.30) SSE	n/a	n/a
Hanford Site historic MEIs (Rokkan et al. 2015)			
PNNL Campus at PSF (46.352, -119.277)	0 (0)	n/a	n/a
Sagemoor Rd (46.368, -119.257)	2.47 (1.5) NE	3.85 (2.4) NNE	3.14 (1.9) NNE
Ringold (46.485, -119.255)	15.22 (9.5) N	16.89 (10.5) N	15.99 (9.9) N

(a) Business varies for each reference location.
(b) No individual resides at this location, but 2014 meteorology indicates that this would be the region of greatest particulate air concentrations from PSF emissions. This location is 2.51 km S of the Hanford Site 300 Area.

3.2 Summary of Input Parameters

The PNNL Campus dose calculations were performed in a manner very similar to the established standards used for the Hanford Site NESHAP dose calculations (refer to DOE 2008). Radionuclide emissions data from the PNNL Campus (Table 2.4) were used in the dose calculations. Emissions from each PSF major stack were modeled in CAP88-PC Version 3 with 2014 meteorology and stack characteristics of Table 1.4. The greatest dose impact from facility emissions occurred on George Washington Way, just south of 10th Street where an office building is located; as a result, this is the 2014 MEI location. MEI dose calculations apply the 3410 Building stack characteristics for this assessment.

PSF emissions reported as gross alpha or gross beta were conservatively evaluated as $^{239/240}$Pu or ^{90}Sr, respectively. Additional data used for dose calculations can be found in Appendix A; all other radionuclide-specific parameters used were default values in CAP88-PC Version 3 data libraries. Maximum individual exposure and consumption parameters are assumed to be the same as those routinely used for the Hanford Site analyses (DOE 2008). The entire hypothetical MEI diet was constructed using the "local" food production option in CAP88-PC Version 3 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 models. The dispersion models yield annual average dispersion factors, in units of Ci/m^3 per Ci/second (or s/m^3). Applying these factors to the annual average release rates yields an estimate of average radionuclide air concentrations for the year.

Radionuclide air concentrations at receptor locations are determined using the site-specific meteorological data. CAP88-PC Version 3 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 2014. Meteorological data for 2014 are presented in Appendix A 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 (1500 m from PSF and 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

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 (2002) and applies to radionuclide air emissions, other than radon, from DOE facilities. For CY2014, 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-5 mrem (2.4E-7 mSv) EDE. Including the fugitive PIC-5 category doses increases the total MEI dose to 2.7E-5 mrem (2.7E-7 mSv) EDE. Table 3.2 shows the relative contributions of each nuclide to the MEI dose.

The MEI dose attributed to each emission point is indicated in Table 3.3. The PSF facility emissions contribute the majority of the dose to the MEI. The four fugitive PIC-5 permitted emissions, which indicate a maximum dose impact, are included in the table.

For comparison, the PNNL Campus 2014 MEI dose to average U.S. background radiation (NCRP 2009) is 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 2014 MEI dose** (40 CFR61, Subpart H)	**0.000027**	**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).

Table 3.2. PNNL Campus 2014 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units and Fugitive Emissions

Radionuclide	Releases (Ci)	Dose to MEI (mrem EDE)	% of Total EDE percent
^{3}H[(a)]	7.4E-05	4.8E-08	<1%
^{60}Co[(a)]	4.1E-10	7.2E-10	<1%
^{57}Ni[(a)]	5.0E-10	8.1E-12	<1%
^{90}Sr[(b)]	9.9E-07	4.2E-06	16%
^{109}Cd[(a)]	3.1E-09	6.1E-10	<1%
^{131}I[(a)]	2.0E-08	1.9E-07	1%
^{132}I[(a)]	2.9E-08	4.8E-11	<1%
^{133}I[(a)]	3.2E-08	2.3E-09	<1%
^{133}Xe[(a)]	9.3E-05	5.5E-10	<1%
^{137}Cs[(b)]	7.2E-09	2.0E-08	<1%
^{140}Ba[(a)]	2.0E-08	3.7E-09	<1%
^{140}La[(a)]	3.9E-08	8.2E-10	<1%
^{194}Au[(a)]	1.1E-09	7.9E-12	<1%
^{196}Au[(a)]	5.0E-09	7.5E-11	<1%
^{210}Pb[(a)]	1.0E-09	3.7E-08	<1%
^{226}Ra[(a,c)]	1.2E-09	5.2E-08	<1%
$^{233/234}U$	2.2E-08	4.0E-07	2%
^{235}U[(a)]	9.1E-10	1.5E-08	<1%
^{236}U[(a)]	9.2E-11	1.6E-09	<1%
$^{239/240}Pu$[(d)]	3.1E-07	1.9E-05	71%
^{240}Am[(a)]	5.4E-12	5.8E-14	<1%
^{241}Am[(e)]	3.5E-10	4.6E-08	<1%
^{243}Am[(a)]	2.6E-15	5.2E-13	<1%
$^{243/244}Cm$	5.5E-11	2.1E-09	<1%
Table 2.3 nuclides	3.5E-06	7.4E-09	<1%
PIC-5 emissions – VRRM	n/a	9.4E-07[(f)]	3%
PIC-5 emissions – Facilities Restoration	n/a	8.4E-07[(f)]	3%
PIC-5 emissions – LLS	n/a	1.0E-06[(f)]	4%
PIC-5 emissions – NDRM	n/a	6.6E-08[(f)]	<1%
Total	**1.7E-04**	**2.7E-05**	**100%**

(a) Release based on 40 CFR 61, Appendix D (1989) or release records.
(b) Gross beta from PSF building sampling assumed to be ^{90}Sr. Gross beta from RTL-520 sampling assumed to be ^{137}Cs. Also, calculated ^{137}Cs release based on 40 CFR 61, Appendix D (1989) and LSLII gross beta.
(c) Dose includes progeny isotope ^{222}Rn.
(d) Gross alpha from PSF building and RTL-520 sampling assumed to be ^{239}Pu. Also includes ^{239}Pu and ^{240}Pu calculated based on 40 CFR 61, Appendix D (1989).
(e) Gross alpha from LSLII assigned as ^{241}Am.
(f) The PIC-5 emissions doses are assigned based on permit value.

Table 3.3. Dose Contributions from Each Registered Emission Point

Facility/Building	Emission Point	Emissions[a]	Dose to MEI (mrem EDE)	% of Total MEI Dose
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%
Campus	J-NDRM	PIC-5	6.6E-08[b]	<1%
PSF/3430 Building	EP-3430-02-S	Estimated	6.5E-08	<1%
PSF/3425 Building	J-3425	Estimated	3.3E-09	<1%
LSLII	EP-LSLII-01-V	Estimated	7.3E-10	<1%
LSLII	EP-LSLII-02-V	Estimated	7.3E-10	<1%
PSF/3430 Building	EP-3430-1606P-S	Estimated	1.5E-13	<1%
PSF/3430 Building	EP-3430-1608P-S	Estimated	1.5E-13	<1%
PSF/3430 Building	EP-3430-1610P-S	Estimated	1.5E-13	<1%
PSF/3430 Building	EP-3430-1612P-S	Estimated	1.5E-13	<1%
PSF/3430 Building	EP-3430-1614P-S	Estimated	1.5E-13	<1%
RTL/RTL-530	J-RTL530	None	0	0%

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

For information purposes, the nearby Hanford Site, which is the adjacent DOE site with major emissions units, was also considered for comparative evaluation. PNNL Campus air compliance is a distinctly separate issue, but the dose from such nearby major radiological emitters is worthy of consideration for total DOE-source impacts to the region. Hanford Site 300 Area emissions and the Hanford Site MEI for CY2014 were reviewed. Both the PNNL Campus and the Hanford Site (Rokkan, Perkins, and Snyder 2015) are in compliance with the 10 mrem/yr regulatory standard for CY2014 radiological emissions. The CY2014 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 2014. The same was true in 2012 and 2013. The dose to the PNNL Campus MEI from the Hanford Site 300 Area emissions excluding radon (emissions listed in Table 3-1 of Rokkan, Perkins, and Snyder 2015), was estimated to be 1.7E-1 mrem (1.7E-3 mSv) EDE. The majority of the impact from Hanford Site 300 Area emissions to the PNNL Campus MEI is attributable to ^{3}H emissions (99.99%).[3]

As indicated earlier, the 10 mrem/y EDE standard in Subpart H applies to radionuclide air emissions, other than radon, from DOE facilities. Figure 3.2 shows CY2014 and past PNNL Campus MEI dose relative to the 10 mrem standard and also includes the 2011 through 2014 Hanford Site doses (Snyder, Barnett, and Bisping 2014; Rokkan, Perkins, and Snyder 2015) for comparison. The figure indicates the comparative radiological impact of each closely situated DOE site with respect to its MEI. In Figure 3.2, "MEI_Hanford" is the Hanford Site's Sagemoor Road MEI (2011) and "MEI_PNNL" is the PNNL Campus's MEI located SSE of PSF.

[3] Exclusion of Hanford Site 300 Area tritium emissions results in an estimated dose to the PNNL Site MEI of 2E-5 mrem (2E-7 mSv), about half of which results from the conservative assumptions used to calculate gross alpha and gross beta contributions.

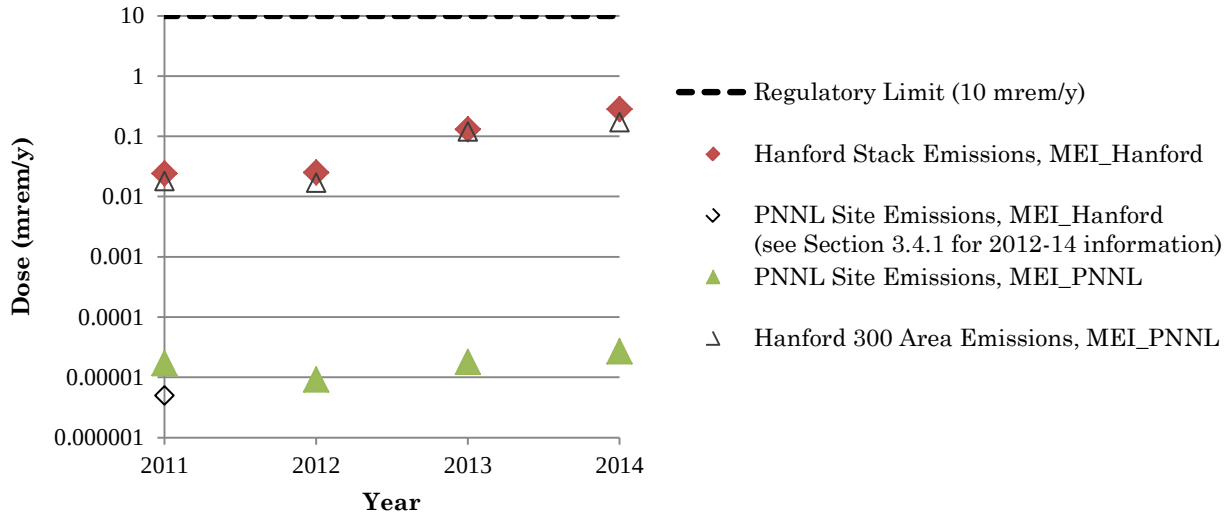

Figure 3.2. PNNL Campus and Hanford Site MEI Doses, 2011 through 2014

3.4.2 Washington Administrative Code 246-247

For PNNL Campus radionuclide air emissions, Washington State in WAC 246-247-040(1) has adopted the federal dose standard of 10 mrem/yr found in 40 CFR 61, Subpart H (2002). In addition to the maximum dose attributable to radionuclides emitted from point sources, WAC 246-247-040(6) requires that the dose to the MEI also include doses attributable to fugitive emissions, radon, and nonroutine events. The total dose to the MEI from all PNNL Campus radionuclide emissions, including major and minor points, fugitive emissions, PIC-5, and radon-222, is 3E-5 mrem (3E-07 mSv). There were no nonroutine emissions (refer to Section 3.5) in 2014 that would contribute to dose that is considered for compliance determination with the WAC 246-247 (2014) standard.

Dose due to routine major point source emissions is 2.3E-5 mrem (2.3E-7 mSv). Dose from facility minor and fugitive emissions is 9.6E-07 mrem (9.6E-09 mSv). Assigned dose from PIC-5 permits is 2.8E-6 mrem (2.8E-08 mSv). And finally, the dose from radon is 1.2E-06 mrem (1.2E-08 mSv). The total WAC 246-247 (2014)-standard MEI dose of 3E-5 mrem (3E-7 mSv) is more than 100,000 times smaller than the 10 mrem/yr WAC 246-247 (2014) limit.

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No instances of nonroutine emissions were reported in 2014.

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 site selection and sampling program optimization requirements are documented in Barnett et al. 2012. Particulate air sampling stations were established at three locations in mid-2010. These operated for the first full calendar year in 2011. 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 of the approval process under 40 CFR 61.96 were requested or granted in 2014.

3.6.3 Radon-220 and Radon-222 Emissions

^{220}Radon was not emitted from PNNL Campus operations in 2014. Some ^{222}Rn, 1.4E-04 Ci, was emitted from EP-3420-01-S in 2014 resulting in a dose of 1.2E-6 mrem (1.2E-8 mSv) ED to the MEI. In addition, the 40 CFR 61, Appendix D (1989) estimate of ^{226}Ra emissions includes its progeny ^{222}Rn in the impact estimate (Table 3.2). Radon is exempt from consideration in determining compliance with the dose standard of 40 CFR 61, Subpart H (2002), but it is encompassed by state regulations, as in WAC-246-247-040(6) (2014), which states that "[a]ll emissions of radionuclides . . . are subject to the standards of this section."

4.0 Fugitive Sources of Emissions

The Clean Air Act (i.e., 40 CFR 61, Subpart H [2002]) governs emissions of radionuclides from DOE facilities and the resulting radiological doses to members of the public. A dose standard of 10 mrem/yr EDE was implemented, to which compliance is expected for radionuclide emissions emanating from both point and fugitive sources. Measuring and/or modeling these emissions are fundamental to demonstrating compliance with the standard.

In general, fugitive sources of radioactive emissions are 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 [2014]). 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 2014, only J-3425 had radioactive material emissions. In addition to facility-specific fugitive sources, PNNL Campus-wide permits for fugitive emissions are registered with the WDOH. These include:

- 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 3.2) is larger than the actual dose from respective applicable Campus-wide releases. These permits include PIC-5 (Ballinger et al. 2012) emissions levels of radionuclide emission and cover a broad range of the nuclides listed in Appendix B.

Emissions from fugitive sources mix with ambient air, which may also include emissions from point sources. Emissions from all PNNL Campus sources are monitored by four particulate air sampling stations. The air surveillance program conducted in 2014 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 impact the PNNL Campus. The Hanford Site fugitive emissions are evaluated in detail in their Radiological Air Emissions Report (e.g., Rokkan, Perkins, and Snyder 2015).

The 2014 PNNL Campus emissions from facility fugitive sources were estimated (see Table 2.2, with only emission unit J-3425 for 2014) and dose was determined (see Table 3.3). Table 3.3 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 2.8E-06 mrem/yr (11%) of the total 2.7E-05 mrem MEI dose for 2014.

5.0 Supplemental Information

This Section provides supplemental information related to PNNL Campus radionuclide air emissions in 2014 and consists of the following:

- collective dose estimate
- 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 (2000), Method 114.

5.1 Collective Dose Estimate

The estimated regional collective dose from PNNL Campus air emissions in 2014 was calculated using a simplified method that overestimates dose. The population consists of approximately 432,000 people residing within a 50-mi (80-km) radius of the Hanford Site 300 Area (Hamilton and Snyder 2011). The close 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 consumption of food.

Population exposure to radionuclide air emissions was determined using the MEI dose estimate (2.7E-5 mrem) times the 50-mi population (432,117). The 2014 total collective dose from radionuclide air emissions estimated in this very conservative manner from nuclides that originate from the PNNL Campus was 0.012 person-rem (1.2E-4 person-Sv). This represents a small increase over the 2013 estimate of 0.0078 person-rem (Snyder, Barnett, and Bisping 2014).

5.2 Compliance Status with 40 CFR 61, 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 provisions of Subpart Q apply to the design and operation of all storage and disposal facilities for radium-bearing material that emit ^{222}Rn 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 ^{222}Rn in excess of a standard of 20 $pCi/m^2/s$. No operations from the storage and disposal of radium-bearing material resulting in radon emissions are conducted at 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 at the PNNL Campus.

Subparts Q and T do not apply to the PNNL Campus for CY2014 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 prior to the start of radiological operations at the new PSF buildings. The first full calendar year of air surveillance was conducted in 2011. To satisfy air permit requirements, throughout 2014 sampling data was collected at four ambient air samplers at 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 2014, 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 2014, environmental air surveillance continued to be performed 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 ($^{233/234}$U, ^{235}U, and ^{238}U), and plutonium isotopes (^{238}Pu and $^{239/240}$Pu).[4] Gamma-emitting isotope concentrations reported in 2014 include ^{60}Co. In addition, americium isotopes (^{241}Am and ^{243}Am) and $^{243/244}$Cm 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 2014). 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 CY2014 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 in Table 5.1 were less than 40 CFR Part 61 Appendix E, Table 2 (1989) values. There was no indication of substantially elevated levels of monitored particulate radionuclides in the vicinity of the PNNL Campus from either onsite or other nearby sources.

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

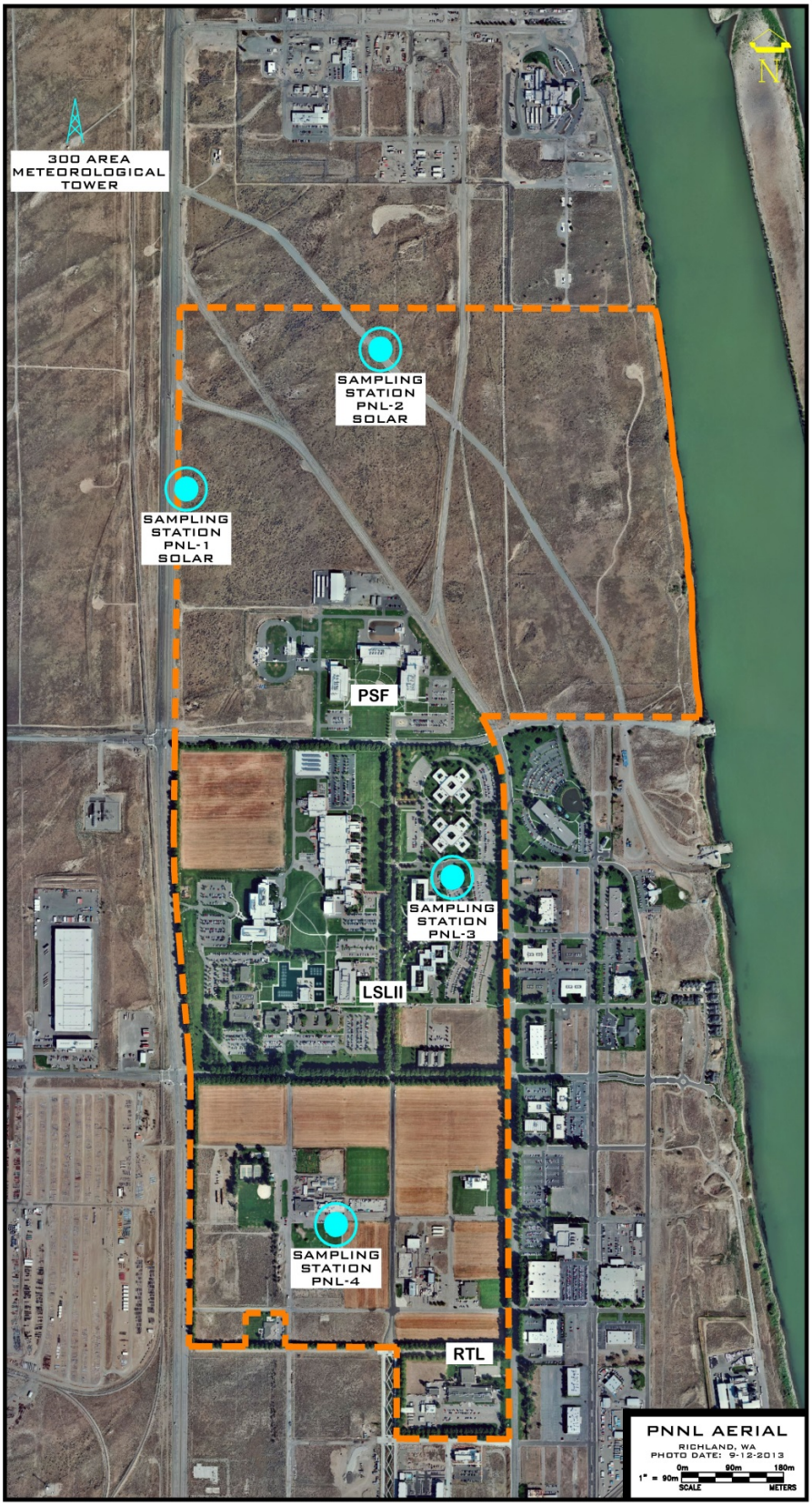

Figure 5.1. Air Surveillance Station Locations for the PNNL Campus

Table 5.1. Summary of 2014 Air Sampling Results

Nuclide	Location[a]	No. of Samples Analyzed	No. of Detections	Value ± Error (pCi/m3)[b]		
Gross Alpha	PNL-1	25	20	7.8E-04	±	1.9E-03
	PNL-2	25	18	6.7E-04	±	1.8E-03
	PNL-3	26	21	6.6E-04	±	1.7E-03
	PNL-4	26	19	6.9E-04	±	1.8E-03
	YAKIMA	26	20	8.7E-04	±	1.9E-03
Gross Beta	PNL-1	25	25	2.3E-02	±	7.6E-03
	PNL-2	25	25	2.4E-02	±	7.6E-03
	PNL-3	26	26	2.0E-02	±	6.6E-03
	PNL-4	26	26	2.2E-02	±	7.3E-03
	YAKIMA	26	26	1.9E-02	±	6.5E-03
^{60}Co	PNL-1	2	0	5.5E-05	±	1.5E-04
	PNL-2	2	0	1.1E-04	±	3.8E-04
	PNL-3	2	0	2.8E-04	±	6.9E-04
	PNL-4	2	0	-1.7E-04	±	6.7E-04
	YAKIMA	2	0	2.1E-04	±	6.0E-04
$^{233/234}$U	PNL-1	2	2	4.6E-05	±	1.8E-05
	PNL-2	2	2	4.4E-05	±	1.7E-05
	PNL-3	2	2	3.5E-05	±	2.1E-05
	PNL-4	2	2	5.1E-05	±	1.9E-05
^{234}U	YAKIMA	2	2	3.3E-05	±	1.7E-05
^{238}Pu	PNL-1	2	0	-3.2E-07	±	2.3E-06
	PNL-2	2	0	-1.1E-07	±	1.7E-06
	PNL-3	2	0	5.1E-07	±	1.4E-06
	PNL-4	2	0	5.9E-07	±	1.9E-06
	YAKIMA	2	0	5.8E-07	±	1.6E-06
$^{239/240}$Pu	PNL-1	2	0	1.9E-07	±	3.7E-07
	PNL-2	2	0	2.8E-07	±	8.0E-07
	PNL-3	2	0	1.6E-06	±	5.4E-06
	PNL-4	2	0	1.3E-06	±	2.7E-06
	YAKIMA	2	0	-1.4E-06	±	2.9E-06
^{241}Am	PNL-1	2	0	-1.0E-06	±	3.7E-06
	PNL-2	2	0	1.4E-06	±	2.8E-06
	PNL-3	2	0	2.0E-06	±	6.4E-06
	PNL-4	2	0	1.4E-06	±	2.9E-06
	YAKIMA	0	0		NA[c]	
^{243}Am	PNL-1	2	0	2.4E-06	±	5.1E-06
	PNL-2	2	0	1.9E-06	±	5.2E-06
	PNL-3	2	0	3.7E-07	±	1.0E-06
	PNL-4	2	0	1.1E-06	±	2.2E-06
	YAKIMA	0	0		NA[c]	
$^{243/244}$Cm	PNL-1	2	0	1.0E-06	±	2.8E-06
	PNL-2	2	0	1.1E-06	±	2.1E-06
	PNL-3	2	0	-7.1E-07	±	4.2E-06
	PNL-4	2	0	6.7E-07	±	5.2E-06
	YAKIMA	0	0		NA[c]	

NA = Not Analyzed

(a) Refer to Figure 5.1.

(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) ^{241}Am values reported for PNNL Campus locations use a more sensitive alpha spectroscopy analytical method, which differs from the method used for Yakima; therefore, Yakima ^{241}Am measurements are not directly applicable. ^{243}Am and $^{243/244}$Cm 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) are compatible with one or more of the documents shown in Table 5.2 during CY2014. 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 Quality Assurance-Related Documents

10 CFR 830 (2001), *Nuclear Safety Management*
40 CFR 61, Appendix B (2000), "*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/EH-0173T (1991), Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance
EPA QA/R-5 (2001), EPA Requirements for Quality Assurance Project Plans

6.0 References

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40 CFR 61, Appendix E. 1989. *Compliance Procedures Methods for Determining Compliance with Subpart I*, U.S. Government Printing Office, Washington, D.C.

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

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

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

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

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

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

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

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PNNL—Pacific Northwest National Laboratory. 2013. *Pacific Northwest National Laboratory Effluent Management Quality Assurance Plan,* EM-QA-1 <current revision>, Pacific Northwest National Laboratory, Richland, Washington.

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

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

Snyder SF, JM Barnett, and LE Bisping. 2014. *Pacific Northwest National Laboratory Site Radionuclide Air Emissions Report for Calendar Year 2013*. PNNL-20436-4, Pacific Northwest National Laboratory, Richland, Washington.

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

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Appendix A

Dose Modeling and Meteorological Data

Appendix A
Dose Modeling and Meteorological Data

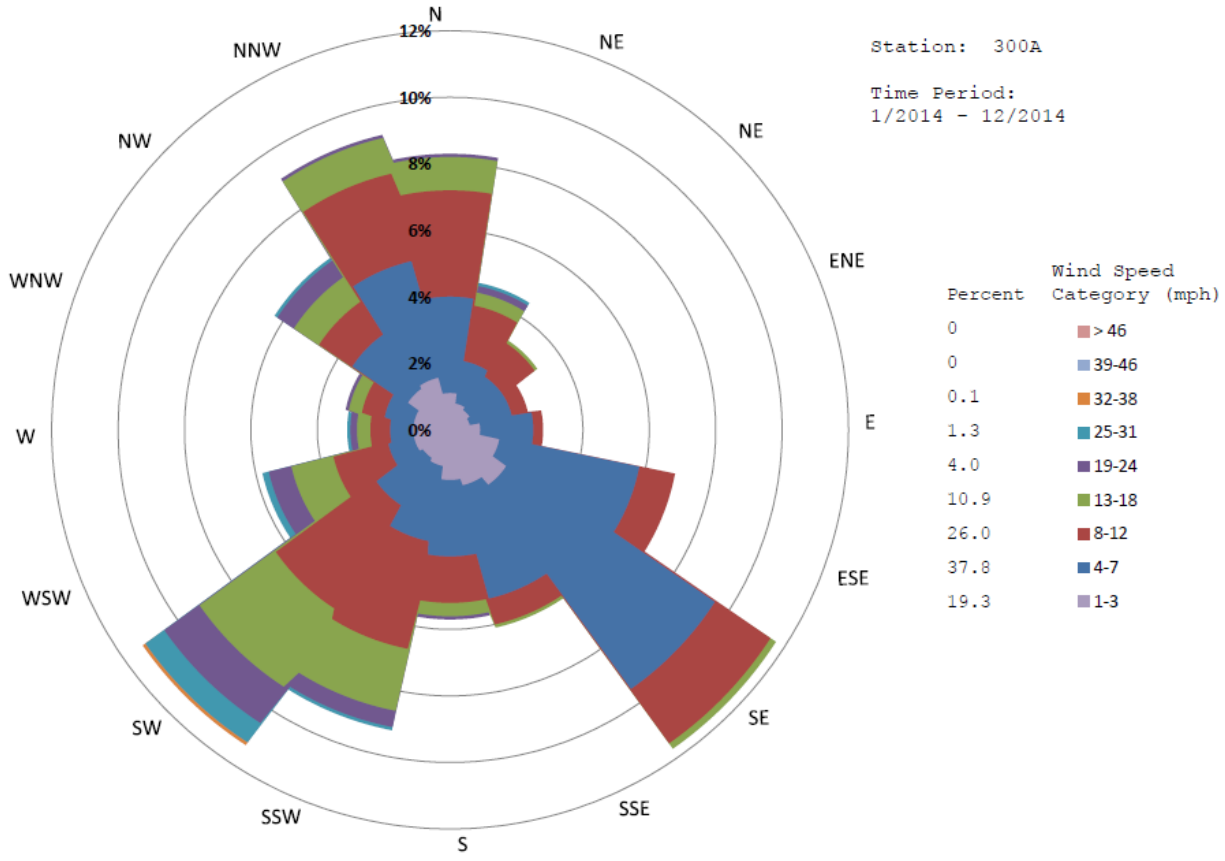

Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2014

Table A.1. Annual Average Joint Frequency During 2014 (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																
		S	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**Total**
0.89	A	0.02	0.02	0.01	0.01	0.02	0.03	0.01	0.02	0.01	0.01	0.02	0.00	0.01	0.01	0.00	0.00	0.20
	B	0.01	0.01	0.00	0.01	0.01	0.03	0.04	0.04	0.01	0.06	0.03	0.02	0.00	0.00	0.00	0.00	0.27
	C	0.02	0.07	0.11	0.12	0.03	0.07	0.09	0.02	0.02	0.02	0.03	0.01	0.00	0.01	0.01	0.02	0.65
	D	0.29	0.14	0.23	0.22	0.43	0.51	0.54	0.42	0.41	0.31	0.21	0.29	0.32	0.29	0.52	0.48	5.61
	E	0.45	0.24	0.17	0.10	0.21	0.49	0.68	0.70	0.51	0.47	0.49	0.51	0.42	0.50	0.49	0.55	6.98
	F	0.23	0.24	0.14	0.13	0.12	0.25	0.58	0.46	0.49	0.21	0.21	0.22	0.26	0.21	0.37	0.47	4.59
	G	0.13	0.06	0.06	0.01	0.07	0.18	0.15	0.13	0.15	0.09	0.07	0.10	0.08	0.12	0.14	0.11	1.65
	Total	**1.15**	**0.78**	**0.72**	**0.60**	**0.89**	**1.56**	**2.09**	**1.79**	**1.60**	**1.17**	**1.06**	**1.15**	**1.09**	**1.14**	**1.53**	**1.63**	**19.95**
2.65	A	0.02	0.08	0.23	0.52	0.53	0.43	0.32	0.06	0.06	0.08	0.08	0.10	0.06	0.01	0.00	0.02	2.60
	B	0.03	0.07	0.20	0.26	0.29	0.33	0.33	0.21	0.20	0.24	0.19	0.04	0.02	0.00	0.01	0.04	2.46
	C	0.10	0.19	0.28	0.20	0.16	0.37	0.41	0.26	0.07	0.26	0.11	0.02	0.05	0.02	0.05	0.03	2.58
	D	0.84	0.53	0.40	0.24	0.31	0.89	1.55	0.51	0.42	0.40	0.29	0.18	0.12	0.23	0.69	0.98	8.58
	E	1.16	0.31	0.09	0.08	0.21	1.20	2.04	0.99	0.88	0.88	0.77	0.38	0.26	0.39	0.70	1.45	11.79
	F	0.63	0.13	0.03	0.01	0.08	0.87	2.15	1.02	0.51	0.33	0.27	0.05	0.20	0.13	0.34	0.76	7.51
	G	0.17	0.04	0.00	0.00	0.00	0.17	0.71	0.42	0.14	0.09	0.01	0.02	0.01	0.06	0.16	0.30	2.30
	Total	**2.95**	**1.35**	**1.23**	**1.31**	**1.58**	**4.26**	**7.51**	**3.47**	**2.28**	**2.28**	**1.72**	**0.79**	**0.72**	**0.84**	**1.95**	**3.58**	**37.82**
4.70	A	0.06	0.30	0.45	0.23	0.18	0.33	0.45	0.16	0.22	0.30	0.51	0.38	0.08	0.03	0.04	0.05	3.77
	B	0.16	0.36	0.39	0.15	0.06	0.11	0.14	0.07	0.10	0.33	0.31	0.13	0.02	0.03	0.01	0.05	2.42
	C	0.17	0.19	0.19	0.05	0.00	0.06	0.12	0.10	0.11	0.39	0.33	0.10	0.04	0.02	0.04	0.04	1.95
	D	0.66	0.32	0.10	0.03	0.00	0.15	0.25	0.10	0.30	0.85	0.83	0.25	0.25	0.20	0.39	1.02	5.70
	E	1.24	0.33	0.05	0.01	0.01	0.17	0.42	0.26	0.45	0.83	1.24	0.61	0.17	0.33	0.65	1.01	7.78
	F	0.57	0.11	0.00	0.01	0.02	0.16	0.41	0.10	0.15	0.47	0.38	0.23	0.01	0.04	0.11	0.34	3.11
	G	0.30	0.05	0.00	0.00	0.01	0.09	0.23	0.04	0.09	0.09	0.07	0.02	0.00	0.01	0.01	0.22	1.23
	Total	**3.16**	**1.66**	**1.18**	**0.48**	**0.28**	**1.07**	**2.02**	**0.83**	**1.42**	**3.26**	**3.67**	**1.72**	**0.57**	**0.66**	**1.25**	**2.73**	**25.96**
7.15	A	0.06	0.10	0.04	0.00	0.01	0.00	0.01	0.00	0.03	0.36	0.55	0.34	0.06	0.03	0.06	0.06	1.71
	B	0.04	0.02	0.00	0.00	0.00	0.00	0.03	0.01	0.02	0.15	0.27	0.09	0.01	0.02	0.03	0.04	0.73
	C	0.07	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.15	0.27	0.12	0.02	0.03	0.04	0.06	0.81
	D	0.45	0.17	0.03	0.00	0.00	0.00	0.02	0.01	0.06	0.38	0.59	0.35	0.16	0.14	0.37	0.52	3.25
	E	0.31	0.13	0.04	0.02	0.02	0.00	0.05	0.08	0.13	0.71	0.85	0.35	0.12	0.13	0.36	0.34	3.64
	F	0.03	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.06	0.08	0.20	0.01	0.00	0.00	0.03	0.06	0.50
	G	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.05	0.08	0.02	0.00	0.00	0.00	0.00	0.20
	Total	**0.97**	**0.44**	**0.11**	**0.02**	**0.03**	**0.00**	**0.15**	**0.12**	**0.34**	**1.88**	**2.81**	**1.28**	**0.37**	**0.35**	**0.89**	**1.08**	**10.84**

Table A.1. (contd)

Wind speed (m/sec)	Stability class	Wind direction toward																
		S	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**Total**
9.8	A	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.20	0.13	0.03	0.02	0.08	0.00	0.49
	B	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.14	0.14	0.06	0.00	0.01	0.00	0.41
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.22	0.07	0.04	0.00	0.08	0.00	0.45
	D	0.02	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.16	0.30	0.21	0.07	0.11	0.33	0.06	1.36
	E	0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.16	0.39	0.14	0.01	0.01	0.11	0.05	1.09
	F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.09
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.03
	Total	**0.08**	**0.21**	**0.02**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.07**	**0.48**	**1.29**	**0.69**	**0.21**	**0.14**	**0.61**	**0.11**	**3.92**
12.7	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.04	0.00	0.00	0.00	0.09
	B	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.00	0.00	0.00	0.11
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.03	0.00	0.02	0.00	0.00	0.10
	D	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.25	0.12	0.00	0.01	0.07	0.00	0.49
	E	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.37	0.02	0.00	0.00	0.00	0.00	0.49
	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**	**0.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.11**	**0.71**	**0.20**	**0.07**	**0.03**	**0.07**	**0.00**	**1.28**
15.6	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	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	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.07
	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.13**
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	0.02	0.00	0.00	0.00	0.00	0.00	0.02
	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**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**

Table A.1. (contd)

Wind speed (m/sec)	Stability class	Wind direction toward																
		S	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**Total**
Total	A	0.17	0.51	0.73	0.76	0.74	0.79	0.79	0.24	0.32	0.77	1.39	0.96	0.28	0.10	0.18	0.13	8.86
	B	0.24	0.50	0.59	0.42	0.36	0.47	0.54	0.33	0.33	0.84	0.96	0.44	0.14	0.05	0.06	0.13	6.40
	C	0.36	0.46	0.58	0.37	0.19	0.50	0.63	0.39	0.22	0.88	1.00	0.35	0.15	0.10	0.22	0.15	6.55
	D	2.26	1.23	0.78	0.50	0.74	1.55	2.36	1.04	1.20	2.13	2.56	1.40	0.92	0.98	2.37	3.06	25.08
	E	3.20	1.18	0.35	0.21	0.45	1.86	3.19	2.03	2.03	3.10	4.16	2.01	0.98	1.36	2.31	3.40	31.82
	F	1.47	0.49	0.17	0.15	0.22	1.28	3.16	1.58	1.22	1.13	1.09	0.51	0.47	0.38	0.85	1.63	15.80
	G	0.61	0.15	0.06	0.01	0.08	0.44	1.10	0.60	0.40	0.34	0.24	0.16	0.09	0.19	0.31	0.63	5.41
	Total	**8.31**	**4.52**	**3.26**	**2.42**	**2.78**	**6.89**	**11.77**	**6.21**	**5.72**	**9.19**	**11.40**	**5.83**	**3.03**	**3.16**	**6.30**	**9.13**	**99.92**

Table A.2. Radionuclide Data on Clearance Type, Particle Size, Scavenging Coefficient, and Deposition Velocity Used for CAP88-PC Version 3 Dose Calculations

Radionuclide	Clearance Type[(a)]	Particle Size (1 m)	Scavenging Coefficient (per second)	Deposition Velocity (m/s)
^{3}H (vapor)	V	0	0	0
^{3}H (elemental)	G	0	0	0
^{47}Ar	G	0	0	0
^{60}Co	M	1	1.60 E-06	1.80 E-03
^{57}Ni	M	1	1.60 E-06	1.80 E-03
^{83m}Kr	G	0	0	0
^{85}Kr	G	0	0	0
^{90}Sr	M	1	1.60 E-06	1.80 E-03
^{109}Cd	M	1	1.60 E-06	1.80 E-03
^{131}I	F	1	1.60 E-06	0.035
^{132}I	F	1	1.60 E-06	0.035
^{133}I	F	1	1.60 E-06	0.035
^{127}Xe	G	0	0	0
^{133}Xe	G	0	0	0
^{133m}Xe	G	0	0	0
^{135}Xe	G	0	0	0
^{137}Cs	F	1	1.60 E-06	1.80 E-03
^{140}Ba	M	1	1.60 E-06	1.80 E-03
^{140}La	M	1	1.60 E-06	1.80 E-03
^{194}Au[(b)]	M	1	1.60 E-06	1.80 E-03
^{210}Pb	M	1	1.60 E-06	1.80 E-03
^{220}Rn	G	0	0	0
^{222}Rn	G	0	0	0
^{226}Ra	M	1	1.60 E-06	1.80 E-03
^{233}U	M	1	1.60 E-06	1.80 E-03
^{234}U	M	1	1.60 E-06	1.80 E-03
^{235}U	M	1	1.60 E-06	1.80 E-03
^{236}U	M	1	1.60 E-06	1.80 E-03
^{239}Pu	M	1	1.60 E-06	1.80 E-03
^{241}Pu	M	1	1.60 E-06	1.80 E-03
^{240}Am	M	1	1.60 E-06	1.80 E-03
^{241}Am	M	1	1.60 E-06	1.80 E-03
^{243}Am	M	1	1.60 E-06	1.80 E-03
^{244}Cm	M	1	1.60 E-06	1.80 E-03

(a) V = vapor (water vapor for tritium); G = gas (elemental gas for tritium); M = particulate, moderate clearance rate; F = particulate, fast clearance rate.
(b) Also used as surrogate for ^{196}Au.

Table A.3. Radionuclide Data on Decay Constant and Transfer Coefficient Used for CAP88-PC Version 3 Dose Calculations

	Decay Constant (per day)			Transfer Coefficient	
Radionuclide	**Radioactive**	**Surface**	**Water**	**Milk[(a)]**	**Meat[(b)]**
^{3}H (vapor)	1.54 E-04	5.48 E-05	0	0	0
^{3}H (elemental)	1.54 E-04	5.48 E-05	0	0	0
^{47}Ar	1.98 E-02	5.48 E-05	0	0	0
^{60}Co	3.60 E-04	5.48 E-05	0	2.00 E-03	3.00 E-02
^{57}Ni	4.61 E-01	5.48 E-05	0	2.00 E-02	5.00 E-03
^{83m}Kr	9.09 E+00	5.48 E-05	0	0	0
^{85}Kr	1.77 E-04	5.48 E-05	0	0	0
^{90}Sr	6.52 E–05	5.48 E-05	0	2.00 E-03	1.00 E-02
^{109}Cd	1.49 E-03	5.48 E-05	0	2.00 E-03	1.00 E-03
^{131}I	8.62 E-02	5.48 E-05	0	1.00 E-02	4.00 E-02
^{132}I	7.23 E+00	5.48 E-05	0	1.00 E-02	4.00 E-02
^{133}I	8.00 E-01	5.48 E-05	0	1.00 E-02	4.00 E-02
^{127}Xe	1.90 E-02	5.48 E-05	0	0	0
^{133}Xe	1.32 E-01	5.48 E-05	0	0	0
^{133m}Xe	3.17E-01	5.48 E-05	0	0	0
^{135}Xe	1.83 E+00	5.48 E-05	0	0	0
^{137}Cs	6.32 E–05	5.48 E-05	0	1.00 E-02	5.00 E-02
^{140}Ba	5.44 E-02	5.48 E-05	0	5.00 E-04	2.00 E-04
^{140}La	4.13 E-01	5.48 E-05	0	6.00 E-05	2.00 E-03
^{194}Au[(c)]	4.21 E-01	5.48 E-05	0	1.00 E-05	5.00 E-03
^{210}Pb	8.51 E-05	5.48 E-05	0	3.00 E-04	8.00 E-04
^{220}Rn	1.08 E+03	5.48 E-05	0	0	0
^{222}Rn	1.81 E-01	5.48 E-05	0	0	0
^{226}Ra	1.19 E-06	5.48 E-05	0	1.00 E-03	2.00 E-03
^{233}U	1.20 E-08	5.48 E-05	0	4.00 E-04	8.00 E-04
^{234}U	7.76 E-09	5.48 E-05	0	4.00 E-04	8.00 E-04
^{235}U	2.70 E-12	5.48 E-05	0	4.00 E-04	8.00 E-04
^{236}U	8.10 E-11	5.48 E-05	0	4.00 E-04	8.00 E-04
^{239}Pu	7.88 E-08	5.48 E-05	0	1.00 E-06	1.00 E-04
^{241}Pu	1.32 E-04	5.48 E-05	0	1.00 E-06	1.00 E-04
^{240}Am	3.27 E-01	5.48 E-05	0	2.00 E-06	5.00 E-05
^{241}Am	4.39 E-06	5.48 E-05	0	2.00 E-06	5.00 E-05
^{243}Am	2.57 E-07	5.48 E-05	0	2.00 E-06	5.00 E-05
^{244}Cm	6.66 E-05	5.48 E-05	0	2.00 E-06	2.00 E-05

(a) Fraction of animal's daily intake of nuclide that appears in each liter of milk, in days/L.
(b) Fraction of animal's daily intake of nuclide that appears in each kg of meat, in days/kg.
(c) Also used as surrogate for ^{196}Au.

Table A.4. Radionuclide Data on Concentration Uptake Factor and Gastric Intestinal Uptake Fraction Used for CAP88-PC Version 3 Dose Calculations

	Concentration Uptake Factor		GI Uptake Fraction	
Radionuclide	**Forage[(a)]**	**Edible[(b)]**	**Inhalation**	**Ingestion**
^{3}H (vapor)	0	0	1.00 E+00	1.00 E+00
^{3}H (elemental)	0	0	1.00 E+00	1.00 E+00
^{47}Ar	0	0	0	0
^{60}Co	2.00 E+00	8.00 E-02	1.00 E-01	1.00 E-01
^{57}Ni	1.00 E+00	5.00 E-02	5.00 E-02	5.00 E-02
^{83m}Kr	0	0	0	0
^{85}Kr	0	0	0	0
^{90}Sr	4.00 E+00	3.00 E-01	3.00 E-01	3.00 E-01
^{109}Cd	1.00 E+00	5.00 E-01	5.00 E-02	5.00 E-02
^{131}I	1.00 E-01	2.00 E-02	1.00 E+00	1.00 E+00
^{132}I	1.00 E-01	2.00 E-02	1.00 E+00	1.00 E+00
^{133}I	1.00 E-01	2.00 E-02	1.00 E+00	1.00 E+00
^{127}Xe	0	0	0	0
^{133}Xe	0	0	0	0
^{133m}Xe	0	0	0	0
^{135}Xe	0	0	0	0
^{137}Cs	1.00 E+01	2.00 E-01	1.00 E+00	1.00 E+00
^{140}Ba	1.00 E-01	1.00 E-02	2.00 E-01	2.00 E-01
^{140}La	1.00 E-01	2.00 E-03	5.00 E-04	5.00 E-04
^{194}Au[(c)]	4.00 E-01	1.00 E-01	1.00 E-01	1.00 E-01
^{210}Pb	1.00 E-01	4.00 E-03	2.00 E-01	2.00 E-01
^{220}Rn	0	0	0	0
^{222}Rn	0	0	0	0
^{226}Ra	2.00 E-01	4.00 E-02	2.00 E-01	2.00 E-01
^{233}U	1.00 E-01	2.00 E-03	2.00 E-02	2.00 E-02
^{234}U	1.00 E-01	2.00 E-03	2.00 E-02	2.00 E-02
^{235}U	1.00 E-01	2.00 E-03	2.00 E-02	2.00 E-02
^{236}U	1.00 E-01	2.00 E-03	2.00 E-02	2.00 E-02
^{239}Pu	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{241}Pu	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{240}Am	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{241}Am	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{243}Am	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{243}Cm	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04

GI = gastric intestinal
(a) Concentration factor for uptake from soil for pasture and forage, pCi/kg dry weight per pCi/kg dry soil.
(b) Concentration factor for uptake from soil by edible parts of crops, pCi/kg wet weight per pCi/kg dry soil.
(c) Also used as surrogate for ^{196}Au.

Table A.5. 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) = 9.70 E+05

SOIL PARAMETERS
Effective surface density, kg/sq m, dry weight
(assumes 15-cm plow layer) = 2.24 E+02

BUILDUP TIMES
For activity in soil (yr) = 5.00 E+01
For radionuclides deposited on ground/water (d) = 1.83E+04

DELAY TIMES
Ingestion of pasture grass by animals (hr) = 0.00 E+00
Ingestion of stored feed by animals (hr) = 2.40 E+03
Ingestion of leafy vegetables by man (hr) = 2.40 E+01
Ingestion of produce by man (hours) = 1.20 E+02
Transport time from animal feed-milk-man (d) = 2.00 E+00
Time from slaughter to consumption (d) = 1.50 E+01

WEATHERING
Removal rate constant for physical loss (per hr) = 3.00 E–03

CROP EXPOSURE DURATION
Pasture grass (hr) = 7.20 E+02
Crops/leafy vegetables (hr) = 2.16 E+03

AGRICULTURAL PRODUCTIVITY
Grass-cow-milk-man pathway (kg/m^2) = 3.00 E–01
Produce/leafy veg for human consumption (kg/m^2) = 2.00 E+00

FALLOUT INTERCEPTION FRACTIONS
Vegetables = 2.50 E-01
Pasture = 2.50 E-01

GRAZING PARAMETERS
Fraction of year animals graze on pasture = 7.50 E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture = 1.00 E+00

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

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

Table A.5. (contd)

DECONTAMINATION
Fraction of radioactivity retained after washing
or leafy vegetables and produce = 1.00 E+00

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) = 2.20 E+02
Milk ingestion (L/yr) = 2.70 E+02
Meat ingestion (kg/yr) = 9.80 E+01
Leafy vegetable ingestion (kg/yr) = 3.00 E+01

SWIMMING PARAMETERS
Fraction of time spent swimming = 1.00 E-02
Dilution depth for water (cm) = 1.00 E+00

EXTERNAL DOSE
Ground surface contamination correction factor = 1.00 E+00

The following meteorological data describe the PNNL Campus for application in CAP88-PC Version 3 (EPA 2013).

Table A.6. PNNL Campus Meteorological Data — General Information

HEIGHT OF LID
LIDAI = 1,000 m

RAINFALL RATE
RR = 16 cm/yr

AVERAGE AIR TEMPERATURE
A = 12.0 degrees C (53.6 degrees F; 285.2 K)

SURFACE ROUGHNESS LENGTH
0 = 0.010 m

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

STABILITY E	0.073
STABILITY F	0.109
STABILITY G	0.146

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Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2014

Appendix B
List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2014

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Campus in 2014

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

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Appendix C

Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2014

Appendix C
Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2014

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 qualtitation limit. 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 2014

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	341128001	26-Dec-13	08-Jan-14	ALPHA	1.3E-03	pCi/m3	5.3E-04	5.4E-04				
PNL-1	FILTER2 SOLAR	341953001	08-Jan-14	22-Jan-14	ALPHA	1.3E-03	pCi/m3	4.2E-04	4.2E-04				
PNL-1	FILTER2 SOLAR	342584001	22-Jan-14	05-Feb-14	ALPHA	8.3E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-1	FILTER2 SOLAR	343324001	05-Feb-14	19-Feb-14	ALPHA	8.1E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-1	FILTER2 SOLAR	344428001	19-Feb-14	05-Mar-14	ALPHA	1.2E-03	pCi/m3	4.3E-04	4.4E-04				
PNL-1	FILTER2 SOLAR	344879001	05-Mar-14	18-Mar-14	ALPHA	1.6E-04	pCi/m3	2.5E-04	2.5E-04	U			
PNL-1	FILTER2 SOLAR	345826001	18-Mar-14	02-Apr-14	ALPHA	2.7E-04	pCi/m3	2.6E-04	2.6E-04	U			
PNL-1	FILTER2 SOLAR	347308001	02-Apr-14	16-Apr-14	ALPHA	5.5E-04	pCi/m3	4.0E-04	4.0E-04	U			
PNL-1	FILTER2 SOLAR	347832001	16-Apr-14	30-Apr-14	ALPHA	5.4E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-1	FILTER2 SOLAR	348885001	30-Apr-14	14-May-14	ALPHA	8.9E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-1	FILTER2 SOLAR	349627001	14-May-14	28-May-14	ALPHA	4.5E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-1	FILTER2 SOLAR	350907001	28-May-14	11-Jun-14	ALPHA	6.7E-04	pCi/m3	4.5E-04	4.5E-04				
PNL-1	FILTER2 SOLAR	351415001	11-Jun-14	25-Jun-14	ALPHA	4.5E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-1	FILTER2 SOLAR		25-Jun-14	09-Jul-14	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP14-004. SAMPLER NOT RUNNING. REPLACED #22494 WITH #24094, EXPIRES 05/16/15.		
PNL-1	FILTER2 SOLAR	353441001	09-Jul-14	23-Jul-14	ALPHA	3.9E-04	pCi/m3	3.1E-04	3.1E-04	U			
PNL-1	FILTER2 SOLAR	354371001	23-Jul-14	06-Aug-14	ALPHA	1.0E-03	pCi/m3	4.2E-04	4.2E-04		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-1	FILTER2 SOLAR	355277001	06-Aug-14	20-Aug-14	ALPHA	5.6E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-1	FILTER2 SOLAR	355996001	20-Aug-14	03-Sep-14	ALPHA	6.0E-04	pCi/m3	3.7E-04	3.8E-04				
PNL-1	FILTER2 SOLAR	357092001	03-Sep-14	17-Sep-14	ALPHA	5.4E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-1	FILTER2 SOLAR	358054001	17-Sep-14	01-Oct-14	ALPHA	6.8E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-1	FILTER2 SOLAR	359392001	01-Oct-14	15-Oct-14	ALPHA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-1	FILTER2 SOLAR	360326001	15-Oct-14	29-Oct-14	ALPHA	5.0E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-1	FILTER2 SOLAR	361345001	29-Oct-14	12-Nov-14	ALPHA	3.4E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-1	FILTER2 SOLAR	362240001	12-Nov-14	26-Nov-14	ALPHA	1.7E-03	pCi/m3	5.1E-04	5.1E-04				
PNL-1	FILTER2 SOLAR	363046001	26-Nov-14	10-Dec-14	ALPHA	1.4E-03	pCi/m3	4.9E-04	5.0E-04				
PNL-1	FILTER2 SOLAR	363755001	10-Dec-14	23-Dec-14	ALPHA	1.1E-03	pCi/m3	4.0E-04	4.0E-04				
PNL-1	FILTER2 SOLAR	364609001	23-Dec-14	07-Jan-15	ALPHA	1.4E-03	pCi/m3	4.3E-04	4.3E-04		AS-FOUND FLOW RATE LOW AT 0.08 CFM; 15-DAY SAMPLE PERIOD, FILTER PAPER APPEARED DAMP.		
PNL-1	FILTER2 SOLAR	341128001	26-Dec-13	08-Jan-14	BETA	3.7E-02	pCi/m3	1.7E-03	2.0E-03				
PNL-1	FILTER2 SOLAR	341953001	08-Jan-14	22-Jan-14	BETA	3.3E-02	pCi/m3	1.6E-03	1.9E-03				
PNL-1	FILTER2 SOLAR	342584001	22-Jan-14	05-Feb-14	BETA	4.1E-02	pCi/m3	1.7E-03	2.2E-03				
PNL-1	FILTER2 SOLAR	343324001	05-Feb-14	19-Feb-14	BETA	2.2E-02	pCi/m3	1.3E-03	1.6E-03				
PNL-1	FILTER2 SOLAR	344428001	19-Feb-14	05-Mar-14	BETA	2.8E-02	pCi/m3	1.4E-03	1.5E-03				
PNL-1	FILTER2 SOLAR	344879001	05-Mar-14	18-Mar-14	BETA	9.8E-03	pCi/m3	9.3E-04	1.0E-03				
PNL-1	FILTER2 SOLAR	345826001	18-Mar-14	02-Apr-14	BETA	9.9E-03	pCi/m3	8.5E-04	9.4E-04				
PNL-1	FILTER2 SOLAR	347308001	02-Apr-14	16-Apr-14	BETA	1.3E-02	pCi/m3	9.9E-04	1.0E-03				
PNL-1	FILTER2 SOLAR	347832001	16-Apr-14	30-Apr-14	BETA	1.0E-02	pCi/m3	8.9E-04	9.8E-04				
PNL-1	FILTER2 SOLAR	348885001	30-Apr-14	14-May-14	BETA	1.4E-02	pCi/m3	1.1E-03	1.1E-03				
PNL-1	FILTER2 SOLAR	349627001	14-May-14	28-May-14	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-1	FILTER2 SOLAR	350907001	28-May-14	11-Jun-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03				

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-1	FILTER2 SOLAR	351415001	11-Jun-14	25-Jun-14	BETA	9.7E-03	pCi/m3	8.7E-04	8.9E-04				
PNL-1	FILTER2 SOLAR		25-Jun-14	09-Jul-14	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY RPT EMP14-004. SAMPLER NOT RUNNING. REPLACED #22494 WITH #24094, EXPIRES 05/16/15.		
PNL-1	FILTER2 SOLAR	353441001	09-Jul-14	23-Jul-14	BETA	2.0E-02	pCi/m3	1.2E-03	1.5E-03				
PNL-1	FILTER2 SOLAR	354371001	23-Jul-14	06-Aug-14	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-1	FILTER2 SOLAR	355277001	06-Aug-14	20-Aug-14	BETA	2.0E-02	pCi/m3	1.3E-03	1.4E-03				
PNL-1	FILTER2 SOLAR	355996001	20-Aug-14	03-Sep-14	BETA	1.7E-02	pCi/m3	1.1E-03	1.3E-03				
PNL-1	FILTER2 SOLAR	357092001	03-Sep-14	17-Sep-14	BETA	2.1E-02	pCi/m3	1.3E-03	1.3E-03				
PNL-1	FILTER2 SOLAR	358054001	17-Sep-14	01-Oct-14	BETA	2.1E-02	pCi/m3	1.2E-03	1.3E-03				
PNL-1	FILTER2 SOLAR	359392001	01-Oct-14	15-Oct-14	BETA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-1	FILTER2 SOLAR	360326001	15-Oct-14	29-Oct-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.2E-03				
PNL-1	FILTER2 SOLAR	361345001	29-Oct-14	12-Nov-14	BETA	1.5E-02	pCi/m3	1.1E-03	1.2E-03				
PNL-1	FILTER2 SOLAR	362240001	12-Nov-14	26-Nov-14	BETA	6.0E-02	pCi/m3	2.1E-03	2.4E-03				
PNL-1	FILTER2 SOLAR	363046001	26-Nov-14	10-Dec-14	BETA	4.2E-02	pCi/m3	1.7E-03	2.2E-03				
PNL-1	FILTER2 SOLAR	363755001	10-Dec-14	23-Dec-14	BETA	2.6E-02	pCi/m3	1.4E-03	1.7E-03				
PNL-1	FILTER2 SOLAR	364609001	23-Dec-14	07-Jan-15	BETA	4.3E-02	pCi/m3	1.8E-03	2.0E-03		AS-FOUND FLOW RATE LOW AT 0.08 CFM; 15-DAY SAMPLE PERIOD, FILTER PAPER APPEARED DAMP.		
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Be-7	4.5E-02	pCi/m3	9.8E-03	1.1E-02				Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Be-7	3.3E-02	pCi/m3	6.4E-03	6.9E-03				Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Co-60	1.1E-04	pCi/m3	5.7E-04	5.7E-04	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Co-60	-8.2E-05	pCi/m3	2.8E-04	2.9E-04	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Cs-134	-5.6E-04	pCi/m3	5.9E-04	6.4E-04	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Cs-134	-1.3E-04	pCi/m3	3.9E-04	3.9E-04	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Cs-137	-4.3E-04	pCi/m3	5.2E-04	5.6E-04	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Cs-137	-4.2E-05	pCi/m3	3.7E-04	3.7E-04	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Eu-152	6.7E-04	pCi/m3	1.7E-03	1.8E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Eu-152	2.8E-04	pCi/m3	1.0E-03	1.0E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Eu-154	2.0E-04	pCi/m3	1.5E-03	1.5E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Eu-154	4.7E-05	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Eu-155	-5.2E-04	pCi/m3	1.4E-03	1.4E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Eu-155	2.2E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	K-40	-7.7E-04	pCi/m3	6.6E-03	6.6E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	K-40	4.9E-03	pCi/m3	5.6E-03	6.0E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Ru-106	-1.4E-03	pCi/m3	5.2E-03	5.2E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Ru-106	7.6E-04	pCi/m3	3.1E-03	3.1E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Sb-125	1.2E-04	pCi/m3	1.3E-03	1.3E-03	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Sb-125	-5.5E-04	pCi/m3	9.7E-04	1.0E-03	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Am-241	0.0E+00	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Am-241	-2.1E-06	pCi/m3	2.7E-06	2.7E-06	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Am-243	3.8E-06	pCi/m3	3.9E-06	4.0E-06	U			Y

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Am-243	9.4E-07	pCi/m3	3.2E-06	3.2E-06	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Cm-243/244	2.0E-06	pCi/m3	3.9E-06	3.9E-06	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Cm-243/244	-1.7E-06	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Pu-238	-2.6E-07	pCi/m3	1.8E-06	1.8E-06	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Pu-238	-3.7E-07	pCi/m3	1.4E-06	1.4E-06	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	Pu-239/240	0.0E+00	pCi/m3	2.1E-06	2.1E-06	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	Pu-239/240	3.7E-07	pCi/m3	1.8E-06	1.8E-06	U			Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	U-233/234	4.4E-05	pCi/m3	1.2E-05	1.3E-05				Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	U-233/234	4.7E-05	pCi/m3	1.0E-05	1.2E-05				Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	U-235	4.6E-07	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	U-235	5.9E-06	pCi/m3	4.3E-06	4.4E-06				Y
PNL-1	FILTER2 SOLAR	353103001	26-Dec-13	25-Jun-14	U-238	4.0E-05	pCi/m3	1.1E-05	1.2E-05				Y
PNL-1	FILTER2 SOLAR	365310002	09-Jul-14	07-Jan-15	U-238	4.3E-05	pCi/m3	9.4E-06	1.1E-05				Y
PNL-2	FILTER2 SOLAR	341128002	26-Dec-13	08-Jan-14	ALPHA	1.8E-03	pCi/m3	5.2E-04	5.2E-04			REFER TO FOLLOW-UP ANALYSIS #A14-001 AND DISCREPANCY REPORT EMP14-002, ORIGINAL VALUE REPLACED BY RECOUNT VALUE.	
PNL-2	FILTER2 SOLAR	341953002	08-Jan-14	22-Jan-14	ALPHA	8.3E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-2	FILTER2 SOLAR	342584002	22-Jan-14	05-Feb-14	ALPHA	8.0E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-2	FILTER2 SOLAR	343324002	05-Feb-14	19-Feb-14	ALPHA	1.1E-03	pCi/m3	4.1E-04	4.2E-04				
PNL-2	FILTER2 SOLAR	344428002	19-Feb-14	05-Mar-14	ALPHA	9.3E-04	pCi/m3	4.3E-04	4.3E-04				
PNL-2	FILTER2 SOLAR	344879002	05-Mar-14	18-Mar-14	ALPHA	3.7E-04	pCi/m3	3.1E-04	3.1E-04	U			
PNL-2	FILTER2 SOLAR	345826002	18-Mar-14	02-Apr-14	ALPHA	4.0E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-2	FILTER2 SOLAR	347308002	02-Apr-14	16-Apr-14	ALPHA	3.8E-04	pCi/m3	3.1E-04	3.1E-04	U			
PNL-2	FILTER2 SOLAR	347832002	16-Apr-14	30-Apr-14	ALPHA	2.3E-04	pCi/m3	2.9E-04	2.9E-04	U			
PNL-2	FILTER2 SOLAR	348885002	30-Apr-14	14-May-14	ALPHA	4.1E-04	pCi/m3	2.9E-04	2.9E-04		AIR SAMPLER #21710 REPLACED 05/14/14 WITH #24094 BUT FLOW RATE ON PANEL AND AIR FLOW CALIBRATOR READING NOT MATCHING; REPLACED #24094 (RAN FOR 79 MIN) WITH #24095.		
PNL-2	FILTER2 SOLAR	349627002	14-May-14	28-May-14	ALPHA	4.3E-04	pCi/m3	3.1E-04	3.1E-04		DISPLAY PANEL ELAPSED TIME READING IN MINUTES (20,077) CONVERTED TO HOURS (334.6 HRS).		
PNL-2	FILTER2 SOLAR	350907002	28-May-14	11-Jun-14	ALPHA	1.9E-04	pCi/m3	3.1E-04	3.1E-04	U			
PNL-2	FILTER2 SOLAR	351415002	11-Jun-14	25-Jun-14	ALPHA	1.2E-04	pCi/m3	2.2E-04	2.2E-04	U			
PNL-2	FILTER2 SOLAR	352394002	25-Jun-14	09-Jul-14	ALPHA	6.1E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-2	FILTER2 SOLAR		09-Jul-14	23-Jul-14	ALPHA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP14-004. SAMPLER NOT RUNNING. REPLACED #24095 WITH #22974, EXPIRES 01/28/15.		
PNL-2	FILTER2 SOLAR	354371002	23-Jul-14	06-Aug-14	ALPHA	5.5E-04	pCi/m3	3.3E-04	3.3E-04		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-2	FILTER2 SOLAR	355277002	06-Aug-14	20-Aug-14	ALPHA	8.9E-04	pCi/m3	3.6E-04	3.6E-04		DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND		

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
											DISPLAYED REALISTIC MONITORING DATA; FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-2	FILTER2 SOLAR	355996002	20-Aug-14	03-Sep-14	ALPHA	5.5E-04	pCi/m3	3.5E-04	3.5E-04				
PNL-2	FILTER2 SOLAR	357092002	03-Sep-14	17-Sep-14	ALPHA	6.0E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-2	FILTER2 SOLAR	358054002	17-Sep-14	01-Oct-14	ALPHA	2.7E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-2	FILTER2 SOLAR	359392002	01-Oct-14	15-Oct-14	ALPHA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-2	FILTER2 SOLAR	360326002	15-Oct-14	29-Oct-14	ALPHA	3.0E-04	pCi/m3	3.0E-04	3.1E-04	U			
PNL-2	FILTER2 SOLAR	361345002	29-Oct-14	12-Nov-14	ALPHA	4.4E-04	pCi/m3	3.0E-04	3.0E-04				
PNL-2	FILTER2 SOLAR	362240002	12-Nov-14	26-Nov-14	ALPHA	1.6E-03	pCi/m3	5.2E-04	5.2E-04				
PNL-2	FILTER2 SOLAR	363046002	26-Nov-14	10-Dec-14	ALPHA	1.3E-03	pCi/m3	5.0E-04	5.0E-04				
PNL-2	FILTER2 SOLAR	363755002	10-Dec-14	23-Dec-14	ALPHA	7.6E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-2	FILTER2 SOLAR	364609002	23-Dec-14	07-Jan-15	ALPHA	1.0E-03	pCi/m3	3.5E-04	3.5E-04		DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA; 15-DAY SAMPLE PERIOD, FILTER PAPER APPEARED DAMP WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-2	FILTER2 SOLAR	341128002	26-Dec-13	08-Jan-14	BETA	4.3E-02	pCi/m3	1.9E-03	2.1E-03			REFER TO FOLLOW-UP ANALYSIS #A14-001 AND DISCREPANCY REPORT EMP14-002, ORIGINAL VALUE REPLACED BY RECOUNT VALUE.	
PNL-2	FILTER2 SOLAR	341953002	08-Jan-14	22-Jan-14	BETA	3.8E-02	pCi/m3	1.7E-03	1.9E-03				
PNL-2	FILTER2 SOLAR	342584002	22-Jan-14	05-Feb-14	BETA	3.9E-02	pCi/m3	1.8E-03	1.9E-03				
PNL-2	FILTER2 SOLAR	343324002	05-Feb-14	19-Feb-14	BETA	2.0E-02	pCi/m3	1.2E-03	1.5E-03				
PNL-2	FILTER2 SOLAR	344428002	19-Feb-14	05-Mar-14	BETA	2.9E-02	pCi/m3	1.5E-03	1.7E-03				
PNL-2	FILTER2 SOLAR	344879002	05-Mar-14	18-Mar-14	BETA	1.2E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-2	FILTER2 SOLAR	345826002	18-Mar-14	02-Apr-14	BETA	1.1E-02	pCi/m3	8.8E-04	1.0E-03				
PNL-2	FILTER2 SOLAR	347308002	02-Apr-14	16-Apr-14	BETA	1.4E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-2	FILTER2 SOLAR	347832002	16-Apr-14	30-Apr-14	BETA	1.0E-02	pCi/m3	9.0E-04	1.0E-03				
PNL-2	FILTER2 SOLAR	348885002	30-Apr-14	14-May-14	BETA	1.5E-02	pCi/m3	1.1E-03	1.2E-03		AIR SAMPLER #21710 REPLACED 05/14/14 WITH #24094 BUT FLOW RATE ON PANEL AND AIR FLOW CALIBRATOR READING NOT MATCHING; REPLACED #24094 (RAN FOR 79 MINUTES) WITH #24095.		
PNL-2	FILTER2 SOLAR	349627002	14-May-14	28-May-14	BETA	1.3E-02	pCi/m3	9.9E-04	1.1E-03		DISPLAY PANEL ELAPSED TIME READING IN MINUTES (20,077), CONVERTED TO HOURS (334.6 HRS).		
PNL-2	FILTER2 SOLAR	350907002	28-May-14	11-Jun-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.2E-03				
PNL-2	FILTER2 SOLAR	351415002	11-Jun-14	25-Jun-14	BETA	1.0E-02	pCi/m3	8.8E-04	9.0E-04				
PNL-2	FILTER2 SOLAR	352394002	25-Jun-14	09-Jul-14	BETA	1.2E-02	pCi/m3	9.7E-04	1.0E-03				

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-2	FILTER2 SOLAR		09-Jul-14	23-Jul-14	BETA						NO SAMPLE. DO NOT SAVE FOR COMPOSITE. REFER TO DISCREPANCY REPORT EMP14-004. SAMPLER NOT RUNNING. REPLACED #24095 WITH #22974, EXPIRES 01/28/15.		
PNL-2	FILTER2 SOLAR	354371002	23-Jul-14	06-Aug-14	BETA	2.1E-02	pCi/m3	1.3E-03	1.6E-03		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-2	FILTER2 SOLAR	355277002	06-Aug-14	20-Aug-14	BETA	2.0E-02	pCi/m3	1.3E-03	1.4E-03		DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA; FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-2	FILTER2 SOLAR	355996002	20-Aug-14	03-Sep-14	BETA	1.9E-02	pCi/m3	1.2E-03	1.5E-03				
PNL-2	FILTER2 SOLAR	357092002	03-Sep-14	17-Sep-14	BETA	2.7E-02	pCi/m3	1.4E-03	1.5E-03				
PNL-2	FILTER2 SOLAR	358054002	17-Sep-14	01-Oct-14	BETA	2.0E-02	pCi/m3	1.2E-03	1.3E-03				
PNL-2	FILTER2 SOLAR	359392002	01-Oct-14	15-Oct-14	BETA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-2	FILTER2 SOLAR	360326002	15-Oct-14	29-Oct-14	BETA	1.4E-02	pCi/m3	1.1E-03	1.2E-03				
PNL-2	FILTER2 SOLAR	361345002	29-Oct-14	12-Nov-14	BETA	1.6E-02	pCi/m3	1.1E-03	1.3E-03				
PNL-2	FILTER2 SOLAR	362240002	12-Nov-14	26-Nov-14	BETA	6.4E-02	pCi/m3	2.1E-03	2.5E-03				
PNL-2	FILTER2 SOLAR	363046002	26-Nov-14	10-Dec-14	BETA	4.8E-02	pCi/m3	1.8E-03	2.2E-03				
PNL-2	FILTER2 SOLAR	363755002	10-Dec-14	23-Dec-14	BETA	2.4E-02	pCi/m3	1.4E-03	1.6E-03				
PNL-2	FILTER2 SOLAR	364609002	23-Dec-14	07-Jan-15	BETA	4.5E-02	pCi/m3	1.7E-03	1.8E-03		DISPLAY PANEL INDICATED AIR FLOW FAILURE, SAMPLER WAS RUNNING AND DISPLAYED REALISTIC MONITORING DATA; 15-DAY SAMPLE PERIOD, FILTER PAPER APPEARED DAMP WITH SUBSTANTIAL AIRBORNE PARTICLES COLLECTED.		
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Be-7	3.7E-02	pCi/m3	7.0E-03	7.7E-03				Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Be-7	2.7E-02	pCi/m3	7.2E-03	7.6E-03				Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Co-60	6.7E-05	pCi/m3	2.7E-04	2.7E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Co-60	1.5E-04	pCi/m3	2.6E-04	2.7E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Cs-134	4.2E-05	pCi/m3	3.0E-04	3.0E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Cs-134	2.1E-04	pCi/m3	2.9E-04	3.1E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Cs-137	2.4E-04	pCi/m3	3.5E-04	3.7E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Cs-137	-1.4E-04	pCi/m3	2.4E-04	2.5E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Eu-152	-2.9E-04	pCi/m3	7.1E-04	7.2E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Eu-152	4.4E-04	pCi/m3	7.3E-04	7.6E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Eu-154	-2.2E-04	pCi/m3	7.8E-04	7.8E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Eu-154	-2.9E-04	pCi/m3	6.8E-04	7.0E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Eu-155	-1.7E-04	pCi/m3	6.5E-04	6.5E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Eu-155	3.9E-04	pCi/m3	7.8E-04	8.0E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	K-40	2.2E-03	pCi/m3	3.8E-03	3.9E-03	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	K-40	9.5E-04	pCi/m3	3.5E-03	3.5E-03	U			Y

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Ru-106	5.1E-05	pCi/m3	2.4E-03	2.4E-03	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Ru-106	-1.6E-03	pCi/m3	2.7E-03	2.8E-03	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Sb-125	-4.3E-04	pCi/m3	7.1E-04	7.4E-04	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Sb-125	-7.7E-05	pCi/m3	6.8E-04	6.8E-04	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Am-241	2.8E-06	pCi/m3	3.9E-06	3.9E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Am-241	0.0E+00	pCi/m3	3.0E-06	3.0E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Am-243	3.7E-06	pCi/m3	4.3E-06	4.3E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Am-243	-4.9E-07	pCi/m3	3.2E-06	3.2E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Cm-243/244	2.1E-06	pCi/m3	3.7E-06	3.7E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Cm-243/244	0.0E+00	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Pu-238	-2.1E-07	pCi/m3	1.3E-06	1.3E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Pu-238	0.0E+00	pCi/m3	1.2E-06	1.2E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	Pu-239/240	-6.3E-07	pCi/m3	1.8E-06	1.8E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	Pu-239/240	5.6E-07	pCi/m3	2.3E-06	2.3E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	U-233/234	4.0E-05	pCi/m3	1.2E-05	1.3E-05				Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	U-233/234	4.8E-05	pCi/m3	9.4E-06	1.1E-05				Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	U-235	-1.6E-06	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	U-235	2.2E-06	pCi/m3	3.1E-06	3.1E-06	U			Y
PNL-2	FILTER2 SOLAR	353103002	26-Dec-13	25-Jun-14	U-238	4.7E-05	pCi/m3	1.3E-05	1.4E-05				Y
PNL-2	FILTER2 SOLAR	365310003	25-Jun-14	07-Jan-15	U-238	5.0E-05	pCi/m3	9.4E-06	1.1E-05				Y
PNL-3	FILTER2	341128003	26-Dec-13	08-Jan-14	ALPHA	8.4E-04	pCi/m3	3.6E-04	3.6E-04				
PNL-3	FILTER2	341953003	08-Jan-14	22-Jan-14	ALPHA	1.2E-03	pCi/m3	4.0E-04	4.1E-04				
PNL-3	FILTER2	342584003	22-Jan-14	05-Feb-14	ALPHA	9.3E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-3	FILTER2	343324003	05-Feb-14	19-Feb-14	ALPHA	9.1E-04	pCi/m3	3.8E-04	3.9E-04				
PNL-3	FILTER2	344428003	19-Feb-14	05-Mar-14	ALPHA	1.1E-03	pCi/m3	4.1E-04	4.2E-04				
PNL-3	FILTER2	344879003	05-Mar-14	18-Mar-14	ALPHA	4.5E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-3	FILTER2	345826003	18-Mar-14	02-Apr-14	ALPHA	2.6E-04	pCi/m3	1.9E-04	1.9E-04		SECOND POWER OUTLET INSTALLED PERIODIC POWER OUTAGES 03/19/14 - 03/20/14.		
PNL-3	FILTER2	347308003	02-Apr-14	16-Apr-14	ALPHA	4.8E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-3	FILTER2	347832003	16-Apr-14	30-Apr-14	ALPHA	2.2E-04	pCi/m3	1.8E-04	1.8E-04	U			
PNL-3	FILTER2	348885003	30-Apr-14	14-May-14	ALPHA	4.3E-04	pCi/m3	2.5E-04	2.5E-04				
PNL-3	FILTER2	349627003	14-May-14	28-May-14	ALPHA	7.9E-04	pCi/m3	4.1E-04	4.1E-04				
PNL-3	FILTER2	350907003	28-May-14	11-Jun-14	ALPHA	3.2E-04	pCi/m3	3.3E-04	3.3E-04	U			
PNL-3	FILTER2	351415003	11-Jun-14	25-Jun-14	ALPHA	3.8E-04	pCi/m3	2.6E-04	2.6E-04				
PNL-3	FILTER2	352394003	25-Jun-14	09-Jul-14	ALPHA	2.8E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-3	FILTER2	353441003	09-Jul-14	23-Jul-14	ALPHA	4.5E-04	pCi/m3	2.7E-04	2.7E-04				
PNL-3	FILTER2	354371003	23-Jul-14	06-Aug-14	ALPHA	9.2E-04	pCi/m3	3.7E-04	3.7E-04		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-3	FILTER2	355277003	06-Aug-14	20-Aug-14	ALPHA	4.9E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-3	FILTER2	355996003	20-Aug-14	03-Sep-14	ALPHA	3.2E-04	pCi/m3	2.7E-04	2.7E-04	U			
PNL-3	FILTER2	357092003	03-Sep-14	17-Sep-14	ALPHA	4.9E-04	pCi/m3	2.9E-04	2.9E-04				
PNL-3	FILTER2	358054003	17-Sep-14	01-Oct-14	ALPHA	5.8E-04	pCi/m3	3.1E-04	3.1E-04				
PNL-3	FILTER2	359392003	01-Oct-14	15-Oct-14	ALPHA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-3	FILTER2	360326003	15-Oct-14	29-Oct-14	ALPHA	2.7E-04	pCi/m3	2.3E-04	2.3E-04	U			
PNL-3	FILTER2	361345003	29-Oct-14	12-Nov-14	ALPHA	3.7E-04	pCi/m3	2.6E-04	2.6E-04		TOTALIZER #28914 REPLACED WITH TOTALIZER 28915 ON 11/12/14 AT 0955 HRS, START VOLUME 3148, EXPIRES 10/3/15.		
PNL-3	FILTER2	362240003	12-Nov-14	26-Nov-14	ALPHA	1.7E-03	pCi/m3	5.7E-04	5.8E-04				
PNL-3	FILTER2	363046003	26-Nov-14	10-Dec-14	ALPHA	1.2E-03	pCi/m3	4.3E-04	4.3E-04				
PNL-3	FILTER2	363755003	10-Dec-14	23-Dec-14	ALPHA	6.8E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-3	FILTER2	364609003	23-Dec-14	07-Jan-15	ALPHA	1.2E-03	pCi/m3	3.8E-04	3.8E-04				
PNL-3	FILTER2	341128003	26-Dec-13	08-Jan-14	BETA	3.3E-02	pCi/m3	1.6E-03	1.7E-03				
PNL-3	FILTER2	341953003	08-Jan-14	22-Jan-14	BETA	2.6E-02	pCi/m3	1.4E-03	1.5E-03				
PNL-3	FILTER2	342584003	22-Jan-14	05-Feb-14	BETA	3.3E-02	pCi/m3	1.4E-03	1.6E-03				
PNL-3	FILTER2	343324003	05-Feb-14	19-Feb-14	BETA	2.2E-02	pCi/m3	1.3E-03	1.5E-03				
PNL-3	FILTER2	344428003	19-Feb-14	05-Mar-14	BETA	2.6E-02	pCi/m3	1.3E-03	1.4E-03				
PNL-3	FILTER2	344879003	05-Mar-14	18-Mar-14	BETA	8.8E-03	pCi/m3	8.0E-04	8.9E-04				
PNL-3	FILTER2	345826003	18-Mar-14	02-Apr-14	BETA	8.4E-03	pCi/m3	7.6E-04	8.1E-04		SECOND POWER OUTLET INSTALLED PERIODIC POWER OUTAGES 03/19/14 - 03/20/14.		
PNL-3	FILTER2	347308003	02-Apr-14	16-Apr-14	BETA	1.0E-02	pCi/m3	8.2E-04	8.5E-04				
PNL-3	FILTER2	347832003	16-Apr-14	30-Apr-14	BETA	9.1E-03	pCi/m3	8.2E-04	8.8E-04				
PNL-3	FILTER2	348885003	30-Apr-14	14-May-14	BETA	1.2E-02	pCi/m3	9.4E-04	9.7E-04				
PNL-3	FILTER2	349627003	14-May-14	28-May-14	BETA	1.1E-02	pCi/m3	8.8E-04	9.3E-04				
PNL-3	FILTER2	350907003	28-May-14	11-Jun-14	BETA	1.1E-02	pCi/m3	8.9E-04	9.7E-04				
PNL-3	FILTER2	351415003	11-Jun-14	25-Jun-14	BETA	9.0E-03	pCi/m3	8.1E-04	8.3E-04				
PNL-3	FILTER2	352394003	25-Jun-14	09-Jul-14	BETA	1.1E-02	pCi/m3	8.6E-04	8.8E-04				
PNL-3	FILTER2	353441003	09-Jul-14	23-Jul-14	BETA	1.8E-02	pCi/m3	1.1E-03	1.3E-03				
PNL-3	FILTER2	354371003	23-Jul-14	06-Aug-14	BETA	1.9E-02	pCi/m3	1.1E-03	1.3E-03		FILTER PAPER HAD SUBSTANTIAL AIRBORNE PARTICLES COLLECTED, MORE THAN TYPICALLY OBSERVED.		
PNL-3	FILTER2	355277003	06-Aug-14	20-Aug-14	BETA	1.9E-02	pCi/m3	1.1E-03	1.2E-03				
PNL-3	FILTER2	355996003	20-Aug-14	03-Sep-14	BETA	1.4E-02	pCi/m3	9.9E-04	1.2E-03				
PNL-3	FILTER2	357092003	03-Sep-14	17-Sep-14	BETA	2.1E-02	pCi/m3	1.2E-03	1.2E-03				
PNL-3	FILTER2	358054003	17-Sep-14	01-Oct-14	BETA	1.7E-02	pCi/m3	1.1E-03	1.1E-03				
PNL-3	FILTER2	359392003	01-Oct-14	15-Oct-14	BETA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-3	FILTER2	360326003	15-Oct-14	29-Oct-14	BETA	1.2E-02	pCi/m3	8.8E-04	9.8E-04				
PNL-3	FILTER2	361345003	29-Oct-14	12-Nov-14	BETA	1.4E-02	pCi/m3	9.5E-04	9.9E-04		TOTALIZER #28914 REPLACED WITH TOTALIZER 28915 ON 11/12/14 AT 0955 HRS, START VOLUME 3148, EXPIRES 10/3/15.		
PNL-3	FILTER2	362240003	12-Nov-14	26-Nov-14	BETA	6.2E-02	pCi/m3	2.1E-03	2.2E-03				
PNL-3	FILTER2	363046003	26-Nov-14	10-Dec-14	BETA	4.2E-02	pCi/m3	1.7E-03	1.9E-03				
PNL-3	FILTER2	363755003	10-Dec-14	23-Dec-14	BETA	2.3E-02	pCi/m3	1.3E-03	1.6E-03				
PNL-3	FILTER2	364609003	23-Dec-14	07-Jan-15	BETA	4.0E-02	pCi/m3	1.6E-03	1.8E-03				
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Be-7	3.3E-02	pCi/m3	6.5E-03	7.3E-03				Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Be-7	3.0E-02	pCi/m3	1.0E-02	1.1E-02				Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Co-60	4.6E-04	pCi/m3	4.8E-04	5.2E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Co-60	9.5E-05	pCi/m3	4.5E-04	4.5E-04	U			Y

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Cs-134	-1.2E-05	pCi/m3	3.0E-04	3.0E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Cs-134	7.0E-04	pCi/m3	5.7E-04	6.5E-04	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Cs-137	-2.0E-06	pCi/m3	2.8E-04	2.8E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Cs-137	-2.5E-04	pCi/m3	5.3E-04	5.4E-04	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Eu-152	-3.3E-04	pCi/m3	6.9E-04	7.0E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Eu-152	-1.9E-04	pCi/m3	1.5E-03	1.5E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Eu-154	4.1E-04	pCi/m3	7.5E-04	7.7E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Eu-154	-7.3E-04	pCi/m3	1.5E-03	1.5E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Eu-155	3.6E-04	pCi/m3	4.2E-04	4.5E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Eu-155	3.7E-05	pCi/m3	1.0E-03	1.0E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	K-40	2.8E-04	pCi/m3	4.6E-03	4.6E-03	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	K-40	3.5E-03	pCi/m3	5.8E-03	6.0E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Ru-106	7.0E-04	pCi/m3	2.8E-03	2.8E-03	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Ru-106	1.4E-03	pCi/m3	5.3E-03	5.4E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Sb-125	2.0E-04	pCi/m3	7.7E-04	7.8E-04	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Sb-125	-5.1E-04	pCi/m3	1.2E-03	1.3E-03	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Am-241	3.2E-06	pCi/m3	5.6E-06	5.6E-06	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Am-241	7.2E-07	pCi/m3	3.2E-06	3.2E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Am-243	-3.5E-06	pCi/m3	7.5E-06	7.5E-06	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Am-243	7.4E-07	pCi/m3	4.8E-06	4.8E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Cm-243/244	0.0E+00	pCi/m3	3.0E-06	3.0E-06	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Cm-243/244	-1.4E-06	pCi/m3	4.0E-06	4.0E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Pu-238	1.0E-06	pCi/m3	2.5E-06	2.5E-06	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Pu-238	-1.1E-06	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	Pu-239/240	6.7E-07	pCi/m3	2.9E-06	2.9E-06	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	Pu-239/240	2.5E-06	pCi/m3	4.5E-06	4.5E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	U-233/234	3.2E-05	pCi/m3	1.7E-05	1.7E-05				Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	U-233/234	3.7E-05	pCi/m3	1.2E-05	1.3E-05				Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	U-235	9.6E-06	pCi/m3	1.1E-05	1.1E-05	U			Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	U-235	2.1E-06	pCi/m3	4.9E-06	4.9E-06	U			Y
PNL-3	FILTER2	353103003	26-Dec-13	25-Jun-14	U-238	6.1E-05	pCi/m3	2.1E-05	2.3E-05				Y
PNL-3	FILTER2	365310001	25-Jun-14	07-Jan-15	U-238	3.5E-05	pCi/m3	1.2E-05	1.2E-05				Y
PNL-4	FILTER2	341128004	26-Dec-13	08-Jan-14	ALPHA	6.2E-04	pCi/m3	3.7E-04	3.7E-04				
PNL-4	FILTER2	341953004	08-Jan-14	22-Jan-14	ALPHA	1.3E-03	pCi/m3	3.6E-04	3.7E-04		HIGH TOTALIZER READING.		
PNL-4	FILTER2	342584004	22-Jan-14	05-Feb-14	ALPHA	1.1E-03	pCi/m3	4.5E-04	4.5E-04				
PNL-4	FILTER2	343324004	05-Feb-14	19-Feb-14	ALPHA	6.8E-04	pCi/m3	3.4E-04	3.4E-04				
PNL-4	FILTER2	344428004	19-Feb-14	05-Mar-14	ALPHA	8.0E-04	pCi/m3	4.2E-04	4.3E-04				
PNL-4	FILTER2	344879004	05-Mar-14	18-Mar-14	ALPHA	1.1E-04	pCi/m3	2.0E-04	2.0E-04	U			
PNL-4	FILTER2	345826004	18-Mar-14	02-Apr-14	ALPHA	3.0E-04	pCi/m3	2.6E-04	2.6E-04	U			
PNL-4	FILTER2	347308004	02-Apr-14	16-Apr-14	ALPHA	3.6E-04	pCi/m3	3.4E-04	3.4E-04	U			
PNL-4	FILTER2	347832004	16-Apr-14	30-Apr-14	ALPHA	4.1E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-4	FILTER2	348885004	30-Apr-14	14-May-14	ALPHA	6.6E-04	pCi/m3	3.2E-04	3.2E-04				
PNL-4	FILTER2	349627004	14-May-14	28-May-14	ALPHA	6.2E-04	pCi/m3	3.3E-04	3.3E-04				
PNL-4	FILTER2	350907004	28-May-14	11-Jun-14	ALPHA	1.7E-05	pCi/m3	2.3E-04	2.3E-04	U			
PNL-4	FILTER2	351415004	11-Jun-14	25-Jun-14	ALPHA	2.8E-04	pCi/m3	2.9E-04	2.9E-04	U			
PNL-4	FILTER2	352394004	25-Jun-14	09-Jul-14	ALPHA	3.1E-04	pCi/m3	2.6E-04	2.6E-04	U			

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-4	FILTER2	353441004	09-Jul-14	23-Jul-14	ALPHA	4.9E-04	pCi/m3	2.8E-04	2.8E-04				
PNL-4	FILTER2	354371004	23-Jul-14	06-Aug-14	ALPHA	1.1E-03	pCi/m3	3.6E-04	3.7E-04				
PNL-4	FILTER2	355277004	06-Aug-14	20-Aug-14	ALPHA	9.5E-04	pCi/m3	4.4E-04	4.4E-04				
PNL-4	FILTER2	355996004	20-Aug-14	03-Sep-14	ALPHA	3.8E-04	pCi/m3	2.5E-04	2.5E-04				
PNL-4	FILTER2	357092004	03-Sep-14	17-Sep-14	ALPHA	7.6E-04	pCi/m3	3.8E-04	3.9E-04				
PNL-4	FILTER2	358054004	17-Sep-14	01-Oct-14	ALPHA	6.8E-04	pCi/m3	4.2E-04	4.2E-04				
PNL-4	FILTER2	359392004	01-Oct-14	15-Oct-14	ALPHA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-4	FILTER2	360326004	15-Oct-14	29-Oct-14	ALPHA	3.8E-04	pCi/m3	2.9E-04	2.9E-04	U			
PNL-4	FILTER2	361345004	29-Oct-14	12-Nov-14	ALPHA	8.3E-04	pCi/m3	4.1E-04	4.1E-04		TOTALIZER #28919 REPLACED WITH TOTALIZER #28917 ON 11/12/14 AT 1025 HRS, START VOLUME 6109, EXPIRES 10/3/15.		
PNL-4	FILTER2	362240004	12-Nov-14	26-Nov-14	ALPHA	1.7E-03	pCi/m3	5.0E-04	5.0E-04				
PNL-4	FILTER2	363046004	26-Nov-14	10-Dec-14	ALPHA	1.3E-03	pCi/m3	4.5E-04	4.5E-04				
PNL-4	FILTER2	363755004	10-Dec-14	23-Dec-14	ALPHA	8.4E-04	pCi/m3	3.8E-04	3.8E-04				
PNL-4	FILTER2	364609004	23-Dec-14	07-Jan-15	ALPHA	1.1E-03	pCi/m3	3.6E-04	3.6E-04				
PNL-4	FILTER2	341128004	26-Dec-13	08-Jan-14	BETA	3.8E-02	pCi/m3	1.7E-03	1.8E-03				
PNL-4	FILTER2	341953004	08-Jan-14	22-Jan-14	BETA	2.7E-02	pCi/m3	1.1E-03	1.2E-03		HIGH TOTALIZER READING.		
PNL-4	FILTER2	342584004	22-Jan-14	05-Feb-14	BETA	4.0E-02	pCi/m3	1.7E-03	1.8E-03				
PNL-4	FILTER2	343324004	05-Feb-14	19-Feb-14	BETA	2.5E-02	pCi/m3	1.4E-03	1.8E-03				
PNL-4	FILTER2	344428004	19-Feb-14	05-Mar-14	BETA	2.7E-02	pCi/m3	1.4E-03	1.4E-03				
PNL-4	FILTER2	344879004	05-Mar-14	18-Mar-14	BETA	9.0E-03	pCi/m3	8.6E-04	9.7E-04				
PNL-4	FILTER2	345826004	18-Mar-14	02-Apr-14	BETA	9.3E-03	pCi/m3	8.0E-04	8.4E-04				
PNL-4	FILTER2	347308004	02-Apr-14	16-Apr-14	BETA	1.2E-02	pCi/m3	9.5E-04	9.7E-04				
PNL-4	FILTER2	347832004	16-Apr-14	30-Apr-14	BETA	1.1E-02	pCi/m3	8.7E-04	9.2E-04				
PNL-4	FILTER2	348885004	30-Apr-14	14-May-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-4	FILTER2	349627004	14-May-14	28-May-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-4	FILTER2	350907004	28-May-14	11-Jun-14	BETA	1.2E-02	pCi/m3	9.5E-04	1.0E-03				
PNL-4	FILTER2	351415004	11-Jun-14	25-Jun-14	BETA	1.1E-02	pCi/m3	8.8E-04	9.0E-04				
PNL-4	FILTER2	352394004	25-Jun-14	09-Jul-14	BETA	1.3E-02	pCi/m3	9.7E-04	1.0E-03				
PNL-4	FILTER2	353441004	09-Jul-14	23-Jul-14	BETA	1.7E-02	pCi/m3	1.1E-03	1.3E-03				
PNL-4	FILTER2	354371004	23-Jul-14	06-Aug-14	BETA	2.1E-02	pCi/m3	1.2E-03	1.4E-03				
PNL-4	FILTER2	355277004	06-Aug-14	20-Aug-14	BETA	2.0E-02	pCi/m3	1.2E-03	1.5E-03				
PNL-4	FILTER2	355996004	20-Aug-14	03-Sep-14	BETA	1.6E-02	pCi/m3	1.1E-03	1.3E-03				
PNL-4	FILTER2	357092004	03-Sep-14	17-Sep-14	BETA	2.3E-02	pCi/m3	1.3E-03	1.3E-03				
PNL-4	FILTER2	358054004	17-Sep-14	01-Oct-14	BETA	1.9E-02	pCi/m3	1.2E-03	1.2E-03				
PNL-4	FILTER2	359392004	01-Oct-14	15-Oct-14	BETA						NO SAMPLE. REFER TO CARR 141028-912 AND 10/29/14 INCIDENT REPORT, SAMPLE FILTER LOST PRIOR TO ANALYSIS.	SAMPLE FILTER LOST PRIOR TO ANALYSIS.	
PNL-4	FILTER2	360326004	15-Oct-14	29-Oct-14	BETA	1.3E-02	pCi/m3	1.0E-03	1.1E-03				
PNL-4	FILTER2	361345004	29-Oct-14	12-Nov-14	BETA	1.5E-02	pCi/m3	1.1E-03	1.1E-03		TOTALIZER #28919 REPLACED WITH TOTALIZER #28917 ON 11/12/14 AT 1025 HRS, START VOLUME 6109, EXPIRES 10/3/15.		
PNL-4	FILTER2	362240004	12-Nov-14	26-Nov-14	BETA	5.9E-02	pCi/m3	2.1E-03	2.8E-03				
PNL-4	FILTER2	363046004	26-Nov-14	10-Dec-14	BETA	4.1E-02	pCi/m3	1.7E-03	1.9E-03				

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
PNL-4	FILTER2	363755004	10-Dec-14	23-Dec-14	BETA	2.3E-02	pCi/m3	1.3E-03	1.8E-03				
PNL-4	FILTER2	364609004	23-Dec-14	07-Jan-15	BETA	4.1E-02	pCi/m3	1.6E-03	1.9E-03				
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Be-7	4.4E-02	pCi/m3	9.7E-03	1.0E-02				Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Be-7	2.4E-02	pCi/m3	7.8E-03	8.1E-03				Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Co-60	-1.6E-04	pCi/m3	4.3E-04	4.4E-04	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Co-60	-1.8E-04	pCi/m3	5.0E-04	5.1E-04	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Cs-134	0.0E+00	pCi/m3	5.2E-04	0.0E+00	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Cs-134	4.3E-05	pCi/m3	4.9E-04	4.9E-04	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Cs-137	-6.8E-04	pCi/m3	5.5E-04	6.3E-04	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Cs-137	-6.6E-05	pCi/m3	4.8E-04	4.8E-04	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Eu-152	-3.8E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Eu-152	8.6E-04	pCi/m3	1.1E-03	1.2E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Eu-154	6.9E-04	pCi/m3	7.4E-04	8.0E-04	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Eu-154	-4.9E-04	pCi/m3	1.3E-03	1.3E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Eu-155	-1.5E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Eu-155	-8.6E-04	pCi/m3	9.5E-04	1.0E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	K-40	1.8E-03	pCi/m3	4.9E-03	4.9E-03	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	K-40	-1.1E-05	pCi/m3	5.6E-03	5.6E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Ru-106	-1.0E-03	pCi/m3	3.5E-03	3.5E-03	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Ru-106	-2.0E-03	pCi/m3	4.0E-03	4.1E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Sb-125	6.1E-04	pCi/m3	8.1E-04	8.5E-04	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Sb-125	-5.3E-04	pCi/m3	1.1E-03	1.1E-03	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Am-241	0.0E+00	pCi/m3	3.7E-06	3.7E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Am-241	2.9E-06	pCi/m3	3.4E-06	3.4E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Am-243	2.2E-06	pCi/m3	3.4E-06	3.4E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Am-243	0.0E+00	pCi/m3	2.6E-06	2.6E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Cm-243/244	7.6E-07	pCi/m3	4.0E-06	4.0E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Cm-243/244	5.7E-07	pCi/m3	3.3E-06	3.3E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Pu-238	8.1E-07	pCi/m3	1.4E-06	1.4E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Pu-238	3.7E-07	pCi/m3	1.3E-06	1.3E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	Pu-239/240	1.1E-06	pCi/m3	1.8E-06	1.8E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	Pu-239/240	1.5E-06	pCi/m3	2.0E-06	2.0E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	U-233/234	4.7E-05	pCi/m3	1.1E-05	1.3E-05				Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	U-233/234	5.6E-05	pCi/m3	1.1E-05	1.3E-05				Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	U-235	1.2E-06	pCi/m3	3.0E-06	3.1E-06	U			Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	U-235	1.9E-06	pCi/m3	3.3E-06	3.3E-06	U			Y
PNL-4	FILTER2	353103004	26-Dec-13	25-Jun-14	U-238	5.3E-05	pCi/m3	1.2E-05	1.4E-05				Y
PNL-4	FILTER2	365310004	25-Jun-14	07-Jan-15	U-238	3.8E-05	pCi/m3	9.1E-06	1.0E-05				Y
YAKIMA	FILTER1	341340019	23-Dec-13	08-Jan-14	ALPHA	7.6E-04	pCi/m3	3.1E-04	3.1E-04				
YAKIMA	FILTER1	342312019	08-Jan-14	22-Jan-14	ALPHA	9.4E-04	pCi/m3	3.4E-04	3.4E-04				
YAKIMA	FILTER1	343030012	22-Jan-14	05-Feb-14	ALPHA	1.5E-03	pCi/m3	5.0E-04	5.1E-04				
YAKIMA	FILTER1	343976019	05-Feb-14	19-Feb-14	ALPHA	7.4E-04	pCi/m3	3.1E-04	3.1E-04				
YAKIMA	FILTER1	344429012	19-Feb-14	05-Mar-14	ALPHA	1.2E-03	pCi/m3	4.7E-04	4.7E-04				
YAKIMA	FILTER1	345450019	05-Mar-14	19-Mar-14	ALPHA	1.4E-04	pCi/m3	2.3E-04	2.3E-04	U			
YAKIMA	FILTER1	346465018	19-Mar-14	02-Apr-14	ALPHA	2.9E-04	pCi/m3	2.2E-04	2.2E-04	U			
YAKIMA	FILTER1	347310018	02-Apr-14	16-Apr-14	ALPHA	3.2E-04	pCi/m3	2.1E-04	2.1E-04				

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
YAKIMA	FILTER1	348172012	16-Apr-14	30-Apr-14	ALPHA	3.8E-04	pCi/m3	2.1E-04	2.1E-04				
YAKIMA	FILTER1	349129018	30-Apr-14	14-May-14	ALPHA	3.3E-04	pCi/m3	2.6E-04	2.6E-04	U			
YAKIMA	FILTER1	349950018	14-May-14	28-May-14	ALPHA	2.2E-04	pCi/m3	2.0E-04	2.0E-04	U			
YAKIMA	FILTER1	350915003	28-May-14	10-Jun-14	ALPHA	5.1E-04	pCi/m3	2.9E-04	2.9E-04				
YAKIMA	FILTER1	351676007	10-Jun-14	25-Jun-14	ALPHA	3.4E-04	pCi/m3	2.3E-04	2.3E-04				
YAKIMA	FILTER1	352621016	25-Jun-14	09-Jul-14	ALPHA	1.5E-04	pCi/m3	2.3E-04	2.3E-04	U			
YAKIMA	FILTER1	353775008	09-Jul-14	23-Jul-14	ALPHA	5.5E-04	pCi/m3	2.7E-04	2.7E-04				
YAKIMA	FILTER1	354640017	23-Jul-14	06-Aug-14	ALPHA	7.7E-04	pCi/m3	3.2E-04	3.2E-04				
YAKIMA	FILTER1	355605008	06-Aug-14	20-Aug-14	ALPHA	8.9E-04	pCi/m3	4.3E-04	4.4E-04				
YAKIMA	FILTER1	356359016	20-Aug-14	03-Sep-14	ALPHA	4.1E-04	pCi/m3	2.9E-04	2.9E-04	U			
YAKIMA	FILTER1	357586014	03-Sep-14	17-Sep-14	ALPHA	7.2E-04	pCi/m3	3.6E-04	3.6E-04				
YAKIMA	FILTER1	358809011	17-Sep-14	01-Oct-14	ALPHA	7.4E-04	pCi/m3	2.9E-04	2.9E-04				
YAKIMA	FILTER1	359788008	01-Oct-14	15-Oct-14	ALPHA	1.8E-03	pCi/m3	5.1E-04	5.1E-04				
YAKIMA	FILTER1	360540011	15-Oct-14	29-Oct-14	ALPHA	7.5E-04	pCi/m3	3.5E-04	3.6E-04				
YAKIMA	FILTER1	361773008	29-Oct-14	12-Nov-14	ALPHA	7.6E-04	pCi/m3	3.6E-04	3.6E-04				
YAKIMA	FILTER1	362239018	12-Nov-14	24-Nov-14	ALPHA	4.2E-03	pCi/m3	7.9E-04	7.9E-04				
YAKIMA	FILTER1	363524008	24-Nov-14	10-Dec-14	ALPHA	2.1E-03	pCi/m3	5.2E-04	5.2E-04				
YAKIMA	FILTER1	364293011	10-Dec-14	22-Dec-14	ALPHA	1.0E-03	pCi/m3	3.7E-04	3.7E-04				
YAKIMA	FILTER1	341340019	23-Dec-13	08-Jan-14	BETA	2.9E-02	pCi/m3	1.3E-03	1.4E-03				
YAKIMA	FILTER1	342312019	08-Jan-14	22-Jan-14	BETA	2.5E-02	pCi/m3	1.3E-03	1.4E-03				
YAKIMA	FILTER1	343030012	22-Jan-14	05-Feb-14	BETA	3.5E-02	pCi/m3	1.4E-03	1.9E-03				
YAKIMA	FILTER1	343976019	05-Feb-14	19-Feb-14	BETA	2.6E-02	pCi/m3	1.3E-03	1.7E-03				
YAKIMA	FILTER1	344429012	19-Feb-14	05-Mar-14	BETA	2.6E-02	pCi/m3	1.3E-03	1.6E-03				
YAKIMA	FILTER1	345450019	05-Mar-14	19-Mar-14	BETA	7.9E-03	pCi/m3	7.2E-04	7.3E-04				
YAKIMA	FILTER1	346465018	19-Mar-14	02-Apr-14	BETA	8.3E-03	pCi/m3	7.3E-04	7.4E-04				
YAKIMA	FILTER1	347310018	02-Apr-14	16-Apr-14	BETA	1.2E-02	pCi/m3	8.8E-04	9.2E-04				
YAKIMA	FILTER1	348172012	16-Apr-14	30-Apr-14	BETA	8.1E-03	pCi/m3	7.2E-04	7.8E-04				
YAKIMA	FILTER1	349129018	30-Apr-14	14-May-14	BETA	1.2E-02	pCi/m3	8.6E-04	8.9E-04				
YAKIMA	FILTER1	349950018	14-May-14	28-May-14	BETA	1.3E-02	pCi/m3	9.3E-04	9.7E-04				
YAKIMA	FILTER1	350915003	28-May-14	10-Jun-14	BETA	1.3E-02	pCi/m3	8.8E-04	9.2E-04				
YAKIMA	FILTER1	351676007	10-Jun-14	25-Jun-14	BETA	9.2E-03	pCi/m3	7.4E-04	8.0E-04				
YAKIMA	FILTER1	352621016	25-Jun-14	09-Jul-14	BETA	9.7E-03	pCi/m3	7.8E-04	9.2E-04				
YAKIMA	FILTER1	353775008	09-Jul-14	23-Jul-14	BETA	1.6E-02	pCi/m3	1.0E-03	1.2E-03				
YAKIMA	FILTER1	354640017	23-Jul-14	06-Aug-14	BETA	1.9E-02	pCi/m3	1.1E-03	1.4E-03				
YAKIMA	FILTER1	355605008	06-Aug-14	20-Aug-14	BETA	1.7E-02	pCi/m3	1.0E-03	1.2E-03				
YAKIMA	FILTER1	356359016	20-Aug-14	03-Sep-14	BETA	1.5E-02	pCi/m3	9.6E-04	1.1E-03				
YAKIMA	FILTER1	357586014	03-Sep-14	17-Sep-14	BETA	2.0E-02	pCi/m3	1.1E-03	1.4E-03				
YAKIMA	FILTER1	358809011	17-Sep-14	01-Oct-14	BETA	1.7E-02	pCi/m3	1.0E-03	1.0E-03				
YAKIMA	FILTER1	359788008	01-Oct-14	15-Oct-14	BETA	2.0E-02	pCi/m3	1.1E-03	1.2E-03				
YAKIMA	FILTER1	360540011	15-Oct-14	29-Oct-14	BETA	1.2E-02	pCi/m3	8.9E-04	1.0E-03				
YAKIMA	FILTER1	361773008	29-Oct-14	12-Nov-14	BETA	1.4E-02	pCi/m3	9.1E-04	9.9E-04				
YAKIMA	FILTER1	362239018	12-Nov-14	24-Nov-14	BETA	5.6E-02	pCi/m3	2.1E-03	2.3E-03				
YAKIMA	FILTER1	363524008	24-Nov-14	10-Dec-14	BETA	4.0E-02	pCi/m3	1.7E-03	1.8E-03				
YAKIMA	FILTER1	364293011	10-Dec-14	22-Dec-14	BETA	1.8E-02	pCi/m3	1.1E-03	1.3E-03				
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Am-241 (Gamma)	9.3E-05	pCi/m3	3.1E-04	3.1E-04	U			Y

Table C.2. (contd)

Samp Site Name	Samp Mthd	Lab Samp Id	Samp Date Time On	Samp Date Time	Con Short Name	Value Rptd	Anal Units Rptd	Counting Error	Total Anal Error 2-Sigma	Lab Quali-fier	Samp Comment	Result Comment	Com-posite Flag
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Am-241 (Gamma)	-9.7E-05	pCi/m3	1.0E-03	1.0E-03	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Co-60	4.3E-04	pCi/m3	4.9E-04	5.3E-04	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Co-60	-9.6E-05	pCi/m3	2.4E-04	2.4E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Cs-134	8.6E-05	pCi/m3	3.8E-04	3.9E-04	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Cs-134	1.3E-04	pCi/m3	3.1E-04	3.2E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Cs-137	4.0E-06	pCi/m3	3.7E-04	3.7E-04	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Cs-137	1.8E-04	pCi/m3	3.0E-04	3.1E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Eu-152	8.7E-05	pCi/m3	8.5E-04	8.5E-04	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Eu-152	-2.2E-04	pCi/m3	9.0E-04	9.1E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Eu-154	-1.1E-03	pCi/m3	9.6E-04	1.1E-03	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Eu-154	2.3E-04	pCi/m3	7.2E-04	7.3E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Eu-155	6.0E-04	pCi/m3	5.9E-04	6.5E-04	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Eu-155	1.9E-04	pCi/m3	7.8E-04	7.8E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	K-40	8.3E-04	pCi/m3	6.0E-03	6.0E-03	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	K-40	3.5E-03	pCi/m3	4.9E-03	4.9E-03	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Ru-106	3.0E-03	pCi/m3	3.0E-03	3.3E-03	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Ru-106	-3.0E-05	pCi/m3	2.4E-03	2.4E-03	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Sb-125	1.2E-03	pCi/m3	8.4E-04	1.0E-03	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Sb-125	6.2E-04	pCi/m3	7.3E-04	7.9E-04	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Pu-238	-1.3E-06	pCi/m3	1.8E-06	1.8E-06	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Pu-238	1.2E-06	pCi/m3	2.3E-06	2.3E-06	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	Pu-239/240	-9.9E-07	pCi/m3	1.4E-06	1.4E-06	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	Pu-239/240	-1.7E-06	pCi/m3	2.5E-06	2.5E-06	U			Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	U-234	3.7E-05	pCi/m3	8.5E-06	9.7E-06				Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	U-234	3.0E-05	pCi/m3	1.3E-05	1.4E-05				Y
YAKIMA	FILTER1	353665010	23-Dec-13	25-Jun-14	U-235	1.1E-06	pCi/m3	2.2E-06	2.2E-06	U			Y
YAKIMA	FILTER1	367238009	25-Jun-14	22-Dec-14	U-235	3.2E-06	pCi/m3	5.5E-06	5.5E-06	U			Y
YAKIMA	FILTER1		23-Dec-13	25-Jun-14	U-238	3.8E-05	pCi/m3		9.6E-06				Y
YAKIMA	FILTER1		25-Jun-14	22-Dec-14	U-238	2.3E-05	pCi/m3		1.2E-05				Y

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