U.S. DEPARTMENT OF ENERGY

PNNL-20436-2

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

Department of Energy – Office of Science

Pacific Northwest National Laboratory Site Radionuclide Air Emissions Report for Calendar Year 2011

SF Snyder
JM Barnett
LE Bisping

June 2012

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

Facilities with potential emissions of radioactive materials at the U.S. Department of Energy Office of Science (DOE-SC) Pacific Northwest National Laboratory Site (PNNL Site) are research laboratories at the Physical Sciences Facility (PSF) and the Environmental Molecular Sciences Laboratory (EMSL). This is the second Air Emissions Report for the PNNL Site since the start of PSF radiological operations in 2010 and is the first full year of PSF operations.

This report documents radionuclide air emissions that result in the highest effective dose equivalent (EDE) to a 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 Subpart H of 40 CFR 61 require the measurement and reporting of radionuclides emitted from DOE facilities and the resulting public dose from those emissions. Those regulations impose a standard of 10 mrem/yr EDE, which is not to be exceeded. Washington State adopted the 40 CFR 61 standard of 10 mrem/yr EDE into its regulations that require the calculation and reporting of the EDE to the MEI from both point source emissions and from fugitive source emissions of radionuclides. WAC 246-247 further requires the reporting of radionuclide emissions, including radon, from all PNNL Site 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.

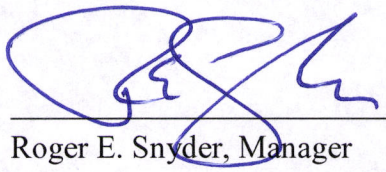
The EDE to the PNNL Site MEI due to routine emissions in 2011 from PNNL Site sources was 1.7E-05 mrem (1.7E-7 mSv) EDE. No nonroutine emissions occurred in 2011. The total radiological dose for 2011 to the MEI from all PNNL Site radionuclide emissions was more than 10,000 times smaller than the federal and state standard of 10 mrem/yr, to which the PNNL Site is in compliance.

For further information concerning this report, you may contact Theresa L. Aldridge, of the U.S. Department of Energy, Pacific Northwest Site Office, by telephone at (509) 372 4508 or by e-mail at Theresa.Aldridge@pnso.science.doe.gov.

CERTIFICATION of PNNL-20436-2

DOE-SC PNNL Site
Radionuclide Air Emissions Report
Calendar Year 2011

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)]



6/13/12

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

Date

Acronyms and Abbreviations

CAP88-PC	Clean Air Act Assessment Package 1988-Personal Computer
CFR	Code of Federal Regulations
CGS	Columbia Generating Station
Ci	curie
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
ENW	Energy Northwest
EPA	U.S. Environmental Protection Agency
gsf	gross square feet
HEPA	high-efficiency particulate air (filter)
km	kilometer
Major	a radioactive point source having a radiological dose potential of greater than 0.1 mrem/yr effective dose equivalent, 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
Minor	a radioactive point source having a radiological dose potential of less than or equal to 0.1 mrem/yr effective dose equivalent, 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
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
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
rem	roentgen equivalent man
SD	standard deviation
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

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1.0 Introduction

This report documents calendar year 2011 radionuclide air emissions from the U.S. Department of Energy Office of Science (DOE-SC) Pacific Northwest National Laboratory Site (hereafter, PNNL Site), 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, "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, "Radiation Protection — Air Emissions." In addition, the report is compatible with the quality principles of 10 CFR 830, *Nuclear Safety Management;* DOE Order 414.1D, *Quality Assurance;* ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Application;* and U.S. Environmental Protection Agency (EPA) QA/R-5, *EPA Requirements for Quality Assurance Project Plans.*

1.1 PNNL Site Description

The PNNL Site (Figure 1.1) is located in southeastern Washington State. It is less than a mile south of the much larger U.S. DOE Hanford Site (see Figure 1.2). The PNNL Site occupies 0.54 mi^2 (1.4 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 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. The area immediately south of the PNNL Site is developed with office, laboratory, and retail space. The Columbia River borders the PNNL Site on the east. Environmental conditions of non-operational Hanford Site areas are also characteristic of the PNNL Site. 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).

1.1.1 Historical Background

The U.S. DOE chartered the Pacific Northwest Site Office in December 2003 under the Office of Science. The Battelle Memorial Institute[1] is contracted to the DOE to operate PNNL (contract DE-AC06-76RL01830). Battelle has managed PNNL since its inception. The PNNL Site, with boundaries identified in Figure 1.1, was established in the last decade. The PNNL Site is currently occupied by two facilities: the Environmental Molecular Sciences Laboratory (EMSL) and the Physical Sciences Facility (PSF). Battelle also conducts research and administrative functions in a number of facilities adjacent to the PNNL Site. Battelle has owned and leased facilities in the region south of the PNNL Site since the mid-1960s.

EMSL is a single 224,000 gsf 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.

[1] Battelle Memorial Institute, Pacific Northwest Division, Richland, WA 99352.

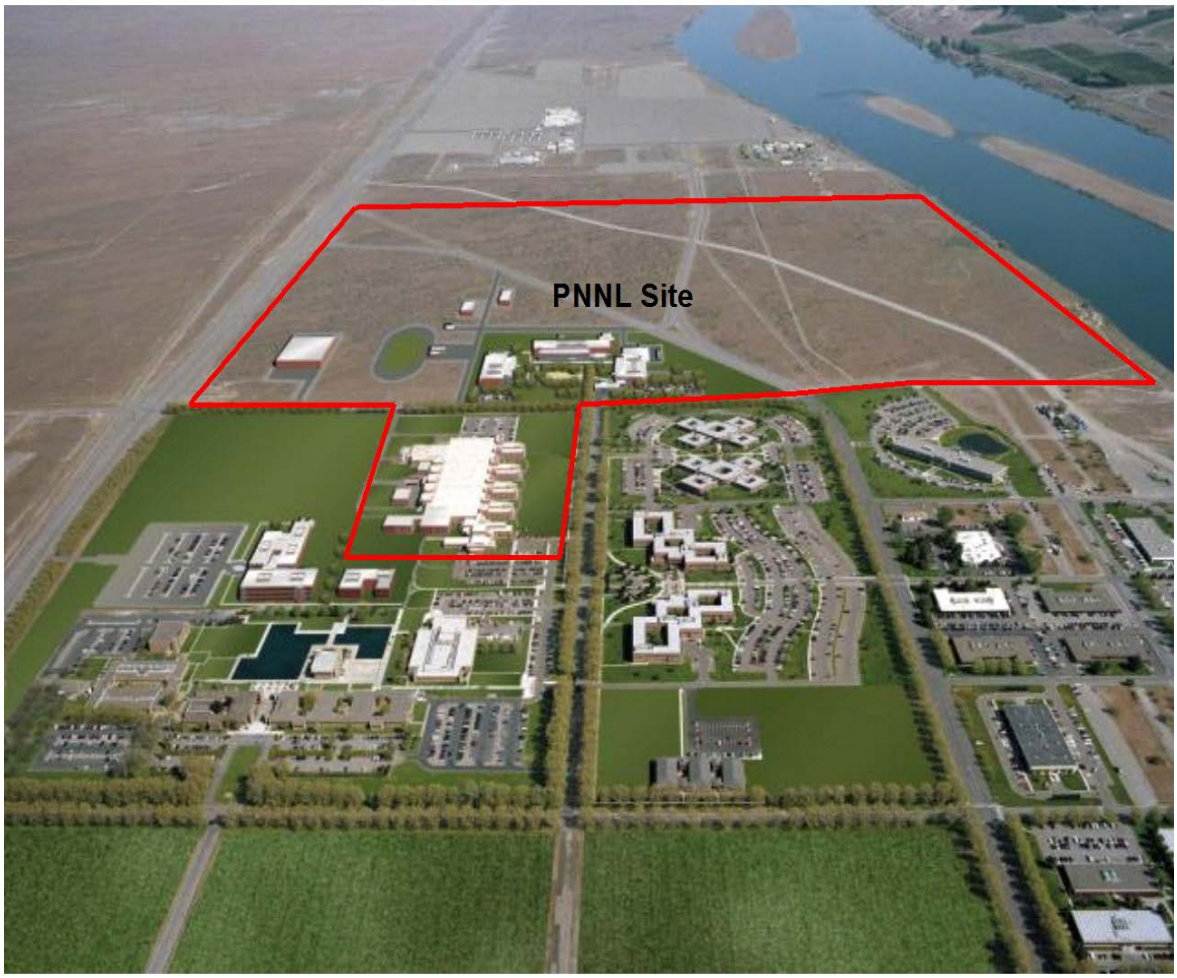

Figure 1.1. DOE-SC PNNL Site Boundary

The PNNL Site contains six buildings, listed in Table 1.1. The five buildings of the PSF (see 3400 series buildings of Table 1.1) were constructed in 2009 and 2010 to replace aging laboratory infrastructure on the Hanford Site. The first radioactive materials were moved into a PSF facility in July 2010.

Each PSF facility has unique research areas. However, as research facilities, projects are expected to change over time. The PSF Materials Sciences and Technology Laboratory (3410 Building) supports research in the development of materials for advanced energy systems. The PSF Radiation Detection Laboratory (3420 Building) supports research in radionuclide measurement technologies and capabilities. Here, scientists develop and apply radiation detection methods needed for identifying weapons of mass destruction and terrorist activities, and in support of international treaties and agreements. The PSF Underground Laboratory (3425 Building) is located 40 ft (12 m) below ground and supports homeland and national security missions including the development and advancement of radiation detection technologies. The PSF Ultra-Trace Laboratory (3430 Building) supports research in the characterization of radionuclides for detecting the proliferation of weapons of mass destruction. The PSF Large Detector Laboratory (3440 Building) and the accompanying Radiation Portal Monitoring Test Track support the development and testing of radiation detection technologies designed to be deployed at U.S. borders and ports of entry.

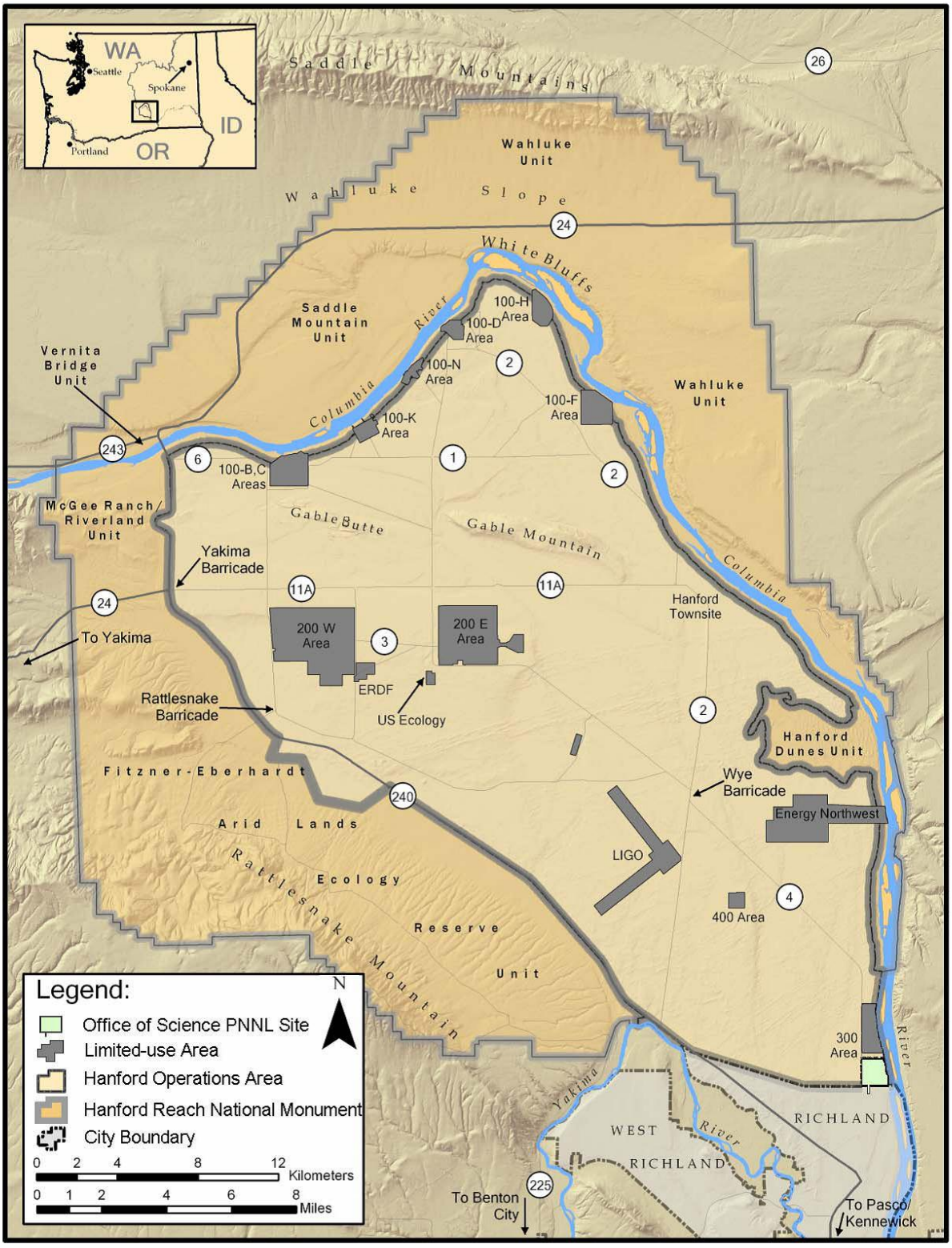

Figure 1.2. Location of the Hanford Site in Relation to the PNNL Site

Table 1.1. Operational Buildings on the PNNL Site

Building	Start Date of 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	1997

(a) Sealed sources only.

The Hanford Site history is briefly described here because of its proximity adjacent to the PNNL Site and because it is a source of radiological airborne emissions that could impact the PNNL Site. 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 Site, 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 Site Facilities and Activities

Permitting requirements for the new PSF buildings were established and met prior to their opening. Emission unit designations for PSF buildings were established during permitting of the facilities. 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 dose greater or less than 0.1 mrem/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] The five buildings that comprise the PSF contain both major and minor emission units or fugitive release sites (see Table 1.2 and Figure 1.3).

Table 1.2. Types of Emission Units at PNNL Site Buildings

Building	Building Name	Emission Unit Type
3410	Materials Sciences and Technology Laboratory	Major
3420	Radiation Detection Laboratory	Major and Minor
3425	Underground Laboratory	Fugitive
3430	Ultra-Trace Laboratory	Major and Minor
3440	Large Detector Laboratory	None
3020	Environmental Molecular Sciences Laboratory	Fugitive

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

Figure 1.3. Physical Sciences Facility on the PNNL Site

Notable events in calendar year 2011 relevant to radioactive airborne emissions monitoring and reporting are summarized as follows:

- PSF facilities were occupied and conducted a first full year of operations in 2011.
- The first full year of ambient air monitoring occurred in 2011.
- The set of documents that comprise the PNNL Site Environmental Monitoring Plan for ambient air surveillance was published in 2011 (i.e., Snyder et al. 2011, Meier 2011, Bisping 2011, and Snyder 2011).

1.1.3 Prime Contractor

Battelle Memorial Institute is contracted to operate PNNL for DOE-SC. PNNL manages operations at the PNNL Site and at additional research and office areas adjacent to the Site toward the north, south, and east. Activities at PNNL Site include research and development in the physical, chemical, life, and environmental sciences; and relevant environmental monitoring for the Site.

1.1.4 Facilities Adjacent to the PNNL Site

Land adjacent to the PNNL Site 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). The Hanford Site 300 Area, just north of the PNNL Site, has radiological operations (primarily operated by Battelle-Pacific Northwest Division) that need to be considered in conjunction with releases, dose estimates, and environmental monitoring of the PNNL Site. The 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 300 Area activities are cleanup, research, and office facilities. Radiological emissions from the Hanford Site are described in the Hanford Site Radionuclide Air Emissions Report (Rokkan et al. 2011).

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 Site. 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 (ENW CGS) 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 Site; 4) the AREVA Federal Services LLC fuel fabrication facility, west of the PNNL Site; 5) Perma-Fix Northwest, Inc., adjacent to the east side of the AREVA Federal Services LLC; 6) Interstate Nuclear Services, southwest of the PNNL Site; and 7) Battelle's non-DOE research laboratories in north Richland, south of the PNNL Site. AREVA is a nuclear reactor fuel fabrication facility and Perma-Fix NW manages and treats low-level and mixed radioactive waste. These facilities will be discussed in the appropriate sections of this report to the extent necessary. Emissions from these facilities are not included in this report because they are regulated separately from the PNNL Site.

1.2 Point Source Descriptions

This section includes descriptions of point sources at the PNNL Site. A point source is reported in this document if it met the following four criteria during 2011:

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

Air emissions from other sources of radioactive materials are discussed in Sections 4.0 and 5.0, as applicable.

The PNNL Site emission units registered with the WDOH for radiological emissions are given in Table 1.3 (PNNL 2011, Attachment E).

Table 1.3. PNNL Site 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)]

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

1.2.1 PNNL Site Radiological Operations

In general, radionuclide air emissions from point sources are discharged from stacks and vents. Discharge heights for PSF stack and fugitive emission points range from nearly ground level to 45 ft (14 m), and flow rates range from 17,900 ft^3/min (8.4 m^3/s) to 66,500 ft^3/min (31 m^3/s).

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 Site and who lives near and/or has unrestricted access to a place of employment on the PNNL Site. 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 Site 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 2011 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).

Table 1.4. Emission Point Characteristics

Unit Type/ Emission Point ID	Average Flow Rate	Physical Discharge Height	Physical Discharge Diameter	Effective Discharge Height	Abatement Technology
Major EP-3410-01-S	17,900 ft^3/min (8.44 m^3/s)	45 ft (13.7 m)	3.3 ft (1.02 m)	98.5 ft (30.0 m)	Single-stage HEPA filter
Major EP-3420-01-S	36,700 ft^3/min (17.3 m^3/s)	45 ft (13.8 m)	4.3ft (1.3 m)	121 ft (36.9 m)	Single-stage HEPA filter
Major EP-3430-01-S	31,800 ft^3/min (15.0 m^3/s)	44 ft (13.4 m)	3.7 ft (1.1 m)	115 ft (35.1 m)	Single-stage HEPA filter

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

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. 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 forensics instrumentation. Applications for these capabilities range from fundamental science, such as neutrino mass detection, to applied systems for prevention of nuclear proliferation and radiation portal monitoring at U.S. borders.

3430 Building – Ultra-Trace Laboratory

The 3430 Building provides ultra-trace radio-analytical capabilities for nuclear forensics in support of critical national needs, such as international treaty verification and detection of weapons of mass destruction. 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.

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. Additional activities include radiation physics experiments, development of ultra-low radioactivity materials, and other fundamental sciences studies.

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.

1.2.2 Emission Point Characteristics

The average operating characteristics of each PNNL Site sampled emission unit are indicated in Table 1.4. The single-stage HEPA filter abatement technology listed in the table has a design efficiency of 99.95%.

2.0 Radionuclide Air Emissions for Point Sources

This section presents information on point sources of radionuclide emissions at the PNNL Site. The point sources listed are actively ventilated stacks using electrically powered exhausters and from which emissions are discharged under controlled conditions. The point sources are major-, minor-, and fugitive emissions units. The criteria for reporting point source radioactive emissions in this report can be found in Section 1.2.

2.1 Radioactive Emissions

Data on radionuclides with the greatest dose impact that are emitted from PNNL Site point sources that operated in 2011 are shown in Table 2.1 and Table 2.2. Significant emissions from minor and fugitive emissions units (Table 2.2) were calculated using the Appendix D method of 40 CFR 61.[1] Table 2.3 indicates Appendix D calculated emissions that impose insignificant dose contributions relative to those of Table 2.2. A summary of the nuclides activity emitted from major, minor, and fugitive emissions units is provided in Table 2.4.

Table 2.1. PNNL Site Radionuclide Emissions (Ci) from Major Point Sources in 2011

Radionuclide	EP-3410-01-S 3410 Building	EP-3420-01-S 3420 Building	EP-3430-01-S 3430 Building	Total
gross α [(a)]	4.04E-08	6.66E-08	4.10E-08	1.5E-07
gross β [(a)]	2.14E-07	4.61E-07	2.16E-07	8.9E-07
^{60}Co	1.43E-09	ND	8.85E-09	1.0E-08
$^{233/234}$U	NA	NA	1.18E-09	1.2E-09
^{238}Pu	ND	1.13E-10	5.23E-10	6.4E-10
$^{239/240}$Pu	1.98E-09	2.26E-09	1.75E-09	6.0E-09
^{241}Am	ND	1.13E-10	5.23E-10	6.4E-10
^{243}Am	2.12E-08	4.66E-08	2.34E-08	9.1E-08
^{244}Cm	5.06E-11	1.86E-11	ND	6.9E-11

(a) Maximum of the biweekly or composited average measurement.
ND = not detected
NA = not applicable

[1] Emissions are calculated from inventory. The annual possession quantity based on inventory at the beginning of the calendar year plus quantity received or produced during the calendar year is estimated (per Ballinger et al. 2011) and Appendix D 40 CFR 61 methods are applied.

Table 2.2. PNNL Site Appendix D Calculated Radionuclide Emissions (Ci) from Minor Emissions Units and Fugitive Sources in 2011[(a),(b)]

Nuclide	EP-3420-02-S 3420 Building	EP-3430-02-S 3430 Building	J-3425 3440 Building	Total
^{24}Na	NA	1.3E-08	NA	1.3E-08
^{60}Co	5.3E-11	1.9E-11	5.1E-12	7.7E-11
^{82}Br	NA	1.3E-08	NA	1.3E-08
^{88}Y	9.5E-11	3.0E-11	9.6E-12	1.3E-10
^{109}Cd	1.1E-10	3.1E-12	9.6E-13	1.1E-10
^{137}Cs	3.7E-11	1.4E-11	3.7E-12	5.5E-11
^{210}Pb	7.7E-11	2.5E-12	7.1E-15	8.0E-11
^{226}Ra	NA	1.2E-09	NA	1.2E-09
^{241}Am	1.3E-11	3.2E-12	6.9E-13	1.7E-11

(a) Values are not from actual measurements, but calculated from in-facility material inventories and estimates and Appendix D method of 40 CFR 61.
(b) Listed nuclides account for over 99% of dose impact from Minor and Fugitive sources in 2011.
NA = not applicable

Table 2.3. Non-significant PNNL Site Radionuclide Emissions (Ci) from Minor Emission Units and Fugitive Sources in 2011

Nuclide	Release (Ci)	Nuclide	Release (Ci)	Nuclide	Release (Ci)
^{110m}Ag	3.5E-17	^{99}Mo	6.3E-13	^{125}Sb	5.0E-16
^{242}Am	8.7E-20	^{95}Nb	8.5E-14	^{75}Se	3.0E-17
^{243}Am	5.1E-16	^{97}Nb	1.9E-14	^{153}Sm	1.1E-14
^{140}Ba	3.0E-13	^{97m}Nb	1.7E-14	^{113}Sn	5.2E-11
^{139}Ce	1.5E-11	^{147}Nd	1.8E-13	^{85}Sr	8.5E-11
^{141}Ce	2.1E-13	^{236}Np	1.4E-17	^{89}Sr	1.1E-13
^{143}Ce	1.8E-12	^{237}Np	4.0E-19	^{90}Sr	9.9E-13
^{144}Ce	1.7E-14	^{149}Pm	1.2E-13	^{99m}Tc	6.1E-13
^{57}Co	1.2E-11	^{143}Pr	5.7E-13	^{234}U	1.3E-14
^{134}Cs	1.6E-14	^{238}Pu	5.7E-18	^{235}U	4.0E-16
^{154}Eu	3.4E-15	^{239}Pu	1.3E-16	^{238}U	4.0E-18
^{155}Eu	1.2E-15	^{240}Pu	4.6E-17	^{131m}Xe [(a)]	2.7E-07
^{203}Hg	4.6E-11	^{241}Pu	3.0E-16	^{133}Xe	8.5E-13
^{131}I	3.1E-13	^{242}Pu	1.9E-19	^{133m}Xe	2.4E-14
^{132}I	2.6E-13	^{244}Pu	6.6E-20	^{95}Zr	1.2E-13
^{133}I	5.7E-14	^{103m}Rh	9.1E-14	^{97}Zr	1.7E-14
^{192}Ir	4.2E-14	^{105}Rh	7.6E-14		
^{140}La	4.4E-13	^{103}Ru	9.2E-14	**Total**	**2.7E-07**

(a) Value from known release from minor emission unit EP-3420-02-S. Other emissions calculated from 40 CFR 61 Appendix D methods.

Table 2.4. PNNL Site Total Radionuclide Emissions (Ci) in 2011

Nuclide	Major Emissions Units	Minor and Fugitive Emissions Units	Total (Ci)
gross α [(a)]	1.5E-07	NA	1.5E-07
gross β [(a)]	8.9E-07	NA	8.9E-07
^{24}Na	NA	1.3E-08	1.3E-08
^{60}Co	1.0E-08	7.7E-11	1.0E-08
^{82}Br	NA	1.3E-08	1.3E-08
^{88}Y	NA	1.3E-10	1.3E-10
^{109}Cd	NA	1.1E-10	1.1E-10
^{131m}Xe	NA	2.7E-07	2.7E-07
^{137}Cs	NA	5.5E-11	5.5E-11
^{210}Pb	NA	8.0E-11	8.0E-11
^{226}Ra	NA	1.2E-09	1.2E-09
$^{233/234}$U	1.2E-09	1.3E-14[(b)]	1.2E-09
^{238}Pu	6.4E-10	5.7E-18[(b)]	6.4E-10
$^{239/240}$Pu	6.0E-09	1.8E-16[(b)]	6.0E-09
^{241}Am	6.4E-10	1.7E-11	6.6E-10
^{243}Am	9.1E-08	5.1E-16[(b)]	9.1E-08
^{244}Cm	6.9E-11	NA	6.9E-11

(a) Maximum of the biweekly or semi-annual average measurement.
(b) 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 Site is evaluated in this section.

3.1 Description of Dose Model

During 2010, several PNNL Site major emission units became operational and, thus, this report is required for Clean Air Act compliance determination. 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 2007, *CAP88-PC Version 3.0 User Guide*), approved by the EPA. This dose value was used to determine the compliance of the PNNL Site with the dose standard of 10 mrem/yr EDE to any member of the public in 40 CFR 61, Subpart H and WAC 246-247.

CAP88-PC 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 Site radionuclide emissions (see Table 2.4).

The nearest location (e.g., dwelling, business, school, office) relative to the PNNL Site is determined for a public receptor not located within the boundary of the PNNL Site and who has the potential of receiving the maximum exposure to emissions from that area. This may be a hypothetical person but there must be some potential for continued occupancy at the location indicated. For example, a northwest fence line location was not considered because no one individual routinely occupies this location, which is in the middle of 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 the offsite businesses and the year-to-year variability of dispersion estimates at close distances, several options for maximally impacted locations are presented (see Table 3.1) based on evaluations of average meteorology from 1983 through 2006, and individual year meteorology from 2006 through 2009. The PNNL Site 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.

The PNNL Site MEI is a member of the public who hypothetically receives the highest calculated radiological dose attributable to exposure to PNNL Site emissions in one calendar year. Selection of the annual MEI, who cannot be an employee of DOE or its contractors, is contingent on the MEI's place of residence or employment.

For information purposes only, the dose from PNNL Site emissions was also determined for the Hanford Site MEI near Sagemoor Road, directly east and across the Columbia River from the Hanford Site 300 Area. This information is presented to compare the impacts of radiological emissions from the two DOE sites.

Table 3.1. PNNL Site Potential Receptors

	Distance km (mi)
Offsite residence	
MEI[(a)]	0.48 (0.30) SSE
Physically nearest (User Housing Facility [UHF])	0.88 (0.55) S
Location of maximum impact, actual resident:	
Option 1: UHF (short-term resident)	0.88 (0.55) S
Option 2: Condominiums (long-term resident)	0.97 (0.60) SE
Offsite business	
Physically nearest (ISB1)	0.17 (0.11) SSE
Location of maximum impact	
NSB Parking Lot and George Washington Way	0.55 (0.34) SSE
Onsite public receptor	
Physically nearest (EMSL)	0.32 (0.20) SSW
Farm with potential for crops or livestock	
Nearest (east of river)	1.5 (0.93) E
Hanford Site historic MEIs (Rokkan et al. 2011)	
Sagemoor Rd (46.368, -119.257)	2.47 (1.5) NE
Ringold (46.485, -119.255)	15.22 (9.5) N

(a) No individual resides at this location, but long-term meteorology indicates this would be the region of greatest particulate air concentrations from a facility with emissions units like those of PSF (Snyder 2011).

When the potential MEI locations of Table 3.1, as well as year 2011 annual meteorological data (see Appendix A) were evaluated with CAP88-PC v3 models, the 2011 receptor of maximum impact from PSF emissions (i.e., the MEI) was determined to be 550 m SSE of PSF (see Figure 3.1). This is slightly farther from PSF than last year's MEI location, a consequence of changes in stack operating parameters in 2011. The MEI location is a routinely occupied parking area adjacent to office buildings leased by Battelle. This individual could not reasonably produce his or her own food supply at this location, but it was conservatively assumed that this was the case.

3.2 Summary of Input Parameters

For many years, the nearby Hanford Site NESHAP dose calculations were performed using established standard parameters for the Hanford Site and its environment (refer to DOE 2008, *Methods for Calculating Doses to Demonstrate Compliance with Air Pathway Radiation Dose Standards at the Hanford Site*). A similar method was used for PNNL Site dose calculations. Radionuclide emissions data from the PNNL Site (see Table 2.4) were used in the dose calculations. Emissions from 3410 Building major emission unit has been determined by modeling to most greatly impact the MEI location, primarily as a result of its lower effective release height relative to the other buildings. Therefore, the dose assessment conservatively assumed that all PSF emissions were emitted from the 3410 Building. As a conservative assumption, emissions reported as gross alpha or gross beta were evaluated as $^{239/240}$Pu or ^{90}Sr, respectively. Fugitive and minor releases were assumed to be released from a 10-m release height, whereas 3410 Building emission unit characteristics were assumed for major emissions unit releases.

Additional data used for dose calculations can be found in Appendix A; all other radionuclide-specific parameters used were default values in CAP88-PC data libraries. Maximum individual exposure and consumption parameters are assumed to be the same as those routinely used for the Hanford Site analyses (see DOE 2008). The entire hypothetical MEI diet was constructed using the "local" food production option in CAP88-PC 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. PNNL Site 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 wind files were prepared from data collected at the Hanford Site 300 Area weather station just north of the PNNL Site (see Figure 1.2, Figure 5.1) and represent the average of hourly data recorded in 2011. Meteorological data for 2011 are presented in Appendix A as joint frequency of wind speed, wind direction, and stability category for station located at the Hanford 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 Site boundary) and lack of turbulent interference allows the 300 Area meteorological data to be used to represent the PNNL Site 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, and applies to radionuclide air emissions, other than radon, from DOE facilities. For calendar year 2011, the PNNL Site MEI location was 0.55 km (34 mi) SSE of the PSF. The dose to the PNNL Site MEI from routine and nonroutine point source emissions was 1.7E-5 mrem (1.7E-7 mSv) EDE. Table 3.2 shows the relative contributions of each nuclide to the MEI dose.

The nearby Hanford Site, the adjacent DOE site with major emissions units, was also considered for comparative evaluation. PNNL Site 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. Hanford Site 300 Area emissions and the Hanford Site MEI for calendar year 2011 were reviewed. Both PNNL and Hanford (Rokkan et al. 2012) are in compliance with the 10 mrem/yr regulatory standard for calendar year 2011 radiological emissions.

The calendar year 2011 Hanford Site MEI location was near Sagemoor Road, Franklin County, Washington, directly east of the 300 Area. The dose to the Hanford MEI from PNNL Site emissions was estimated to be 5E-6 mrem (5E-8 mSv). The dose to the PNNL Site MEI from the Hanford Site 300 Area emissions excluding radon (emissions listed in Table 3-1 of Rokkan et al. 2012), was estimated to be 2E-2 mrem (2E-4 mSv) EDE. The majority of the impact from Hanford Site 300 Area emissions to the PNNL Site MEI is attributable to ^{3}H emissions (99.9%).[1]

[1] Exclusion of Hanford Site 300 Area tritium emissions results in an estimated dose to the PNNL Site MEI of 1E-5 mrem (1E-7 mSv), the majority of that dose is from $^{239/240}Pu$ which includes gross alpha.

Table 3.2. PNNL Site 2011 Combined Radionuclide Emissions and Dose Contributions by Nuclide from Major and Minor Emission Units

Radionuclide	Releases Ci	EDE to MEI mrem	% of Total EDE percent
gross α[(a)]	1.5E-07	9E-06	54%
gross β[(a)]	8.9E-07	3E-06	16%
^{24}Na[(b)]	1.3E-08	2E-10	<1%
^{60}Co	1.0E-08	6E-09	<1%
^{82}Br[(b)]	1.3E-08	4E-10	<1%
^{88}Y[(b)]	1.3E-10	1E-10	<1%
^{109}Cd[(b)]	1.1E-10	1E-10	<1%
^{137}Cs[(b)]	5.5E-11	5E-10	<1%
^{210}Pb[(b)]	8.0E-11	3E-09	<1%
^{226}Ra[(b),(c)]	1.2E-09	6E-08	<1%
^{233}U	1.2E-09	5E-09	<1%
^{238}Pu	6.4E-10	4E-08	<1%
$^{239/240}Pu$	6.0E-09	4E-07	2%
^{241}Am	6.6E-10	4E-08	<1%
^{243}Am	9.1E-08	5E-06	27%
^{244}Cm	6.9E-11	3E-09	<1%
Table 2.3 nuclides	2.7E-07	1E-10	<1%
Total	**1.4E-06**	**2E-05**	**100%**[(d)]

(a) Alphas assumed to be ^{239}Pu for dose calculation purposes; betas assumed to be ^{90}Sr.
(b) Calculated release based on Appendix D method of 40 CFR 61.
(c) Dose includes radon-222 progeny.
(d) Tabulated nuclide-specific values do not add to 100% due to rounding.
ND = not detected
NA = not applicable

Figure 3.2 shows the PNNL Site dose relative to the 10 mrem federal limit; it also includes the 2008 through 2011 Hanford Site doses (Rokkan et al. 2011) 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 and MEI_PNNL is the PNNL Site's MEI located 0.55 km SSE of PSF.

3.4.2 Washington Administrative Code 246-247

For PNNL Site 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. 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 combined PNNL Site fugitive and diffuse emissions were included in the dose evaluation of Section 3.4. Emissions from diffuse and fugitive PNNL Site sources add 7E-8 mrem (7E-10 mSv) EDE (see Table 3.2) to the 1.7E-5 mrem (1.7E-7 mSv) EDE PNNL Site dose. The combined PNNL Site dose from both point and fugitive sources remains well below the 10 mrem/yr WAC 246-247 limit. There were no radon emissions (refer to Table 3.2 and Section 3.6.3) and no nonroutine emissions (refer to Section 3.5) from the PNNL Site in 2011 that would contribute to dose that is considered for compliance determination with the WAC 246-247 standard.

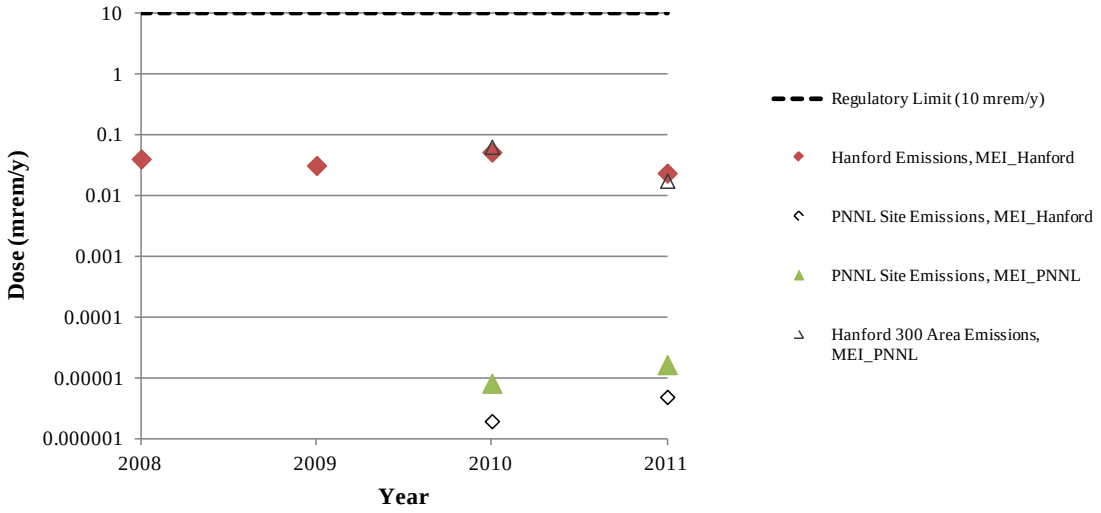

Figure 3.2. Doses to the PNNL Site and Hanford Site MEIs Due to Emissions of Radionuclides from the PNNL Site, 2011, and the Hanford Site, 2008 through 2011

3.5 Nonroutine Releases of Radionuclides to the Atmosphere

No instances of significant nonroutine emissions were reported in 2011.

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 Site 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. 2010. Particulate air sampling stations were established at three locations in mid-2010. These operated for the first full calendar year in 2011. The PNNL Site 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 2011.

3.6.3 Radon-220 and Radon-222 Emissions

^{220}Radon was not emitted from PNNL Site operations in 2011. However, the 40 CFR 61 Appendix D estimate of radium-226 emissions includes its progeny radon-222 in the impact estimate (see Table 3.2). Radon is exempted from consideration in determining compliance with the dose standard of Subpart H of 40 CFR 61, but it is encompassed by state regulations, as in WAC-246-247-040(6), which states that "[a]ll emissions of radionuclides . . . are subject to the standards of this section . . . ."

4.0 Fugitive Sources of Emissions

The Clean Air Act Amendments of 1990, promulgated in 54 Federal Register 16965, December 15, 1989, amended NESHAP regulations (i.e., 40 CFR 61, Subpart H) to govern 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 the PNNL Site sources are monitored by three offsite particulate air sampling stations. The air surveillance program conducted in 2011 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 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 Site. The Hanford Site fugitive emissions are evaluated in detail in their Radiological Air Emissions Report (e.g., Rokkan et al. 2012). The PNNL Site contains no comparable non-facility-specific fugitive emission sources.

The PNNL Site has two sources characterized as fugitive sources from Site facilities, as well as several minor sources that have been grouped for purposes of estimating the MEI dose (see Section 3.4.2). Because the PNNL Site emission units are well characterized, emissions from the fugitive and minor sources have been estimated using methods previously approved by WDOH and EPA. For this report, doses from fugitive and minor emission units have been calculated using CAP88-PC 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 7E-8 mrem (7E-11 mSv) EDE.

5.0 Supplemental Information

This section provides supplemental information related to PNNL Site radionuclide air emissions in 2011 and consists of the following:

- population dose estimate
- compliance status with Subparts Q and T of 40 CFR 61
- 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, Method 114.

5.1 Population Dose Estimate

The estimated regional population radiation dose (i.e., the collective EDE) from PNNL Site air emissions in 2011 was calculated using a simplified method that overestimates the population dose. The population consists of approximately 432,000 people residing within a 50-mi (80-km) radius of the 300 Area (Hamilton and Snyder 2011). The close proximity of the Hanford 300 Area and rural region within 50 mi of the PNNL Site permits the 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 (1.7E-5 mrem) times the 50-mi population (432,117). The 2011 total population dose from radionuclide air emissions estimated in this very conservative manner from nuclides that originate from the PNNL Site was 7.3 person-rem (0.073 person-Sv). This represents an increase over the 2010 estimate as a result of both the higher MEI dose and updated census data.

5.2 Compliance Status with 40 CFR 61, Subparts Q and T

In 40 CFR 61, Subpart Q, "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 Site.

Activities at the PNNL Site were evaluated for compliance with 40 CFR 61 Subpart T, "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 Site.

Subparts T and Q do not apply to the PNNL Site for calendar year 2011 operations.

5.3 Environmental Surveillance for the PNNL Site

A particulate air sampling network was established in 2010 to monitor radioactive particulates in ambient air near the PNNL Site. The first full calendar year of air surveillance was conducted in 2011. Sampling data are collected at three ambient air samplers (Figure 5.1) at locations just outside the perimeter of the PNNL Site to satisfy air permit requirements. In addition to PNNL Site emissions, these samplers can collect radioactive particulates released from other nearby sources. During 2011, the Hanford Site 300 Area would have contributed most of the non-PNNL particulates detected from offsite facilities.

5.3.1 Environmental Surveillance

Environmental air surveillance is performed at three sampling stations off the PNNL Site (see Figure 5.1). This sampling was initiated prior to July 2010, the month that radiological operations at the new PSF buildings began. Routine surveillance activities at the PNNL Site 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).

Airborne particulate radionuclides are sampled and analyzed at all PNNL Site monitoring stations. 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 2011 include ^{60}Co. In addition, americium isotopes (^{241}Am and ^{243}Am) and ^{243}Cm are analyzed. Also, the Hanford Site has several nearby community sampling locations within a 30-mi (48-km) radius of the PNNL Site as well as a background location at a single distant community station in Yakima. The Yakima station is upwind of both the PNNL Site and the Hanford Site, and is considered to be unaffected by either of the DOE operations. Summary data from the Hanford Site monitoring program are reported in the Hanford Site Annual Environmental Report each year (e.g., Poston et al. 2011).

5.3.2 Air Sampling Results for Calendar Year 2011 Operations

The particulate air sampling results are provided in Appendix C, Table C.2, for the calendar year 2011 PNNL Site sampling, as well as the Yakima background station. Results are summarized in Table 5.1 for the PNNL Site stations and the Yakima background station. With the exception of samples for $^{233}U/^{234}U$, and Am and Cm isotopes (for which no background samples were available), all results at the PNNL Site sample stations were within 2 standard deviations (sd) of the background levels. All other average air concentrations were at or near detection limits. There was no indication of substantially elevated levels of monitored particulate radionuclides in the vicinity of the PNNL Site from either onsite or other nearby sources.

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

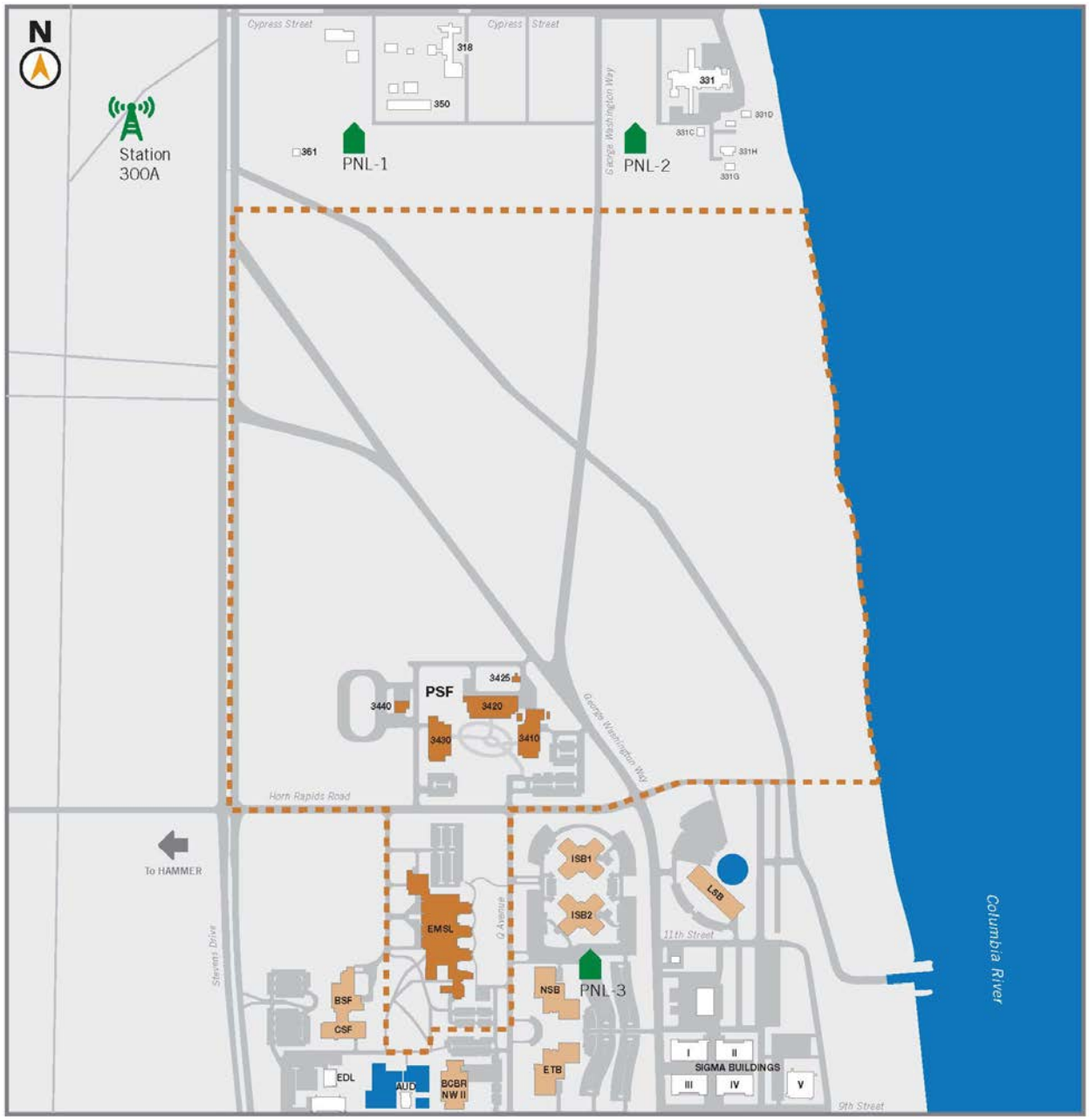

Figure 5.1. Offsite Air Surveillance Locations for the PNNL Site (⌂)

Table 5.1. Summary of 2011 Air Sampling Results

Nuclide	Location	No. of Samples	No. of Detections	Average ± 2 sd (pCi/m3)
Gross Alpha	PNL-1	25	21	0.00077 ± 0.00086
	PNL-2	26	24	0.00074 ± 0.00096
	PNL-3	26	21	0.00086 ± 0.0014
	YAKIMA	26	19	0.00056 ± 0.00061
Gross Beta	PNL-1	25	25	0.020 ± 0.025
	PNL-2	26	26	0.018 ± 0.022
	PNL-3	26	26	0.026 ± 0.034
	YAKIMA	26	26	0.018 ± 0.022
Cobalt-60	PNL-1	4	0	-0.000062 ± 0.00075
	PNL-2	4	0	-0.000091 ± 0.00039
	PNL-3	4	0	0.000013 ± 0.00098
	YAKIMA	4	0	0.000027 ± 0.00037
Uranium-234	PNL-1	4	4	0.000056 ± 0.000031
	PNL-2	4	4	0.000036 ± 0.000021
	PNL-3	4	4	0.000067 ± 0.000027
	YAKIMA	4	4	0.000039 ± 0.000017
Plutonium 238	PNL-1	4	0	-0.0000017 ± .0000076
	PNL-2	4	0	-0.0000058 ± 0.000011
	PNL-3	4	0	-0.0000070 ± 0.000022
	YAKIMA	4	0	0.00000048 ± 0.00000078
Plutonium 239/240	PNL-1	4	0	0.0000016 ± 0.0000021
	PNL-2	4	0	-0.0000017 ± 0.0000065
	PNL-3	4	1	0.00000048 ± 0.000019
	YAKIMA	4	0	0.00000022 ± 0.0000014
Americium-241[(a)]	PNL-1	4	1	0.0000085 ± 0.000023
	PNL-2	4	1	0.0000058 ± 0.0000096
	PNL-3	4	1	0.0000041 ± 0.0000047
	YAKIMA	0	0	NA
Americium-243	PNL-1	4	0	0.0000069 ± 0.000010
	PNL-2	4	0	-0.000000045 ± 0.000020
	PNL-3	4	0	0.000012 ± 0.0000090
	YAKIMA	0	0	NA
Curium-243/244	PNL-1	4	0	-0.0000030 ± 0.000013
	PNL-2	4	0	-0.0000080 ± 0.000016
	PNL-3	4	0	0.00000043 ± 0.0000090
	YAKIMA	0	0	NA

(a) ^{241}Am values reported are for the analyses done by the more sensitive alpha spectroscopy method.

NA = Not Analyzed.

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

Table 5.2. Summary List of Quality-Assurance-Related Documents

10 CFR 830, *Nuclear Safety Management*
40 CFR 61, Appendix B, "*Method 114 – Test Methods for Measuring Radionuclide Emissions from Stationary Sources*"
ANSI/ASME NQA-1-1988, *Quality Assurance Requirements for Nuclear Facilities*
ANSI/ASME NQA-2-1986, *Quality Assurance Requirements for Nuclear Facilities*
DOE Order 414.1D, *Quality Assurance* (2011)
DOE Order 450.1A, *Environmental Protection Program* (2008)
DOE Order 458.1, *Radiation Protection of the Public and the Environment* (2011)
DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (1991)
EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans (2001).

6.0 References

10 CFR 830, "Nuclear Safety Management," Title 10, *Code of Federal Regulations*, Part 830, as amended.

40 CFR 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," Title 40, *Code of Federal Regulations*, Part 61, as amended.

40 CFR 61, *National Emission Standards for Hazardous Air Pollutants* (NESHAP), Subpart Q - National Emission Standards for Radon Emissions from Department of Energy Facilities," Title 40, *Code of Federal Regulations*, Part 61.

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Appendix A

Dose Modeling and Meteorological Data

Appendix A

Dose Modeling and Meteorological Data

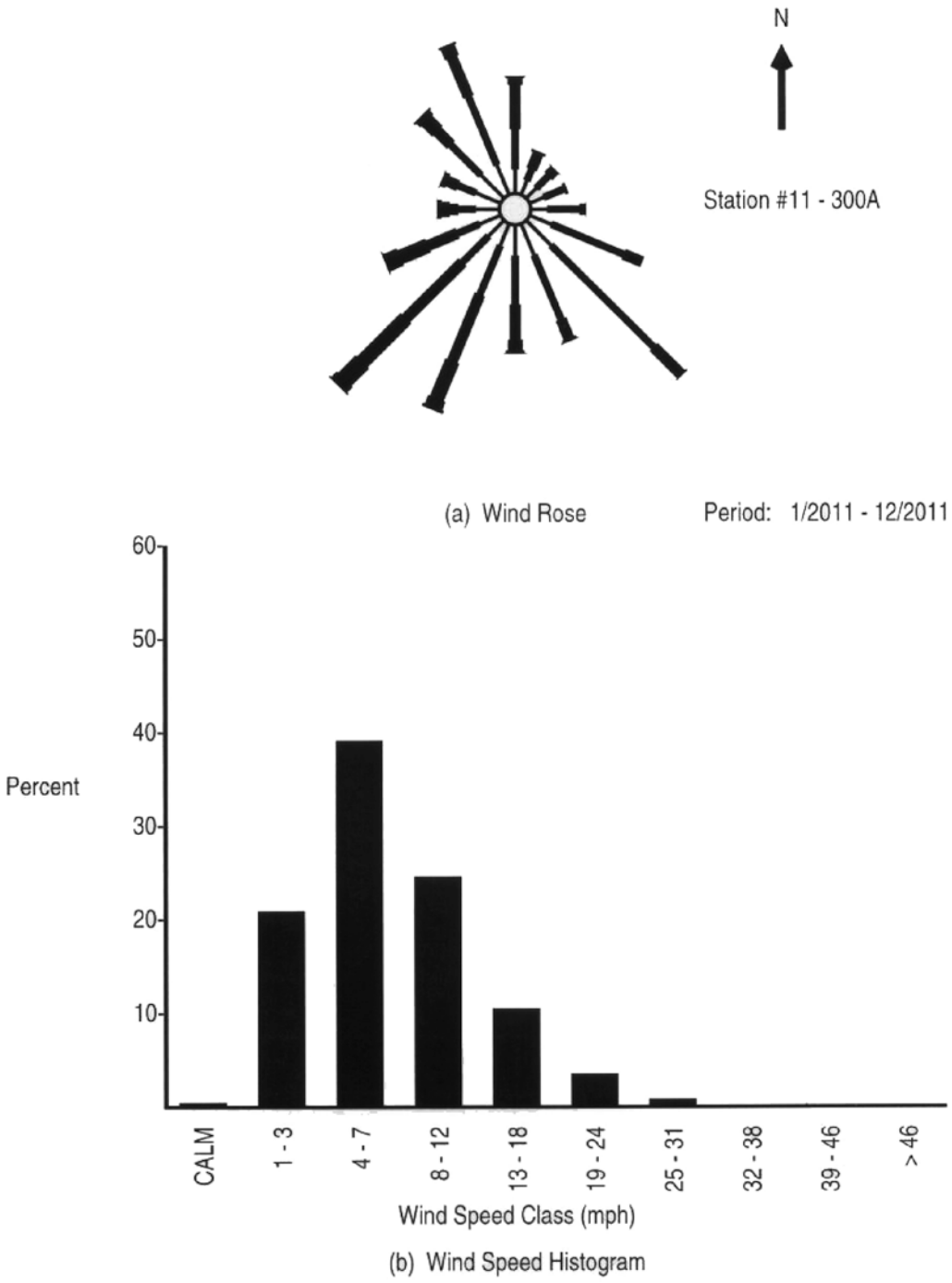

Figure A.1. 300 Area Wind Rose and Histogram Applied to PNNL Site Modeling

Table A.1. Annual Average Joint Frequency during 2011 (as percent of time) of Wind Speed, Stability Class, and Direction for the 300 Area (Station 11) at the 10-Meter Level (3 sheets)

Wind speed (m/sec)	Stability class	Wind direction toward:																Total
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
0.89	A	0.01	0.03	0.01	0.01	0	0	0.03	0.02	0.01	0	0	0.02	0	0	0	0	0.14
	B	0.02	0.03	0.07	0.09	0.07	0.05	0.04	0.04	0.01	0.01	0	0.02	0.01	0	0	0	0.46
	C	0.08	0.06	0.05	0.07	0.06	0.12	0.16	0.08	0.05	0.03	0.04	0.04	0.02	0.02	0.04	0.06	0.98
	D	0.33	0.24	0.23	0.21	0.30	0.30	0.35	0.29	0.32	0.30	0.30	0.31	0.32	0.33	0.43	0.47	5.03
	E	0.33	0.21	0.20	0.24	0.29	0.46	0.58	0.75	0.77	0.48	0.52	0.48	0.45	0.54	0.55	0.51	7.36
	F	0.33	0.17	0.13	0.16	0.13	0.23	0.49	0.47	0.38	0.29	0.23	0.30	0.35	0.41	0.54	0.45	5.06
	G	0.21	0.09	0.07	0.04	0.05	0.13	0.26	0.18	0.12	0.15	0.11	0.08	0.12	0.14	0.22	0.27	2.24
	Total	**1.31**	**0.83**	**0.76**	**0.82**	**0.90**	**1.29**	**1.91**	**1.83**	**1.66**	**1.26**	**1.20**	**1.25**	**1.27**	**1.44**	**1.78**	**1.76**	**21.27**
2.65	A	0.01	0.06	0.24	0.39	0.47	0.54	0.24	0.19	0.20	0.22	0.24	0.05	0.04	0	0	0	2.89
	B	0.07	0.10	0.16	0.32	0.44	0.39	0.33	0.19	0.18	0.27	0.13	0.09	0.05	0.03	0.02	0.03	2.8
	C	0.14	0.06	0.19	0.22	0.22	0.30	0.27	0.23	0.18	0.28	0.18	0.05	0.02	0	0.07	0.12	2.53
	D	0.46	0.15	0.16	0.07	0.22	0.71	1.42	0.72	0.55	0.60	0.45	0.38	0.23	0.22	0.61	0.97	7.92
	E	0.80	0.16	0.11	0.10	0.27	0.95	2.26	1.11	0.72	0.90	0.74	0.51	0.41	0.41	0.85	1.37	11.67
	F	0.49	0.12	0.05	0.04	0.09	1.05	2.39	1.00	0.59	0.44	0.16	0.16	0.14	0.29	0.50	1.16	8.67
	G	0.15	0.01	0	0.01	0.02	0.25	0.82	0.30	0.21	0.12	0.07	0.07	0.06	0.10	0.22	0.28	2.69
	Total	**2.12**	**0.66**	**0.91**	**1.15**	**1.73**	**4.19**	**7.73**	**3.74**	**2.63**	**2.83**	**1.97**	**1.31**	**0.95**	**1.05**	**2.27**	**3.93**	**39.17**
4.70	A	0.04	0.21	0.33	0.01	0.16	0.44	0.36	0.15	0.29	0.46	0.57	0.13	0.04	0.02	0.02	0.03	3.26
	B	0.09	0.15	0.13	0.11	0.06	0.18	0.18	0.13	0.23	0.48	0.44	0.12	0.02	0.05	0.04	0.05	2.46
	C	0.08	0.11	0.02	0.02	0.03	0.06	0.12	0.14	0.14	0.31	0.37	0.13	0.02	0.03	0.02	0.08	1.68
	D	0.49	0.15	0	0.01	0.05	0.12	0.39	0.23	0.44	1.09	1.07	0.55	0.26	0.22	0.42	0.64	6.13
	E	1.00	0.19	0	0.01	0.02	0.11	0.41	0.29	0.57	0.98	1.27	0.60	0.11	0.27	0.44	0.92	7.19
	F	0.49	0.06	0	0.01	0.02	0.10	0.32	0.11	0.17	0.43	0.45	0.14	0.02	0.01	0.05	0.49	2.87
	G	0.20	0.03	0	0	0	0.05	0.29	0.03	0.05	0.10	0.09	0.03	0	0	0.03	0.09	0.99
	Total	**2.39**	**0.90**	**0.48**	**0.17**	**0.34**	**1.06**	**2.07**	**1.08**	**1.89**	**3.85**	**4.26**	**1.70**	**0.47**	**0.60**	**1.02**	**2.30**	**24.58**

Table A.1. (contd)

Wind speed (m/sec)	Stability class	Wind direction toward:																Total
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
7.15	A	0.05	0.08	0	0	0	0	0.01	0.01	0.12	0.26	0.64	0.34	0.07	0.04	0.01	0.03	1.66
	B	0.03	0.03	0.01	0	0	0	0.01	0	0.04	0.22	0.48	0.24	0.04	0.05	0.05	0.03	1.23
	C	0.04	0	0	0	0	0	0.02	0	0.03	0.27	0.20	0.14	0.05	0.01	0.04	0.07	0.87
	D	0.09	0.03	0	0	0	0	0.01	0.02	0.20	0.61	0.76	0.51	0.15	0.08	0.35	0.29	3.1
	E	0.13	0.01	0	0	0.01	0	0	0.08	0.16	0.67	0.80	0.30	0.11	0.10	0.29	0.17	2.83
	F	0.03	0	0	0	0.01	0	0	0	0.02	0.09	0.35	0.05	0	0	0.05	0.01	0.61
	G	0	0	0	0	0	0	0	0	0.01	0.04	0.07	0.01	0	0	0	0	0.13
	Total	**0.37**	**0.15**	**0.01**	**0.00**	**0.02**	**0.00**	**0.05**	**0.11**	**0.58**	**2.16**	**3.30**	**1.59**	**0.42**	**0.28**	**0.79**	**0.60**	**10.43**
9.8	A	0.04	0	0	0	0	0	0	0	0.02	0.05	0.22	0.31	0.06	0.03	0.02	0.02	0.77
	B	0.01	0	0	0	0	0	0	0	0	0.06	0.17	0.08	0.02	0	0.01	0.03	0.38
	C	0.01	0	0	0	0	0	0	0	0.02	0.04	0.12	0.11	0.05	0.01	0	0	0.36
	D	0.03	0	0	0	0	0	0	0	0.06	0.16	0.30	0.16	0.08	0	0.17	0.05	1.01
	E	0.01	0	0	0	0	0	0	0.06	0.06	0.15	0.40	0.11	0.04	0.01	0.07	0.04	0.95
	F	0	0	0	0	0	0	0	0	0	0.01	0.08	0.01	0	0	0	0	0.1
	G	0	0	0	0	0	0	0	0	0	0.01	0	0.01	0	0	0	0	0.02
	Total	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**	**0.16**	**0.48**	**1.29**	**0.79**	**0.25**	**0.05**	**0.27**	**0.14**	**3.59**
12.7	A	0.01	0	0	0	0	0	0	0	0	0	0.02	0	0	0	0.01	0	0.04
	B	0.01	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0.01	0	0.06
	C	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0.02	0	0.05
	D	0	0	0	0	0	0	0	0	0	0.06	0.11	0.02	0.01	0	0.07	0	0.27
	E	0	0	0	0	0	0	0	0	0.02	0.10	0.21	0.04	0	0	0	0	0.37
	F	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0.01
	G	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0.01
	Total	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.17**	**0.41**	**0.07**	**0.01**	**0.00**	**0.11**	**0.00**	**0.81**

Table A.1. (contd)

Wind speed (m/sec)	Stability class	Wind direction toward:																Total
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
15.6	A	0	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	0.07	0.01	0	0	0	0	0.08
	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**	**0.08**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.09**
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	0	0	0	0	0	0.00
	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**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total	A	0.16	0.38	0.58	0.41	0.63	0.98	0.64	0.37	0.64	0.99	1.69	0.85	0.21	0.09	0.06	0.08	8.76
	B	0.23	0.31	0.37	0.52	0.57	0.62	0.56	0.36	0.46	1.05	1.24	0.56	0.14	0.13	0.13	0.14	7.39
	C	0.35	0.23	0.26	0.31	0.31	0.48	0.57	0.45	0.42	0.93	0.94	0.47	0.16	0.07	0.19	0.33	6.47
	D	1.40	0.57	0.39	0.29	0.57	1.13	2.17	1.26	1.57	2.82	3.00	1.93	1.05	0.85	2.05	2.42	23.47
	E	2.27	0.57	0.31	0.35	0.59	1.52	3.25	2.29	2.30	3.28	4.01	2.05	1.12	1.33	2.20	3.01	30.45
	F	1.34	0.35	0.18	0.21	0.25	1.38	3.20	1.58	1.16	1.26	1.28	0.66	0.51	0.71	1.14	2.11	17.32
	G	0.56	0.13	0.07	0.05	0.07	0.43	1.37	0.51	0.39	0.42	0.35	0.20	0.18	0.24	0.47	0.64	6.08
	Total	**6.31**	**2.54**	**2.16**	**2.14**	**2.99**	**6.54**	**11.76**	**6.82**	**6.94**	**10.75**	**12.51**	**6.72**	**3.37**	**3.42**	**6.24**	**8.73**	**99.94**

Table A.2. Radionuclide Data on Clearance Type, Particle Size, Scavenging Coefficient, and Deposition Velocity Used for CAP88-PC 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
^{24}Na				
^{60}Co	M	1.0	1.60 E-06	1.80 E-03
^{82}Br				
^{85}Kr	G	0	0	0
^{90}Sr	M	1.0	1.60 E-06	1.80 E-03
^{99}Tc	M	1.0	1.60 E-06	1.80 E-03
^{131m}Xe	G	0	0	0
^{133}Xe	G	0	0	0
^{133m}Xe	G	0	0	0
^{135}Xe	G	0	0	0
^{137m}Ba	M	1.0	1.60 E-06	1.80 E-03
^{137}Cs	F	1.0	1.60 E-06	1.80 E-03
^{151}Sm	M	1.0	1.60 E-06	1.80 E-03
^{155}Eu	M	1.0	1.60 E-06	1.80 E-03
^{188}W	M	1.0	1.60 E-06	1.80 E-03
^{220}Rn	G	0	0	0
^{222}Rn	G	0	0	0
^{228}Th	S	1.0	1.60 E-06	1.80 E-03
^{232}Th	S	1.0	1.60 E-06	1.80 E-03
^{232}U	M	1.0	1.60 E-06	1.80 E-03
^{233}U	M	1.0	1.60 E-06	1.80 E-03
^{234}U	M	1.0	1.60 E-06	1.80 E-03
^{235}U	M	1.0	1.60 E-06	1.80 E-03
^{236}U	M	1.0	1.60 E-06	1.80 E-03
^{238}U	M	1.0	1.60 E-06	1.80 E-03
^{238}Pu	M	1.0	1.60 E-06	1.80 E-03
^{239}Pu	M	1.0	1.60 E-06	1.80 E-03
^{241}Pu	M	1.0	1.60 E-06	1.80 E-03
^{242}Pu	M	1.0	1.60 E-06	1.80 E-03
^{241}Am	M	1.0	1.60 E-06	1.80 E-03
^{243}Am	M	1.0	1.60 E-06	1.80 E-03
^{244}Cm	M	1.0	1.60 E-06	1.80 E-03
^{250}Cf[(a)]	M	1.0	1.60 E-06	1.80 E-03

(a) ^{250}Cf is an EPA-approved surrogate for ^{252}Cf, used here due to issues with CAP88-PC v3 computational errors related to ^{252}Cf (Rhoads and Barnett 2009).

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 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
^{24}Na					
^{60}Co	3.60 E–04	5.48 E–05	0	2.00 E–03	3.00 E–02
^{82}Br					
^{85}Kr	1.77 E–04	5.48 E–05	0	0	0
^{90}Sr	6.52 E–05	5.48 E–05	0	2.00 E–03	1.00 E–02
^{99}Tc	8.91 E-09	5.48 E-05	0	1.00 E-03	1.00 E-04
^{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	1.32 E–01	5.48 E–05	0	0	0
^{135}Xe	1.83 E+00	5.48 E–05	0	0	0
^{137m}Ba	3.91 E+02	5.48 E-05	0	5.00 E-04	2.00 E-04
^{137}Cs	6.32 E–05	5.48 E–05	0	0	0
^{151}Sm	2.11 E-05	5.48 E-05	0	6.00 E-05	2.00 E-03
^{155}Eu	4.00 E-04	5.48 E-05	0	6.00 E-05	2.00 E-03
^{183}Ta	1.36 E-01	5.48 E-05	0	5.00 E-06	5.00 E-06
^{188}W	9.99 E-03	5.48 E-05	0	3.00 E-04	4.00 E-02
^{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
^{228}Th	9.92 E-04	5.48 E-05	0	5.00 E-06	1.00 E-04
^{232}Th	1.35 E-13	5.48 E-05	0	5.00 E-06	1.00 E-04
^{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}U	4.25 E–13	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
^{242}Pu	5.04 E-09	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	1.05 E–04	5.48 E–05	0	2.00 E–06	2.00 E–05
^{250}Cf [(c)]	1.45 E-04	5.48 E-05	0	2.00 E-06	6.00 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) ^{250}Cf is a surrogate for ^{252}Cf (Rhoads and Barnett 2009).

Table A.4. Radionuclide Data on Concentration Uptake Factor and Gastric Intestinal Uptake Fraction Used for CAP88-PC 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
^{24}Na				
^{60}Co	2.00 E+00	8.00 E–02	1.00 E–01	1.00 E–01
^{82}Br				
^{85}Kr	0	0	0	0
^{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
^{131m}Xe	0	0	0	0
^{133}Xe	0	0	0	0
^{133m}Xe	0	0	0	0
^{135}Xe	0	0	0	0
^{137m}Ba	1.00 E-01	1.00 E-02	2.00 E-01	2.00 E-01
^{137}Cs	1.00 E+00	2.00 E–01	1.00 E+00	1.00 E+00
^{151}Sm	1.00 E-01	2.00 E-03	5.00 E-04	5.00 E-04
^{155}Eu	1.00 E-01	2.00 E-03	5.00 E-04	5.00 E-04
^{188}W	3.00 E+00	8.00 E-01	3.00 E-01	3.00 E-01
^{220}Rn	0	0	0	0
^{222}Rn	0	0	0	0
^{228}Th	1.00 E-01	1.00 E-03	5.00 E-04	5.00 E-04
^{232}Th	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}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
^{242}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
^{244}Cm	1.00 E–01	1.00 E–03	5.00 E–04	5.00 E–04
^{250}Cf[(c)]	1.00 E–01	1.00 E–03	5.00 E–04	5.00 E–04

GI = gastric intestinal

(a) Concentration factor for uptake of nuclide from soil for pasture and forage, in pCi/kg dry weight per pCi/kg dry soil.

(b) Concentration factor for uptake of nuclide from soil by edible parts of crops, in pCi/kg wet weight per pCi/kg dry soil.

(c) ^{250}Cf is a surrogate for ^{252}Cf (Rhoads and Barnett 2009).

Table A.5. Exposure and Consumption Data for the PNNL Site

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) = 365

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

Table A.5. (contd)

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

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 Site for application in CAP88-PC (EPA 2007).

Table A.6. PNNL Site 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 Site in 2011

Appendix B

List of Radioactive Materials Handled or Potentially Handled at the PNNL Site in 2011

Table B.1. Radionuclides Used and/or Potentially Used at the PNNL Site in 2011 (2 sheets)

Ac-225	Bi-211	Cm-245	Ga-67	Ir-192	Nd-147	Po-210
Ac-227	Bi-212	Cm-246	Ga-72	K-40	Ni-56	Po-211
Ac-228	Bi-213	Cm-247	Gd-148	K-42	Ni-59	Po-212
Ag-108	Bi-214	Cm-248	Gd-149	Kr-81	Ni-63	Po-213
Ag-108m	Bk-249	Co-56	Gd-151	Kr-81m	Ni-65	Po-214
Ag-109m	Bk-250	Co-57	Gd-152	Kr-83m	Np-235	Po-215
Ag-110	Br-82	Co-58	Gd-153	Kr-85	Np-236	Po-216
Ag-110m	Br-82m	Co-60	Ge-68	Kr-85m	Np-237	Po-218
Ag-111	Br-83	Cr-49	H-3	Kr-87	Np-238	Pr-143
Al-26	Br-84	Cr-51	Hf-175	Kr-88	Np-239	Pr-144
Al-28	Br-84m	Cr-55	Hf-178m	Kr-89	Np-240	Pr-144m
Am-241	Br-85	Cs-131	Hf-181	Kr-90	Np-240m	Pu-234
Am-242	C-11	Cs-132	Hf-182	La-138	O-15	Pu-236
Am-242m	C-14	Cs-134	Hg-203	La-140	Os-191	Pu-237
Am-243	C-15	Cs-134m	Ho-166	La-141	P-32	Pu-238
Am-245	Ca-41	Cs-135	Ho-166m	La-142	P-33	Pu-239
Ar-37	Ca-45	Cs-136	I-122	Lu-177	Pa-231	Pu-240
Ar-39	Ca-47	Cs-137	I-123	Mg-27	Pa-233	Pu-241
Ar-41	Cd-109	Cs-138	I-125	Mg-28	Pa-234	Pu-242
Ar-42	Cd-113	Cs-139	I-129	Mn-52	Pa-234m	Pu-243
As-74	Cd-113m	Cu-64	I-130	Mn-54	Pb-209	Pu-244
As-76	Cd-115	Dy-165	I-130m	Mn-56	Pb-210	Ra-223
At-217	Cd-115m	Er-169	I-131	Mo-93	Pb-211	Ra-224
Au-195	Ce-139	Er-171	I-132	Mo-99	Pb-212	Ra-225
Au-198	Ce-141	Es-254	I-132m	N-13	Pb-214	Ra-226
Ba-131	Ce-142	Eu-150	I-133	Na-22	Pd-103	Ra-228
Ba-133	Ce-143	Eu-152	I-133m	Na-24	Pd-107	Rb-83
Ba-133m	Ce-144	Eu-152m	I-134	Nb-91	Pd-109	Rb-84
Ba-137m	Cf-249	Eu-154	I-134m	Nb-91m	Pm-145	Rb-86
Ba-139	Cf-250	Eu-155	I-135	Nb-92	Pm-146	Rb-87
Ba-140	Cf-251	Eu-156	In-106	Nb-93m	Pm-147	Rb-88
Ba-141	Cf-252	Eu-157	In-111	Nb-94	Pm-148	Rb-89
Ba-142	Cl-36	F-18	In-113m	Nb-95	Pm-148m	Rb-90
Be-7	Cm-241	Fe-55	In-114	Nb-95m	Pm-149	Rb-90m
Be-10	Cm-242	Fe-59	In-114m	Nb-97	Pm-151	Re-186
Bi-207	Cm-243	Fr-221	In-115	Nb-97m	Po-208	Re-187
Bi-210	Cm-244	Fr-223	In-115m	Nd-144	Po-209	Re-188

Table B.1. (contd)

Rh-102	Sn-121m	Th-227	Xe-127			
Rh-103m	Sn-123	Th-228	Xe-127m			
Rh-105	Sn-125	Th-229	Xe-129m			
Rh-105m	Sn-126	Th-230	Xe-131m			
Rh-106	Sr-85	Th-231	Xe-133			
Rn-219	Sr-87m	Th-232	Xe-133m			
Rn-220	Sr-89	Th-233	Xe-135			
Rn-222	Sr-90	Th-234	Xe-135m			
Rn-224	Sr-91	Ti-44	Xe-137			
Ru-97	Sr-92	Ti-45	Xe-138			
Ru-103	Ta-179	Ti-51	Y-88			
Ru-105	Ta-182	Tl-201	Y-90			
Ru-106	Ta-183	Tl-204	Y-90m			
S-35	Tb-160	Tl-206	Y-91			
Sb-122	Tb-161	Tl-207	Y-91m			
Sb-124	Tc-95m	Tl-208	Y-92			
Sb-125	Tc-97	Tl-209	Y-93			
Sb-126	Tc-97m	Tm-170	Yb-164			
Sb-126m	Tc-98	Tm-171	Yb-169			
Sb-127	Tc-99	U-232	Yb-175			
Sb-129	Tc-99m	U-233	Yb-177			
Sc-46	Tc-101	U-234	Zn-65			
Sc-47	Te-121	U-235	Zn-69			
Se-75	Te-121m	U-236	Zn-69m			
Se-79	Te-123	U-237	Zr-88			
Se-79m	Te-123m	U-238	Zr-89			
Si-31	Te-125m	U-239	Zr-93			
Sm-145	Te-127	U-240	Zr-95			
Sm-146	Te-127m	V-48	Zr-97			
Sm-147	Te-129	V-49				
Sm-151	Te-129m	W-181				
Sm-153	Te-131	W-185				
Sm-157	Te-131m	W-187				
Sn-113	Te-132	W-188				
Sn-117m	Te-133	Xe-122				
Sn-119m	Te-133m	Xe-123				
Sn-121	Te-134	Xe-125				

Appendix C

Ambient Air Sampling Results for PNNL Site Air Surveillance in 2011

Table C.1. Definitions for Air Sampling Data

Column Heading	Data Type/Format	Content
SAMP_SITE_NAME	text	Location of sampling station. Yakima = background location; PNL-1, PNL-2, PNL-3 = PNNL Site sampling stations.
LAB_SAMP_ID	9-digit number	
SAMP_DATE_TIME_ON	date (dd-month-yy)	Date when air sampling started.
SAMP_DATE_TIME	date (dd-month-yy)	Date when air sampling ended.
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. Not indicated in pre-operations samples, because all were blank.
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 sample (e.g., analysis method) can be obtained from the full database (HEIS 1989).

Table C.2. Air Sampling Results for the PNNL Site and the Yakima Background Station for Calendar Year 2011

Samp Site Name	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-1	270517001	28-Dec-10	11-Jan-11	ALPHA	0.000899	pCi/m3	0.000356	0.000362				
PNL-1	271249001	11-Jan-11	26-Jan-11	ALPHA	0.000341	pCi/m3	0.000229	0.000231				
PNL-1	272196001	26-Jan-11	8-Feb-11	ALPHA	0.00126	pCi/m3	0.000608	0.000622		GFCI RESET, POWER RESTORED.		
PNL-1	273726001	23-Feb-11	8-Mar-11	ALPHA	0.000639	pCi/m3	0.000343	0.000349				
PNL-1	274511001	8-Mar-11	23-Mar-11	ALPHA	0.00024	pCi/m3	0.000244	0.000245	U			
PNL-1	275785001	23-Mar-11	6-Apr-11	ALPHA	0.000322	pCi/m3	0.000318	0.000319	U	REPLACED TOTALIZER.		
PNL-1	276655001	6-Apr-11	20-Apr-11	ALPHA	0.000704	pCi/m3	0.000323	0.000327				
PNL-1	277574001	20-Apr-11	4-May-11	ALPHA	0.00046	pCi/m3	0.000255	0.000259				
PNL-1	278518001	4-May-11	18-May-11	ALPHA	0.000288	pCi/m3	0.000249	0.000249	U			
PNL-1	279360001	18-May-11	1-Jun-11	ALPHA	0.000948	pCi/m3	0.000341	0.000355				
PNL-1	280343001	1-Jun-11	15-Jun-11	ALPHA	0.000343	pCi/m3	0.000219	0.00022				
PNL-1	280875001	15-Jun-11	29-Jun-11	ALPHA	0.000199	pCi/m3	0.000191	0.000191	U			
PNL-1	281999001	29-Jun-11	13-Jul-11	ALPHA	0.000708	pCi/m3	0.000316	0.000324				
PNL-1	282897001	13-Jul-11	27-Jul-11	ALPHA	0.000721	pCi/m3	0.000331	0.000339				
PNL-1	283824001	27-Jul-11	10-Aug-11	ALPHA	0.000607	pCi/m3	0.000302	0.000308				
PNL-1	284746001	10-Aug-11	24-Aug-11	ALPHA	0.000599	pCi/m3	0.000292	0.000295				
PNL-1	285570001	24-Aug-11	6-Sep-11	ALPHA	0.00109	pCi/m3	0.000421	0.000431				
PNL-1	286558001	6-Sep-11	21-Sep-11	ALPHA	0.00119	pCi/m3	0.000378	0.000397				
PNL-1	287457001	21-Sep-11	5-Oct-11	ALPHA	0.000797	pCi/m3	0.000366	0.000373				
PNL-1	288560001	5-Oct-11	19-Oct-11	ALPHA	0.000992	pCi/m3	0.000369	0.000371				
PNL-1	289444001	19-Oct-11	2-Nov-11	ALPHA	0.000656	pCi/m3	0.000328	0.000331				
PNL-1	290452001	2-Nov-11	16-Nov-11	ALPHA	0.00083	pCi/m3	0.00032	0.000322				
PNL-1	291142001	16-Nov-11	30-Nov-11	ALPHA	0.000855	pCi/m3	0.00036	0.000362				
PNL-1	292218001	30-Nov-11	14-Dec-11	ALPHA	0.00133	pCi/m3	0.000503	0.000528				
PNL-1	293201001	14-Dec-11	28-Dec-11	ALPHA	0.00214	pCi/m3	0.000575	0.000593				
PNL-1	277486001	28-Dec-10	6-Apr-11	Am-241	0.0000243	pCi/m3	0.0000084	0.00000867				Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Am-241	0.0000078	pCi/m3	0.0000108	0.0000108	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Am-241	0.00000546	pCi/m3	6.42E-06	0.00000645	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Am-241	-3.38E-06	pCi/m3	6.63E-06	0.00000663	U			Y

Table C.2. (contd)

Samp Site Name	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-1	277486001	28-Dec-10	6-Apr-11	Am-241 Gamma	0.00148	pCi/m3	0.00371	0.00377	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Am-241 Gamma	0.00037	pCi/m3	0.00208	0.00209	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Am-241 Gamma	-0.000493	pCi/m3	0.00267	0.00268	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Am-241 Gamma	0.00143	pCi/m3	0.00111	0.00128	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Am-243	-7.13E-07	pCi/m3	0.0000114	0.0000114	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Am-243	0.0000084	pCi/m3	0.0000113	0.0000113	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Am-243	0.0000108	pCi/m3	8.47E-06	0.00000858	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Am-243	0.00000898	pCi/m3	9.31E-06	0.00000936	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Be-7	0.0438	pCi/m3	0.017	0.017				Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Be-7	0.0502	pCi/m3	0.0151	0.0151				Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Be-7	0.0627	pCi/m3	0.0165	0.0165				Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Be-7	0.0367	pCi/m3	0.0155	0.0155				Y
PNL-1	270517001	28-Dec-10	11-Jan-11	BETA	0.05	pCi/m3	0.00193	0.00252				
PNL-1	271249001	11-Jan-11	26-Jan-11	BETA	0.0143	pCi/m3	0.00105	0.00117				
PNL-1	272196001	26-Jan-11	8-Feb-11	BETA	0.0282	pCi/m3	0.0022	0.00242		GFCI RESET, POWER RESTORED.		
PNL-1	273726001	23-Feb-11	8-Mar-11	BETA	0.0138	pCi/m3	0.00114	0.00128				
PNL-1	274511001	8-Mar-11	23-Mar-11	BETA	0.0257	pCi/m3	0.0014	0.00163				
PNL-1	275785001	23-Mar-11	6-Apr-11	BETA	0.0157	pCi/m3	0.00115	0.00131		REPLACED TOTALIZER.		
PNL-1	276655001	6-Apr-11	20-Apr-11	BETA	0.0128	pCi/m3	0.000949	0.00104				
PNL-1	277574001	20-Apr-11	4-May-11	BETA	0.00974	pCi/m3	0.000836	0.000933				
PNL-1	278518001	4-May-11	18-May-11	BETA	0.0096	pCi/m3	0.000835	0.000863				
PNL-1	279360001	18-May-11	1-Jun-11	BETA	0.0109	pCi/m3	0.000857	0.000975				
PNL-1	280343001	1-Jun-11	15-Jun-11	BETA	0.00995	pCi/m3	0.00082	0.000881				
PNL-1	280875001	15-Jun-11	29-Jun-11	BETA	0.00907	pCi/m3	0.0008	0.000867				
PNL-1	281999001	29-Jun-11	13-Jul-11	BETA	0.0135	pCi/m3	0.000962	0.00107				
PNL-1	282897001	13-Jul-11	27-Jul-11	BETA	0.0099	pCi/m3	0.000846	0.000945				
PNL-1	283824001	27-Jul-11	10-Aug-11	BETA	0.0135	pCi/m3	0.000993	0.0011				

Table C.2. (contd)

Samp Site Name	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-1	284746001	10-Aug-11	24-Aug-11	BETA	0.0169	pCi/m3	0.00109	0.00122				
PNL-1	285570001	24-Aug-11	6-Sep-11	BETA	0.018	pCi/m3	0.00117	0.0013				
PNL-1	286558001	6-Sep-11	21-Sep-11	BETA	0.0264	pCi/m3	0.00132	0.00173				
PNL-1	287457001	21-Sep-11	5-Oct-11	BETA	0.0187	pCi/m3	0.00116	0.00135				
PNL-1	288560001	5-Oct-11	19-Oct-11	BETA	0.02	pCi/m3	0.0012	0.00136				
PNL-1	289444001	19-Oct-11	2-Nov-11	BETA	0.0163	pCi/m3	0.0011	0.00125				
PNL-1	290452001	2-Nov-11	16-Nov-11	BETA	0.0221	pCi/m3	0.00124	0.00149				
PNL-1	291142001	16-Nov-11	30-Nov-11	BETA	0.0147	pCi/m3	0.00107	0.00117				
PNL-1	292218001	30-Nov-11	14-Dec-11	BETA	0.0514	pCi/m3	0.0019	0.00223				
PNL-1	293201001	14-Dec-11	28-Dec-11	BETA	0.0464	pCi/m3	0.00184	0.00247				
PNL-1	277486001	28-Dec-10	6-Apr-11	Cm-243/244	0.00000228	pCi/m3	2.58E-06	0.00000259	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Cm-243/244	0.00000196	pCi/m3	0.0000102	0.0000102	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Cm-243/244	-0.0000044	pCi/m3	0.0000061	0.0000061	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Cm-243/244	-0.0000119	pCi/m3	0.00001	0.00001	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Co-60	0.000346	pCi/m3	0.000679	0.000697	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Co-60	-0.000262	pCi/m3	0.000558	0.00057	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Co-60	0.000145	pCi/m3	0.000563	0.000567	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Co-60	-0.000478	pCi/m3	0.000779	0.000809	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Cs-134	0.000101	pCi/m3	0.000816	0.000817	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Cs-134	-0.000177	pCi/m3	0.000623	0.000628	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Cs-134	-0.000211	pCi/m3	0.000622	0.000629	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Cs-134	0.000344	pCi/m3	0.000901	0.000914	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Cs-137	0.00057	pCi/m3	0.000679	0.000726	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Cs-137	-0.000489	pCi/m3	0.000589	0.000629	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Cs-137	-0.0000498	pCi/m3	0.000483	0.000483	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Cs-137	-0.000637	pCi/m3	0.000801	0.000851	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Eu-152	-0.00126	pCi/m3	0.00194	0.00202	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Eu-152	0.00095	pCi/m3	0.00166	0.00171	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Eu-152	-0.000171	pCi/m3	0.00157	0.00157	U			Y

Table C.2. (contd)

Samp Site Name	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-1	294597001	5-Oct-11	28-Dec-11	Eu-152	-0.000219	pCi/m3	0.00214	0.00215	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Eu-154	-0.00254	pCi/m3	0.00193	0.00225	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Eu-154	0.000736	pCi/m3	0.00173	0.00176	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Eu-154	0.000774	pCi/m3	0.0017	0.00174	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Eu-154	0.0000736	pCi/m3	0.00236	0.00236	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Eu-155	-0.00184	pCi/m3	0.00193	0.0021	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Eu-155	-0.000861	pCi/m3	0.00174	0.00178	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Eu-155	-0.000523	pCi/m3	0.00132	0.00134	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Eu-155	-0.000874	pCi/m3	0.00169	0.00174	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	K-40	0.0108	pCi/m3	0.00778	0.00916	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	K-40	0.000377	pCi/m3	0.00964	0.00964	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	K-40	0.00542	pCi/m3	0.00789	0.00826	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	K-40	0.0103	pCi/m3	0.00786	0.00914	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Pu-238	0.00000157	pCi/m3	2.17E-06	0.00000218	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Pu-238	-4.68E-06	pCi/m3	8.99E-06	0.00000899	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Pu-238	0.00000166	pCi/m3	3.26E-06	0.00000326	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Pu-238	-5.26E-06	pCi/m3	7.07E-06	0.00000707	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Pu-239/240	0.00000313	pCi/m3	4.85E-06	0.00000486	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Pu-239/240	6.68E-07	pCi/m3	6.55E-06	0.00000655	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Pu-239/240	0.00000111	pCi/m3	4.06E-06	0.00000406	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Pu-239/240	0.0000015	pCi/m3	5.51E-06	0.00000551	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Ru-106	-0.00208	pCi/m3	0.00628	0.00635	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Ru-106	-0.00128	pCi/m3	0.00548	0.00551	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Ru-106	-0.00109	pCi/m3	0.00464	0.00467	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Ru-106	-0.00168	pCi/m3	0.00699	0.00703	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	Sb-125	-0.00104	pCi/m3	0.00181	0.00187	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	Sb-125	-0.000479	pCi/m3	0.00152	0.00154	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	Sb-125	0.0000884	pCi/m3	0.00128	0.00128	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	Sb-125	-0.0000658	pCi/m3	0.00191	0.00191	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	U-234	0.0000627	pCi/m3	0.0000246	0.0000261				Y
PNL-1	282713002	6-Apr-11	29-Jun-11	U-234	0.0000565	pCi/m3	0.0000224	0.0000237				Y
PNL-1	289237001	29-Jun-11	5-Oct-11	U-234	0.0000697	pCi/m3	0.0000167	0.0000191				Y
PNL-1	294597001	5-Oct-11	28-Dec-11	U-234	0.0000348	pCi/m3	0.000018	0.0000185				Y

Table C.2. (contd)

Samp Site Name	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-1	277486001	28-Dec-10	6-Apr-11	U-235	0.00000869	pCi/m3	0.0000127	0.0000128	U			Y
PNL-1	282713002	6-Apr-11	29-Jun-11	U-235	-4.52E-06	pCi/m3	0.0000109	0.0000109	U			Y
PNL-1	289237001	29-Jun-11	5-Oct-11	U-235	0.00000627	pCi/m3	0.0000065	0.00000655	U			Y
PNL-1	294597001	5-Oct-11	28-Dec-11	U-235	0.00000244	pCi/m3	8.29E-06	0.00000829	U			Y
PNL-1	277486001	28-Dec-10	6-Apr-11	U-238	0.0000609	pCi/m3	0.000026	0.0000273				Y
PNL-1	282713002	6-Apr-11	29-Jun-11	U-238	0.0000604	pCi/m3	0.0000218	0.0000234				Y
PNL-1	289237001	29-Jun-11	5-Oct-11	U-238	0.0000659	pCi/m3	0.000016	0.0000183				Y
PNL-1	294597001	5-Oct-11	28-Dec-11	U-238	0.0000336	pCi/m3	0.0000169	0.0000174				Y
PNL-2	270517002	28-Dec-10	11-Jan-11	ALPHA	0.00045	pCi/m3	0.000235	0.000236				
PNL-2	271249002	11-Jan-11	26-Jan-11	ALPHA	0.000139	pCi/m3	0.000128	0.000129	U			
PNL-2	272196002	26-Jan-11	8-Feb-11	ALPHA	0.000606	pCi/m3	0.000266	0.000273				
PNL-2	272946002	8-Feb-11	23-Feb-11	ALPHA	0.000424	pCi/m3	0.000271	0.000272				
PNL-2	273726002	23-Feb-11	8-Mar-11	ALPHA	0.000396	pCi/m3	0.000214	0.000217				
PNL-2	274511002	8-Mar-11	23-Mar-11	ALPHA	0.00038	pCi/m3	0.000217	0.000219		REPLACED TOTALIZER.		
PNL-2	275785002	23-Mar-11	6-Apr-11	ALPHA	0.000403	pCi/m3	0.000262	0.000263				
PNL-2	276655002	6-Apr-11	20-Apr-11	ALPHA	0.000427	pCi/m3	0.000242	0.000243				
PNL-2	277574002	20-Apr-11	4-May-11	ALPHA	0.000393	pCi/m3	0.000228	0.00023				
PNL-2	278518002	4-May-11	18-May-11	ALPHA	0.000659	pCi/m3	0.00029	0.000293				
PNL-2	279360002	18-May-11	1-Jun-11	ALPHA	0.000506	pCi/m3	0.000296	0.000299				
PNL-2	280343002	1-Jun-11	15-Jun-11	ALPHA	0.000372	pCi/m3	0.00027	0.000271				
PNL-2	280875002	15-Jun-11	29-Jun-11	ALPHA	0.000334	pCi/m3	0.000271	0.000273	U			
PNL-2	281999002	29-Jun-11	13-Jul-11	ALPHA	0.00079	pCi/m3	0.000352	0.000358				
PNL-2	282897002	13-Jul-11	27-Jul-11	ALPHA	0.000477	pCi/m3	0.000274	0.000277				
PNL-2	283824002	27-Jul-11	10-Aug-11	ALPHA	0.00121	pCi/m3	0.000423	0.00044				
PNL-2	284746002	10-Aug-11	24-Aug-11	ALPHA	0.00112	pCi/m3	0.000401	0.000406				
PNL-2	285570002	24-Aug-11	6-Sep-11	ALPHA	0.000705	pCi/m3	0.000356	0.000361				
PNL-2	286558002	6-Sep-11	21-Sep-11	ALPHA	0.000748	pCi/m3	0.000332	0.000338				
PNL-2	287457002	21-Sep-11	5-Oct-11	ALPHA	0.000777	pCi/m3	0.00036	0.000372				
PNL-2	288560002	5-Oct-11	19-Oct-11	ALPHA	0.00145	pCi/m3	0.000464	0.000466				
PNL-2	289444002	19-Oct-11	2-Nov-11	ALPHA	0.00062	pCi/m3	0.00033	0.000333				
PNL-2	290452002	2-Nov-11	16-Nov-11	ALPHA	0.00117	pCi/m3	0.000402	0.000407				
PNL-2	291142002	16-Nov-11	30-Nov-11	ALPHA	0.000819	pCi/m3	0.000477	0.000487				

Table C.2. (contd)

Samp Site Name	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	292218002	30-Nov-11	14-Dec-11	ALPHA	0.00165	pCi/m3	0.000416	0.000418				
PNL-2	293201002	14-Dec-11	28-Dec-11	ALPHA	0.00226	pCi/m3	0.00052	0.00054				
PNL-2	277486002	28-Dec-10	6-Apr-11	Am-241	0.00000377	pCi/m3	3.18E-06	0.0000032	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Am-241	0.0000129	pCi/m3	0.0000093	0.00000938				Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Am-241	0.00000354	pCi/m3	6.13E-06	0.00000614	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Am-241	0.00000283	pCi/m3	7.85E-06	0.00000785	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Am-241 Gamma	-0.0000796	pCi/m3	0.0019	0.0019	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Am-241 Gamma	0.0000433	pCi/m3	0.00138	0.00138	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Am-241 Gamma	-0.000291	pCi/m3	0.002	0.00201	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Am-241 Gamma	0.000815	pCi/m3	0.00478	0.0048	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Am-243	-1.11E-06	pCi/m3	6.56E-06	0.00000656	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Am-243	-0.0000109	pCi/m3	8.42E-06	0.00000842	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Am-243	-1.47E-06	pCi/m3	4.99E-06	0.00000499	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Am-243	0.0000133	pCi/m3	0.0000126	0.0000127	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Be-7	0.0218	pCi/m3	0.0099	0.00991				Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Be-7	0.0493	pCi/m3	0.0124	0.0125				Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Be-7	0.0967	pCi/m3	0.0236	0.0237				Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Be-7	0.0348	pCi/m3	0.0131	0.0132				Y
PNL-2	270517002	28-Dec-10	11-Jan-11	BETA	0.0362	pCi/m3	0.00145	0.00212				
PNL-2	271249002	11-Jan-11	26-Jan-11	BETA	0.00855	pCi/m3	0.000644	0.000722				
PNL-2	272196002	26-Jan-11	8-Feb-11	BETA	0.0169	pCi/m3	0.000983	0.00118				
PNL-2	272946002	8-Feb-11	23-Feb-11	BETA	0.0115	pCi/m3	0.000858	0.000897				
PNL-2	273726002	23-Feb-11	8-Mar-11	BETA	0.0081	pCi/m3	0.000697	0.000745				
PNL-2	274511002	8-Mar-11	23-Mar-11	BETA	0.0107	pCi/m3	0.00078	0.000846		REPLACED TOTALIZER.		
PNL-2	275785002	23-Mar-11	6-Apr-11	BETA	0.0107	pCi/m3	0.000808	0.000843				
PNL-2	276655002	6-Apr-11	20-Apr-11	BETA	0.0109	pCi/m3	0.000831	0.000953				
PNL-2	277574002	20-Apr-11	4-May-11	BETA	0.0081	pCi/m3	0.000725	0.000771				
PNL-2	278518002	4-May-11	18-May-11	BETA	0.00839	pCi/m3	0.00069	0.000713				
PNL-2	279360002	18-May-11	1-Jun-11	BETA	0.0124	pCi/m3	0.000912	0.000996				

Table C.2. (contd)

Samp Site Name	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	280343002	1-Jun-11	15-Jun-11	BETA	0.0121	pCi/m3	0.000971	0.00104				
PNL-2	280875002	15-Jun-11	29-Jun-11	BETA	0.011	pCi/m3	0.000927	0.00102				
PNL-2	281999002	29-Jun-11	13-Jul-11	BETA	0.015	pCi/m3	0.00108	0.00121				
PNL-2	282897002	13-Jul-11	27-Jul-11	BETA	0.0112	pCi/m3	0.000911	0.000981				
PNL-2	283824002	27-Jul-11	10-Aug-11	BETA	0.014	pCi/m3	0.00101	0.00115				
PNL-2	284746002	10-Aug-11	24-Aug-11	BETA	0.0169	pCi/m3	0.0011	0.00132				
PNL-2	285570002	24-Aug-11	6-Sep-11	BETA	0.0178	pCi/m3	0.00114	0.00126				
PNL-2	286558002	6-Sep-11	21-Sep-11	BETA	0.0294	pCi/m3	0.00139	0.00168				
PNL-2	287457002	21-Sep-11	5-Oct-11	BETA	0.0194	pCi/m3	0.00119	0.00141				
PNL-2	288560002	5-Oct-11	19-Oct-11	BETA	0.0204	pCi/m3	0.00121	0.00149				
PNL-2	289444002	19-Oct-11	2-Nov-11	BETA	0.0193	pCi/m3	0.0012	0.00141				
PNL-2	290452002	2-Nov-11	16-Nov-11	BETA	0.0215	pCi/m3	0.00123	0.00152				
PNL-2	291142002	16-Nov-11	30-Nov-11	BETA	0.0159	pCi/m3	0.00122	0.00127				
PNL-2	292218002	30-Nov-11	14-Dec-11	BETA	0.0513	pCi/m3	0.00169	0.00276				
PNL-2	293201002	14-Dec-11	28-Dec-11	BETA	0.0433	pCi/m3	0.00157	0.00228				
PNL-2	277486002	28-Dec-10	6-Apr-11	Cm-243/244	-1.68E-06	pCi/m3	2.48E-06	0.00000248	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Cm-243/244	-1.44E-06	pCi/m3	4.88E-06	0.00000488	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Cm-243/244	-0.0000119	pCi/m3	0.0000114	0.0000114	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Cm-243/244	-0.0000171	pCi/m3	0.0000112	0.0000112	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Co-60	0.0000526	pCi/m3	0.000359	0.00036	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Co-60	-0.000371	pCi/m3	0.000626	0.000648	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Co-60	-0.0000873	pCi/m3	0.000911	0.000912	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Co-60	0.0000404	pCi/m3	0.000755	0.000755	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Cs-134	0.000259	pCi/m3	0.000426	0.000442	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Cs-134	0.000285	pCi/m3	0.000588	0.000602	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Cs-134	0.000587	pCi/m3	0.00109	0.00112	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Cs-134	0.00034	pCi/m3	0.000749	0.000765	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Cs-137	0.000231	pCi/m3	0.000354	0.000369	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Cs-137	-0.0000694	pCi/m3	0.000582	0.000583	U			Y

Table C.2. (contd)

Samp Site Name	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	289237002	29-Jun-11	5-Oct-11	Cs-137	-0.000668	pCi/m3	0.000828	0.000881	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Cs-137	0.000678	pCi/m3	0.000651	0.000719	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Eu-152	-0.00153	pCi/m3	0.00107	0.00128	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Eu-152	-0.000332	pCi/m3	0.00137	0.00138	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Eu-152	0.000997	pCi/m3	0.00231	0.00235	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Eu-152	0.0016	pCi/m3	0.00181	0.00195	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Eu-154	-0.00237	pCi/m3	0.00121	0.00162	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Eu-154	-0.000753	pCi/m3	0.00154	0.00158	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Eu-154	-0.00114	pCi/m3	0.00265	0.0027	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Eu-154	-0.000213	pCi/m3	0.00229	0.00229	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Eu-155	-0.000578	pCi/m3	0.00114	0.00117	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Eu-155	-0.00143	pCi/m3	0.00153	0.00166	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Eu-155	-0.00037	pCi/m3	0.00192	0.00193	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Eu-155	0.000111	pCi/m3	0.00188	0.00188	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	K-40	0.00669	pCi/m3	0.0039	0.00493	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	K-40	0.00932	pCi/m3	0.0074	0.00851	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	K-40	0.000846	pCi/m3	0.0128	0.0128	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	K-40	0.00479	pCi/m3	0.00775	0.00805	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Pu-238	-3.47E-06	pCi/m3	3.46E-06	0.00000346	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Pu-238	-9.84E-06	pCi/m3	0.0000105	0.0000105	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Pu-238	6.25E-07	pCi/m3	1.23E-06	0.00000123	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Pu-238	-0.0000105	pCi/m3	9.27E-06	0.00000927	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Pu-239/240	-6.16E-06	pCi/m3	5.34E-06	0.00000534	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Pu-239/240	-1.73E-06	pCi/m3	4.39E-06	0.00000439	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Pu-239/240	0.00000125	pCi/m3	5.47E-06	0.00000547	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Pu-239/240	-1.24E-12	pCi/m3	8.02E-06	0.00000802	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Ru-106	0.00188	pCi/m3	0.00367	0.00376	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Ru-106	-0.00156	pCi/m3	0.00493	0.00498	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Ru-106	0.00202	pCi/m3	0.00795	0.008	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	Ru-106	0.000458	pCi/m3	0.0053	0.0053	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	Sb-125	0.0000614	pCi/m3	0.000887	0.000888	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	Sb-125	-0.00033	pCi/m3	0.00132	0.00133	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	Sb-125	0.000759	pCi/m3	0.00221	0.00224	U			Y

Table C.2. (contd)

Samp Site Name	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	294597002	5-Oct-11	28-Dec-11	Sb-125	-0.00118	pCi/m3	0.0017	0.00179	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	U-234	0.0000276	pCi/m3	0.0000136	0.0000141				Y
PNL-2	282713003	6-Apr-11	29-Jun-11	U-234	0.0000362	pCi/m3	0.0000201	0.0000208				Y
PNL-2	289237002	29-Jun-11	5-Oct-11	U-234	0.0000507	pCi/m3	0.0000209	0.0000221				Y
PNL-2	294597002	5-Oct-11	28-Dec-11	U-234	0.0000294	pCi/m3	0.0000186	0.000019				Y
PNL-2	277486002	28-Dec-10	6-Apr-11	U-235	0	pCi/m3	4.35E-06	0.00000435	U			Y
PNL-2	282713003	6-Apr-11	29-Jun-11	U-235	0.000009	pCi/m3	0.0000108	0.0000109	U			Y
PNL-2	289237002	29-Jun-11	5-Oct-11	U-235	0.00000435	pCi/m3	6.02E-06	0.00000605	U			Y
PNL-2	294597002	5-Oct-11	28-Dec-11	U-235	0.00000696	pCi/m3	7.88E-06	0.00000793	U			Y
PNL-2	277486002	28-Dec-10	6-Apr-11	U-238	0.0000292	pCi/m3	0.0000143	0.0000149				Y
PNL-2	282713003	6-Apr-11	29-Jun-11	U-238	0.0000346	pCi/m3	0.0000163	0.0000171				Y
PNL-2	289237002	29-Jun-11	5-Oct-11	U-238	0.0000756	pCi/m3	0.0000251	0.0000272				Y
PNL-2	294597002	5-Oct-11	28-Dec-11	U-238	0.0000394	pCi/m3	0.0000176	0.0000183				Y
PNL-3	270517003	28-Dec-10	11-Jan-11	ALPHA	0.00107	pCi/m3	0.00051	0.000513				
PNL-3	271249003	11-Jan-11	26-Jan-11	ALPHA	0.000178	pCi/m3	0.000171	0.000172	U			
PNL-3	272196003	26-Jan-11	8-Feb-11	ALPHA	0.000483	pCi/m3	0.0003	0.000303				
PNL-3	272946003	8-Feb-11	23-Feb-11	ALPHA	0.00143	pCi/m3	0.000927	0.000929		TOTAL VOLUME LOW, FAILED PUMP REPLACED.		
PNL-3	273726003	23-Feb-11	8-Mar-11	ALPHA	0.000459	pCi/m3	0.00027	0.000273				
PNL-3	274511003	8-Mar-11	23-Mar-11	ALPHA	0.00046	pCi/m3	0.000298	0.0003		REPLACED PUMP, WAS RUNNING UPON ARRIVAL BUT QUIT DURING SAMPLE COLLECTION.		
PNL-3	275785003	23-Mar-11	6-Apr-11	ALPHA	0.000387	pCi/m3	0.000349	0.000349	U	REPLACED TOTALIZER.		
PNL-3	276655003	6-Apr-11	20-Apr-11	ALPHA	0.000526	pCi/m3	0.000374	0.000376				
PNL-3	277574003	20-Apr-11	4-May-11	ALPHA	0.000141	pCi/m3	0.000188	0.000189	U			
PNL-3	278518003	4-May-11	18-May-11	ALPHA	0.000286	pCi/m3	0.000251	0.000251	U			
PNL-3	279360003	18-May-11	1-Jun-11	ALPHA	0.000391	pCi/m3	0.000265	0.000267				
PNL-3	280343003	1-Jun-11	15-Jun-11	ALPHA	0.000539	pCi/m3	0.000307	0.000309				
PNL-3	280875003	15-Jun-11	29-Jun-11	ALPHA	0.000635	pCi/m3	0.000337	0.000342				

Table C.2. (contd)

Samp Site Name	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-3	281999003	29-Jun-11	13-Jul-11	ALPHA	0.000807	pCi/m3	0.000401	0.000407				
PNL-3	282897003	13-Jul-11	27-Jul-11	ALPHA	0.000615	pCi/m3	0.000328	0.000332				
PNL-3	283824003	27-Jul-11	10-Aug-11	ALPHA	0.00108	pCi/m3	0.000446	0.000455				
PNL-3	284746003	10-Aug-11	24-Aug-11	ALPHA	0.00109	pCi/m3	0.000478	0.000484				
PNL-3	285570003	24-Aug-11	6-Sep-11	ALPHA	0.00065	pCi/m3	0.000387	0.00039				
PNL-3	286558003	6-Sep-11	21-Sep-11	ALPHA	0.000753	pCi/m3	0.000362	0.000368				
PNL-3	287457003	21-Sep-11	5-Oct-11	ALPHA	0.00099	pCi/m3	0.000431	0.000438				
PNL-3	288560003	5-Oct-11	19-Oct-11	ALPHA	0.000945	pCi/m3	0.000447	0.000447				
PNL-3	289444003	19-Oct-11	2-Nov-11	ALPHA	0.000394	pCi/m3	0.000344	0.000346	U			
PNL-3	290452003	2-Nov-11	16-Nov-11	ALPHA	0.00105	pCi/m3	0.000471	0.000481				
PNL-3	291142003	16-Nov-11	30-Nov-11	ALPHA	0.00123	pCi/m3	0.00053	0.000531				
PNL-3	292218003	30-Nov-11	14-Dec-11	ALPHA	0.00266	pCi/m3	0.000781	0.000784				
PNL-3	293201003	14-Dec-11	28-Dec-11	ALPHA	0.0032	pCi/m3	0.000853	0.000918				
PNL-3	277486003	28-Dec-10	6-Apr-11	Am-241	0.00000608	pCi/m3	0.0000045	0.00000453				Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Am-241	0.00000613	pCi/m3	7.36E-06	0.00000738	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Am-241	0.00000139	pCi/m3	0.0000125	0.0000125	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Am-241	0.00000297	pCi/m3	0.0000193	0.0000193	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Am-241 Gamma	-0.000754	pCi/m3	0.00601	0.00601	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Am-241 Gamma	0.000482	pCi/m3	0.00214	0.00215	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Am-241 Gamma	-0.000744	pCi/m3	0.00523	0.00524	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Am-241 Gamma	0.000506	pCi/m3	0.00338	0.00339	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Am-243	0.0000133	pCi/m3	0.0000114	0.0000115	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Am-243	0.00000814	pCi/m3	0.0000091	0.00000911	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Am-243	0.0000084	pCi/m3	7.76E-06	0.00000784	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Am-243	0.0000176	pCi/m3	0.0000163	0.0000164	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Be-7	0.0504	pCi/m3	0.0216	0.0216				Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Be-7	0.0771	pCi/m3	0.0181	0.0182				Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Be-7	0.0855	pCi/m3	0.0199	0.02				Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Be-7	0.0597	pCi/m3	0.0147	0.0147				Y

Table C.2. (contd)

Samp Site Name	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-3	270517003	28-Dec-10	11-Jan-11	BETA	0.0559	pCi/m3	0.00226	0.00259				
PNL-3	271249003	11-Jan-11	26-Jan-11	BETA	0.0171	pCi/m3	0.00122	0.00137				
PNL-3	272196003	26-Jan-11	8-Feb-11	BETA	0.0286	pCi/m3	0.00172	0.00201				
PNL-3	272946003	8-Feb-11	23-Feb-11	BETA	0.0359	pCi/m3	0.00301	0.00312		TOTAL VOLUME LOW, FAILED PUMP REPLACED.		
PNL-3	273726003	23-Feb-11	8-Mar-11	BETA	0.0139	pCi/m3	0.00102	0.0011				
PNL-3	274511003	8-Mar-11	23-Mar-11	BETA	0.0286	pCi/m3	0.00158	0.002		REPLACED PUMP, WAS RUNNING UPON ARRIVAL BUT QUIT DURING SAMPLE COLLECTION.		
PNL-3	275785003	23-Mar-11	6-Apr-11	BETA	0.018	pCi/m3	0.0014	0.00146		REPLACED TOTALIZER.		
PNL-3	276655003	6-Apr-11	20-Apr-11	BETA	0.0148	pCi/m3	0.00112	0.00126				
PNL-3	277574003	20-Apr-11	4-May-11	BETA	0.0115	pCi/m3	0.000993	0.00105				
PNL-3	278518003	4-May-11	18-May-11	BETA	0.0122	pCi/m3	0.00104	0.00108				
PNL-3	279360003	18-May-11	1-Jun-11	BETA	0.0144	pCi/m3	0.00107	0.00116				
PNL-3	280343003	1-Jun-11	15-Jun-11	BETA	0.0131	pCi/m3	0.00105	0.00119				
PNL-3	280875003	15-Jun-11	29-Jun-11	BETA	0.0113	pCi/m3	0.00101	0.00119				
PNL-3	281999003	29-Jun-11	13-Jul-11	BETA	0.0159	pCi/m3	0.00124	0.00139				
PNL-3	282897003	13-Jul-11	27-Jul-11	BETA	0.0142	pCi/m3	0.00109	0.00117				
PNL-3	283824003	27-Jul-11	10-Aug-11	BETA	0.0166	pCi/m3	0.00122	0.00136				
PNL-3	284746003	10-Aug-11	24-Aug-11	BETA	0.0193	pCi/m3	0.00125	0.00147				
PNL-3	285570003	24-Aug-11	6-Sep-11	BETA	0.0192	pCi/m3	0.00129	0.00147				
PNL-3	286558003	6-Sep-11	21-Sep-11	BETA	0.0348	pCi/m3	0.00161	0.00194				
PNL-3	287457003	21-Sep-11	5-Oct-11	BETA	0.0241	pCi/m3	0.00149	0.00199				
PNL-3	288560003	5-Oct-11	19-Oct-11	BETA	0.0239	pCi/m3	0.0015	0.00169				
PNL-3	289444003	19-Oct-11	2-Nov-11	BETA	0.0263	pCi/m3	0.0017	0.00195				
PNL-3	290452003	2-Nov-11	16-Nov-11	BETA	0.0307	pCi/m3	0.00171	0.00211				
PNL-3	291142003	16-Nov-11	30-Nov-11	BETA	0.0211	pCi/m3	0.0016	0.00183				
PNL-3	292218003	30-Nov-11	14-Dec-11	BETA	0.0783	pCi/m3	0.00286	0.00383				
PNL-3	293201003	14-Dec-11	28-Dec-11	BETA	0.0672	pCi/m3	0.00266	0.00361				

Table C.2. (contd)

Samp Site Name	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-3	277486003	28-Dec-10	6-Apr-11	Cm-243/244	-1.74E-06	pCi/m3	5.41E-06	0.00000541	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Cm-243/244	0.00000617	pCi/m3	0.0000113	0.0000113	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Cm-243/244	-0.0000042	pCi/m3	0.0000218	0.0000218	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Cm-243/244	0.00000149	pCi/m3	0.0000163	0.0000163	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Co-60	-0.000463	pCi/m3	0.000913	0.000936	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Co-60	0.000688	pCi/m3	0.00088	0.000933	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Co-60	-0.000163	pCi/m3	0.000666	0.00067	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Co-60	-9.71E-06	pCi/m3	0.000639	0.000639	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Cs-134	0.00105	pCi/m3	0.00091	0.00103	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Cs-134	0.0000786	pCi/m3	0.000636	0.000637	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Cs-134	-0.000377	pCi/m3	0.000711	0.000731	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Cs-134	0.000401	pCi/m3	0.000636	0.000662	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Cs-137	-0.000151	pCi/m3	0.000939	0.000941	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Cs-137	0.0000088	pCi/m3	0.000622	0.000622	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Cs-137	0.000297	pCi/m3	0.000652	0.000666	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Cs-137	-0.000141	pCi/m3	0.000501	0.000505	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Eu-152	0.00000501	pCi/m3	0.0024	0.0024	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Eu-152	0.000197	pCi/m3	0.0017	0.0017	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Eu-152	-0.00205	pCi/m3	0.00203	0.00223	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Eu-152	-0.000815	pCi/m3	0.00168	0.00172	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Eu-154	0.000703	pCi/m3	0.0029	0.00292	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Eu-154	-0.00105	pCi/m3	0.00187	0.00193	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Eu-154	0.000712	pCi/m3	0.00207	0.00209	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Eu-154	-0.0000842	pCi/m3	0.00169	0.00169	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Eu-155	0.00114	pCi/m3	0.00234	0.00239	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Eu-155	0.0000132	pCi/m3	0.00169	0.00169	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Eu-155	-0.000486	pCi/m3	0.00224	0.00225	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Eu-155	0.000967	pCi/m3	0.00164	0.00169	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	K-40	0.0144	pCi/m3	0.0077	0.0077	X		Data rejected due to no	Y

Table C.2. (contd)

Samp Site Name	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
											valid peak.	
PNL-3	282713001	6-Apr-11	29-Jun-11	K-40	0.00364	pCi/m3	0.00898	0.00913	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	K-40	0.0224	pCi/m3	0.0111	0.0112				Y
PNL-3	294597003	5-Oct-11	28-Dec-11	K-40	-0.00365	pCi/m3	0.00757	0.00775	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Pu-238	0.00000151	pCi/m3	2.09E-06	0.00000209	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Pu-238	-0.0000226	pCi/m3	0.000014	0.000014	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Pu-238	-7.98E-07	pCi/m3	0.0000035	0.0000035	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Pu-238	-5.96E-06	pCi/m3	8.42E-06	0.00000842	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Pu-239/240	0.00000677	pCi/m3	4.42E-06	0.00000447				Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Pu-239/240	-0.0000128	pCi/m3	0.0000109	0.0000109	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Pu-239/240	0.00000796	pCi/m3	6.24E-06	0.00000629	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Pu-239/240	-1.98E-12	pCi/m3	0.0000128	0.0000128	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Ru-106	0.00874	pCi/m3	0.00753	0.0085	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Ru-106	0.00061	pCi/m3	0.00637	0.00637	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Ru-106	-0.00315	pCi/m3	0.00677	0.00692	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Ru-106	0.00117	pCi/m3	0.00495	0.00498	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	Sb-125	0.00166	pCi/m3	0.00198	0.00212	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	Sb-125	0.00127	pCi/m3	0.00161	0.00171	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	Sb-125	0.000208	pCi/m3	0.00181	0.00181	U			Y
PNL-3	294597003	5-Oct-11	28-Dec-11	Sb-125	-0.000577	pCi/m3	0.00144	0.00146	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	U-234	0.0000477	pCi/m3	0.0000233	0.0000242				Y
PNL-3	282713001	6-Apr-11	29-Jun-11	U-234	0.0000699	pCi/m3	0.000021	0.0000231				Y
PNL-3	289237003	29-Jun-11	5-Oct-11	U-234	0.0000761	pCi/m3	0.0000188	0.0000214				Y
PNL-3	294597003	5-Oct-11	28-Dec-11	U-234	0.000076	pCi/m3	0.0000199	0.0000217				Y
PNL-3	277486003	28-Dec-10	6-Apr-11	U-235	0.00000851	pCi/m3	0.0000124	0.0000125	U			Y
PNL-3	282713001	6-Apr-11	29-Jun-11	U-235	0.0000039	pCi/m3	0.0000054	0.00000543	U			Y
PNL-3	289237003	29-Jun-11	5-Oct-11	U-235	0.0000135	pCi/m3	8.83E-06	0.00000901				Y
PNL-3	294597003	5-Oct-11	28-Dec-11	U-235	0.00000565	pCi/m3	0.000013	0.000013	U			Y
PNL-3	277486003	28-Dec-10	6-Apr-11	U-238	0.0000505	pCi/m3	0.0000211	0.0000223				Y
PNL-3	282713001	6-Apr-11	29-Jun-11	U-238	0.0000567	pCi/m3	0.000019	0.0000205				Y
PNL-3	289237003	29-Jun-11	5-Oct-11	U-238	0.0000668	pCi/m3	0.0000195	0.0000214				Y
PNL-3	294597003	5-Oct-11	28-Dec-11	U-238	0.0000537	pCi/m3	0.0000197	0.0000206				Y
YAKIMA	270512009	3-Jan-11	11-Jan-11	ALPHA	0.00104	pCi/m3	0.000567	0.000573				

Table C.2. (contd)

Samp Site Name	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
YAKIMA	271252005	11-Jan-11	26-Jan-11	ALPHA	0.000198	pCi/m3	0.000196	0.000196	U			
YAKIMA	272191005	26-Jan-11	8-Feb-11	ALPHA	0.000571	pCi/m3	0.000319	0.000322				
YAKIMA	272948013	8-Feb-11	23-Feb-11	ALPHA	0.000396	pCi/m3	0.000245	0.000246				
YAKIMA	273723005	23-Feb-11	8-Mar-11	ALPHA	0.000716	pCi/m3	0.000373	0.000378				
YAKIMA	274527005	8-Mar-11	21-Mar-11	ALPHA	0.000202	pCi/m3	0.000207	0.000207	U			
YAKIMA	275787005	21-Mar-11	6-Apr-11	ALPHA	0.000193	pCi/m3	0.000178	0.000178	U			
YAKIMA	276672013	6-Apr-11	20-Apr-11	ALPHA	0.000321	pCi/m3	0.000238	0.000239				
YAKIMA	277580013	20-Apr-11	4-May-11	ALPHA	0.000184	pCi/m3	0.000227	0.000227	U			
YAKIMA	278563013	4-May-11	18-May-11	ALPHA	0.000466	pCi/m3	0.000294	0.000298				
YAKIMA	279372013	18-May-11	1-Jun-11	ALPHA	0.000693	pCi/m3	0.00032	0.000324				
YAKIMA	280381013	1-Jun-11	15-Jun-11	ALPHA	0.000335	pCi/m3	0.000247	0.000248		REPLACED TOTALIZER.		
YAKIMA	280881005	15-Jun-11	29-Jun-11	ALPHA	0.000242	pCi/m3	0.000212	0.000212	U			
YAKIMA	281957005	29-Jun-11	13-Jul-11	ALPHA	0.000551	pCi/m3	0.000316	0.00032				
YAKIMA	282984005	13-Jul-11	27-Jul-11	ALPHA	0.000348	pCi/m3	0.000229	0.000231				
YAKIMA	283835013	27-Jul-11	10-Aug-11	ALPHA	0.00041	pCi/m3	0.000263	0.000264				
YAKIMA	284810005	10-Aug-11	24-Aug-11	ALPHA	0.000941	pCi/m3	0.000391	0.000395				
YAKIMA	285573013	24-Aug-11	7-Sep-11	ALPHA	0.0003	pCi/m3	0.00029	0.00029	U			
YAKIMA	286561013	7-Sep-11	21-Sep-11	ALPHA	0.000961	pCi/m3	0.000356	0.000366				
YAKIMA	287468013	21-Sep-11	5-Oct-11	ALPHA	0.000333	pCi/m3	0.000297	0.000298	U			
YAKIMA	288615005	5-Oct-11	19-Oct-11	ALPHA	0.000833	pCi/m3	0.000333	0.000335				
YAKIMA	289454013	19-Oct-11	2-Nov-11	ALPHA	0.000702	pCi/m3	0.000347	0.000347				
YAKIMA	290609005	2-Nov-11	16-Nov-11	ALPHA	0.000869	pCi/m3	0.000399	0.000411				
YAKIMA	291174013	16-Nov-11	30-Nov-11	ALPHA	0.000607	pCi/m3	0.000323	0.000327				
YAKIMA	292224013	30-Nov-11	14-Dec-11	ALPHA	0.00119	pCi/m3	0.000437	0.000451				
YAKIMA	292808013	14-Dec-11	28-Dec-11	ALPHA	0.000987	pCi/m3	0.000392	0.000393				
YAKIMA	278712008	3-Jan-11	6-Apr-11	Am-241 Gamma	-0.00242	pCi/m3	0.00588	0.00598	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Am-241 Gamma	0.000712	pCi/m3	0.00186	0.00189	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Am-241 Gamma	-0.0000636	pCi/m3	0.00444	0.00444	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Am-241 Gamma	0.00023	pCi/m3	0.00241	0.00241	U			Y

Table C.2. (contd)

Samp Site Name	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
YAKIMA	278712008	3-Jan-11	6-Apr-11	Be-7	0.0398	pCi/m3	0.0209	0.0275	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Be-7	0.0585	pCi/m3	0.0143	0.0143				Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Be-7	0.0905	pCi/m3	0.02	0.0201				Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Be-7	0.0478	pCi/m3	0.0163	0.0163				Y
YAKIMA	270512009	3-Jan-11	11-Jan-11	BETA	0.0556	pCi/m3	0.00269	0.00343				
YAKIMA	271252005	11-Jan-11	26-Jan-11	BETA	0.0122	pCi/m3	0.000871	0.000919				
YAKIMA	272191005	26-Jan-11	8-Feb-11	BETA	0.0216	pCi/m3	0.00132	0.00149				
YAKIMA	272948013	8-Feb-11	23-Feb-11	BETA	0.0129	pCi/m3	0.000963	0.00111				
YAKIMA	273723005	23-Feb-11	8-Mar-11	BETA	0.0125	pCi/m3	0.000963	0.00109				
YAKIMA	274527005	8-Mar-11	21-Mar-11	BETA	0.0262	pCi/m3	0.00143	0.00156				
YAKIMA	275787005	21-Mar-11	6-Apr-11	BETA	0.0121	pCi/m3	0.000908	0.00105				
YAKIMA	276672013	6-Apr-11	20-Apr-11	BETA	0.0113	pCi/m3	0.000957	0.00114				
YAKIMA	277580013	20-Apr-11	4-May-11	BETA	0.0108	pCi/m3	0.000894	0.000929				
YAKIMA	278563013	4-May-11	18-May-11	BETA	0.0112	pCi/m3	0.000948	0.00113				
YAKIMA	279372013	18-May-11	1-Jun-11	BETA	0.0116	pCi/m3	0.000969	0.00104				
YAKIMA	280381013	1-Jun-11	15-Jun-11	BETA	0.0109	pCi/m3	0.000897	0.000932		REPLACED TOTALIZER.		
YAKIMA	280881005	15-Jun-11	29-Jun-11	BETA	0.00839	pCi/m3	0.000772	0.000851				
YAKIMA	281957005	29-Jun-11	13-Jul-11	BETA	0.0101	pCi/m3	0.000951	0.00104				
YAKIMA	282984005	13-Jul-11	27-Jul-11	BETA	0.0105	pCi/m3	0.000841	0.00094				
YAKIMA	283835013	27-Jul-11	10-Aug-11	BETA	0.0114	pCi/m3	0.000916	0.000959				
YAKIMA	284810005	10-Aug-11	24-Aug-11	BETA	0.0168	pCi/m3	0.00115	0.00136				
YAKIMA	285573013	24-Aug-11	7-Sep-11	BETA	0.0177	pCi/m3	0.00121	0.00127				
YAKIMA	286561013	7-Sep-11	21-Sep-11	BETA	0.0257	pCi/m3	0.00137	0.00167				
YAKIMA	287468013	21-Sep-11	5-Oct-11	BETA	0.015	pCi/m3	0.00103	0.00136				
YAKIMA	288615005	5-Oct-11	19-Oct-11	BETA	0.0179	pCi/m3	0.00115	0.00133				
YAKIMA	289454013	19-Oct-11	2-Nov-11	BETA	0.0175	pCi/m3	0.00119	0.0021				
YAKIMA	290609005	2-Nov-11	16-Nov-11	BETA	0.0203	pCi/m3	0.00131	0.00152				
YAKIMA	291174013	16-Nov-11	30-Nov-11	BETA	0.0156	pCi/m3	0.00115	0.00143				
YAKIMA	292224013	30-Nov-11	14-Dec-11	BETA	0.0397	pCi/m3	0.0017	0.00233				
YAKIMA	292808013	14-Dec-11	28-Dec-11	BETA	0.0391	pCi/m3	0.00167	0.00206				
YAKIMA	278712008	3-Jan-11	6-Apr-11	Co-60	-0.000178	pCi/m3	0.000853	0.000857	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Co-60	0.000138	pCi/m3	0.000647	0.00065	U			Y

Table C.2. (contd)

Samp Site Name	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
YAKIMA	289201015	29-Jun-11	5-Oct-11	Co-60	0.000225	pCi/m3	0.000687	0.000694	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Co-60	-0.0000763	pCi/m3	0.000572	0.000573	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Cs-134	0.00000937	pCi/m3	0.000752	0.000752	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Cs-134	-0.000241	pCi/m3	0.00072	0.000728	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Cs-134	-0.0000599	pCi/m3	0.000744	0.000745	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Cs-134	-0.000139	pCi/m3	0.000595	0.000598	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Cs-137	0.000771	pCi/m3	0.000909	0.000909	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Cs-137	0.000324	pCi/m3	0.000572	0.00059	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Cs-137	0.000254	pCi/m3	0.000658	0.000668	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Cs-137	-0.000166	pCi/m3	0.000631	0.000636	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Eu-152	0.00131	pCi/m3	0.00244	0.00251	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Eu-152	-0.000278	pCi/m3	0.00176	0.00176	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Eu-152	-0.00058	pCi/m3	0.00171	0.00173	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Eu-152	0.000319	pCi/m3	0.00167	0.00167	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Eu-154	0.000346	pCi/m3	0.0026	0.0026	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Eu-154	0.000745	pCi/m3	0.00144	0.00147	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Eu-154	0.000619	pCi/m3	0.00178	0.0018	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Eu-154	-0.000749	pCi/m3	0.00153	0.00157	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Eu-155	-0.000495	pCi/m3	0.00256	0.00257	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Eu-155	-0.000494	pCi/m3	0.00151	0.00153	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Eu-155	-0.00212	pCi/m3	0.00189	0.00212	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Eu-155	0.000441	pCi/m3	0.00158	0.0016	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	K-40	0.0091	pCi/m3	0.0105	0.0113	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	K-40	0.000489	pCi/m3	0.00795	0.00796	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	K-40	0.00619	pCi/m3	0.00714	0.00767	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	K-40	0.0128	pCi/m3	0.00958	0.0112	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Pu-238	8.77E-07	pCi/m3	1.72E-06	0.00000172	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Pu-238	0	pCi/m3	9.54E-07	0.000000954	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Pu-238	3.52E-07	pCi/m3	0.0000012	0.0000012	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Pu-238	6.96E-07	pCi/m3	1.93E-06	0.00000193	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Pu-239/240	8.75E-07	pCi/m3	0.0000021	0.0000021	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Pu-239/240	6.87E-07	pCi/m3	1.65E-06	0.00000165	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Pu-239/240	-5.86E-14	pCi/m3	9.74E-07	0.000000975	U			Y

Table C.2. (contd)

Samp Site Name	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
YAKIMA	294587010	5-Oct-11	28-Dec-11	Pu-239/240	-6.94E-07	pCi/m3	1.67E-06	0.00000167	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Ru-106	-0.00508	pCi/m3	0.00743	0.00778	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Ru-106	0.00424	pCi/m3	0.00552	0.00584	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Ru-106	-0.00129	pCi/m3	0.0054	0.00543	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Ru-106	0.00237	pCi/m3	0.00651	0.0066	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Sb-125	0.000384	pCi/m3	0.00216	0.00217	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Sb-125	-0.000552	pCi/m3	0.00157	0.00159	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Sb-125	0.00131	pCi/m3	0.00153	0.00164	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Sb-125	0.00135	pCi/m3	0.00159	0.00171	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	Sr-90	-0.0000197	pCi/m3	0.0000605	0.0000605	U			Y
YAKIMA	282707009	6-Apr-11	29-Jun-11	Sr-90	0.0000414	pCi/m3	0.000753	0.000753	U			Y
YAKIMA	289201015	29-Jun-11	5-Oct-11	Sr-90	0.00000153	pCi/m3	0.0000242	0.0000242	U			Y
YAKIMA	294587010	5-Oct-11	28-Dec-11	Sr-90	0.0000686	pCi/m3	0.0000531	0.0000532	U			Y
YAKIMA	278712008	3-Jan-11	6-Apr-11	U-234	0.0000509	pCi/m3	0.0000277	0.0000286				Y
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