U.S. DEPARTMENT OF ENERGY

Department of Energy – Office of Science

Pacific Northwest National Laboratory Campus Radionuclide Air Emissions Report for Calendar Year 2013

SF Snyder
JM Barnett
LE Bisping

June 2014

Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

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

Printed in the United States of America

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

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


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

PNNL-20436-4

Department of Energy – Office of Science

Pacific Northwest National Laboratory Campus Radionuclide Air Emissions Report for Calendar Year 2013

SF Snyder
JM Barnett
LE Bisping

June 2014

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

Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

The U.S. Department of Energy (DOE) Office of Science (SC) Pacific Northwest National Laboratory (PNNL) Site is located on the PNNL Campus. Facilities with potential emissions of radioactive materials at the DOE-SC PNNL Campus are research laboratories at the Physical Sciences Facility, Environmental Molecular Sciences Laboratory, 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 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 2013 from PNNL Campus sources is 2E-05 mrem (2E-07 mSv) EDE. The dose from all fugitive sources is 2E-6 mrem (2E-8 mSv) EDE. The dose from radon emissions is 1E-11 mrem (1E-13 mSv) EDE. No nonroutine emissions occurred in 2013. The total radiological dose for 2013 to the MEI from all PNNL Campus radionuclide emissions, including fugitive emissions and radon, is 2E-5 mrem (2E-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-20436-4

DOE-SC
Pacific Northwest National Laboratory Campus
Radionuclide Air Emissions Report
Calendar Year 2013

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

for RES

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

6-19-14

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
ft^2	square feet
HEPA	high-efficiency particulate air (filter)
km	kilometer(s)
LSL	Life Sciences Laboratory
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

Contents

Figures

Tables

1.0 Introduction

This report documents calendar year (CY) 2013 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 (2011), "Radiation Protection—Air Emissions." This report satisfies the annual reporting requirements under the DOE PNNL Campus license, Radioactive Air Emissions License-05, for CY2013 operations. In addition, the report is compatible with the quality principles of 10 CFR 830 (2001), *Nuclear Safety Management*; DOE Order 414.1D (2011), *Quality Assurance*; American Society of Mechanical Engineers (ASME) NQA-1 (2000), *Quality Assurance Requirements for Nuclear Facility Application, 2000 edition*; and U.S. Environmental Protection Agency (EPA) QA/R-5 (2001), *EPA Requirements for Quality Assurance Project Plans*.

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 U.S. 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-05 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

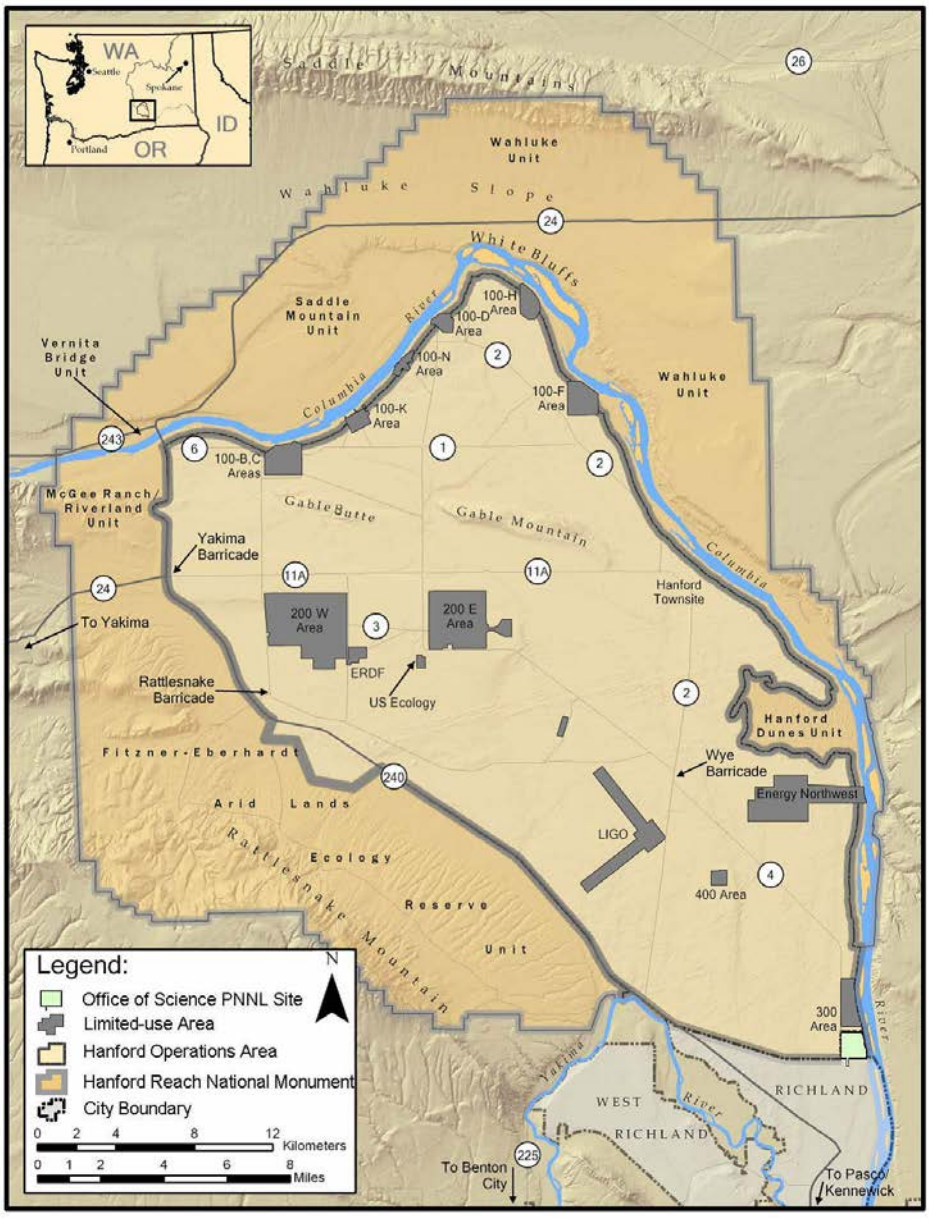

Figure 1.2. Location of the Hanford Site in Relation to the PNNL Campus

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 LSLII. 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 authorized to conduct work with volumetrically released materials and limited non-dispersible materials released from radiological controls.

The nine buildings subject to Subpart H reporting are listed in Table 1.1. The five 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 Facilities 2013

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
3440 Building – Large Detector Laboratory	September 2010[(a)]
3020 Building – Environmental Molecular Sciences Laboratory	2004[(b)]
LSLII – Life Science Laboratory-II	October 2012[(c, d)]
RTL-520 – Research Technology Laboratory-520	October 2012[(d)]
RTL-530 – Research Technology Laboratory Radioactive Storage	October 2012[(d)]

(a) Sealed sources only.
(b) EMSL operations commenced in 1997 and came under DOE-SC oversight in 2004.
(c) Residual contamination in ducts only, no active radiological operations.
(d) 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 2013 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 Potential Impact Category-5 (PIC-5) permits for Campus-wide operations (Table 1.2; Figure 1.3 and Figure 1.1). PIC-5 emissions are very low potential to emit activities that are permitted under the license and conform to PNNL operational controls; emissions are conservatively reported as the permit maximum (Ballinger, Gervais, and Barnett 2012).

Table 1.2. Types of Emission Units Under the DOE PNNL Campus License – 2013

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
EMSL/3020	Environmental Molecular Sciences Laboratory	Fugitive
- /LSLII	Life Science 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
PNNL Campus	Non-dispersible Radioactive Material (NDRM; 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 CY2013 relevant to radioactive airborne emissions monitoring and reporting are summarized as follows:

- A fourth ambient air monitoring station was permanently established in the southern portion of the PNNL Campus to replace a nearby temporary station.
- WDOH approval of PNNL Potential Impact Category-5 (PIC-5) permits for Campus-wide use of volumetrically released radioactive material and for non-dispersible radioactive material.

1.1.3 Prime Contractor

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.

1.1.4 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 2014).

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 four criteria during 2013:

- required continuous monitoring or periodic confirmatory measurements (PCMs) in accordance with 40 CFR 61, Subpart H (2002), and with WAC 246-247 (2011)
- was described in the Washington State Department of Health (WDOH)-issued RAEL-05
- emitted or had the potential to emit radionuclides
- was monitored using effluent sampling.

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)]
3020	J-3020	Fugitive emissions. Activities limited to volumetrically released and non-dispersible materials.	None[(b)]
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

(a) Values are calculated from in-facility material inventories and estimates and 40 CFR 61, Appendix D (1989).
(b) The 3020 Building was exempted from the permitting process for limited work with radioactive materials not considered viable for emissions.

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 114 ft (34.9 m) applied to all PSF main stack emissions. RTL-520 was conservatively modeled with an effective discharge height of 66.3 ft (20.2 m) and LSLII was 65 ft (20 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	28,100 ft^3/min (13.2 m^3/s)	44 ft (13.4 m)	3.3 ft (1.0 m)	115 ft (34.9 m)	Single-stage HEPA filter
Major EP-3420-01-S	39,400 ft^3/min (18.6 m^3/s)	45 ft (13.8 m)	4.3ft (1.3 m)	123 ft (37.6 m)	Single-stage HEPA filter
Major EP-3430-01-S	33,200 ft^3/min (15.7 m^3/s)	44 ft (13.4 m)	3.7 ft (1.1 m)	118 ft (35.8 m)	Single-stage HEPA filter
Minor EP-RTL-10-V	14,000 ft^3/min (6.6 m^3/s)	26 ft (7.9 m)	2.7 ft (0.81 m)	62.3 ft (19.0 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)	70.1 ft (21.4 m)	Single-stage HEPA filter

A point source is designated *major* when hypothetically, in the absence of all pollution-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. A point source is *minor* when under the same hypothetical conditions its potential maximum emissions in the absence of all pollution-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 2013 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 each stack). The single-stage HEPA filter abatement technology listed in the table has a minimum acceptable test criteria rating of 99% efficient.

1.2.2 PNNL Campus Radiological Operations

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.

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.

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.

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.

Environmental Molecular Sciences Laboratory (EMSL)

3020 Building – Environmental Molecular Sciences Laboratory

Since 1997, EMSL has supported world-class research in biological, chemical, and environmental sciences. Research focuses on integrating computational and experimental capabilities. It is a national user facility and has radiological operations limited to sealed source use and authorized work with volumetrically released and non-dispersible materials. Approval of the PNNL Campus PIC-5 permits in 2013 made the EMSL emission unit obsolete.

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.

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.

Life Sciences Laboratory (LSL) 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.

2.0 Radionuclide Air Emissions

This section presents information on quantities of radionuclide emissions at the PNNL Campus. The 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.

Data on 2013 radioactive emissions at the PNNL Campus are provided. There were no emissions from the 3440 Building of PSF; the 3020 Building (EMSL); nor RTL-530 in 2013. Table 2.1 indicates emissions from monitored point sources. Table 2.2 shows the emissions that result in 99% of the dose impact from unmonitored 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 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 2013.

Table 2.1. PNNL Campus Radionuclide Emissions (Ci) from Monitored Point Sources in 2013

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)]	4.69E-08	1.03E-07	4.79E-08	2.61E-09	3.35E-09	2.0E-07
gross β [(a)]	4.26E-07	4.42E-07	2.84E-07	1.53E-08	4.94E-08	1.2E-06
^{3}H	3.31E-06[(b)]	NA	NA	NA	NA	3.3E-06
^{60}Co	ND	7.09E-09	1.48E-08	NA	NA	2.2E-08
^{133}Xe	NA	1.50E-06[(b)]	NA	NA	NA	1.5E-06
^{222}Rn[(c)]	NA	2.05E-09[(b)]	NA	NA	NA	2.1E-09
$^{233/234}U$	NA	NA	1.58E-09	NA	NA	1.6E-09
^{238}Pu	ND	ND	1.19E-11	NA	NA	1.2E-11
$^{239/240}Pu$	4.92E-08	1.11E-07	5.20E-08	NA	NA	2.1E-07
^{241}Am	ND	ND	1.19E-11	NA	NA	1.2E-11
^{243}Am	3.26E-08	4.15E-08	1.96E-08	NA	NA	9.4E-08
^{244}Cm	ND	ND	2.39E-11	NA	NA	2.4E-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
ND = not detected
NA = not applicable

Table 2.2. PNNL Campus Appendix D Calculated Radionuclide Emissions (Ci) from Minor Emissions Units and Fugitive Sources in 2013[(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	1.96E-10	5.29E-11	NA	4.55E-11	NA	2.94E-10
^{57}Ni	5.00E-10	NA	NA	NA	NA	5.00E-10
^{83}Rb	1.50E-08	NA	NA	NA	NA	1.50E-08
^{109}Cd	2.18E-09	3.85E-10	NA	1.05E-09	NA	3.62E-09
^{131}I	1.99E-08	NA	NA	8.83E-12	NA	1.99E-08
^{132}I	2.84E-08	NA	NA	7.85E-12	NA	2.84E-08
^{127}Xe	7.30E-06	NA	NA	NA	NA	7.30E-06
^{133}Xe	9.46E-04	NA	NA	NA	NA	9.46E-04
^{137}Cs	1.21E-08	4.34E-11	NA	3.60E-11	NA	1.22E-08
^{140}Ba	1.97E-08	NA	NA	7.19E-12	NA	1.97E-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	7.07E-10	2.52E-12	NA	3.03E-11	NA	7.40E-10
^{226}Ra	NA	1.19E-09	NA	NA	NA	1.19E-09
$^{233/234}$U	2.13E-08	NA	NA	1.20E-11	NA	2.13E-08
^{235}U	9.12E-10	NA	2.21E-19	5.19E-13	NA	9.13E-10
^{236}U	9.16E-11	NA	NA	5.09E-14	NA	9.17E-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
^{241}Am	8.96E-10	5.73E-11	8.50E-17	3.03E-12	1.25E-11	9.69E-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).
(b) Listed nuclides account for over 99% of dose impact from Appendix D calculated Minor and Fugitive sources in 2013.
(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 2013.
NA = not applicable for the indicated stack

Table 2.3. Non-significant PNNL Campus Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources in 2013

Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)
^{108m}Ag	5.5E-18	^{155}Eu	6.9E-17	^{33}P	3.4E-15	^{85}Sr	2.0E-10
^{110m}Ag	3.1E-16	^{55}Fe	6.7E-18	^{236}Np	3.5E-16	^{89}Sr	1.2E-09
^{242}Am	2.2E-18	^{59}Fe	5.3E-21	^{237}Np	9.9E-18	^{90}Sr	4.7E-12
^{37}Ar[(a)]	3.5E-06	^{203}Hg	1.2E-10	^{234m}Pa	7.3E-17	^{182}Ta	2.6E-13
^{193}Au	5.0E-11	^{133}I	3.2E-08	^{147}Pm	4.3E-12	^{99m}Tc	6.8E-08
^{195}Au	1.4E-10	^{114m}In	2.7E-16	^{149}Pm	1.7E-08	^{127}Te	5.7E-11
^{198}Au	6.3E-10	^{115}In	5.4E-17	^{151}Pm	4.2E-11	^{127m}Te	6.7E-13
^{137m}Ba	4.6E-12	^{115m}In	4.1E-12	^{143}Pr	3.1E-08	^{129}Te	1.7E-10
^{82}Br	1.3E-08	^{192}Ir	1.2E-16	^{144}Pr	1.1E-10	^{129m}Te	2.7E-10
^{47}Ca	2.0E-11	^{83m}Kr[(a)]	6.4E-05	^{144m}Pr	1.5E-12	^{131}Te	1.2E-11
^{111m}Cd	8.9E-16	^{140}La	3.9E-08	^{241}Pu	7.6E-15	^{131m}Te	5.5E-11
^{115}Cd	2.9E-12	^{52}Mn	1.1E-11	^{242}Pu	4.9E-18	^{132}Te	2.8E-08
^{115m}Cd	1.6E-19	^{54}Mn	7.5E-11	^{244}Pu	1.7E-18	^{231}Th	3.5E-12
^{139}Ce	5.4E-11	^{99}Mo	7.5E-08	^{103m}Rh	5.3E-10	^{234}Th	3.3E-15
^{141}Ce	1.2E-08	^{22}Na	1.8E-18	^{105}Rh	1.7E-08	^{238}U	4.8E-11
^{143}Ce	6.4E-08	^{24}Na	1.3E-08	^{103}Ru	5.4E-10	^{131m}Xe[(a)]	1.3E-07
^{144}Ce	1.1E-10	^{94}Nb	6.9E-11	^{106}Ru	1.3E-17	^{133m}Xe[(a)]	1.4E-08
^{252}Cf	5.4E-16	^{95}Nb	2.4E-10	^{35}S	3.4E-15	^{135}Xe[(a)]	4.0E-07
^{56}Co	1.4E-11	^{95m}Nb	4.3E-12	^{125}Sb	3.8E-17	^{88}Y	5.9E-10
^{57}Co	1.7E-10	^{97}Nb	1.9E-08	^{127}Sb	6.0E-11	^{90}Y	2.2E-08
^{58}Co	2.1E-11	^{97m}Nb	1.6E-08	^{46}Sc	1.1E-10	^{91}Y	1.3E-10
^{51}Cr	2.1E-11	^{147}Nd	1.2E-08	^{47}Sc	2.1E-09	^{65}Zn	1.9E-10
^{134}Cs	2.2E-11	^{56}Ni	1.5E-12	^{75}Se	1.8E-10	^{95}Zr	7.1E-10
^{64}Cu	5.5E-13	^{63}Ni	1.3E-19	^{153}Sm	3.5E-11	^{97}Zr	1.7E-08
^{154}Eu	3.6E-11	^{32}P	6.8E-15	^{113}Sn	2.2E-10		
						Total	**6.8E-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 2013

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units[a]	Total (Ci)
gross α [b]	2.0E-07	6.0E-09	2.1E-07
gross β [b]	1.2E-06	6.5E-08	1.3E-06
^{3}H	3.3E-06 [c]	NA	3.3E-06
^{60}Co	2.2E-08	2.9E-10	2.2E-08
^{57}Ni	NA	5.0E-10	5.0E-10
^{83}Rb	NA	1.5E-08	1.5E-08
^{109}Cd	NA	3.6E-09	3.6E-09
^{131}I	NA	2.0E-08	2.0E-08
^{132}I	NA	2.8E-08	2.8E-08
^{127}Xe	NA	7.3E-06[c]	7.3E-06
^{133}Xe	1.5E-06[c]	9.5E-04[c]	9.5E-04
^{137}Cs	NA	1.2E-08	1.2E-08
^{140}Ba	NA	2.0E-08	2.0E-08
^{194}Au	NA	1.1E-09	1.1E-09
^{196}Au	NA	5.0E-09	5.0E-09
^{210}Pb	NA	7.4E-10	7.4E-10
^{226}Ra	NA	1.2E-09	1.2E-09
$^{233/234}U$	1.6E-09	2.1E-08	2.3E-08
^{235}U	NA	9.1E-10	9.1E-10
^{236}U	NA	9.2E-11	9.2E-11
^{238}Pu	1.2E-11	2.9E-17	1.2E-11
$^{239/240}Pu$	2.1E-07	8.6E-16[d]	2.1E-07
^{241}Am	1.2E-11	9.7E-10	9.8E-10
^{243}Am	9.4E-08	2.6E-15	9.4E-08
$^{243/244}Cm$	2.4E-11	NA	2.4E-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

Dose from radiological emissions from the PNNL Campus 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 the 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 (2011).

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. Environmental dispersion and impact models are 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) relative to the PNNL Campus is determined for a public receptor who has the potential to receive the maximum exposure to RAEL-05 permitted emissions. 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. The PNNL Campus locations of nearest public receptors were determined. Information on these nearest receptors is provided in Table 3.1, including distances to the nearest farms that produce milk, meat, and vegetables.

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			
Condominiums (“Condos”)	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, between 9th and 10th St[(b)]	0.75 (0.47) SSE	0.98 (0.61) 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			
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. 2014)			
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 2013 meteorology indicates this would be the region of greatest particulate air concentrations from PSF emissions. This location is 2.56 km S of the Hanford Site 300 Area.

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 CY2013, the Hanford Site MEI was determined to be at the PNNL Campus PSF. This information can be 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 2013 annual meteorological data (Appendix A) were evaluated with CAP88-PC Version 3 model, the 2013 receptor of maximum impact from PSF emissions (i.e., the MEI) was determined to be 750 m SSE of PSF (Figure 3.1). This is 200 m farther afield than last year's MEI location due to flow rate changes at PSF in 2013. 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.

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 with 2013 meteorology and stack characteristics of Table 1.4. The greatest dose impact from facility emissions occurred on George Washington Way, between 9th and 10th Streets, where the Sigma Office Complex is located; as a result, this is the 2013 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. Joint-frequency distributions and 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 (Figure 5.1) and represent the average of hourly data recorded in 2013. Meteorological data for 2013 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 CY2013, the PNNL Campus MEI location was 0.75 km (0.47 mi) SSE of the PSF. The dose to the PNNL Campus MEI from routine and nonroutine point source emissions was 1.7E-5 mrem (1.7E-7 mSv) EDE. Including the PIC-5 category doses increases the total MEI dose to 1.8E-5 mrem (1.8E-7 mSv) EDE. Table 3.2 shows the relative contributions of each nuclide to the MEI dose. Table 3.3 shows the relative dose contribution of each emission point/unit.

For information purposes, the nearby Hanford Site, 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 CY2013 were reviewed. Both the PNNL Campus and the Hanford Site (Rokkan, Perkins, and Snyder 2014) are in compliance with the 10 mrem/yr regulatory standard for CY2013 radiological emissions. The CY2013 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 2013. The same was true in 2012. 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 2014), was estimated to be 1.2E-1 mrem (1.2E-3 mSv) EDE. The majority of the impact from Hanford Site 300 Area emissions to the PNNL Campus MEI is attributable to ^3H emissions (99.99%).[1]

[1] Exclusion of Hanford Site 300 Area tritium emissions results in an estimated dose to the PNNL Site MEI of 8E-6 mrem (8E-8 mSv), the majority of that dose results from the conservative assumptions used to calculate gross alpha and gross beta contributions.

Table 3.2. PNNL Campus 2013 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	3.3E-06	1.4E-09	<1%
^{60}Co	2.2E-08	7.9E-09	<1%
^{57}Ni[a]	5.0E-10	7.9E-12	<1%
^{83}Rb[a]	1.5E-08	4.5E-09	<1%
^{90}Sr [b]	1.2E-06	3.4E-06	**19%**
^{109}Cd[a]	3.6E-09	6.9E-10	<1%
^{131}I[a]	2.0E-08	1.7E-07	1%
^{132}I[a]	2.8E-08	4.5E-11	<1%
^{127}Xe[a]	7.3E-06	1.4E-09	<1%
^{133}Xe[a]	9.5E-04	2.2E-08	<1%
^{137}Cs[b]	1.2E-08	2.9E-07	**2%**
^{140}Ba[a]	2.0E-08	3.6E-09	<1%
^{194}Au[a]	1.1E-09	7.6E-12	<1%
^{196}Au[a]	5.0E-09	7.3E-11	<1%
^{210}Pb[a]	7.4E-10	2.6E-08	<1%
^{226}Ra[a],[c]	1.2E-09	5.1E-08	<1%
$^{233/234}U$	2.3E-08	3.9E-07	2%
^{235}U[a]	9.1E-10	1.5E-08	<1%
^{236}U[a]	9.2E-11	1.5E-09	<1%
^{238}Pu	1.2E-11	4.5E-10	<1%
$^{239/240}Pu$[d]	2.2E-07	9.2E-06	**51%**
^{241}Am[e]	9.8E-10	1.9E-07	1%
^{243}Am	9.4E-08	3.2E-06	**18%**
$^{243/244}Cm$	2.4E-11	6.2E-10	<1%
Table 2.3 nuclides	6.8E-05	9.8E-09	<1%
PIC-5 emissions - VRRM	n/a	9.4E-07[f]	**5%**
PIC-5 emissions - NDRM	n/a	6.6E-08[f]	<1%
Total	**1.0E-03**	**1.8E-05**	**100%[g]**

(a) Release based on 40 CFR 61, Appendix D (1989) or release records.
(b) Gross beta from PSF building monitoring assumed to be ^{90}Sr. Gross beta from RTL-520 monitoring 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 monitoring 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 VRRM and NDRM doses are assigned based on permit value.
(g) Tabulated nuclide-specific values do not add to 100% due to rounding.

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 two PIC-5 permitted emissions, which indicate a maximum dose impacts are included in the table.

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	7.3E-06	41%
PSF / 3410 Building	EP-3410-01-S	Sampled	4.4E-06	24%
PSF / 3430 Building	EP-3430-01-S	Sampled	3.7E-06	20%
Campus	J-VRRM	PIC-5	9.4E-07[(b)]	5.2%
PSF / 3420 Building	EP-3420-02-S	Estimated	9.1E-07	5.1%
RTL / RTL-520	EP-RTL-11-V	Sampled	3.9E-07	2%
RTL / RTL-520	EP-RTL-10-V	Sampled	2.4E-07	1%
Campus	J-NDRM	PIC-5	6.6E-08[(b)]	<1%
PSF / 3430 Building	EP-3430-02-S	Estimated	6.3E-08	<1%
PSF / 3425 Building	J-3425	Estimated	2.5E-09	<1%
LSLII	EP-LSLII-01-V	Estimated	5.6E-10	<1%
LSLII	EP-LSLII-02-V	Estimated	5.6E-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	Estimated	0	0%
EMSL	J-3020	Estimated	0	0%

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

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 CY2013 and past PNNL Campus MEI dose relative to the 10 mrem standard (Snyder, Barnett, and Bisping 2013); it also includes the 2010 through 2013 Hanford Site doses (Rokkan, Perkins, and Snyder 2013; Rokkan, Perkins, and Snyder 2014) 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 (2010 and 2011) and “MEI_PNNL” is the PNNL Campus’s MEI located SSE of PSF.

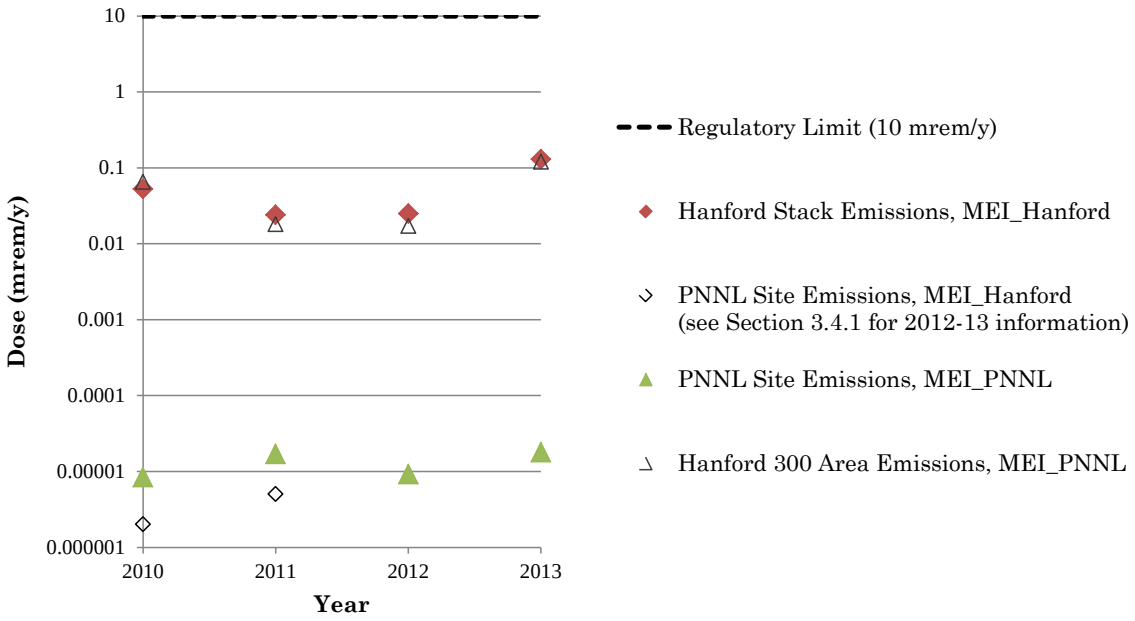

Figure 3.2. Doses to the PNNL Campus and Hanford Site MEIs Due to Emissions from the PNNL Campus and the Hanford Site, 2010 through 2013

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 EDE 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 2E-5 mrem (2E-07 mSv) EDE. There were no nonroutine emissions (refer to section 3.5) in 2013 that would contribute to dose that is considered for compliance determination with the WAC 246-247 (2011) standard.

Dose due to routine major and minor point source emissions is 1.7E-5 mrem (1.7E-7 mSv) EDE. Dose from all fugitive emissions is 2.0E-06 mrem (2.0E-08 mSv), which includes the dose from unsampled licensed sources of 9.8E-7 mrem (9.8E-9 mSv) EDE and the total PIC-5 assigned doses of 1.0E-6 mrem (1.0E-08 mSv) EDE. The dose from radon is 1.2E-11 mrem (1.2E-13 mSv) EDE. The total dose of 2E-5 mrem (2E-7 mSv) EDE is more than 100,000 times smaller than the 10 mrem/yr WAC 246-247 (2011) limit.

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No instances of nonroutine emissions were reported in 2013.

3.6 Additional Compliance Information

3.6.1 Applicability of Stack Emissions Data to Air Emission Permits and Licenses

The WDOH license (RAEL-05) requires that an environmental monitoring program be established for the PNNL Campus as a condition of operation. Environmental monitoring supplements the required stack monitoring 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. One monitoring station location was re-located in 2013, based on Barnett et al. 2012. 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 2013.

3.6.3 Radon-220 and Radon-222 Emissions

^{220}Radon was not emitted from PNNL Campus operations in 2013. However, the 40 CFR 61, Appendix D (1989) estimate of ^{226}Ra emissions includes its progeny ^{222}Rn in the impact estimate (Table 3.2). In addition, 2.05E-9 Ci of ^{222}Rn was emitted from EP-3420-01-S in 2013. This emission resulted in a 2E-11 mrem (2E-13 mSv) EDE dose to the MEI. Radon is exempted 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) (2011), 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 sources not actively ventilated, are not sealed to prevent the escape of volatile or resuspended radioactive material to the ambient air, and are not as amenable to routine sampling in a controlled manner as is done with stacks. Emissions released from buildings to the ambient air via passive ventilation systems are also considered fugitive because they lack a measurable flow. These emissions 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 2013 is described in Section 5.3.

Measuring emissions from point sources (i.e., generally stacks) is ordinarily a prescriptive process, using well-defined technical methods, as described in 40 CFR 61, Subpart H, or alternatives approved by the EPA, and includes applying atmospheric transport models to emissions measured at the facility stack. Subpart H monitoring methods, however, are not intended for, nor amenable to, measuring fugitive emissions.

With respect to dose effects from fugitive emissions, WDOH regulations are consistent with a mutual inter-agency Memorandum of Understanding (DOE 1995), as evidenced by WAC 246-247-010(2), which states that the Subpart H dose standard applies to “point sources, nonpoint sources, and fugitive emissions.” However, WAC 246-247-030(12) acknowledges that some fugitive emissions “are not feasible to directly measure and quantify.” This admission underscores the technical difficulties and inherent complexities in estimating fugitive emissions and their dose effects. 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 2013). The PNNL Campus contains no comparable non-facility-specific fugitive emission sources.

The PNNL Campus has five sources characterized as fugitive sources from Campus facilities. Only one of these (3425 Building) had emissions in 2013. This source and several minor sources were grouped for purposes of estimating the MEI dose with emissions estimated using 40 CFR Part 61, Appendix D (1989) methodologies (Table 2.2 and Table 2.3). Because the PNNL Campus emission units are well characterized, emissions from the fugitive and minor sources have been estimated in this manner, previously approved by WDOH and EPA. For this report, doses from fugitive and minor emission units have been calculated using CAP88-PC Version 3 and are included with the dose from major point source emissions, for purposes of demonstrating compliance with the dose standard. Doses from only the fugitive and minor sources are 2E-6 mrem (2E-8 mSv) EDE.

5.0 Supplemental Information

This section provides supplemental information related to PNNL Campus radionuclide air emissions in 2013 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 2013 was calculated using a simplified method that overestimates the dose (also known as the population 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 (1.8E-5 mrem) times the 50-mi population (432,117). The 2013 total collective dose from radionuclide air emissions estimated in this very conservative manner from nuclides that originate from the PNNL Campus was 0.0078 person-rem (7.8E-5 person-Sv). This represents a small increase over the 2012 estimate of 0.0040 person-rem (Snyder, Barnett, and Bisping 2013).

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 T and Q do not apply to the PNNL Campus for CY2013 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 2013 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 2013, the Hanford Site 300 Area would have contributed most of the non-PNNL particulates detected from offsite facilities.

5.3.1 Environmental Surveillance

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 2013, environmental air surveillance continued to be performed at PNL-1 (solar), PNL-2 (solar), PNL-3 and PNL-4 (Figure 5.1). In June 2013, the temporary PNL-4 station was discontinued; simultaneously a new permanent PNL-4 station was established to cover the same southern extent of the PNNL Campus (Barnett et al. 2012).

CAP88-PC Version 3 modeling was used to calculate an adjustment factor to approximate the PNL-4 particulate air concentrations to model the station results, as if the air was monitored at the permanent PNL-4 position. The adjustment factor was based on full 2013 meteorology rather than just the 6 months that the temporary PNL-4 location was operational. The adjustment factor for PNL-4 was 1.5. Table 5.1 indicates the PNL-4 unadjusted and adjusted results.

Particulate air samples are routinely analyzed for gross alpha activity, gross beta activity, gamma-emitting isotopes, uranium isotopes (^{234}U[1], ^{235}U, and ^{238}U), and plutonium isotopes (^{238}Pu and $^{239/240}$Pu). Gamma-emitting isotope concentrations reported in 2013 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 2013). 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.

[1] ^{234}U is a naturally-occurring radionuclide. It is co-reported with ^{233}U by the analytical laboratory because the emission peaks overlap.

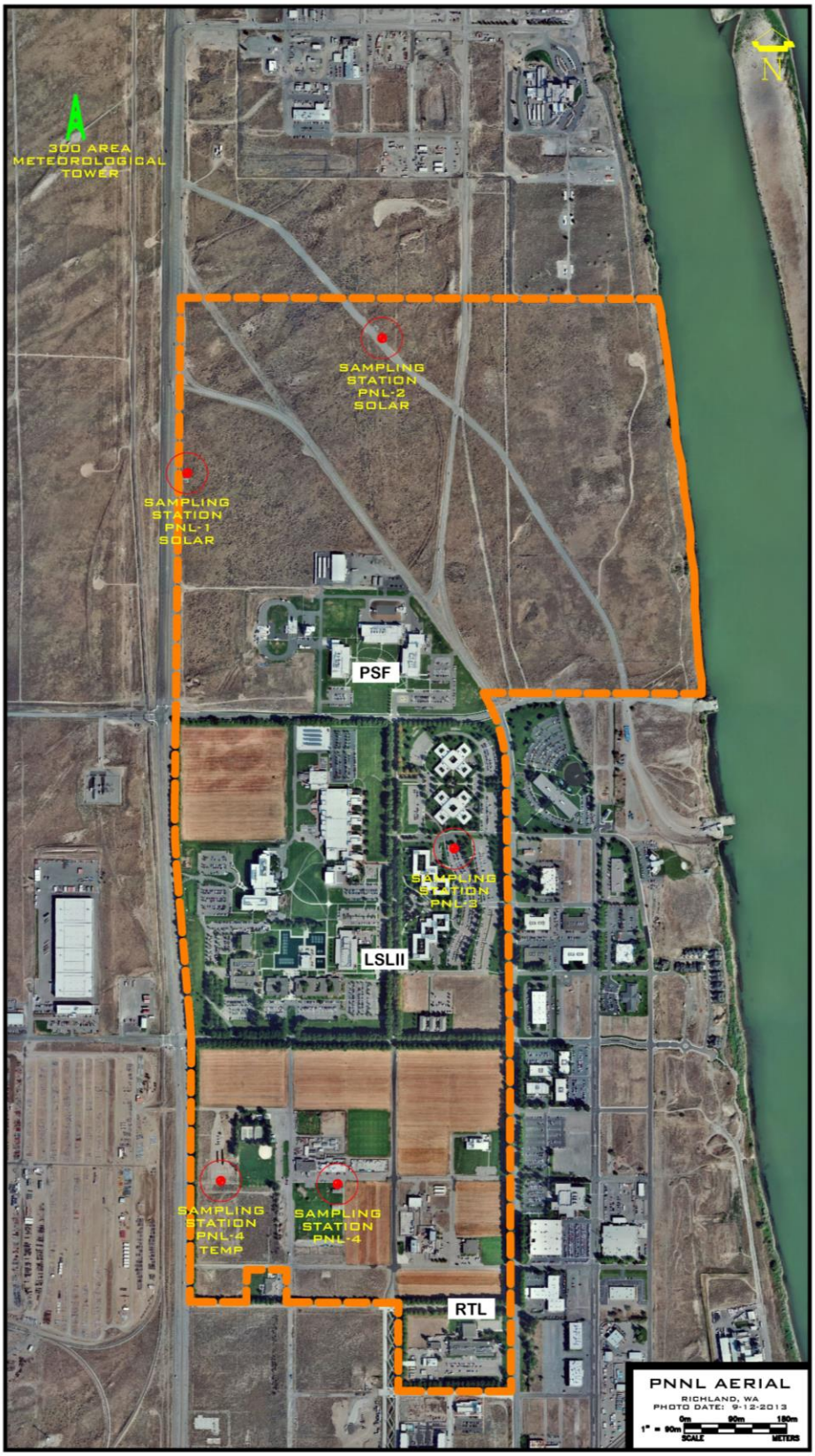

Figure 5.1. Air Surveillance Station Locations for the PNNL Campus

Table 5.1. Summary of 2013 Air Sampling Results for PNL-4

Nuclide	Location[(a)]	No. of Samples	No. of Detections	Value ± Error (pCi/m^3)[(b)]	Adj. Factor[(c)]	Adjusted Value ± Error (pCi/m^3)[(b)]
Gross Alpha	PNL-4 (temp)	13	11	6.5E-04 ± 1.2E-03	1.5	9.8E-04 ± 1.7E-03
	PNL-4	13	8	8.7E-04 ± 1.4E-03	n/a	
Gross Beta	PNL-4 (temp)	13	13	1.9E-02 ± 4.8E-03	1.5	2.9E-02 ± 7.1E-03
	PNL-4	13	13	2.9E-02 ± 6.3E-03	n/a	
^{60}Co	PNL-4 (temp)	1	0	-2.4E-04 ± 3.6E-04	1.5	-1.2E-04 ± 5.4E-04
	PNL-4	1	0	-4.7E-05 ± 2.2E-04	n/a	
$^{233/234}U$	PNL-4 (temp)	1	1	6.2E-05 ± 1.6E-05	1.5	9.3E-05 ± 2.3E-05
	PNL-4	1	1	4.7E-05 ± 1.7E-05	n/a	
^{238}Pu	PNL-4 (temp)	1	0	-3.8E-07 ± 1.7E-06	1.5	-1.9E-07 ± 2.5E-06
	PNL-4	1	0	-2.9E-07 ± 1.3E-06	n/a	
$^{239/240}Pu$	PNL-4 (temp)	1	0	7.6E-07 ± 2.1E-06	1.5	1.1E-06 ± 3.2E-06
	PNL-4	1	0	1.1E-06 ± 1.8E-06	n/a	
^{241}Am	PNL-4 (temp)	1	0	7.5E-07 ± 4.2E-06	1.5	1.1E-06 ± 6.3E-06
	PNL-4	1	0	-2.5E-06 ± 3.2E-06	n/a	
^{243}Am	PNL-4 (temp)	1	0	-2.1E-06 ± 4.8E-06	1.5	-1.1E-06 ± 7.2E-06
	PNL-4	1	0	1.3E-06 ± 5.0E-06	n/a	
$^{243/244}Cm$	PNL-4 (temp)	1	0	-1.7E-06 ± 3.3E-06	1.5	-8.6E-07 ± 4.9E-06
	PNL-4	1	0	-8.9E-07 ± 8.1E-06	n/a	

(a) Refer to Figure 5.1. The temporary PNL-4 air monitoring station was located southwest of the Battelle baseball field and was operational between January–June 2013. An air monitoring station, located approximately 0.32 km (0.20 mi) E from the PNL-4 (temp) location, became the permanent PNL-4 air monitoring station and operated between July–December 2013.

(b) Gross alpha and gross beta results are 13-week averages. Nuclide-specific results are reported or adjusted reported values for each 6-month composite sample. Error is the total analytical error (2σ).

(c) The adjustment factor based on full 2013 meteorology was determined by using modeling program CAP88-PC and applied to PNL-4 (temp) station results for the first half of 2013.

5.3.2 Air Sampling Results for Calendar Year 2013 Operations

The particulate air sampling results are provided in Appendix C for the CY2013 PNNL Campus sampling, as well as the Yakima background station. Results are summarized in Table 5.2 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 (Table 5.2) 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.

Table 5.2. Summary of 2013 Air Sampling Results

Radionuclide	Location[(a)]	No. of Samples	No. of Detections	Average ± Error (pCi/m3)[(b)]			Adjusted Average ± Adjusted Error (pCi/m^3)[(c)]		
Gross Alpha	PNL-1	26	20	7.9E-04	±	1.9E-03			
	PNL-2	26	21	8.9E-04	±	2.0E-03			
	PNL-3	26	21	6.8E-04	±	1.6E-03			
	PNL-4	26	19	7.6E-04	±	1.8E-03	9.2E-04	±	2.2E-03
	Yakima	26	23	8.1E-04	±	1.8E-03			
Gross Beta	PNL-1	26	26	2.5E-02	±	8.7E-03			
	PNL-2	26	26	2.6E-02	±	8.5E-03			
	PNL-3	26	26	2.1E-02	±	7.0E-03			
	PNL-4	26	26	2.4E-02	±	7.9E-03	2.9E-02	±	9.6E-03
	Yakima	26	26	2.1E-02	±	7.0E-03			
^{60}Co	PNL-1	2	0	-1.4E-04	±	4.0E-04			
	PNL-2	2	0	1.4E-04	±	5.0E-05			
	PNL-3	2	0	1.1E-04	±	3.5E-04			
	PNL-4	2	0	-1.4E-04	±	4.2E-04	-8.4E-05	±	5.8E-04
	Yakima	2	0	1.1E-04	±	4.7E-04			
$^{233/234}$U	PNL-1	2	2	4.1E-05	±	2.2E-05			
	PNL-2	2	2	4.7E-05	±	2.3E-05			
	PNL-3	2	2	3.9E-05	±	3.3E-05			
	PNL-4	2	2	5.4E-05	±	2.3E-05	7.0E-05	±	2.9E-05
^{234}U	Yakima	2	2	3.5E-05	±	2.2E-05			
^{238}Pu	PNL-1	2	0	5.3E-07	±	2.9E-06			
	PNL-2	2	0	0.0E+00	±	2.1E-06			
	PNL-3	2	0	4.7E-07	±	4.1E-06			
	PNL-4	2	0	-3.3E-07	±	2.1E-06	-2.4E-07	±	2.8E-06
	Yakima	2	0	0.0E+00	±	1.5E-06			
$^{239/240}$Pu	PNL-1	2	0	1.0E-06	±	2.8E-06			
	PNL-2	2	0	6.4E-07	±	2.7E-06			
	PNL-3	2	1	3.2E-06	±	6.0E-06			
	PNL-4	2	0	9.5E-07	±	2.8E-06	1.1E-06	±	8.6E-06
	Yakima	2	0	1.4E-06	±	2.9E-06			
^{241}Am	PNL-1	2	0	1.0E-06	±	6.7E-06			
	PNL-2	2	0	-5.1E-07	±	4.2E-06			
	PNL-3	2	0	4.7E-07	±	1.4E-05			
	PNL-4	2	0	3.8E-07	±	5.9E-06	5.7E-07	±	8.9E-06
	Yakima	0	0		NA[(d)]				
^{243}Am	PNL-1	2	0	-1.6E-06	±	6.1E-06			
	PNL-2	2	0	1.2E-06	±	6.7E-06			
	PNL-3	2	0	2.4E-06	±	1.5E-05			
	PNL-4	2	0	6.5E-07	±	7.1E-06	6.5E-07[(e)]	±	7.1E-06
	Yakima	0	0		NA[(d)]				
$^{243/244}$Cm	PNL-1	2	0	7.9E-07	±	7.4E-06			
	PNL-2	2	0	9.2E-07	±	8.2E-06			
	PNL-3	2	0	4.1E-06	±	1.6E-05			
	PNL-4	2	0	-1.3E-06	±	8.7E-06	-8.7E-07	±	9.4E-06
	Yakima	0	0		NA[(d)]				

NA = Not Analyzed

(a) Refer to Figure 5.1**.**

(b) The PNL-4 average was calculated using data from the unadjusted PNL-4 (temp) location and the permanent PNL-4 location. Error is the total analytical error (2σ).

(c) The PNL-4 adjusted average is an annual average calculated using data from the adjusted PNL-4 (temp) location and the permanent PNL-4 location. Error is the total analytical error (2σ).

(d) ^{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.

(e) The method used to determine the adjusted value, produced the same result as the original unadjusted value.

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 2012) and in the PNNL Campus Environmental Monitoring Plan (Snyder et al. 2011). The effluent monitoring QA elements described in PNNL (2012) are compatible with one or more of the documents shown in Table 5.3 during CY2013. QA requirements were implemented, as appropriate, at the PNNL Campus as new facilities became operational and programmatic plans were developed.

Table 5.3. 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*
DOE Order 450.1A (2008), *Environmental Protection Program*
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

10 CFR 830. 2001. *Nuclear Safety Management*, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Appendix B. 2000. *Test Methods*, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Appendix D. 1989. *Methods for Estimating Radionuclide Emissions*, U.S. Government Printing Office, Washington, D.C.

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

40 CFR 61, Subpart H. 2002. *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities*, U.S. Government Printing Office, Washington, D.C.

40 CFR 61, Subpart Q. 2000. *National Emission Standards for Radon Emissions from Department of Energy Facilities*, 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.

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

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

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

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

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

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

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

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

DOE Order 450.1A. 2008. *Environmental Protection Program*, U.S. Department of Energy, Washington, D.C.

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

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

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

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

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

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

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

MSA—Mission Support Alliance, LLC. 2013. Annual Hanford Site Environmental Reports, available at http://msa.hanford.gov/page.cfm/EnvironmentalReports2001-latest. Last accessed: May 2014.

PNNL—Pacific Northwest National Laboratory. 2012. *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.

Rhoads K and JM Barnett. 2009. *PNNL Site Dose-per-Unit-Release Factors for Use in Calculating Radionuclide Air Emissions Potential-to-Emit Doses*, PNNL-17847, Rev. 1 [aka CRL-TECH-ESH-007, Rev. 1]. Pacific Northwest National Laboratory, Richland, Washington.

Rokkan DJ, CJ Perkins, and SF Snyder. 2013. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2012*, DOE/RL-2013-12, Revision 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Rokkan DJ, CJ Perkins, and SF Snyder. 2014. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2013*, DOE/RL-2014-14, Revision 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

Snyder SF, JM Barnett, and LE Bisping. 2013. *Pacific Northwest National Laboratory Site Radionuclide Air Emissions Report for Calendar Year 2012*. PNNL-20436-3, 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.

Washington Administrative Code—WAC . 2011. WAC 246-247, "Radiation Protection – Air Emissions." Issued: December, 19, 2011. Washington Administrative Code.

Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

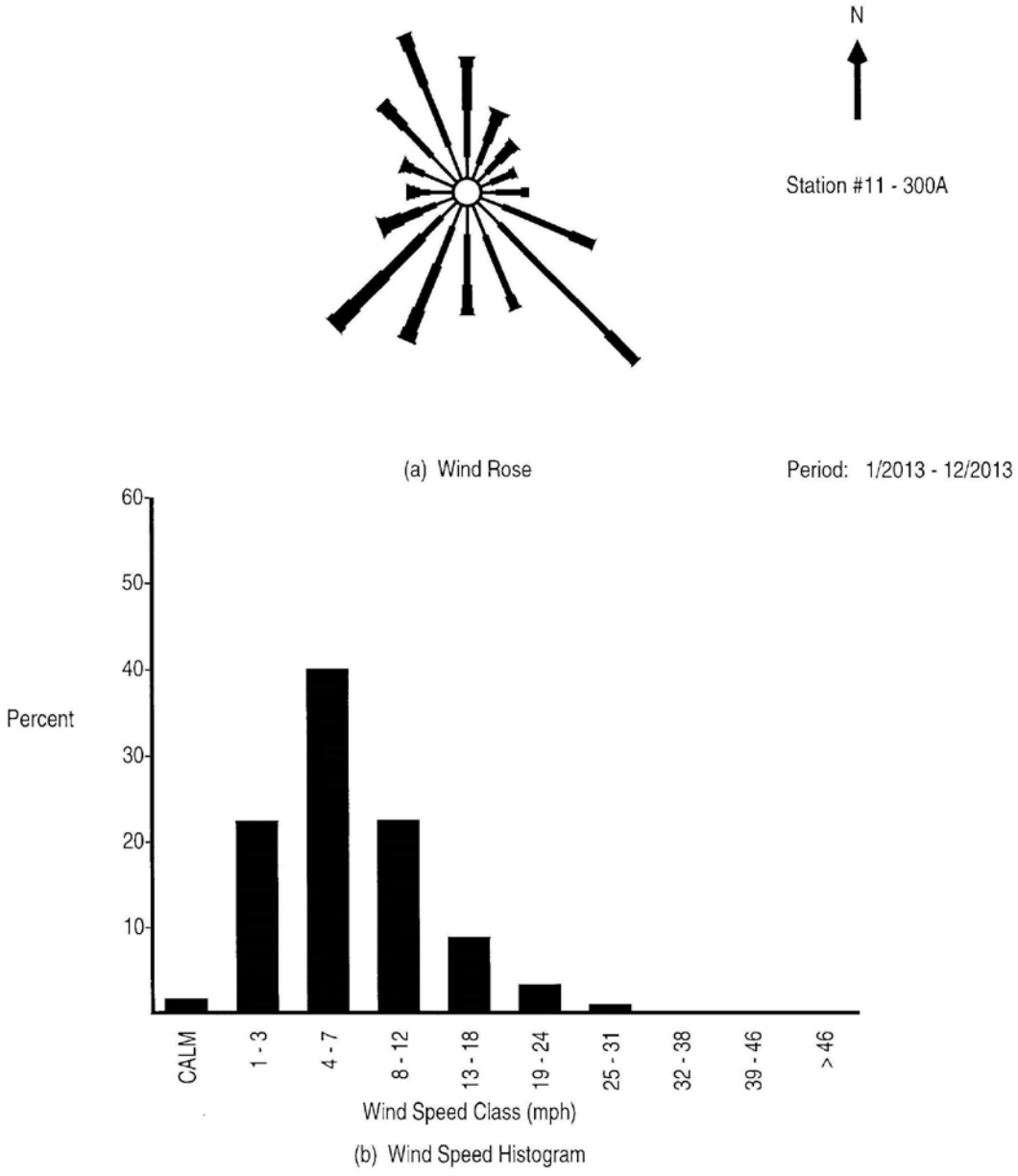

Figure A.1. Hanford Site 300 Area Meteorological Station Wind Rose and Histogram for 2013

Table A.1. Annual Average Joint Frequency during 2012 (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	0.08	0.15	0.11	0.09	0.11	0.15	0.10	0.16	0.07	0.07	0.04	0.05	0.05	0.07	0.06	0.05	1.41
	B	0.01	0.06	0.03	0.01	0.01	0.05	0.01	0	0.03	0.03	0.04	0.02	0	0	0	0.01	0.31
	C	0.01	0.02	0.03	0.07	0.06	0.12	0.09	0.07	0.02	0.02	0.02	0	0	0.01	0	0.02	0.56
	D	0.31	0.27	0.19	0.18	0.18	0.41	0.46	0.36	0.30	0.20	0.15	0.22	0.21	0.30	0.41	0.45	4.60
	E	0.22	0.14	0.16	0.15	0.16	0.38	0.57	0.54	0.62	0.45	0.38	0.41	0.36	0.58	0.59	0.49	6.20
	F	0.46	0.23	0.26	0.15	0.20	0.29	0.50	0.57	0.53	0.46	0.46	0.36	0.54	0.73	0.81	0.69	7.24
	G	0.18	0.11	0.06	0.08	0.18	0.14	0.24	0.37	0.20	0.25	0.26	0.18	0.28	0.35	0.38	0.46	3.72
	Total	**1.27**	**0.98**	**0.84**	**0.73**	**0.90**	**1.54**	**1.97**	**2.07**	**1.77**	**1.48**	**1.35**	**1.24**	**1.44**	**2.04**	**2.25**	**2.17**	**24.04**
2.65	A	0.40	0.39	0.40	0.49	0.78	0.95	1.19	0.51	0.50	0.59	0.42	0.16	0.14	0.08	0.07	0.15	7.22
	B	0.08	0.06	0.17	0.34	0.29	0.36	0.32	0.10	0.05	0.18	0.05	0.05	0.01	0	0.02	0.07	2.15
	C	0.08	0.10	0.19	0.20	0.13	0.21	0.34	0.15	0.11	0.11	0.14	0.02	0.01	0.01	0.01	0.03	1.84
	D	0.46	0.27	0.14	0.12	0.15	0.45	1.12	0.43	0.32	0.36	0.28	0.17	0.08	0.11	0.31	0.74	5.51
	E	0.58	0.23	0.02	0.04	0.11	0.87	1.89	0.88	0.82	0.64	0.37	0.39	0.23	0.29	0.73	1.02	9.11
	F	0.72	0.24	0.04	0.04	0.06	1.18	2.69	1.09	0.79	0.38	0.26	0.15	0.09	0.19	0.81	1.16	9.89
	G	0.32	0.04	0	0	0	0.31	1.50	0.64	0.34	0.13	0.08	0.04	0.03	0.07	0.33	0.55	4.38
	Total	**2.64**	**1.33**	**0.96**	**1.23**	**1.52**	**4.33**	**9.05**	**3.80**	**2.93**	**2.39**	**1.60**	**0.98**	**0.59**	**0.75**	**2.28**	**3.72**	**40.10**
4.70	A	0.26	0.34	0.61	0.17	0.23	0.65	0.74	0.27	0.27	0.81	0.94	0.23	0.06	0.05	0.08	0.15	5.86
	B	0.07	0.16	0.19	0.12	0.15	0.17	0.14	0.02	0.06	0.16	0.17	0.05	0	0	0.01	0.04	1.51
	C	0.06	0.08	0.10	0.03	0.04	0.03	0.08	0.09	0.04	0.11	0.14	0.03	0.01	0	0.02	0.06	0.92
	D	0.33	0.16	0.02	0	0.01	0.05	0.24	0.11	0.27	0.33	0.42	0.25	0.08	0.13	0.25	0.63	3.28
	E	0.68	0.15	0.03	0	0.01	0.14	0.26	0.20	0.44	0.71	0.80	0.35	0.10	0.13	0.45	0.75	5.20
	F	0.65	0.14	0.01	0.01	0.02	0.29	0.45	0.07	0.26	0.56	0.47	0.27	0.06	0.07	0.13	0.42	3.88
	G	0.44	0.11	0	0	0	0.16	0.41	0.04	0.06	0.18	0.18	0.02	0	0	0.04	0.21	1.85
	Total	**2.49**	**1.14**	**0.96**	**0.33**	**0.46**	**1.49**	**2.32**	**0.80**	**1.40**	**2.86**	**3.12**	**1.20**	**0.31**	**0.38**	**0.98**	**2.26**	**22.50**
7.15	A	0.19	0.34	0.27	0.01	0	0	0.03	0.02	0.05	0.25	0.51	0.34	0.14	0.06	0.08	0.08	2.37
	B	0.03	0.05	0	0	0	0.01	0	0	0.03	0.07	0.12	0.03	0	0	0	0.02	0.36
	C	0.01	0.02	0.01	0	0	0	0.01	0	0.04	0.12	0.22	0.05	0.02	0.05	0.01	0.04	0.60
	D	0.10	0.07	0.03	0	0	0	0.01	0.01	0.07	0.24	0.49	0.20	0.10	0.02	0.22	0.21	1.77
	E	0.12	0.05	0	0	0	0.01	0.03	0.07	0.16	0.49	0.84	0.20	0.07	0.03	0.32	0.35	2.74
	F	0.03	0	0	0.01	0	0	0	0.03	0.03	0.12	0.29	0.05	0	0	0.04	0.11	0.71
	G	0.02	0.01	0.05	0.03	0	0	0	0	0	0.02	0.12	0.03	0	0	0	0.01	0.29
	Total	**0.50**	**0.54**	**0.36**	**0.05**	**0.00**	**0.02**	**0.08**	**0.13**	**0.38**	**1.31**	**2.59**	**0.90**	**0.33**	**0.16**	**0.67**	**0.82**	**8.84**

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	0.03	0	0	0	0	0	0.01	0.08	0.20	0.12	0.08	0.11	0.12	0.02	0.78
	B	0.01	0	0	0	0	0	0	0	0	0.01	0.07	0.07	0.02	0	0.01	0	0.19
	C	0	0	0	0	0	0	0	0	0	0.03	0.11	0.02	0.01	0.01	0.02	0	0.20
	D	0.06	0.03	0.02	0	0	0	0	0	0.02	0.14	0.31	0.08	0.06	0.01	0.11	0.06	0.90
	E	0.05	0.05	0.01	0	0	0	0	0.01	0.03	0.27	0.51	0.05	0.01	0	0.04	0.03	1.06
	F	0	0	0	0	0	0	0	0	0.01	0.01	0.08	0	0	0	0	0	0.10
	G	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0	0.03
	Total	**0.13**	**0.08**	**0.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.07**	**0.55**	**1.30**	**0.34**	**0.18**	**0.13**	**0.30**	**0.11**	**3.26**
12.7	A	0.01	0.03	0	0	0	0	0	0	0	0	0.12	0.07	0.01	0.01	0	0	0.25
	B	0	0	0	0	0	0	0	0	0	0.01	0.05	0.01	0.01	0	0	0	0.08
	C	0.01	0.01	0	0	0	0	0	0	0	0.01	0.03	0.03	0.01	0	0	0	0.10
	D	0.01	0.07	0	0	0	0	0	0	0	0.03	0.05	0.01	0.01	0	0	0	0.18
	E	0.02	0.03	0	0	0	0	0	0	0	0.10	0.21	0.03	0	0	0	0	0.39
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	Total	**0.05**	**0.14**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.46**	**0.15**	**0.04**	**0.01**	**0.00**	**0.00**	**1.00**
15.6	A	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0.03
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	D	0	0.05	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0.07
	E	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0.01
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	Total	**0.00**	**0.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.11**
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	D	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0.01
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**

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	0.95	1.25	1.42	0.76	1.12	1.75	2.06	0.96	0.90	1.80	2.23	1.00	0.48	0.38	0.41	0.45	17.92
	B	0.20	0.33	0.39	0.47	0.45	0.59	0.47	0.12	0.17	0.46	0.50	0.23	0.04	0.00(a)	0.04	0.14	4.60
	C	0.17	0.23	0.33	0.30	0.23	0.36	0.52	0.31	0.21	0.40	0.66	0.15	0.06	0.08	0.06	0.15	4.22
	D	1.27	0.92	0.40	0.30	0.34	0.91	1.83	0.91	0.98	1.30	1.72	0.94	0.54	0.57	1.30	2.09	16.32
	E	1.67	0.65	0.22	0.19	0.28	1.40	2.75	1.70	2.07	2.66	3.11	1.44	0.77	1.03	2.13	2.64	24.71
	F	1.86	0.61	0.31	0.21	0.28	1.76	3.64	1.76	1.62	1.53	1.56	0.83	0.69	0.99	1.79	2.38	21.82
	G	0.96	0.27	0.11	0.11	0.18	0.61	2.15	1.05	0.60	0.59	0.66	0.27	0.31	0.42	0.75	1.23	10.27
	Total	7.08	4.26	3.18	2.34	2.88	7.38	13.42	6.81	6.55	8.74	10.44	4.86	2.89	3.47	6.48	9.08	99.86

(a) A highly unusual instance of no B Stability Classes in the ESE direction resulted from CY2013 meteorological data at Station 11. This caused an error in CAP88-PC operation. The smallest increment (0.01 and 0.0001) was added to the CAP88-formatted meteorological file to allow code operation and to minimally impact CAP88-PC output.

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	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
^{14}C	M	1	1.60 E–06	1.80 E–03
^{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
^{83}Rb	M	1	1.60 E–06	1.80 E-03
^{90}Sr	M	1	1.60 E-06	1.80 E-03
^{99}Tc	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
^{127}Xe	G	0	0	0
^{131m}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
^{154}Eu	M	1	1.60 E–06	1.80 E–03
^{194}Au[(a)]	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
^{227}Ac	M	1	1.60 E–06	1.80 E–03
^{232}U	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
^{238}Pu	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
^{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) Also used as surrogate for ^{196}Au

(V = vapor (water vapor for tritium); G = gas (elemental gas for tritium); S = particulate, slow clearance rate; M = particulate, moderate clearance rate; F = particulate, fast clearance rate

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
^{14}C	3.31 E–07	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
^{83}Rb	8.04 E-03	5.48 E–05	0	1.00 E-02	3.00 E-02
^{90}Sr	6.52 E–05	5.48 E–05	0	2.00 E–03	1.00 E–02
^{99}Tc	8.91 E–09	5.48 E–05	0	1.00 E–03	1.00 E–04
^{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
^{127}Xe	1.90 E-02	5.48 E–05	0	0	0
^{131m}Xe	5.82 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
^{154}Eu	2.21 E–04	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
^{227}Ac	8.71 E–05	5.48 E–05	0	2.00 E–06	2.00 E–05
^{232}U	2.64 E–05	5.48 E–05	0	4.00 E–04	8.00 E–04
^{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
^{238}Pu	2.16 E–05	5.48 E–05	0	1.00 E–06	1.00 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
^{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
^{14}C	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
^{83}Rb	2.00 E+00	2.00 E-01	1.00 E+00	1.00 E+00
^{90}Sr	4.00 E+00	3.00 E–01	3.00 E–01	3.00 E–01
^{99}Tc	4.00 E+01	5.00 E+00	5.00 E–01	5.00 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
^{127}Xe	0	0	0	0
^{131m}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
^{154}Eu	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
^{227}Ac	1.00 E–01	1.00 E–03	5.00 E–04	5.00 E–04
^{232}U	1.00 E–01	2.00 E–03	2.00 E–02	2.00 E–02
^{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
^{238}Pu	1.00 E–01	1.00 E–03	5.00 E–04	5.00 E–04
^{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
^{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 = 15.9 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

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2013

Appendix B
List of Radioactive Materials Handled or Potentially Handled at the PNNL Campus in 2013

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Campus in 2013 (2 sheets)

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

Appendix C

Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2013

Appendix C

Ambient Air Sampling Results for PNNL Campus Air Surveillance in 2013

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-month-yy)	Date when air sampling started (time field is truncated).
SAMP_DATE_TIME	date (dd-month-yy)	Date when air sampling ended (time field is truncated).
CON_SHORT_NAME	text	ALPHA, BETA, Am-241, Am-241 gamma, Am-243, Be-7, BETA, Cm-243/244, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, H-3, K-40, Pu-238, Pu-239/240, Ru-106, Sb-125, Sr-90, 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 U-234 result is the sum of U-233 and U-234, the analytical method available 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 constituent Value_Rptd is less than the counting error, total analytical error, minimum detectable activity. If blank, no qualifier was needed. If “X”, and the VALUE_RPTD column is not blank, see comment regarding radio-analysis.
SAMP_COMMENT	text or blank	Contains pertinent information about the sample. If blank, no comment was needed
RESULT_COMMENT	text or blank	Comment on the result. If blank, no comment was needed.
COMPOSITE_FLAG	Y or blank	If “Y”, several samples from the same sampling station were composited and the composite measured for radioactivity. If blank, a single sample was evaluated.
Further details on each PNNL Campus sample (e.g., analysis method) can be obtained from the full database (Hanford Environmental Information System [HEIS] 1989).		

Table C.2. Air Sampling Results for the PNNL Campus and the Yakima Background Station for Calendar Year 2013

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	318152001	26-Dec-12	9-Jan-13	ALPHA	8.46E-04	pCi/m^3	3.77E-04	3.80E-04				
PNL-1	FILTER2 SOLAR	319163001	9-Jan-13	23-Jan-13	ALPHA	1.38E-03	pCi/m^3	4.73E-04	4.77E-04				
PNL-1	FILTER2 SOLAR	319856001	23-Jan-13	6-Feb-13	ALPHA	7.36E-04	pCi/m^3	3.14E-04	3.14E-04				
PNL-1	FILTER2 SOLAR	320734001	6-Feb-13	20-Feb-13	ALPHA	4.61E-04	pCi/m^3	2.76E-04	2.77E-04				
PNL-1	FILTER2 SOLAR	321769001	20-Feb-13	6-Mar-13	ALPHA	2.80E-04	pCi/m^3	2.29E-04	2.29E-04	U			
PNL-1	FILTER2 SOLAR	322328001	6-Mar-13	20-Mar-13	ALPHA	7.30E-04	pCi/m^3	3.29E-04	3.30E-04				
PNL-1	FILTER2 SOLAR	323586001	20-Mar-13	3-Apr-13	ALPHA	7.27E-04	pCi/m^3	3.51E-04	3.53E-04		(a)		
PNL-1	FILTER2 SOLAR	324146001	4-Apr-13	17-Apr-13	ALPHA	5.14E-04	pCi/m^3	3.40E-04	3.41E-04				
PNL-1	FILTER2 SOLAR	324944001	17-Apr-13	1-May-13	ALPHA	3.95E-04	pCi/m^3	3.03E-04	3.03E-04	U			
PNL-1	FILTER2 SOLAR	326008001	1-May-13	15-May-13	ALPHA	3.91E-04	pCi/m^3	2.34E-04	2.34E-04				
PNL-1	FILTER2 SOLAR	326702001	15-May-13	29-May-13	ALPHA	2.30E-04	pCi/m^3	2.26E-04	2.26E-04	U			
PNL-1	FILTER2 SOLAR	327731001	29-May-13	12-Jun-13	ALPHA	4.59E-04	pCi/m^3	2.75E-04	2.76E-04				
PNL-1	FILTER2 SOLAR	328378001	12-Jun-13	26-Jun-13	ALPHA	2.42E-04	pCi/m^3	2.11E-04	2.12E-04	U			
PNL-1	FILTER2 SOLAR	329475001	26-Jun-13	10-Jul-13	ALPHA	5.36E-04	pCi/m^3	3.01E-04	3.03E-04				
PNL-1	FILTER2 SOLAR	330622001	10-Jul-13	24-Jul-13	ALPHA	8.03E-04	pCi/m^3	3.31E-04	3.32E-04				
PNL-1	FILTER2 SOLAR	331175001	24-Jul-13	7-Aug-13	ALPHA	4.59E-04	pCi/m^3	2.95E-04	2.96E-04				
PNL-1	FILTER2 SOLAR	332067001	7-Aug-13	21-Aug-13	ALPHA	5.93E-04	pCi/m^3	3.49E-04	3.51E-04				
PNL-1	FILTER2 SOLAR	332798001	21-Aug-13	4-Sep-13	ALPHA	6.02E-04	pCi/m^3	3.48E-04	3.50E-04				
PNL-1	FILTER2 SOLAR	333715001	4-Sep-13	18-Sep-13	ALPHA	2.72E-04	pCi/m^3	3.02E-04	3.03E-04	U			
PNL-1	FILTER2 SOLAR	334608001	18-Sep-13	2-Oct-13	ALPHA	3.68E-04	pCi/m^3	3.35E-04	3.35E-04	U			
PNL-1	FILTER2 SOLAR	335779001	2-Oct-13	16-Oct-13	ALPHA	7.76E-04	pCi/m^3	3.44E-04	3.45E-04				
PNL-1	FILTER2 SOLAR	336616001	16-Oct-13	30-Oct-13	ALPHA	8.88E-04	pCi/m^3	4.02E-04	4.02E-04		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-1	FILTER2 SOLAR	337662001	30-Oct-13	13-Nov-13	ALPHA	7.71E-04	pCi/m^3	3.97E-04	4.00E-04				
PNL-1	FILTER2 SOLAR	338400001	13-Nov-13	27-Nov-13	ALPHA	1.11E-03	pCi/m^3	4.13E-04	4.14E-04				
PNL-1	FILTER2 SOLAR	339163001	27-Nov-13	11-Dec-13	ALPHA	1.95E-03	pCi/m^3	5.93E-04	5.97E-04		SUBFREEZING TEMPS MAY HAVE IMPACTED AIR SAMPLER OPERATION AND RELIABILITY OF 12/11/13 AIR FLOW CALIBRATOR READING AND OVERALL VALIDITY OF THE SAMPLE.	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ELEVATED.	
PNL-1	FILTER2 SOLAR	341126001	11-Dec-13	26-Dec-13	ALPHA	4.00E-03	pCi/m^3	7.20E-04	7.34E-04		AIR SAMPLER #21711 HAD NOT STABILIZED AFTER RUNNING 28.1 HRS, 85.18 CF AND ON 12/12/13 WAS REPLACED WITH SAMPLER #22494; SAMPLE 12/26/13 INCLUDES THE FLOW DATA FROM BOTH SAMPLERS.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-1	FILTER2 SOLAR	318152001	26-Dec-12	9-Jan-13	BETA	3.11E-02	pCi/m^3	1.46E-03	2.00E-03				
PNL-1	FILTER2 SOLAR	319163001	9-Jan-13	23-Jan-13	BETA	4.68E-02	pCi/m^3	1.78E-03	2.72E-03				
PNL-1	FILTER2 SOLAR	319856001	23-Jan-13	6-Feb-13	BETA	3.10E-02	pCi/m^3	1.50E-03	1.86E-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	320734001	6-Feb-13	20-Feb-13	BETA	1.81E-02	pCi/m^3	1.21E-03	1.38E-03				
PNL-1	FILTER2 SOLAR	321769001	20-Feb-13	6-Mar-13	BETA	1.07E-02	pCi/m^3	8.77E-04	9.95E-04				
PNL-1	FILTER2 SOLAR	322328001	6-Mar-13	20-Mar-13	BETA	1.29E-02	pCi/m^3	1.05E-03	1.19E-03				
PNL-1	FILTER2 SOLAR	323586001	20-Mar-13	3-Apr-13	BETA	1.89E-02	pCi/m^3	1.15E-03	1.42E-03		(a)		
PNL-1	FILTER2 SOLAR	324146001	4-Apr-13	17-Apr-13	BETA	7.23E-03	pCi/m^3	7.88E-04	8.49E-04				
PNL-1	FILTER2 SOLAR	324944001	17-Apr-13	1-May-13	BETA	1.36E-02	pCi/m^3	1.02E-03	1.13E-03				
PNL-1	FILTER2 SOLAR	326008001	1-May-13	15-May-13	BETA	2.30E-02	pCi/m^3	1.35E-03	1.69E-03				
PNL-1	FILTER2 SOLAR	326702001	15-May-13	29-May-13	BETA	7.53E-03	pCi/m^3	7.79E-04	8.46E-04				
PNL-1	FILTER2 SOLAR	327731001	29-May-13	12-Jun-13	BETA	1.07E-02	pCi/m^3	9.13E-04	9.87E-04				
PNL-1	FILTER2 SOLAR	328378001	12-Jun-13	26-Jun-13	BETA	8.28E-03	pCi/m^3	7.99E-04	8.78E-04				
PNL-1	FILTER2 SOLAR	329475001	26-Jun-13	10-Jul-13	BETA	1.65E-02	pCi/m^3	1.10E-03	1.31E-03				
PNL-1	FILTER2 SOLAR	330622001	10-Jul-13	24-Jul-13	BETA	1.60E-02	pCi/m^3	1.09E-03	1.13E-03				
PNL-1	FILTER2 SOLAR	331175001	24-Jul-13	7-Aug-13	BETA	1.92E-02	pCi/m^3	1.18E-03	1.32E-03				
PNL-1	FILTER2 SOLAR	332067001	7-Aug-13	21-Aug-13	BETA	2.07E-02	pCi/m^3	1.23E-03	1.53E-03				
PNL-1	FILTER2 SOLAR	332798001	21-Aug-13	4-Sep-13	BETA	1.84E-02	pCi/m^3	1.15E-03	1.41E-03				
PNL-1	FILTER2 SOLAR	333715001	4-Sep-13	18-Sep-13	BETA	2.47E-02	pCi/m^3	1.26E-03	1.56E-03				
PNL-1	FILTER2 SOLAR	334608001	18-Sep-13	2-Oct-13	BETA	1.16E-02	pCi/m^3	9.55E-04	1.06E-03				
PNL-1	FILTER2 SOLAR	335779001	2-Oct-13	16-Oct-13	BETA	2.26E-02	pCi/m^3	1.30E-03	1.64E-03				
PNL-1	FILTER2 SOLAR	336616001	16-Oct-13	30-Oct-13	BETA	4.83E-02	pCi/m^3	1.91E-03	2.16E-03		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-1	FILTER2 SOLAR	337662001	30-Oct-13	13-Nov-13	BETA	1.82E-02	pCi/m^3	1.17E-03	1.42E-03				
PNL-1	FILTER2 SOLAR	338400001	13-Nov-13	27-Nov-13	BETA	4.34E-02	pCi/m^3	1.74E-03	1.86E-03				
PNL-1	FILTER2 SOLAR	339163001	27-Nov-13	11-Dec-13	BETA	8.47E-02	pCi/m^3	2.45E-03	2.91E-03		SUBFREEZING TEMPS MAY HAVE IMPACTED AIR SAMPLER OPERATION AND RELIABILITY OF 12/11/13 AIR FLOW CALIBRATOR READING AND OVERALL VALIDITY OF THE SAMPLE.	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ELEVATED.	
PNL-1	FILTER2 SOLAR	341126001	11-Dec-13	26-Dec-13	BETA	6.42E-02	pCi/m^3	2.18E-03	3.58E-03		AIR SAMPLER #21711 HAD NOT STABILIZED AFTER RUNNING 28.1 HRS, 85.18 CF AND ON 12/12/13 WAS REPLACED WITH SAMPLER #22494; SAMPLE 12/26/13 INCLUDES THE FLOW DATA FROM BOTH SAMPLERS.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Be-7	3.10E-02	pCi/m^3	3.77E-03	4.57E-03				Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Be-7	3.35E-02	pCi/m^3	1.21E-02	1.25E-02				Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Co-60	-5.52E-05	pCi/m^3	1.99E-04	2.01E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Co-60	-2.30E-04	pCi/m^3	3.25E-04	3.42E-04	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Cs-134	-8.77E-05	pCi/m^3	2.31E-04	2.35E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Cs-134	2.15E-04	pCi/m^3	3.12E-04	3.27E-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-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Cs-137	-9.95E-05	pCi/m^3	1.82E-04	1.88E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Cs-137	-2.47E-05	pCi/m^3	3.19E-04	3.19E-04	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Eu-152	-6.02E-04	pCi/m^3	6.32E-04	6.91E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Eu-152	1.68E-04	pCi/m^3	8.78E-04	8.82E-04	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Eu-154	2.07E-04	pCi/m^3	4.67E-04	4.77E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Eu-154	5.00E-04	pCi/m^3	8.09E-04	8.41E-04	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Eu-155	-8.37E-04	pCi/m^3	6.03E-04	7.16E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Eu-155	8.40E-04	pCi/m^3	9.79E-04	1.05E-03	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	K-40	6.54E-03	pCi/m^3	3.44E-03	3.50E-03				Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	K-40	3.60E-03	pCi/m^3	4.11E-03	4.12E-03	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Ru-106	-9.07E-04	pCi/m^3	1.53E-03	1.59E-03	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Ru-106	-1.11E-03	pCi/m^3	3.22E-03	3.26E-03	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Sb-125	4.46E-05	pCi/m^3	4.21E-04	4.21E-04	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Sb-125	-5.65E-04	pCi/m^3	8.39E-04	8.78E-04	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Am-241	2.06E-06	pCi/m^3	4.72E-06	4.73E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Am-241	-4.70E-07	pCi/m^3	4.05E-06	4.07E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Am-243	-2.34E-06	pCi/m^3	4.98E-06	4.98E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Am-243	-7.89E-07	pCi/m^3	3.49E-06	3.50E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Cm-243/244	1.07E-07	pCi/m^3	4.92E-06	4.93E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Cm-243/244	1.48E-06	pCi/m^3	5.54E-06	5.56E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Pu-238	1.06E-06	pCi/m^3	2.08E-06	2.08E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Pu-238	-7.77E-07	pCi/m^3	1.52E-06	1.52E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	Pu-239/240	7.06E-07	pCi/m^3	1.96E-06	1.96E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	Pu-239/240	1.29E-06	pCi/m^3	1.96E-06	1.96E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	U-233/234	3.16E-05	pCi/m^3	9.37E-06	1.04E-05				Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	U-233/234	5.00E-05	pCi/m^3	1.76E-05	1.94E-05				Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	U-235	1.71E-06	pCi/m^3	3.67E-06	3.68E-06	U			Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	U-235	4.93E-06	pCi/m^3	7.10E-06	7.14E-06	U			Y
PNL-1	FILTER2 SOLAR	328627003	26-Dec-12	26-Jun-13	U-238	3.92E-05	pCi/m^3	1.04E-05	1.17E-05				Y
PNL-1	FILTER2 SOLAR	343813002	26-Jun-13	26-Dec-13	U-238	4.37E-05	pCi/m^3	1.61E-05	1.76E-05				Y
PNL-2	FILTER2 SOLAR	318152002	26-Dec-12	9-Jan-13	ALPHA	1.19E-03	pCi/m^3	4.23E-04	4.29E-04				
PNL-2	FILTER2 SOLAR	319163002	9-Jan-13	23-Jan-13	ALPHA	1.34E-03	pCi/m^3	4.39E-04	4.46E-04				
PNL-2	FILTER2 SOLAR	319856002	23-Jan-13	6-Feb-13	ALPHA	1.36E-03	pCi/m^3	4.42E-04	4.49E-04				
PNL-2	FILTER2 SOLAR	320734002	6-Feb-13	20-Feb-13	ALPHA	6.14E-04	pCi/m^3	3.12E-04	3.12E-04				
PNL-2	FILTER2 SOLAR	321769002	20-Feb-13	6-Mar-13	ALPHA	4.66E-04	pCi/m^3	2.66E-04	2.67E-04				
PNL-2	FILTER2 SOLAR	322328002	6-Mar-13	20-Mar-13	ALPHA	6.19E-04	pCi/m^3	3.28E-04	3.29E-04				
PNL-2	FILTER2 SOLAR	323586002	20-Mar-13	3-Apr-13	ALPHA	4.85E-04	pCi/m^3	2.82E-04	2.83E-04				
PNL-2	FILTER2 SOLAR	324146002	3-Apr-13	17-Apr-13	ALPHA	6.17E-04	pCi/m^3	3.59E-04	3.61E-04				
PNL-2	FILTER2 SOLAR	324944002	17-Apr-13	1-May-13	ALPHA	6.89E-04	pCi/m^3	3.21E-04	3.23E-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
PNL-2	FILTER2 SOLAR	326008002	1-May-13	15-May-13	ALPHA	7.42E-04	pCi/m^3	3.74E-04	3.75E-04				
PNL-2	FILTER2 SOLAR	326702002	15-May-13	29-May-13	ALPHA	7.72E-04	pCi/m^3	3.50E-04	3.53E-04		(b)		
PNL-2	FILTER2 SOLAR	327731002	30-May-13	12-Jun-13	ALPHA	2.66E-04	pCi/m^3	2.80E-04	2.80E-04	U	(c)		
PNL-2	FILTER2 SOLAR	328378002	12-Jun-13	26-Jun-13	ALPHA	3.61E-04	pCi/m^3	2.88E-04	2.89E-04	U			
PNL-2	FILTER2 SOLAR	329475002	26-Jun-13	10-Jul-13	ALPHA	2.34E-04	pCi/m^3	2.12E-04	2.13E-04	U			
PNL-2	FILTER2 SOLAR	330622002	10-Jul-13	24-Jul-13	ALPHA	6.21E-04	pCi/m^3	3.12E-04	3.13E-04				
PNL-2	FILTER2 SOLAR	331175002	24-Jul-13	7-Aug-13	ALPHA	7.58E-04	pCi/m^3	3.80E-04	3.82E-04				
PNL-2	FILTER2 SOLAR	332067002	7-Aug-13	21-Aug-13	ALPHA	8.02E-04	pCi/m^3	3.64E-04	3.67E-04				
PNL-2	FILTER2 SOLAR	332798002	21-Aug-13	4-Sep-13	ALPHA	5.28E-04	pCi/m^3	3.24E-04	3.26E-04				
PNL-2	FILTER2 SOLAR	333715002	4-Sep-13	18-Sep-13	ALPHA	3.31E-06	pCi/m^3	2.04E-04	2.04E-04	U			
PNL-2	FILTER2 SOLAR	334608002	18-Sep-13	2-Oct-13	ALPHA	2.02E-04	pCi/m^3	2.68E-04	2.68E-04	U			
PNL-2	FILTER2 SOLAR	335779002	2-Oct-13	16-Oct-13	ALPHA	7.08E-04	pCi/m^3	3.54E-04	3.55E-04				
PNL-2	FILTER2 SOLAR	336616002	16-Oct-13	30-Oct-13	ALPHA	1.45E-03	pCi/m^3	4.44E-04	4.44E-04		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-2	FILTER2 SOLAR	337662002	30-Oct-13	13-Nov-13	ALPHA	5.07E-04	pCi/m^3	3.53E-04	3.54E-04				
PNL-2	FILTER2 SOLAR	338400002	13-Nov-13	27-Nov-13	ALPHA	1.86E-03	pCi/m^3	5.72E-04	5.78E-04				
PNL-2	FILTER2 SOLAR	339163002	27-Nov-13	11-Dec-13	ALPHA	2.44E-03	pCi/m^3	6.30E-04	6.31E-04		SUBFREEZING TEMPS MAY HAVE IMPACTED AIR SAMPLER OPERATION AND RELIABILITY OF 12/11/13 DIGITAL DISPLAY AND AIR FLOW CALIBRATOR READINGS AND OVERALL VALIDITY OF THE SAMPLE.	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ELEVATED.	
PNL-2	FILTER2 SOLAR	341126002	11-Dec-13	26-Dec-13	ALPHA	3.41E-03	pCi/m^3	7.44E-04	7.72E-04		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-2	FILTER2 SOLAR	318152002	26-Dec-12	9-Jan-13	BETA	3.31E-02	pCi/m^3	1.53E-03	1.88E-03				
PNL-2	FILTER2 SOLAR	319163002	9-Jan-13	23-Jan-13	BETA	4.68E-02	pCi/m^3	1.81E-03	2.38E-03				
PNL-2	FILTER2 SOLAR	319856002	23-Jan-13	6-Feb-13	BETA	3.49E-02	pCi/m^3	1.59E-03	1.85E-03				
PNL-2	FILTER2 SOLAR	320734002	6-Feb-13	20-Feb-13	BETA	1.67E-02	pCi/m^3	1.09E-03	1.12E-03				
PNL-2	FILTER2 SOLAR	321769002	20-Feb-13	6-Mar-13	BETA	1.08E-02	pCi/m^3	9.13E-04	9.88E-04				
PNL-2	FILTER2 SOLAR	322328002	6-Mar-13	20-Mar-13	BETA	1.41E-02	pCi/m^3	1.08E-03	1.20E-03				
PNL-2	FILTER2 SOLAR	323586002	20-Mar-13	3-Apr-13	BETA	1.86E-02	pCi/m^3	1.16E-03	1.32E-03				
PNL-2	FILTER2 SOLAR	324146002	3-Apr-13	17-Apr-13	BETA	1.03E-02	pCi/m^3	8.89E-04	9.52E-04				
PNL-2	FILTER2 SOLAR	324944002	17-Apr-13	1-May-13	BETA	1.53E-02	pCi/m^3	1.08E-03	1.15E-03				
PNL-2	FILTER2 SOLAR	326008002	1-May-13	15-May-13	BETA	2.42E-02	pCi/m^3	1.40E-03	1.47E-03				
PNL-2	FILTER2 SOLAR	326702002	15-May-13	29-May-13	BETA	9.26E-03	pCi/m^3	8.46E-04	9.00E-04		(b)		
PNL-2	FILTER2 SOLAR	327731002	30-May-13	12-Jun-13	BETA	1.09E-02	pCi/m^3	9.52E-04	1.03E-03		(c)		
PNL-2	FILTER2 SOLAR	328378002	12-Jun-13	26-Jun-13	BETA	7.75E-03	pCi/m^3	7.86E-04	8.58E-04				
PNL-2	FILTER2 SOLAR	329475002	26-Jun-13	10-Jul-13	BETA	1.70E-02	pCi/m^3	1.13E-03	1.28E-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	330622002	10-Jul-13	24-Jul-13	BETA	1.74E-02	pCi/m^3	1.13E-03	1.18E-03				
PNL-2	FILTER2 SOLAR	331175002	24-Jul-13	7-Aug-13	BETA	1.91E-02	pCi/m^3	1.16E-03	1.23E-03				
PNL-2	FILTER2 SOLAR	332067002	7-Aug-13	21-Aug-13	BETA	2.06E-02	pCi/m^3	1.24E-03	1.43E-03				
PNL-2	FILTER2 SOLAR	332798002	21-Aug-13	4-Sep-13	BETA	1.95E-02	pCi/m^3	1.20E-03	1.38E-03				
PNL-2	FILTER2 SOLAR	333715002	4-Sep-13	18-Sep-13	BETA	3.55E-03	pCi/m^3	5.34E-04	5.62E-04				
PNL-2	FILTER2 SOLAR	334608002	18-Sep-13	2-Oct-13	BETA	1.17E-02	pCi/m^3	9.50E-04	1.08E-03				
PNL-2	FILTER2 SOLAR	335779002	2-Oct-13	16-Oct-13	BETA	2.29E-02	pCi/m^3	1.31E-03	1.56E-03				
PNL-2	FILTER2 SOLAR	336616002	16-Oct-13	30-Oct-13	BETA	5.14E-02	pCi/m^3	1.92E-03	2.00E-03		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-2	FILTER2 SOLAR	337662002	30-Oct-13	13-Nov-13	BETA	2.10E-02	pCi/m^3	1.25E-03	1.45E-03				
PNL-2	FILTER2 SOLAR	338400002	13-Nov-13	27-Nov-13	BETA	4.54E-02	pCi/m^3	1.78E-03	1.98E-03				
PNL-2	FILTER2 SOLAR	339163002	27-Nov-13	11-Dec-13	BETA	1.09E-01	pCi/m^3	3.02E-03	3.81E-03		SUBFREEZING TEMPS MAY HAVE IMPACTED AIR SAMPLER OPERATION AND RELIABILITY OF 12/11/13 DIGITAL DISPLAY AND AIR FLOW CALIBRATOR READINGS AND OVERALL VALIDITY OF THE SAMPLE.	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ELEVATED.	
PNL-2	FILTER2 SOLAR	341126002	11-Dec-13	26-Dec-13	BETA	6.31E-02	pCi/m^3	2.08E-03	3.14E-03		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Be-7	3.01E-02	pCi/m^3	6.30E-03	6.81E-03				Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Be-7	3.30E-02	pCi/m^3	1.31E-02	1.34E-02				Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Co-60	1.32E-04	pCi/m^3	4.01E-04	4.06E-04	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Co-60	1.45E-04	pCi/m^3	2.86E-04	2.94E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Cs-134	2.82E-04	pCi/m^3	3.81E-04	4.03E-04	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Cs-134	-1.78E-04	pCi/m^3	3.80E-04	3.89E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Cs-137	-1.54E-04	pCi/m^3	3.36E-04	3.43E-04	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Cs-137	1.95E-04	pCi/m^3	3.26E-04	3.38E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Eu-152	-1.39E-05	pCi/m^3	1.02E-03	1.02E-03	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Eu-152	-3.14E-04	pCi/m^3	9.76E-04	9.87E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Eu-154	5.29E-04	pCi/m^3	9.20E-04	9.51E-04	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Eu-154	1.07E-04	pCi/m^3	7.95E-04	7.97E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Eu-155	1.78E-04	pCi/m^3	7.12E-04	7.17E-04	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Eu-155	-2.86E-04	pCi/m^3	8.69E-04	8.79E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	K-40	5.32E-03	pCi/m^3	5.75E-03	5.78E-03	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	K-40	7.66E-03	pCi/m^3	3.92E-03	3.99E-03				Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Ru-106	-1.70E-04	pCi/m^3	3.10E-03	3.10E-03	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Ru-106	-2.22E-04	pCi/m^3	3.65E-03	3.65E-03	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Sb-125	2.47E-04	pCi/m^3	8.75E-04	8.82E-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 Qualifier	Samp Comment	Result Comment	Composite Flag
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Sb-125	-7.68E-04	pCi/m^3	8.43E-04	9.14E-04	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Am-241	-6.74E-07	pCi/m^3	2.98E-06	2.99E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Am-241	-3.37E-07	pCi/m^3	2.91E-06	2.92E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Am-243	2.42E-06	pCi/m^3	4.75E-06	4.77E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Am-243	-7.03E-07	pCi/m^3	3.11E-06	3.12E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Cm-243/244	1.84E-06	pCi/m^3	5.76E-06	5.77E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Cm-243/244	-6.70E-07	pCi/m^3	2.96E-06	2.97E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Pu-238	0.00E+00	pCi/m^3	1.48E-06	1.48E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Pu-238	-3.19E-07	pCi/m^3	1.40E-06	1.40E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	Pu-239/240	0.00E+00	pCi/m^3	1.81E-06	1.81E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	Pu-239/240	1.27E-06	pCi/m^3	1.97E-06	1.97E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	U-233/234	3.67E-05	pCi/m^3	9.77E-06	1.10E-05				Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	U-233/234	5.81E-05	pCi/m^3	1.76E-05	1.99E-05				Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	U-235	7.89E-07	pCi/m^3	2.32E-06	2.33E-06	U			Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	U-235	3.76E-06	pCi/m^3	6.65E-06	6.68E-06	U			Y
PNL-2	FILTER2 SOLAR	328627004	26-Dec-12	26-Jun-13	U-238	3.89E-05	pCi/m^3	9.87E-06	1.12E-05				Y
PNL-2	FILTER2 SOLAR	343813003	26-Jun-13	26-Dec-13	U-238	5.31E-05	pCi/m^3	1.68E-05	1.88E-05				Y
PNL-3	FILTER2	318152003	26-Dec-12	9-Jan-13	ALPHA	9.34E-04	pCi/m^3	3.48E-04	3.52E-04		TOTALIZER #28921 REPLACED WITH TOTALIZER #28917 ON 01/09/13 AT 0845 HRS, START VOLUME 3527, EXPIRES 12/26/2013.		
PNL-3	FILTER2	319163003	9-Jan-13	23-Jan-13	ALPHA	1.45E-03	pCi/m^3	4.27E-04	4.35E-04				
PNL-3	FILTER2	319856003	23-Jan-13	6-Feb-13	ALPHA	7.51E-04	pCi/m^3	3.20E-04	3.24E-04				
PNL-3	FILTER2	320734003	6-Feb-13	20-Feb-13	ALPHA	5.79E-04	pCi/m^3	2.83E-04	2.83E-04				
PNL-3	FILTER2	321769003	20-Feb-13	6-Mar-13	ALPHA	3.16E-04	pCi/m^3	2.37E-04	2.38E-04				
PNL-3	FILTER2	322328003	6-Mar-13	20-Mar-13	ALPHA	6.23E-04	pCi/m^3	3.12E-04	3.12E-04				
PNL-3	FILTER2	323586003	20-Mar-13	3-Apr-13	ALPHA	8.34E-04	pCi/m^3	3.91E-04	3.94E-04			(d)	
PNL-3	FILTER2	324146003	3-Apr-13	17-Apr-13	ALPHA	2.14E-04	pCi/m^3	2.19E-04	2.19E-04	U			
PNL-3	FILTER2	324944003	17-Apr-13	1-May-13	ALPHA	4.42E-04	pCi/m^3	2.61E-04	2.62E-04				
PNL-3	FILTER2	326008003	1-May-13	15-May-13	ALPHA	5.04E-04	pCi/m^3	2.56E-04	2.57E-04				
PNL-3	FILTER2	326702003	15-May-13	29-May-13	ALPHA	2.33E-04	pCi/m^3	2.37E-04	2.37E-04	U	TOTAL VOLUME LOW (656 m3), FILTER ANALYZED AND LAB MET MDC.		
PNL-3	FILTER2	327731003	29-May-13	12-Jun-13	ALPHA	1.75E-04	pCi/m^3	1.82E-04	1.82E-04	U			
PNL-3	FILTER2	328378003	12-Jun-13	26-Jun-13	ALPHA	2.96E-04	pCi/m^3	2.37E-04	2.38E-04	U			
PNL-3	FILTER2	329475003	26-Jun-13	10-Jul-13	ALPHA	5.09E-04	pCi/m^3	2.75E-04	2.76E-04				
PNL-3	FILTER2	330622003	10-Jul-13	24-Jul-13	ALPHA	5.55E-04	pCi/m^3	3.12E-04	3.13E-04				
PNL-3	FILTER2	331175003	24-Jul-13	7-Aug-13	ALPHA	4.92E-04	pCi/m^3	2.64E-04	2.65E-04				
PNL-3	FILTER2	332067003	7-Aug-13	21-Aug-13	ALPHA	4.97E-04	pCi/m^3	3.09E-04	3.11E-04				
PNL-3	FILTER2	332798003	21-Aug-13	4-Sep-13	ALPHA	4.26E-04	pCi/m^3	2.60E-04	2.60E-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
PNL-3	FILTER2	333715003	4-Sep-13	18-Sep-13	ALPHA	4.76E-04	pCi/m^3	2.88E-04	2.88E-04				
PNL-3	FILTER2	334608003	18-Sep-13	2-Oct-13	ALPHA	6.56E-04	pCi/m^3	3.26E-04	3.28E-04				
PNL-3	FILTER2	335779003	2-Oct-13	16-Oct-13	ALPHA	7.88E-04	pCi/m^3	3.47E-04	3.48E-04				
PNL-3	FILTER2	336616003	16-Oct-13	30-Oct-13	ALPHA	8.41E-04	pCi/m^3	3.49E-04	3.50E-04		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-3	FILTER2	337662003	30-Oct-13	13-Nov-13	ALPHA	7.19E-04	pCi/m^3	3.41E-04	3.42E-04				
PNL-3	FILTER2	338400003	13-Nov-13	27-Nov-13	ALPHA	1.36E-03	pCi/m^3	4.38E-04	4.40E-04				
PNL-3	FILTER2	339163003	27-Nov-13	11-Dec-13	ALPHA	3.31E-04	pCi/m^3	2.85E-04	2.86E-04	U	(e)	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ON THE LOW SIDE BUT COMPARABLE TO PREVIOUS RESULTS FOR THIS LOCATION.	
PNL-3	FILTER2	341126003	11-Dec-13	26-Dec-13	ALPHA	2.78E-03	pCi/m^3	5.28E-04	5.32E-04		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-3	FILTER2	318152003	26-Dec-12	9-Jan-13	BETA	2.98E-02	pCi/m^3	1.40E-03	1.75E-03		TOTALIZER #28921 REPLACED WITH TOTALIZER #28917 ON 01/09/13 AT 0845 HRS, START VOLUME 3527, EXPIRES 12/26/2013.		
PNL-3	FILTER2	319163003	9-Jan-13	23-Jan-13	BETA	4.28E-02	pCi/m^3	1.66E-03	2.23E-03				
PNL-3	FILTER2	319856003	23-Jan-13	6-Feb-13	BETA	3.00E-02	pCi/m^3	1.38E-03	1.58E-03				
PNL-3	FILTER2	320734003	6-Feb-13	20-Feb-13	BETA	1.51E-02	pCi/m^3	1.00E-03	1.04E-03				
PNL-3	FILTER2	321769003	20-Feb-13	6-Mar-13	BETA	1.03E-02	pCi/m^3	9.14E-04	1.02E-03				
PNL-3	FILTER2	322328003	6-Mar-13	20-Mar-13	BETA	1.20E-02	pCi/m^3	9.67E-04	1.09E-03				
PNL-3	FILTER2	323586003	20-Mar-13	3-Apr-13	BETA	1.89E-02	pCi/m^3	1.34E-03	1.49E-03		(d)		
PNL-3	FILTER2	324146003	3-Apr-13	17-Apr-13	BETA	8.71E-03	pCi/m^3	8.52E-04	9.05E-04				
PNL-3	FILTER2	324944003	17-Apr-13	1-May-13	BETA	1.18E-02	pCi/m^3	8.98E-04	9.48E-04				
PNL-3	FILTER2	326008003	1-May-13	15-May-13	BETA	2.01E-02	pCi/m^3	1.24E-03	1.45E-03				
PNL-3	FILTER2	326702003	15-May-13	29-May-13	BETA	9.58E-03	pCi/m^3	1.05E-03	1.10E-03		TOTAL VOLUME LOW (656 m3), FILTER ANALYZED AND LAB MET MDC.		
PNL-3	FILTER2	327731003	29-May-13	12-Jun-13	BETA	9.53E-03	pCi/m^3	8.02E-04	8.44E-04				
PNL-3	FILTER2	328378003	12-Jun-13	26-Jun-13	BETA	8.41E-03	pCi/m^3	8.34E-04	8.85E-04				
PNL-3	FILTER2	329475003	26-Jun-13	10-Jul-13	BETA	1.57E-02	pCi/m^3	1.06E-03	1.20E-03				
PNL-3	FILTER2	330622003	10-Jul-13	24-Jul-13	BETA	1.40E-02	pCi/m^3	1.00E-03	1.02E-03				
PNL-3	FILTER2	331175003	24-Jul-13	7-Aug-13	BETA	1.79E-02	pCi/m^3	1.10E-03	1.15E-03				
PNL-3	FILTER2	332067003	7-Aug-13	21-Aug-13	BETA	1.92E-02	pCi/m^3	1.24E-03	1.43E-03				
PNL-3	FILTER2	332798003	21-Aug-13	4-Sep-13	BETA	1.83E-02	pCi/m^3	1.22E-03	1.27E-03				
PNL-3	FILTER2	333715003	4-Sep-13	18-Sep-13	BETA	2.29E-02	pCi/m^3	1.25E-03	1.29E-03				
PNL-3	FILTER2	334608003	18-Sep-13	2-Oct-13	BETA	1.12E-02	pCi/m^3	8.60E-04	9.45E-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
PNL-3	FILTER2	335779003	2-Oct-13	16-Oct-13	BETA	2.12E-02	pCi/m^3	1.19E-03	1.48E-03				
PNL-3	FILTER2	336616003	16-Oct-13	30-Oct-13	BETA	4.82E-02	pCi/m^3	1.81E-03	2.08E-03		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-3	FILTER2	337662003	30-Oct-13	13-Nov-13	BETA	1.86E-02	pCi/m^3	1.13E-03	1.42E-03				
PNL-3	FILTER2	338400003	13-Nov-13	27-Nov-13	BETA	4.37E-02	pCi/m^3	1.73E-03	1.92E-03				
PNL-3	FILTER2	339163003	27-Nov-13	11-Dec-13	BETA	9.76E-03	pCi/m^3	8.94E-04	9.15E-04		(e)	SEE SAMP_ COMMENT; MDA ACHIEVED, RESULTS ON THE LOW SIDE BUT COMPARABLE TO PREVIOUS RESULTS FOR THIS LOCATION.	
PNL-3	FILTER2	341126003	11-Dec-13	26-Dec-13	BETA	4.80E-02	pCi/m^3	1.61E-03	1.77E-03		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Be-7	3.19E-02	pCi/m^3	4.52E-03	5.30E-03				Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Be-7	3.72E-02	pCi/m^3	9.70E-03	1.02E-02				Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Co-60	1.57E-04	pCi/m^3	2.04E-04	2.16E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Co-60	6.87E-05	pCi/m^3	2.79E-04	2.81E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Cs-134	3.97E-05	pCi/m^3	2.30E-04	2.30E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Cs-134	1.24E-04	pCi/m^3	2.86E-04	2.92E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Cs-137	-1.57E-04	pCi/m^3	2.06E-04	2.18E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Cs-137	2.28E-04	pCi/m^3	3.58E-04	3.59E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Eu-152	1.62E-04	pCi/m^3	5.39E-04	5.44E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Eu-152	-2.41E-04	pCi/m^3	7.46E-04	7.54E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Eu-154	2.75E-04	pCi/m^3	6.75E-04	6.87E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Eu-154	4.80E-04	pCi/m^3	6.53E-04	6.90E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Eu-155	2.88E-04	pCi/m^3	4.61E-04	4.80E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Eu-155	1.38E-04	pCi/m^3	7.11E-04	7.14E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	K-40	3.46E-03	pCi/m^3	3.82E-03	3.84E-03	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	K-40	5.03E-03	pCi/m^3	3.26E-03	3.29E-03	X		DATA REJECTED DUE TO NO VALID PEAK.	Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Ru-106	2.89E-04	pCi/m^3	1.71E-03	1.72E-03	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Ru-106	-6.21E-04	pCi/m^3	2.38E-03	2.40E-03	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Sb-125	2.81E-04	pCi/m^3	5.34E-04	5.50E-04	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Sb-125	2.15E-04	pCi/m^3	6.98E-04	7.05E-04	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Am-241	9.31E-07	pCi/m^3	9.73E-06	9.75E-06	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Am-241	-6.41E-06	pCi/m^3	9.03E-06	9.06E-06	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Am-243	1.83E-06	pCi/m^3	1.01E-05	1.02E-05	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Am-243	2.92E-06	pCi/m^3	1.09E-05	1.10E-05	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Cm-243/244	3.29E-06	pCi/m^3	9.25E-06	9.27E-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-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Cm-243/244	4.85E-06	pCi/m^3	1.33E-05	1.34E-05	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Pu-238	9.38E-07	pCi/m^3	3.18E-06	3.19E-06	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Pu-238	0.00E+00	pCi/m^3	2.54E-06	2.54E-06	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	Pu-239/240	0.00E+00	pCi/m^3	2.60E-06	2.60E-06	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	Pu-239/240	6.39E-06	pCi/m^3	5.37E-06	5.40E-06				Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	U-233/234	3.24E-05	pCi/m^3	1.79E-05	1.85E-05				Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	U-233/234	4.59E-05	pCi/m^3	2.64E-05	2.75E-05				Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	U-235	1.20E-06	pCi/m^3	7.54E-06	7.55E-06	U			Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	U-235	4.27E-06	pCi/m^3	1.20E-05	1.20E-05	U			Y
PNL-3	FILTER2	328627001	26-Dec-12	26-Jun-13	U-238	4.13E-05	pCi/m^3	1.82E-05	1.91E-05				Y
PNL-3	FILTER2	343813001	26-Jun-13	26-Dec-13	U-238	8.48E-05	pCi/m^3	3.54E-05	3.82E-05				Y
PNL-4	FILTER2	318152004	26-Dec-12	9-Jan-13	ALPHA	6.38E-04	pCi/m^3	2.99E-04	3.00E-04		TOTALIZER #24966 REPLACED WITH TOTALIZER #28919 ON 01/09/13 AT 1000 HRS, START VOLUME 0194, EXPIRES 12/26/2013.		
PNL-4	FILTER2	319163004	9-Jan-13	23-Jan-13	ALPHA	1.33E-03	pCi/m^3	4.43E-04	4.45E-04				
PNL-4	FILTER2	319856004	23-Jan-13	6-Feb-13	ALPHA	6.57E-04	pCi/m^3	3.30E-04	3.31E-04				
PNL-4	FILTER2	320734004	6-Feb-13	20-Feb-13	ALPHA	5.93E-04	pCi/m^3	3.06E-04	3.08E-04				
PNL-4	FILTER2	321769004	20-Feb-13	6-Mar-13	ALPHA	5.82E-04	pCi/m^3	3.04E-04	3.05E-04				
PNL-4	FILTER2	322328004	6-Mar-13	20-Mar-13	ALPHA	6.90E-04	pCi/m^3	3.10E-04	3.10E-04				
PNL-4	FILTER2	323586004	20-Mar-13	3-Apr-13	ALPHA	1.42E-03	pCi/m^3	4.36E-04	4.38E-04				
PNL-4	FILTER2	324146004	3-Apr-13	17-Apr-13	ALPHA	3.22E-04	pCi/m^3	2.92E-04	2.92E-04	U			
PNL-4	FILTER2	324944004	17-Apr-13	1-May-13	ALPHA	6.86E-04	pCi/m^3	3.20E-04	3.21E-04				
PNL-4	FILTER2	326008004	1-May-13	15-May-13	ALPHA	7.45E-04	pCi/m^3	3.54E-04	3.58E-04				
PNL-4	FILTER2	326702004	15-May-13	29-May-13	ALPHA	1.32E-04	pCi/m^3	1.70E-04	1.70E-04	U			
PNL-4	FILTER2	327731004	29-May-13	12-Jun-13	ALPHA	3.64E-04	pCi/m^3	2.62E-04	2.63E-04				
PNL-4	FILTER2	328378004	12-Jun-13	26-Jun-13	ALPHA	3.02E-04	pCi/m^3	2.12E-04	2.13E-04			(f)	
PNL-4	FILTER2	329475004	26-Jun-13	10-Jul-13	ALPHA	3.13E-04	pCi/m^3	2.36E-04	2.36E-04			(g)	
PNL-4	FILTER2	330622004	10-Jul-13	24-Jul-13	ALPHA	3.25E-04	pCi/m^3	3.05E-04	3.05E-04	U			
PNL-4	FILTER2	331175004	24-Jul-13	7-Aug-13	ALPHA	5.45E-04	pCi/m^3	2.63E-04	2.63E-04				
PNL-4	FILTER2	332067004	7-Aug-13	21-Aug-13	ALPHA	3.46E-04	pCi/m^3	2.62E-04	2.63E-04	U			
PNL-4	FILTER2	332798004	21-Aug-13	4-Sep-13	ALPHA	3.46E-04	pCi/m^3	3.17E-04	3.18E-04	U			
PNL-4	FILTER2	333715004	4-Sep-13	18-Sep-13	ALPHA	4.51E-04	pCi/m^3	2.66E-04	2.68E-04				
PNL-4	FILTER2	334608004	18-Sep-13	2-Oct-13	ALPHA	2.61E-04	pCi/m^3	2.87E-04	2.87E-04	U			
PNL-4	FILTER2	335779004	2-Oct-13	16-Oct-13	ALPHA	4.01E-04	pCi/m^3	3.01E-04	3.01E-04	U			
PNL-4	FILTER2	336616004	16-Oct-13	30-Oct-13	ALPHA	1.01E-03	pCi/m^3	3.59E-04	3.59E-04		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-4	FILTER2	337662004	30-Oct-13	13-Nov-13	ALPHA	7.25E-04	pCi/m^3	4.03E-04	4.05E-04				
PNL-4	FILTER2	338400004	13-Nov-13	27-Nov-13	ALPHA	1.28E-03	pCi/m^3	4.61E-04	4.63E-04				
PNL-4	FILTER2	339163004	27-Nov-13	11-Dec-13	ALPHA	1.90E-03	pCi/m^3	5.38E-04	5.40E-04		REPLACED TOTALIZER #28917 WITH 28921 ON 12/11/13, START		

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
											VOLUME 609 M3, EXP 11/20/14.		
PNL-4	FILTER2	341126004	11-Dec-13	26-Dec-13	ALPHA	3.44E-03	pCi/m^3	6.86E-04	7.02E-04		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-4	FILTER2	318152004	26-Dec-12	9-Jan-13	BETA	3.29E-02	pCi/m^3	1.54E-03	1.70E-03		TOTALIZER #24966 REPLACED WITH TOTALIZER #28919 ON 01/09/13 AT 1000 HRS, START VOLUME 0194, EXPIRES 12/26/2013.		
PNL-4	FILTER2	319163004	9-Jan-13	23-Jan-13	BETA	4.83E-02	pCi/m^3	1.86E-03	1.91E-03				
PNL-4	FILTER2	319856004	23-Jan-13	6-Feb-13	BETA	3.22E-02	pCi/m^3	1.66E-03	1.77E-03				
PNL-4	FILTER2	320734004	6-Feb-13	20-Feb-13	BETA	1.78E-02	pCi/m^3	1.13E-03	1.15E-03				
PNL-4	FILTER2	321769004	20-Feb-13	6-Mar-13	BETA	1.31E-02	pCi/m^3	1.05E-03	1.15E-03				
PNL-4	FILTER2	322328004	6-Mar-13	20-Mar-13	BETA	1.10E-02	pCi/m^3	9.14E-04	9.25E-04				
PNL-4	FILTER2	323586004	20-Mar-13	3-Apr-13	BETA	1.96E-02	pCi/m^3	1.21E-03	1.39E-03				
PNL-4	FILTER2	324146004	3-Apr-13	17-Apr-13	BETA	1.03E-02	pCi/m^3	9.24E-04	9.92E-04				
PNL-4	FILTER2	324944004	17-Apr-13	1-May-13	BETA	1.37E-02	pCi/m^3	1.02E-03	1.09E-03				
PNL-4	FILTER2	326008004	1-May-13	15-May-13	BETA	2.18E-02	pCi/m^3	1.31E-03	1.47E-03				
PNL-4	FILTER2	326702004	15-May-13	29-May-13	BETA	8.30E-03	pCi/m^3	9.04E-04	9.76E-04				
PNL-4	FILTER2	327731004	29-May-13	12-Jun-13	BETA	1.11E-02	pCi/m^3	9.50E-04	9.93E-04				
PNL-4	FILTER2	328378004	12-Jun-13	26-Jun-13	BETA	1.12E-02	pCi/m^3	1.02E-03	1.13E-03		(f)		
PNL-4	FILTER2	329475004	26-Jun-13	10-Jul-13	BETA	1.49E-02	pCi/m^3	9.90E-04	1.20E-03		(g)		
PNL-4	FILTER2	330622004	10-Jul-13	24-Jul-13	BETA	1.37E-02	pCi/m^3	1.01E-03	1.12E-03				
PNL-4	FILTER2	331175004	24-Jul-13	7-Aug-13	BETA	1.78E-02	pCi/m^3	1.15E-03	1.21E-03				
PNL-4	FILTER2	332067004	7-Aug-13	21-Aug-13	BETA	1.95E-02	pCi/m^3	1.25E-03	1.45E-03				
PNL-4	FILTER2	332798004	21-Aug-13	4-Sep-13	BETA	1.61E-02	pCi/m^3	1.02E-03	1.31E-03				
PNL-4	FILTER2	333715004	4-Sep-13	18-Sep-13	BETA	2.10E-02	pCi/m^3	1.19E-03	1.32E-03				
PNL-4	FILTER2	334608004	18-Sep-13	2-Oct-13	BETA	1.08E-02	pCi/m^3	9.43E-04	9.65E-04				
PNL-4	FILTER2	335779004	2-Oct-13	16-Oct-13	BETA	2.15E-02	pCi/m^3	1.24E-03	1.28E-03				
PNL-4	FILTER2	336616004	16-Oct-13	30-Oct-13	BETA	4.86E-02	pCi/m^3	1.84E-03	2.21E-03		NEW RAINCAPS WITH INSERTS INSTALLED.		
PNL-4	FILTER2	337662004	30-Oct-13	13-Nov-13	BETA	1.97E-02	pCi/m^3	1.18E-03	1.55E-03				
PNL-4	FILTER2	338400004	13-Nov-13	27-Nov-13	BETA	4.02E-02	pCi/m^3	1.60E-03	1.76E-03				
PNL-4	FILTER2	339163004	27-Nov-13	11-Dec-13	BETA	8.41E-02	pCi/m^3	2.57E-03	3.66E-03		REPLACED TOTALIZER #28917 WITH 28921 ON 12/11/13, START VOLUME 609 M3, EXP 11/20/14.		
PNL-4	FILTER2	341126004	11-Dec-13	26-Dec-13	BETA	5.14E-02	pCi/m^3	1.79E-03	2.05E-03		FOGGY WITH FROST ON FILTER.	REFER TO FOLLOW-UP ANALYSIS #A13-001, KEPT ORIGINAL VALUES.	
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Be-7	2.65E-02	pCi/m^3	4.52E-03	5.05E-03		(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Be-7	3.50E-02	pCi/m^3	9.99E-03	1.04E-02		(g)		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-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Co-60	-2.42E-04	pCi/m^3	3.42E-04	3.59E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Co-60	-4.73E-05	pCi/m^3	2.20E-04	2.21E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Cs-134	-4.10E-05	pCi/m^3	2.55E-04	2.56E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Cs-134	4.86E-05	pCi/m^3	2.63E-04	2.64E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Cs-137	5.69E-05	pCi/m^3	2.27E-04	2.29E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Cs-137	-3.03E-04	pCi/m^3	2.10E-04	2.52E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Eu-152	3.10E-04	pCi/m^3	6.71E-04	6.86E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Eu-152	1.92E-04	pCi/m^3	6.51E-04	6.57E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Eu-154	-3.01E-04	pCi/m^3	6.16E-04	6.31E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Eu-154	8.42E-05	pCi/m^3	6.12E-04	6.13E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Eu-155	2.94E-04	pCi/m^3	6.76E-04	6.90E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Eu-155	6.78E-04	pCi/m^3	6.25E-04	7.00E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	K-40	1.76E-03	pCi/m^3	4.10E-03	4.10E-03	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	K-40	6.98E-04	pCi/m^3	3.28E-03	3.28E-03	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Ru-106	-6.39E-04	pCi/m^3	2.31E-03	2.33E-03	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Ru-106	1.64E-03	pCi/m^3	2.06E-03	2.19E-03	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Sb-125	2.58E-04	pCi/m^3	5.97E-04	6.09E-04	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Sb-125	-2.55E-04	pCi/m^3	7.05E-04	7.14E-04	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Am-241	7.54E-07	pCi/m^3	4.19E-06	4.20E-06	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Am-241	-2.52E-06	pCi/m^3	3.17E-06	3.18E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Am-243	-2.10E-06	pCi/m^3	4.76E-06	4.77E-06	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Am-243	1.29E-06	pCi/m^3	4.98E-06	4.99E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Cm-243/244	-1.72E-06	pCi/m^3	3.27E-06	3.28E-06	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Cm-243/244	-8.88E-07	pCi/m^3	8.05E-06	8.05E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Pu-238	-3.80E-07	pCi/m^3	1.67E-06	1.67E-06	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Pu-238	-2.85E-07	pCi/m^3	1.25E-06	1.25E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	Pu-239/240	7.60E-07	pCi/m^3	2.11E-06	2.11E-06	U	(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	Pu-239/240	1.14E-06	pCi/m^3	1.76E-06	1.77E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	U-233/234	6.23E-05	pCi/m^3	1.29E-05	1.55E-05		(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	U-233/234	4.66E-05	pCi/m^3	1.55E-05	1.71E-05		(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	U-235	5.43E-06	pCi/m^3	4.78E-06	4.84E-06		(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	U-235	3.41E-06	pCi/m^3	6.02E-06	6.05E-06	U	(g)		Y
PNL-4	FILTER2	328627002	26-Dec-12	26-Jun-13	U-238	4.94E-05	pCi/m^3	1.14E-05	1.33E-05		(f)		Y
PNL-4	FILTER2	343813004	26-Jun-13	26-Dec-13	U-238	4.91E-05	pCi/m^3	1.58E-05	1.76E-05		(g)		Y
YAKIMA	FILTER1	318557018	27-Dec-12	8-Jan-13	ALPHA	1.75E-03	pCi/m^3	4.77E-04	4.80E-04				
YAKIMA	FILTER1	319401018	8-Jan-13	23-Jan-13	ALPHA	1.14E-03	pCi/m^3	3.50E-04	3.50E-04				
YAKIMA	FILTER1	320365018	23-Jan-13	6-Feb-13	ALPHA	1.35E-03	pCi/m^3	4.12E-04	4.19E-04				
YAKIMA	FILTER1	321293011	6-Feb-13	20-Feb-13	ALPHA	3.54E-04	pCi/m^3	2.17E-04	2.18E-04				
YAKIMA	FILTER1	321774018	20-Feb-13	6-Mar-13	ALPHA	1.26E-04	pCi/m^3	1.77E-04	1.77E-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
YAKIMA	FILTER1	322807018	6-Mar-13	20-Mar-13	ALPHA	4.13E-04	pCi/m^3	2.36E-04	2.38E-04				
YAKIMA	FILTER1	323600019	20-Mar-13	3-Apr-13	ALPHA	5.80E-04	pCi/m^3	2.70E-04	2.71E-04				
YAKIMA	FILTER1	324541018	3-Apr-13	17-Apr-13	ALPHA	2.29E-04	pCi/m^3	1.87E-04	1.87E-04	U			
YAKIMA	FILTER1	325262010	17-Apr-13	1-May-13	ALPHA	5.16E-04	pCi/m^3	2.44E-04	2.45E-04				
YAKIMA	FILTER1	326233018	1-May-13	15-May-13	ALPHA	7.52E-04	pCi/m^3	3.40E-04	3.42E-04				
YAKIMA	FILTER1	327044010	15-May-13	29-May-13	ALPHA	2.34E-04	pCi/m^3	1.88E-04	1.89E-04	U			
YAKIMA	FILTER1	327978018	29-May-13	12-Jun-13	ALPHA	2.66E-04	pCi/m^3	1.64E-04	1.64E-04				
YAKIMA	FILTER1	328778018	12-Jun-13	26-Jun-13	ALPHA	3.43E-04	pCi/m^3	2.11E-04	2.11E-04				
YAKIMA	FILTER1	329760017	26-Jun-13	10-Jul-13	ALPHA	4.78E-04	pCi/m^3	2.57E-04	2.59E-04				
YAKIMA	FILTER1	330607010	10-Jul-13	24-Jul-13	ALPHA	2.53E-04	pCi/m^3	1.84E-04	1.84E-04				
YAKIMA	FILTER1	331538018	24-Jul-13	7-Aug-13	ALPHA	8.31E-04	pCi/m^3	3.41E-04	3.43E-04				
YAKIMA	FILTER1	332471010	7-Aug-13	21-Aug-13	ALPHA	4.25E-04	pCi/m^3	2.29E-04	2.29E-04				
YAKIMA	FILTER1	333288017	21-Aug-13	4-Sep-13	ALPHA	3.39E-04	pCi/m^3	2.44E-04	2.45E-04				
YAKIMA	FILTER1	334064010	4-Sep-13	18-Sep-13	ALPHA	7.25E-04	pCi/m^3	3.40E-04	3.41E-04				
YAKIMA	FILTER1	335289018	18-Sep-13	2-Oct-13	ALPHA	4.01E-04	pCi/m^3	2.36E-04	2.36E-04				
YAKIMA	FILTER1	336081011	2-Oct-13	16-Oct-13	ALPHA	6.27E-04	pCi/m^3	2.98E-04	3.00E-04				
YAKIMA	FILTER1	337037018	16-Oct-13	29-Oct-13	ALPHA	8.01E-04	pCi/m^3	3.37E-04	3.37E-04				
YAKIMA	FILTER1	338005010	29-Oct-13	13-Nov-13	ALPHA	4.29E-04	pCi/m^3	2.42E-04	2.42E-04				
YAKIMA	FILTER1	338899018	13-Nov-13	26-Nov-13	ALPHA	8.20E-04	pCi/m^3	4.44E-04	4.46E-04				
YAKIMA	FILTER1	339543010	26-Nov-13	11-Dec-13	ALPHA	3.59E-03	pCi/m^3	7.39E-04	7.46E-04				
YAKIMA	FILTER1	341131010	11-Dec-13	23-Dec-13	ALPHA	3.25E-03	pCi/m^3	8.97E-04	9.03E-04				
YAKIMA	FILTER1	318557018	27-Dec-12	8-Jan-13	BETA	3.36E-02	pCi/m^3	1.54E-03	1.66E-03				
YAKIMA	FILTER1	319401018	8-Jan-13	23-Jan-13	BETA	3.26E-02	pCi/m^3	1.43E-03	1.57E-03				
YAKIMA	FILTER1	320365018	23-Jan-13	6-Feb-13	BETA	3.22E-02	pCi/m^3	1.42E-03	1.82E-03				
YAKIMA	FILTER1	321293011	6-Feb-13	20-Feb-13	BETA	1.04E-02	pCi/m^3	8.34E-04	8.94E-04				
YAKIMA	FILTER1	321774018	20-Feb-13	6-Mar-13	BETA	8.91E-03	pCi/m^3	7.44E-04	7.60E-04				
YAKIMA	FILTER1	322807018	6-Mar-13	20-Mar-13	BETA	1.01E-02	pCi/m^3	7.62E-04	8.13E-04				
YAKIMA	FILTER1	323600019	20-Mar-13	3-Apr-13	BETA	1.72E-02	pCi/m^3	1.06E-03	1.30E-03				
YAKIMA	FILTER1	324541018	3-Apr-13	17-Apr-13	BETA	8.77E-03	pCi/m^3	7.46E-04	7.82E-04				
YAKIMA	FILTER1	325262010	17-Apr-13	1-May-13	BETA	1.20E-02	pCi/m^3	8.41E-04	8.70E-04				
YAKIMA	FILTER1	326233018	1-May-13	15-May-13	BETA	1.97E-02	pCi/m^3	1.05E-03	1.07E-03				
YAKIMA	FILTER1	327044010	15-May-13	29-May-13	BETA	6.24E-03	pCi/m^3	5.78E-04	6.23E-04				
YAKIMA	FILTER1	327978018	29-May-13	12-Jun-13	BETA	8.72E-03	pCi/m^3	7.44E-04	7.64E-04				
YAKIMA	FILTER1	328778018	12-Jun-13	26-Jun-13	BETA	8.27E-03	pCi/m^3	7.22E-04	7.38E-04				
YAKIMA	FILTER1	329760017	26-Jun-13	10-Jul-13	BETA	1.43E-02	pCi/m^3	9.17E-04	1.00E-03				
YAKIMA	FILTER1	330607010	10-Jul-13	24-Jul-13	BETA	1.30E-02	pCi/m^3	8.80E-04	9.17E-04				
YAKIMA	FILTER1	331538018	24-Jul-13	7-Aug-13	BETA	1.41E-02	pCi/m^3	9.33E-04	9.42E-04				
YAKIMA	FILTER1	332471010	7-Aug-13	21-Aug-13	BETA	1.62E-02	pCi/m^3	9.71E-04	1.01E-03				
YAKIMA	FILTER1	333288017	21-Aug-13	4-Sep-13	BETA	1.51E-02	pCi/m^3	9.51E-04	1.17E-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
YAKIMA	FILTER1	334064010	4-Sep-13	18-Sep-13	BETA	1.90E-02	pCi/m^3	1.06E-03	1.18E-03				
YAKIMA	FILTER1	335289018	18-Sep-13	2-Oct-13	BETA	8.36E-03	pCi/m^3	7.56E-04	7.74E-04				
YAKIMA	FILTER1	336081011	2-Oct-13	16-Oct-13	BETA	1.54E-02	pCi/m^3	9.63E-04	1.11E-03				
YAKIMA	FILTER1	337037018	16-Oct-13	29-Oct-13	BETA	3.30E-02	pCi/m^3	1.46E-03	1.62E-03				
YAKIMA	FILTER1	338005010	29-Oct-13	13-Nov-13	BETA	1.60E-02	pCi/m^3	9.54E-04	1.16E-03				
YAKIMA	FILTER1	338899018	13-Nov-13	26-Nov-13	BETA	2.36E-02	pCi/m^3	1.34E-03	1.61E-03				
YAKIMA	FILTER1	339543010	26-Nov-13	11-Dec-13	BETA	9.50E-02	pCi/m^3	2.60E-03	3.17E-03				
YAKIMA	FILTER1	341131010	11-Dec-13	23-Dec-13	BETA	6.46E-02	pCi/m^3	2.62E-03	2.88E-03				
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Am-241 (GAMMA)	7.40E-04	pCi/m^3	1.25E-03	1.29E-03	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Am-241 (GAMMA)	1.83E-03	pCi/m^3	1.83E-03	2.01E-03	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Co-60	9.65E-06	pCi/m^3	2.21E-04	2.21E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Co-60	2.04E-04	pCi/m^3	4.02E-04	4.13E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Cs-134	-3.78E-05	pCi/m^3	1.99E-04	1.99E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Cs-134	-2.09E-06	pCi/m^3	3.21E-04	3.21E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Cs-137	-3.11E-05	pCi/m^3	2.04E-04	2.04E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Cs-137	4.25E-05	pCi/m^3	4.39E-04	4.39E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Eu-152	-3.90E-05	pCi/m^3	5.63E-04	5.64E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Eu-152	-1.14E-04	pCi/m^3	9.65E-04	9.72E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Eu-154	5.46E-04	pCi/m^3	6.00E-04	6.51E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Eu-154	5.38E-04	pCi/m^3	1.08E-03	1.11E-03	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Eu-155	1.97E-04	pCi/m^3	6.09E-04	6.17E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Eu-155	1.75E-04	pCi/m^3	8.83E-04	8.83E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	K-40	4.93E-03	pCi/m^3	2.36E-03	2.41E-03				Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	K-40	3.11E-03	pCi/m^3	5.01E-03	5.21E-03	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Ru-106	3.72E-04	pCi/m^3	1.95E-03	1.96E-03	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Ru-106	2.50E-04	pCi/m^3	3.64E-03	3.65E-03	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Sb-125	5.26E-05	pCi/m^3	5.35E-04	5.36E-04	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Sb-125	-3.61E-04	pCi/m^3	1.02E-03	1.04E-03	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Pu-238	0.00E+00	pCi/m^3	1.09E-06	1.09E-06	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Pu-238	-1.87E-07	pCi/m^3	1.57E-06	1.57E-06	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Pu-239/240	1.26E-07	pCi/m^3	1.54E-06	1.54E-06	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Pu-239/240	2.66E-06	pCi/m^3	2.50E-06	2.51E-06	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	Sr-90	5.74E-05	pCi/m^3	4.09E-05	4.38E-05	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	Sr-90	2.80E-04	pCi/m^3	2.31E-04	2.43E-04	U			Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	U-234	3.14E-05	pCi/m^3	1.31E-05	1.41E-05				Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	U-234	3.88E-05	pCi/m^3	1.55E-05	1.68E-05				Y
YAKIMA	FILTER1	330889009	27-Dec-12	26-Jun-13	U-235	2.78E-06	pCi/m^3	5.47E-06	5.50E-06	U			Y
YAKIMA	FILTER1	341977009	26-Jun-13	23-Dec-13	U-235	5.52E-06	pCi/m^3	7.27E-06	7.32E-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
YAKIMA	FILTER1		27-Dec-12	26-Jun-13	U-238	3.46E-05	pCi/m^3		1.47E-05				Y
YAKIMA	FILTER1		26-Jun-13	23-Dec-13	U-238	3.28E-05	pCi/m^3		1.50E-05				Y

(a) REFER TO DISCREPANCY RPT EMP13-003; ON 04/03/13 PERFORMED IN-FIELD CALIBRATION OF AIR SAMPLER #21711 BUT QUESTIONED CALIBRATION RANGE FOR AIR FLOW CALIBRATOR #37079. ON 04/04/13 REPLACED AIR SAMPLER #21711 WITH #22974.
(b) REFER TO DISCREPANCY RPT EMP13-004. FLOW RATE SLIGHTLY ELEVATED; USER-CALIBRATION PERFORMED ON 05/30/13 AT 0930 HRS.
(c) REFER TO DISCREPANCY RPT EMP13-004. SAMPLER STARTED ON 05/30/13 AT 0930 HRS AFTER COMPLETING USER-CALIBRATION.
(d) REFER TO DISCREPANCY REPORT EMP13-002; TOTAL VOLUME SLIGHTLY BELOW THE 728 M3 MINIMUM LIMIT (720 M3), BUT DID HAVE FILTER ANALYZED AND LAB MET MDC.
(e) FILTER PAPER OFF-CENTERED RESULTING IN LOWER THAN NORMAL DUST LOADING; SMALL CRESCENT SHAPED VOID BETWEEN THE EDGE OF THE PAPER AND RIM OF THE CARTRIDGE. REPLACED TOTALIZER #28917 WITH 28914 ON 12/11/13, START VOLUME 3266 M3, EXP 11/19/14.
(d) ON 06/26/13 DISCONTINUED SAMPLER BY BATTELLE BALL FIELD (SITE ID 991787); BEING REPLACED WITH SAMPLER NEAR 6TH STREET WAREHOUSE (SITE ID 991788).
(e) EFFECTIVE 06/26/13, LOCATION NAME CHANGED FROM TEST-E (SITE ID 1349925) TO PNL-4 (SITE ID 991788).

Distribution

No. of Copies

7 U.S. Department of Energy-Headquarters
1000 Independence Ave
Washington, D.C. 20585
JM Blaikie SC-31.1
RL Natoli AU-23
GA Vazquez AU-22
AC Lawrence AU-20
A Wallo III (3) AU-20

2 U.S. Environmental Protection Agency
Region 10
Federal & Delegated Air Programs
1200 Sixth Avenue
Seattle, WA 98101
D Zhen (2) AWT-107

1 U.S. Environmental Protection Agency
US EPA
1310 L Street, NW
Room 553C
Washington, D.C. 20005
R Rosnick

1 Washington State Department of Ecology
Ecology–Eastern Regional Office
4601 N. Monroe St
Spokane, WA 99205-1295
K Wood

1 Washington State Department of Ecology
Ecology –Hanford Project Office
3100 Port of Benton Blvd
Richland, WA 99354
R Skinnarland B5-18

7 Washington State Department of Health
WDOH - Radioactive Air Emissions Section
309 Bradley Blvd., Suite 201
Richland, WA 99352
SD Berven B1-42
PJ Martell, Manager (2) B1-42
JW Schmidt B1-42
ER McCormick B1-42
TA Rogers B1-42
RJ Utley B1-42

No. of Copies

1 Confederated Tribes of the Umatilla Indian Reservation
Richland Office -
Department of Science and Engineering
750 Swift Boulevard, Suite 12
Richland, WA 99352
SG Harris, Director

1 Hoh Indian Tribe of the Hoh Indian Reservation
P.O. Box 2179
Forks, WA 98331
M Lopez, Chairwoman

1 Jamestown S'Kallam Tribe of Washington
1033 Old Blyn Highway
Sequim, WA 98382
WR Allen, Chairman

1 Lower Elwha Tribal Community of the Lower Elwha Reservation
2851 Lower Elwha Road
Port Angeles, WA 98363
FG Charles, Chairwoman

1 Makah Indian Tribe of the Makah Indian Reservation
P.O. Box 115
Neah Bay, WA 98357
TJ Greene, Chairman

1 Nez Perce Tribe
Environmental Restoration and Waste Management
PO Box 365
Lapwai, ID 83540
G Bohnee

1 Quileute Tribe of the Quileute Reservation
P.O. Box 279
La Push, WA 98350
C Woodruff, Chairman

No. of Copies

1 Port Gamble Indian Community of the Port Gamble Reservation
31912 Little Boston Road, NE
Kingston, WA 98346
JC Sullivan, Chairman

2 Yakama Nation
Environmental Restoration Waste Management Program
P.O. Box 151
Toppenish, WA 98948
R Jim
P Rigdon

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

DW Bowser	elec.[1]

8 U.S. Department of Energy
Richland Operations Office

KD Leary	elec.
DE Jackson	elec.
MK Marvin	elec.
MD Silberstein	elec.
TW Ferns	elec.
DL Kreske	elec.
BM Pangborn	elec.
DOE-RL Public Reading Room	H2-53

2 Mission Support Alliance, LLC

AF Shattuck	elec.
DJ Rokkan	H7-28

No. of Copies

ONSITE

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

AS Arend	elec.
JL Carlson	elec.
JW Christ	elec.
TM McDermott (2)	K9-42
TP Pietrok	elec.
CJ Swafford-Bennett	elec.

25 Pacific Northwest National Laboratory

CM Andersen	elec.
BG Anderson	elec.
EJ Antonio	elec.
MY Ballinger	elec.
JM Barnett (4)	J2-25
CP Beus	elec.
LE Bisping	K7-68
SD Cooke	elec.
JP Duncan	K7-70
RJ Ford	elec.
BG Fritz	elec.
TL Gervais	elec.
EE Hickey	elec.
KM McDonald	J2-25
CJ Nichols	elec.
BE Opitz	elec.
RD Sharp	elec.
SF Snyder (2)	K3-54
JA Stegen	elec.
MJ Stephenson	J2-25
HT Tilden II	elec.
PNNL Reference Library	P8-55
Rad Air File Plan A1.1.1.2	J2-25

[1] elec. = electronic distribution only

Pacific Northwest
NATIONAL LABORATORY

U.S. DEPARTMENT OF
ENERGY

Proudly Operated by Battelle *Since 1965*

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